THE GISBORNE ERA OF FOREST FIRE RESEARCH

Charles E. Hardy

University of Montana
Forest and Conservation Experiment Station

In cooperation with

U.S. Department of Agriculture,
Forest Service

February, 1977

Completion Report

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FOREWORD

This report describes the level of excellence that pioneer forest fire researcher Harry T. Gisborne set for himself--an excellence that became a heritage for subsequent workers to respect and one that Gisborne demanded they achieve. The report contains a mere fraction of the available information--just enough to identify events and to get the flavor of fire research as it was in the beginning.

I take pride in being a part of the group that carried on the search for new knowledge and continued to put it into actual field practice. As my 22 years' service at the Northern Forest Fire Laboratory drew to a close, it became poignantly clear to me that an ever-increasing number of our new, younger scientists knew little of this man and his accomplishments--the vital beginnings of the program. The mission to record H. T. Gisborne's role in this microcosm of history became a dream which culminates in this document.

Material came from data and correspondence files at the Northern Forest Fire Laboratory in Missoula, Montana and in the custody of C. A. Wellner in Moscow, Idaho; Northern Rocky Mountain Forest and Range Experiment Station Annual Reports; Region One Information Digests; and most important, interviews and discussions held with some of Gisborne's closest associates: C. A. (Chuck) Wellner, a close personal friend from 1932; G. M. (George) Jemison, Gisborne's first full-time professional employee, later Director of the Northern Rocky Mountain Station, and ultimately Deputy Chief for Research, Washington Office; G. L. (Lloyd) Hayes, his second full-time professional employee and ultimately Assistant Director of Rocky Mountain Station; J. S. (Jack) Barrows, who came on after World War II, enlarged upon Gisborne's beginning, built the Fire Lab at Missoula, and later became Director of Forest Fire and Atmospheric Sciences Research, Washington Office; A. A. (Brownie) Brown, a friend from 1922 on the Coeur d' Alene forest, through fire research and fire control positions in California Station and Region, and on to Fire Control Chief and the first Chief of Division of Fire Research in the Washington Office; C. L. (Charlie) Tebbe, Director of Northern Rocky Mountain Station during Gisborne's last years; W. G. (Bill) Morris, member of Pacific Northwest Station fire research team who conducted parallel fire research for many years; C. S. (Clayton) Crocker, long-time colleague of Gisborne's on the administrative side of the work, who died of a heart attack shortly after being interviewed; V. J. (Vince) Schaefer, who became a close personal friend in a very short period of time while performing cooperative atmospheric research with Gisborne; and R. R. (Bob) Johnson, who with brother Dick, as Johnson Flying Service, made come true many dreams of Gisborne, Flint, Hornby, Schaefer, Barrows, Crocker, Sutliff and a host of others devoted to improving the caliber of forest fire control.

I am especially pleased to mention Mabelle, my wife, for her part in this story--her suggestions, admonitions, and editorial work--and mostly for her patience in listening to my continual thinking aloud as the work progressed from one stage to the next.

The Annual Reports mentioned in the text were, during this time period, basically a summary of the annual joint Experiment Station-Region One Investigative Council meetings where research progress, problems and plans were mutually discussed. These were Investigative Council Reports from 1914 to 1935. After the last such meeting in 1935 the reports became Station Annual Reports.

Some minor liberties were taken with quotes from interviews and written materials for purposes of brevity, simplicity, and relevance.

Charles E. Hardy
February, 1977
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THE GISBORNE ERA OF FOREST FIRE RESEARCH

On November 12, 1947, in the Sylvan Theatre, Washington, D. C., Secretary of Agriculture Clinton P. Anderson awarded the Superior Service Award to Harry T. Gisborne, Chief of Fire Research of the Northern Rocky Mountain Forest and Range Experiment Station, in recognition of his achievements during the past 25 years in the field of forest fire control research. The citation stated: "Superior award for pioneering work and superior accomplishments in research leading to the development of techniques, equipment and practices widely used in forest fire control." Gisborne was the first Region One-Northern Rocky Mountain Station area employee to receive this distinguished honor.

THE BEGINNING

Barely had the first decade of the young U. S. Forest Service gone by before the need for understanding the forest fire problem was clearly evident, especially in the Northern Rocky Mountains. The Great Idaho Fires of 1910 shook forest administrators and residents alike to the bottom of their boots. It awakened everyone to the fact that there could be no resource management without protection.

In 1916, through Assistant Forester Earl H. Clapp, the Forest Service put out an appeal to its experiment stations to initiate research on forest fires. The appeal suggested a general program to divide the forest areas into climatic units, study meteorological and climatic conditions, fire rate of spread under various conditions of weather, fuels (duff moisture was mentioned), topography, and cover, and endeavor to predict dangerous conditions. The extremely tough 1919 fire season, together with the launching of the national forestry policy gave further impetus to formation and implementation of a long range fire research effort.

What amounted to a 'problem delineation' appeared in a memorandum attached to the 1920 Station Annual Report which urged that considerably more research resources should be directed to fire problems, and recommended emphasis on economics of fire protection, origin and behavior of fire, techniques of fire protection, and a statistical analysis of data and problems. The report even mentioned possible experiments with aerial fire control.

Priest River Forest Experiment Station, founded in 1911, received a substantial increase in funds and a new Director in 1921, Robert H. Weidman. Harry T. Gisborne's name came up in January 1922, when Earl Clapp requested him by name from the District Forester in Portland, Oregon, to be transferred to Priest River Experiment Station. He observed that this would be a great opportunity for Gisborne to demonstrate his initiative and use his administrative experience in studying the various phases of the fire problem in the Northern Rockies. Clapp indicated that the man who succeeds in working out satisfactory solutions would receive the highest type of recognition, both within and outside of the Forest Service, and that the men who go into fire research now "...will become the leaders of the most important forest research activities in the country."

Gisborne was appointed Forest Examiner on April 1, 1922, at a salary of $1920 per annum, and assigned to the Director of Priest River Experiment Station, Missoula, Montana.

Thus began the Gisborne era of fire research which was destined over the next 27 years to more than live up to the exciting prophecies of Mr. Clapp.

WHY HARRY THOMAS GISBORNE?

A brief background of Gisborne's formative years shows that he was always associated with forest resources in one way or another. He was born September 12, 1893, in Montpelier, Vermont, into a family whose livelihood was its lumberyard and planing mill. He spent much of his working time during his high school and college years in the family enterprise, doing everything from teamstering at $6 per week to assistant shop boss at $25 per week. His family was apparently not affluent, as he delayed his education a year between high school and college and again during a full college year to work for his dad.

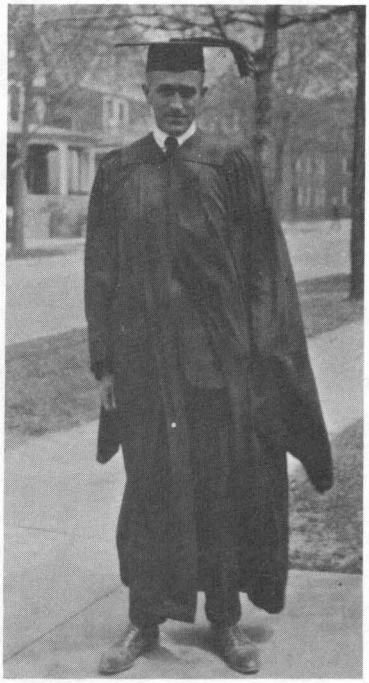
Gisborne enrolled in the Forestry School at the University of Michigan in 1912 and graduated in 1917. In a letter to the Michigan Alumni on March 9, 1940, Gisborne states: "I chose forestry as a profession because I loved the woods and hills and wanted to work in and with them. Went to Vermont summer school of forestry in 1911 to make sure that I knew what I was getting into. Liked it, but actually gained hardly an inkling of what was to come. Can't remember that anyone ever mentioned research." Two working experiences stood out in his mind. One was as field assistant to Professor J. J. (Brig) Young at 35 cents per hour. The other was a highlight throughout the rest of his life--he manned Tip Top Lookout on the Wenatchee National Forest in 1915. Communication was by heliograph which required him to become proficient in Morse code.

After graduation, his cruising job on the Santiam National Forest in Oregon was cut short. He joined the Army on August 1, 1917 and served in France as a corporal with the famous 10th Engineers - the forestry outfit. Soon after his mustering out on February 27, 1919, he was back in the Pacific Northwest on a Forest Service Sitka spruce research study.

He was shifted from one project to another in this Region for the next three years, serving N. L. Terry on the Sitka spruce study, twice at Wind River Experimental Forest under Drs. J. H. Tolmann and Hoffman. In April 1920, he received his probational appointment at $1210 per annum and was soon transferred to the Whitman Forest, serving under R. H. Weidman and R. M. Evans. Here he remained nearly two years, until he came to Priest River.

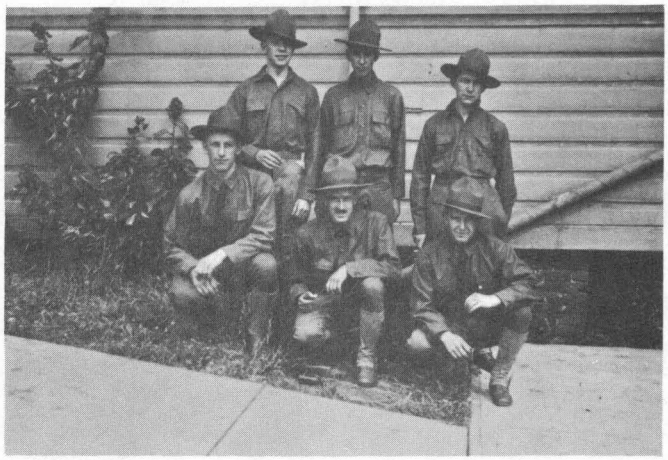
He had not gone unnoticed during his travels about District Six. He had an offer to do research in the South and one to teach at Syracuse Ranger School. In reference to the latter, he showed his already strong affiliation with the Forest Service when he said "But my enjoyment and appreciation of work in the Forest Service coupled with my belief that satisfactory work here would result in promotion led to my refusal of that offer." The Syracuse job would have carried a 50 percent higher salary than he had at that time.

Tip Top Lookout, Wenatchee N.F., 1915



The Graduate. 1917

Baker, Oregon, 1921



"Vancouver Rookies",1917

THE EARLY YEARS (1922-1929)

Gisborne wrote in the Idaho Forester (1926), "The purpose of forest fire research is to discover the fundamental causes and effects which vary in such a way as to cause variable demands on the forest protective organization. When we know accurately all the controlling causes and their effects we should be able to expand the protective organizations sufficiently to give adequate protection during the abnormal years, and to reduce expenses as much as possible and still provide adequate protection during the fire seasons that are less dangerous than the average."

A very productive visit by S. B. Show of California in early summer of 1922 helped Gisborne find his bearings and set his course. By the end of his first year he had established most of the fire research projects that were to be pursued for more than a decade. The Experiment Station's 1922 Annual Report declared that results of earlier studies, although primarily statistical analyses of past fires in relation to weather, made it possible for the present studies to deal directly with current weather in relation to inflammability conditions with the definite object of predicting dangerous fire periods.

SETTING THE STAGE

Many of the earlier studies were conducted by men whose names are still revered by foresters. J. A. Larsen, who came to Priest River in 1913, proceeded to gather meteorological and climatic data for use in silvicultural studies, and soon learned of their equal value in studying fire behavior. By 1916 he was directing research studies toward development of a scientific basis for forest fire hazard and liability evaluation. He, W. C. Lowdermilk, and Station Director D. R. Brewster, were learning the relationship between climate, current weather factors, and forest fuel inflammability. Larsen, through four weather stations, detected significant differences in temperature and humidity between valley bottom and mountain-top locations. He and C. C. Delavan in 1922 reported the results of a massive amount of information relating to climate and forest fires in Montana and North Idaho between 1909 and 1919. He wanted to establish more weather stations but could find no one "with the right attitude" to operate them. In 1918, Larsen also realized that some data must come from the laboratory, but was not successful in locating adequate facilities.

Others also helped provide a solid base for Gisborne to build upon. E. N. Munns, in 1921, had begun to relate vapor pressure and evaporation to fire danger. In California, S. B. Show and E. I. Kotok, had among many fine pieces of fire research related the ignition point of needle duff with seasonal progress of evaporation, surface fire rate of spread, and various wind velocities, in the open sunlight and in the shade.

'New' ideas had been proposed for subsequent fire researchers to consider. The 1919 Annual Report mentioned plans to study the possibility of fighting fires with gas bombs, admitting that the prospect of application by aeroplanes or dirigibles is not especially good. The following year's report recommended development of a lightning detector and a device for measuring static electricity. Lightning fire was considered to have highest priority that year.

Thus 29 year old Harry T. Gisborne inherited a wealth of background information and current studies going for him when he moved from the timber job in the Whitman National Forest to this new challenge at Priest River Forest Experiment Station. His first major task would be to sort out all present knowledge and establish objectives, then begin plugging away at the separate factors required to some day realize his original goals.

FIRE BEHAVIOR

Hope was expressed in the 1920 Annual Report that if sufficient data were at hand and properly compiled, some one factor or some convenient combination of factors might be found that would furnish a warning to increase manpower prior to or during fire emergencies. This became a major goal of Gisborne's which finally bore fruit with the use of the first fire danger rating system on the Pete King-McLendon Butte fires of 1934.

During the first season Gisborne established three intensive fire weather stations on the Kaniksu, Clearwater and Nezperce forests. Data gathered from these stations caused him to declare that the Bates evaporimeters had no value in predicting, for the local station, the evaporation to be expected the next day. He also learned that relative humidity cannot be used as a single accurate index of the moisture content or inflammability of duff and other forest materials. Temperature is an important variable in moisture content determinations, and there is a lag of the moisture content of the duff behind the constantly changing humidity and temperature. The Madison Forest Products Laboratory worked closely with him by becoming involved in laboratory determinations of equilibrium moisture content of duff, twigs, and down logs in relation to temperature and relative humidity.

Moisture contents of forest floor materials were considered in relation to weather forecasts from Pacific Coast secured by 'wireless' in hopes of predicting fire conditions a few days in advance. He began measuring the rate of absorption and dessication of duff moisture from the atmosphere, soil, and precipitation. He noted that the distribution of rainfall, more than the amount, was important in influencing dangerous fire conditions.

By the end of the first year Gisborne had despaired of finding one single factor to measure or predict inflammability. His search focused on some other easily measurable factor that would by nature integrate all the weather and fuel impacts. Duff moisture content apparently showed him the most promise, as he devoted much effort during the next few years to the relationship between duff moisture and weather factors. The 1923 Annual Report states that the principle upon which prediction was being based was that of

knowing the prevailing moisture content of fuels and applying a detailed weather forecast to determine the probable inflammability several days in advance. The average moisture content of the top 1/4" to 1/2" layer of duff is being taken as the index of inflammability of all the important materials which burn in the white pine type.

Measuring duff moisture content by weighing and oven-drying duff samples was too slow and laborious for Gisborne, and would never be used in the field. He and M. E. (Matt) Dunlap of the Madison Laboratory devised and tested the "duff hygrometer" in 1923. The final instrument consisted of a rattan strip encased in and attached to one end of a ventilated hollow spike, and attached at the other end to a gauge which measured changes in length caused by the rattan's hygroscopic reaction to changes in humidity. The long spike was inserted about one-fourth inch below the duff surface, where the rattan responded to the relative humidity of the air within the duff layer, with a read-out scale calibrated in terms of duff moisture content. The instrument was calibrated by inserting the spike into long cans containing duff of known moisture contents. George M. Jemison and G. Lloyd Hayes, Gisborne's first two professional assistants, used duff hygrometers throughout the 1930's. They found calibration difficult to maintain. Even though they were used in conjunction with fire-danger rating, duff hygrometer measurements never became a factor in fire danger. Its use was discontinued about 1940.

An article in the Journal of Forestry in 1923, close to his first of more than a hundred, describes The importance of duff moisture content in the forest fire problem.

Combining weather forecasts and duff measurements, the prediction of duff moisture content was tried by Howard Flint of the District One office in 1923, claiming an accuracy level of 78 percent. Better results came the next year when four cover situations were used at Priest River- a subalpine station near a mountain top, and on a flat, fully covered canopy, a partical cut, and an opening.

Duff hygrometer data were gathered from the Nezperce, Clearwater, Lolo, Bitterroot and Flathead Forests as well as Priest River in 1925 and telegraphed to the District fire desk. The data's significance in relation to dangerous fire conditions was given more credence at the District Office than at the Forest Offices.

Once the duff hygrometer was made sufficiently reliable to measure upper duff moisture, the urgent need was to find a measurable criterion of slash and branchwood moisture. The first recorded mention of using wood as a criterion of atmospheric change came from J. A. Larsen, (February 1, 1976, letter for Forester in charge, Region 1). "In 1923 I went abroad - mainly to contact European Forest Experiment Stations. At Clampenborg at or near Copenhagen, they showed me in the plot a block or cube of even-grained wood. When I asked questions about it, they told me it did absorb vapor at night, lost it again during the day, and indicated or reflected atmospheric humidity. This I conveyed to Mr. Gisborne, hence originated his stick of wood to be weighed regularly."

What a fortuitous observation and questioning by Larsen! This idea came to Gisborne the same summer that the duff hygrometer was undergoing its first trial. He must have welcomed this new idea from the Old World after having struggled with the vagaries of the rattan strips. The very next year he did some experimenting with this idea (Memorandum to Director, December 3, 1945). Gisborne chose to deal with round wood sections rather than cubes as they more nearly represented natural fuels. He endeavored to measure fuel moisture by using calibrated pieces of branchwood. He found them so erratic in response to temperature and humidity changes that he went to turned dowels, or wood sticks, as they were called. This concerted search, which began in 1925, finally included dowels as small as one-half inch in diameter by 1929. Ultimate production of groups of three or four dowels into sets of hazard sticks for use as an input factor to fire danger meters did not take place until the 1930's.

In 1925 Gisborne acquired a field assistant. This left him free to visit 'going' fires. In a letter of April 3, 1926, he described his observational method to Paul W. Stickel of the Northeastern Forest Experiment Station, as "...very simple. It consists of getting inside the fire and as close to the main front as possible, or else on a promontory from which I can see all fronts, and then measuring everything I can measure, including the weather elements and the spread of the fire according to timber type, slope, and kind, size, amount, and arrangement of fuels. Results are something else than simple, however. To you I'll admit that although I worked on four big fires last summer, I did not get any consensus of facts. Contradictions were more common than agreements. The variety seemed unlimited. And worst of all there were too many factors, such as the fuel arrangements, volume, etc. which I could not measure. I learned a lot about fire behavior, but not much about how the weather affects it. It is a good experience because it makes a fire research man see the ultimate application of some phases of his work." He finally admitted, "Actually I haven't any method in this work.."

By this time Gisborne had enough information on hand to prepare a bulletin entitled, Measuring forest fire danger in Northern Idaho, which, however, was not published until 1928.

He told H. B. Rowland, an army buddy and fellow forester, on May 16, 1927, that his basic research work must be amplified and checked by direct comparisons of weather elements and fire behavior. He was just getting ready to tackle this phase of the problem after two seasons of preliminary study on how to tackle it. He mentioned that Richard McArdle, at Portland, was working closely with him, and continued, "The field is so new that we have nothing to help us except our own imagination and what little ingenuity we possess. I've been at this fire research for five years now and, while I'm becoming more and more convinced that there is nothing revolutionary in it, I am also becoming more certain that by better knowledge of details we can tighten up in both prevention and suppression very appreciably."

He indicated in 1928 that many more measurements were required to pin down the relationships between the numerous fire danger and behavior factors than were realized back in 1922 and 1923. His goal was still to integrate the effects of all or at least several of the weather factors into a single measure of resultant inflammability.

Lacking laboratory facilities and personnel trained in specific disciplines, Gisborne turned to the two Universities in the area - Montana and Idaho. He had laboratory privileges at the University of Montana; University of Idaho was to study problems related to combustion of forest fuels. An electrical method of measuring the distribution of moisture in wood was investigated at University of Montana by Professor Ramskill in 1926; however this gradually turned into a lumber moisture meter study and gave no help to Gisborne's needs. The Northeastern Forest Experiment Station and the Forest Products Laboratory also tried to solve this problem with no success. Gisborne said in the 1927 Annual Report that the inflammability of certain size classes of wood, such as slash could be measured if the distribution of moisture could be measured.

E. E. Hubert, at the University of Idaho, completed a study dealing with the inflammability and heat retention of various fuels at different moisture contents - probably the first time that a relative inflammability rating between species had been accomplished.

Results of Gisborne's tremendous efforts were becoming evident by the end of the decade, according to the Annual Reports, "...the technique, methods, and the duff hygrometer...have been adopted in the several other regions throughout the country." "The National Forests in the region, having tested the methods of measuring forest inflammability and other criteria of prevailing fire danger, are each year coming to pay more attention to these results of research in the daily work of fire prevention and control."

LIGHTNING

The second fire project studied the relation of lightning to forest fires. One of the ultimate objects was to predict the approach of lightning storms some time in advance. Gisborne must have worked like lightning when he first arrived on the job April 1, 1922, as a working plan for the "Lightning and Fires" project was approved on June 24, 1922. The broad scope of the study included such fields as effects on lightning occurrence of certain soils, rocks, forest cover and topography, study by instrumental means, and possible ways to control lightning. It is important to note here that outside of one or two meteorological studies in France and America there have been no cases where detailed observations have been made simultaneously at so many closely related stations.

The project began with 1300 storm reports from 146 stations. The 1923 Annual Report admitted that one or two years' record and analysis of this sort are not sufficient to establish the facts, principally, because of the variations in meteorological conditions between one year and another. A surprising and significant observation resulting from the first year's data was that lightning storms in this region do not generally occur as well-defined single storms following definite paths, but are numerous isolated storms occurring more or less simultaneously over a wide area of atmospheric disturbance.

Inclusion of some of the first two years work in the 1924 District Fire Manual signified perhaps the first incorporation of fire research results into operational manuals.

The 1924 and 1925 records were put on punch cards and then compiled by the 'Hollerith' machine in the Washington Office, combined with the earlier years' compilations, and published. Gisborne has two reports based on the study's interim analysis, the basic report in the Monthly Weather Review, 1926, and its discussion in Northwest Science, 1927. The main points of the report were: the value of prompt reporting of a lightning storm and the necessity of taking immediate preparatory action, identification of probable fire-starting storms, and value to the Weather Bureau in making longer-range forecasts.

A specially constructed "quadrant electrometer" was obtained from the University of Idaho Physics Department. In some cases it had indicated a relationship between atmospheric electricity and the weather, precipitation, lightning, and possibly relative humidity. The 1927 Annual Report indicated that the University of Idaho Physics Department's head, Dean Angell, had left so no real evaluating was ever done with this instrument.

Howard R. Flint, Chief of Fire Control in District One's Division of Operations, became interested in 1929 in the possible influence of geologic formations in attracting lightning. His investigation was apparently a spare time venture and continued for a year or two with no formal report of results.

A major effort in 1929 was the compiling and analyzing of 14,754 storm observations in this region during the period of 1924-1928. Up to 344 observation stations participated, principally lookouts. In 1927 and 1928 Districts 2 and 4 and British Columbia joined the program and began submitting reports. The results were put to use in improving the level of protection from lightning fire by increased surveillance, knowledge of the difference between the fire-starting storm and the safe storm, and more accurate 36-hour forecasts of storm occurrence. The formal report by Gisborne was finally published in the Monthly Weather Review in 1931, abstracted in Science Service, and briefed in Readers Digest.

The Bulletin-Northern District, issue of July 1927, contains an article by Gisborne, titled Your lookouts have information for you, based on the analysis and contains two pages of facts showing where immediate reporting to the ranger would have provided greater forewarning of fire control action to come.

Gisborne admitted in the 1929 Annual Report that this work was to be continued because no meteorological phenomenon can be completely accounted for in such a short period as five or even ten years. The Spokane Weather Bureau Office was already four years behind in its use of the data and called for immediate action. He anticipated 3000 to 4000 reports would come in each year.

George Jemison, in speaking of Gisborne's broad interests and how he'd grasp every lead he could and follow up on it, talked about R. B. Adams, who developed the Adams ground line telephone and was some kind of engineer who fooled around with electrical gadgetry. He and Gis got together and decided there must be some way to measure static electricity to predict before the event the occurrence of lightning storms. "So Adams rigged up some kind of aerial and spark gap in the upstairs at the old fire lab. He would sit there during oncoming lightning storms and try to adjust the spark gap to measure the distance it would spark as the electricity built up in the air. But this never led to much."

FIRE WEATHER FORECASTING

The third major continuing project initiated in 1922 or 1923 dealt with fire weather forecasting which heavily involved the Weather Bureau, and through the years created more controversy and arguments than all the rest of the research combined.

The 1923 Annual Report mentions that long range forecasts of 3, 6, and 10 days based chiefly on sunspot forecasts issued by the independent meteorologist Father Richard of Santa Clara, California, were substantially correct in all cases, and included both the worst lightning storm of the season and the drought of September 10 to 20. No further mention of 'sunspot forecasting' was found in the records except for brief comments in 1937 and 1948. Gisborne did continue his interest in long range forecasting and accumulated numerous ideas on weather cycles. Wellner recalls, "I have heard him talk about 11, 22, and 44 year cycles, associated with sunspot activity. He was always interested in past climatic records and what they might reveal. The varves in the clay deposits on the Experimental Forest and along the road to Priest River greatly interested him as a record of yearly fluctuation in rainfall."

The Fire Weather Warning Service was set up in 1923 by the U. S. Weather Bureau and headquartered in San Francisco. Obstacles to its success were many. Transmission of forecasts was mainly by telegraph. Radio transmission was usually in code and receivers were not very powerful. Mountain weather vagaries were not well known. About the only weather data inputs were from the usual large city stations, as virtually no mountain-situated weather stations existed. The forecasts were therefore of very little value. But even then, hopes were high that dependable 6-hour, 36-hour, and longer range forecasts tailored to fire control needs would be forthcoming soon. Howard Flint was realistic, however, when he stated in the November 1923 Bulletin-Northern District that the hope that an abnormal season can be predicted from one to three months in advance has perhaps little or no scientific foundation at this time.

The next year, however, Gisborne was given a detailer for six weeks to assist him in perfecting a statistical method of showing the relative probability that the following spring or summer will be wetter or drier than the last one. He claimed in the 1924 Annual Report that his system proved 86 percent correct over the past fourteen years of record analysis. His 1925 paper presented to the AAAS meeting in Portland, Cyclic fluctuations of rainfall in the Northern Rocky Mountains summarized his attempts to predict rainfall for each month from April through September, based on 44 years' precipitation records.

Evidently the first daily reporting of local fire-weather data to the Weather Bureau occurred in 1926. Although the weather factors measured at Priest River, Musselshell, Savenac, and Spotted Bear were telegraphed to the Spokane Weather Bureau office, the beneficial results were few. Even so, this may be the first year that the Spokane Weather Bureau office became directly involved in fire-weather work.

Early in 1927 Mr. Chapin of the Weather Bureau accompanied Gisborne on an inspection trip of the eight Forest Service weather stations. Chapin made available the use of several Weather Bureau instruments. New recording forms and training in measurement techniques were also provided. (These practices continue to this day.) The successful prediction record of the beginning and ending of thunderstorms was gratifying, and, as the 1927 Annual Report states, "This is thoroughly dependable and useful information of the kind previous investigative committees have outlined as being very desirable." The Report praised Mr. Chapin and Mr. Keyes of the Spokane Weather Bureau office for their excellent cooperation and productivity in spite of inadequate funding, but complained about the small amount of time actually allowed them for research. The equivalent of only a third of one man's time was available for fire weather work. It strongly urged the Weather Bureau to finance adequately a full-time fire-weather person at Spokane.

By 1929 it was realized that a big improvement in the quality of the forecasts had been made in the last few years largely as a result of the Forest Service field station reports. The Experiment Station work was confined to liaison between the Weather Bureau and the Forest Service. Mr. F. C. Crombie, an experienced fire-weather meteorologist, was assigned to analyze the mass of data submitted by Forest Service observers over the past several years. Since Crombie could not give his full time to fire-weather work, the Investigative Council again urged the Weather Bureau to finance more adequately such a position.

Broadcasting of regular fire-weather forecasts and special warnings through commercial radio stations was instituted in 1927. KUOM (University of Montana), KHQ (Spokane), KOMO, KJR, and KFOA (Seattle), and KGW and KOIN (Portland) participated. These forecasts were to augment the regular telegraphed daily forecasts. Gisborne, according to the Bulletin-Northern District, July 1927, hoped that by using the telegraphed predictions received in the morning and by amplifying and checking them with the radioed evening predictions, real value might be realized out of the service that year. KUOM dropped its forecasts that fall due to uncertain field reception and the results were not found to justify the cost.

In commenting on the current status of fire-weather forecasting, Gisborne, in the January 1928 Bulletin, admitted, "This is, nevertheless, the best system yet devised for predicting the weather. There are good salaried jobs and a fair share of fame waiting with open arms for anyone who can improve upon it. Don't crowd, please, don't crowd!"" But in the next month's Bulletin he wrote, "Wanted; better weather forecasts."

Previous to 1926 the weather forecasts received in northern Idaho and western Montana for use in fire protection were not fire-weather or even mountain-weather predictions. In 1926, however, a special appropriation was passed by Congress to assist forest fire-weather forecasting. Some of this money was made available to the Spokane Office of the Weather Bureau so that a specialist could be assigned. Immediately the Weather Bureau men at Spokane began to learn when, where, and why the mountain weather differed from the weather at the other stations. In 1927 the Spokane Office received the San Francisco and Denver forecasts, but waited until the Forest Service reports were received before incorporating all the information into a truly localized forecast which was then sent to the Forest Supervisors.

To his dying day Harry Gisborne was continuously prodding the Weather Bureau to do a better job.

DAMAGES AND VALUES

Investigations involving damage or values associated with forest fires received very little attention in the early years. In fact, throughout Gisborne's time, only a few feeble attempts at establishing going research projects in this area were made. This low priority was not so much from lack of interest as it was from lack of time, funds, and personnel to do the work; he had to learn the fundamental inputs relating to fire-danger rating and fire behavior. Damages was one of the study areas that could be looked at by administrative persons. As early as 1923 Howard Flint, District One Office of Operations (of which Fire Control was a part) had devised and published in the 1925 Idaho Forester, a theoretical order of susceptibility to fire damage, the ratings being based on thickness of bark, root habit, resin content of the bark, branching habit, stand density, inflammability of foliage, and lichen growth. The 1928 Annual Report mentions a tabulation of mortality by species fifteen months after a forest fire, based on Flint's theory. The rating checked without a single deviation the theoretical order published by Flint. The entire method, described on page 121 of Instructions, Fire Protection, Northern District for 1923, was reduced to a simple table occupying a single typewritten page.

FIRE CONTROL PLANNING

Most of the work involving fire control planning and suppression was conducted by the District's Office of Operation. Its fire chief, Howard Flint, and Gisborne worked together so excellently, however, that most studies initiated by 'O' were checked in advance

very closely with Gisborne. This close cooperation became more and more evident as the years went by, particularly during the 1930's. The 1923 Annual Report refers to the preparation of a Forest and District map, showing the location and degree of concentration of lightning fires for the past decade. It was found to be of much interest and of some value in planning protection organizations. It expressed hope that further overlays of timber types, geological formations, and lightning storm zones would be prepared.

Gisborne and Flint had apparently been planning a fire bulletin in 1924, but the Investigative Council told them to drop it until they had more information and more time. Fire records continued to be analyzed by Flint, at least through 1928, but the joint bulletin never materialized.

Forest fires covered so much area and destroyed so much commercial timber and growing stock that fire control and research units gained the full support of industry. Dr. Wilson Compton, then Secretary-Manager of the National Lumber Manufacturers Association, states in the March 1923 Bulletin, "The first requirement of successful private forestry is the efficiency and universality of organized protection against fire." At that time both Idaho and Montana were having difficulty in legislating adequate forestry and fire protection measures.

A fire survey on the Clearwater Forest was completed this year and those on other forests were being continued. The fire survey on the Selway began in 1921. The December 1922 Bulletin stated that while the subject fire is a very important part of the work, yet the survey is really a valuation survey of all our resources. Data were collected on timber types and volumes; fires, their date and area covered; direction of burn; species reproducing; the fire hazard remaining; check for visibility on lookout point; examination of possible new lookouts; possible location of new trails; and kind and amount of grazing.

The fire survey brought out the fact, as reported in the April 1925 Bulletin, that were unfortunate enough to start our attempt at forest protection in an especially unfavorable cycle, as indicated by the fact that during the 40-year period 1885 - 1925, 50 percent of the 3 million acre Clearwater country burned, but during the 80 year period 1805 - 1885, only 17 percent of this area burned.

In the next month's issue Gisborne explained what fire research was trying to do. He was beginning to put numbers together into some form of relative rating. For moss, dead weeds, fine twigs, and other light weight fuels the moisture content changes very closely with relative humidity and air temperature. Similar ratings apply to twigs, upper duff, dead branchwood, and slash except that the moisture content of these fuels lags behind both the wetting and drying cycles of rainy and drying weather. By measuring duff moisture directly (with the duff hygrometer) he found it possible to distinguish six degrees of duff inflammability, and to forecast changes rather accurately, sometimes three or four days ahead. This kind of information put him just a little closer to constructing his first fire danger meter five or six years later.

Although not of direct research value, several developments in 1928 are of historical interest. Flint and others checked out a trail-sized tractor, the "Iron Horse," but found it "unable fully to take the place of a horse," Earlier, in 1926, chain dynamite, or Cordeau-Bickford, was tried for opening up a fire trench, but did not move enough duff unless it was buried. Flint also pushed investigations through 1929 into development of back-pack-portable radios through the expertise of Forest Inspector D. L. Beatty, determination of adequate fire control, rating fire hazard and liability, and aerial photographic mapping. Flint deserves the highest recognition for his pioneering work in this form of mapping. In fact, he promoted use of the airplane at every opportunity.

AERIAL FIRE CONTROL

Use of aircraft in forest fire control assumed importance immediately after the end of World War One. Howard Flint, Kaniksu Supervisor in 1920, was reported in the February 2 issue of the D-1 Bulletin to be making a study of dirigibles' use in fire-fighting and was ready to demonstrate its practicability.

Roy Headley, Chief of Fire Control in Washington, conferred with the Chemical Warfare Division at Edgwood Arsenal (D-1 Bulletin April 1922) about firefighting chemicals. Arsenal personnel were quick to discourage trying hand grenades or gases, but thought that the new fire-foams might have possibilities. No follow-through was found in the records.

CLOUD SEEDING

The first local reference to cloud seeding was an offer received by the District Office to save the forests for a nominal fee. The unknown author's letter appeared in the October 1922 Bulletin-Northern District: "Upon reading the critical danger of forest fires I was impressed with the usefulness I could be in the Forestry Service. I have an invention of Ether Chronometer with which I have made hundreds of rains and snow storms. I could remove the dryness of pine and spruce needles. The weather can be controlled in perfect manner, preventing electrical lightning, and high wind storms. I could devote the next two months to this work." The editor states "Hang up yo' shovel and yo' ho-o-oe!"

The February 1923 issue of the Bulletin quotes an AP dispatch which describes dropping sand, electrified by 10,000 volts, over a fogged-in airfield to permit clear landings. Gisborne says that Priest River "will keep in touch...in the hope that it can be used in fire fighting."

RESEARCH VALUE TO DATE

In 1924 the relative importance of the three studies then underway was ranked by the joint District-Station Investigative Council as first: measuring and forecasting fire conditions, second: lightning and fires, and third: statistical forecasting of rainfall. Larsen resigned this year to take a professional position with Iowa State College at Ames. This left Gisborne the

professional person engaged in research at Priest River Forest Experiment Station.

The 1926 Annual Report stated Gisborne was using his going-fire study of that year to devise guides for future investigation. Study of the Quartz Creek fire showed that when temperature and humidity were high and low enough, respectively, to produce a certain dryness of fuels-less than 10 percent duff moisture content-then slight variations of wind velocity may cause great variations in the area burned. He hoped that forecasts of 'bad conditions' may soon be interpreted in terms of rate of spread of fire.

The District Operations Division this year completed field work for the hour-control study it started three years earlier. The burned area maps prepared in the 'fire surveys' show that fully 75 percent of the gross area of North Idaho Forests have been covered by fire since 1870.

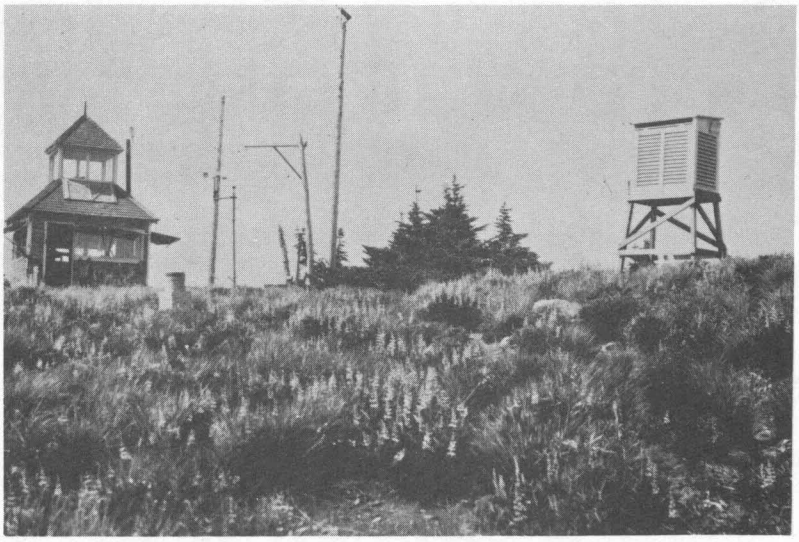
Howard Flint pointed out in the 1928 Annual Report that forest areas in this region were burning five times faster than the acceptable rate for adequate control. He emphasized that the need was for more work on the existent studies rather than additional research projects.

One of the worst fire years since the beginning of organized fire control occurred in 1929. The Annual Report supplied evidence that research since 1922 had been extremely valuable. The 1929 fire season supplied abundant proof of the possibilities of research assisting in many phases of fire control in this region. As one result, agressive action was taken to obtain funds for essential physical improvements, and for additional personnel. Proposals to Washington were made by the District Forester and the Director to accelerate much needed research into improved methods such as dependable weather forecasts, measurement of prevailing inflammability, intensive accounting for lightning storms and strikes, the distribution and most efficient use of the protection force, reduction of elapsed time of both discovery and attack, intensive fire prevention, tactics and tools of suppression, and many others.

A possible reorientation of research goals was suggested in this report. The original three projects were initiated on the basis of both research and administrative experience prior to 1922. Although each of these lines of work was still rated as essentially important, other phases of the fire control problem probably had grown in importance, currently if not fundamentally. Of these original three, lightning storms and fires was most productive and immediately usable; control of forest combustion and inflammability the most complicated and fundamental, while cooperative work with the Weather Bureau in improving forecasts had required the least effort in proportion to the success attained.

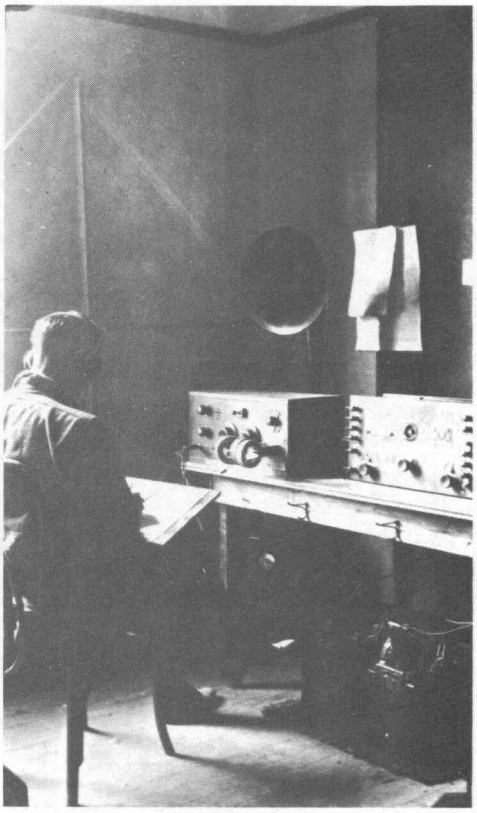
PERSONNEL

No job description, or even Civil Service classification, existed that encompassed the realm of forest fire research. For years fire research's appropriations came as a portion of Silvical Investigations (SI). Gisborne's first fire research title was Forest Examiner, at $1920 per year. He was soon re-designated Assistant Silviculturist, and moved up to Associate Silviculturist



Looking Glass Lookout 1920's

Priest River Experiment Station, 1920's



Gis' prized radio

Priest River Experiment Station, 1927
Top: Averill, Hatch, Munns, Marshall
Bottom: Gisborne, Koch, Weidman, Larsen

Half Moon fire from Desert Mtn.
Lookout, 1929

by 1924 at $3000 per year. Silviculturist at a salary of $4000 per year was his title at decade end.

The total Station allocation was about $14,000 per year, including all salaries and expenses. These funds seemed infinitessimally small for the five-person staff in 1922--Weidman, Larsen, Wahlenberg, Gisborne, and Kempff. I. T. Haig came in 1923; Larsen left in 1924; Marshall joined the staff in 1925, the year that the station name was changed to Northern Rocky Mountain Experiment Station. J. B. (Tommy) Thompson transferred to Priest River in 1928 as superintendent and remained in that position until 1937. Some field help was available in 1927; however, Gisborne's annual expense allotment remained at $400, and he continued to be the only person involved in fire research.

THE RESEARCH BOOM OF THE DEPRESSION
(The 1930's)

The Great Depression could be called a blessing in disguise for forthcoming fire research and control. Beginning in 1931 emergency funds to help the economy and put people back to work aided in meeting some of the physical fire control and research needs. The coming of the CCC's (Civilian Conservation Corps) in 1933, and other emergency programs such as WPA, ECW, ERA, etc. rated a 'Milepost' in Gisborne's 1942 article: "Money and labor of a sort were here made available to carry out Norcross' transportation plans to approach Show's and Kotok's standards of speed and attack, and to build more landing fields for Howard Flint." These funds meant putting some promising young scientists on the emergency payroll and later switching them to regular funds. F. Lloyd Hayes was one of those, in 1934. In a memorandum to Director Bradner dated January 31, 1946, requesting funds for resuming research halted earlier for lack of funds, Gisborne recalls that the timing of the fire control planning field projects such as fuel typing, seen-area mapping, lookout location and construction and fire control roads was actually most fortuitous because they coincided with the beginning of the CCC program, and may otherwise never have been accomplished.

In fact, the research work of the previous decade had brought the state-of-the-art up to the point where fire control planning work was just becoming possible. The coming of Major Evan W. Kelley in 1929 as Regional Forester generated enough enthusiasm for cooperative fire studies which would put research results to work that Lloyd G. Hornby was placed in charge of the project. Thus the stage was set - research waiting to be used, Hornby primed to use it, and then the funds and personnel becoming available to put it all together.

FINANCES AND PERSONNEL

One great problem with the advent of increasing amounts of emergency funds was that regular funds not only did not keep pace; they fell behind. Then, in the late 1930's, when emergency funds dried up, the regular allotments remained too low even to operate at a maintenance level. Personnel built up for a while then reverted to almost none. This trend can be most easily seen from the following tabulation for a few of the depression years:

Fiscal Year	Funds		Personnel
	Regular	Emergency	
1932	$18,900	0	Gisborne, Jemison, Hornby[1/]
1934	14,837	4,630	Gisborne, Jemison, Hornby
1935	13,503	14,811	Gisborne, Jemison, Hayes, Hornby
1937	13,625	18,220	Gisborne, Jemison[2/], Hayes, Hornby, Kachin, Buck, Cline, Naiman
1940	15,000	0	Gisborne, Hayes, Lyman, McKeever, Cline, Naiman, Weyerman

1/ Hornby worked directly with Gisborne as an R-1 collaborator 1931 to mid-1935, and as an Experiment Station employee 1935 until shortly before his death in 1937.

2/ Jemison transferred to Appalachian Station in fall, 1937.

In fiscal year 1927 fire research operated on an annual budget in the neighborhood of $5,000. The McSweeney-McNary Act of 1928 gave tremendous impetus to financial augmentation of research funds, but none showed up in Gisborne's division until July 1, 1931. Gisborne was full of plans for this increase, hoping one new man would work on a fire damage study, himself on fire studies now underway, and one on a new statistical study. However, the nation was in deep financial trouble about then so Congress passed the Economy Act of 1931 which tended gradually to nullify the research gains that had looked so promising.

The first blow came in a memorandum from the Director to his staff on August 3, 1933 indicating a 28 percent cut in funds for FY 1934. As usual, this came a month after the fiscal year had begun. The Annual Report for 1935 stated, "The past year proved to be one of reduction in emergency allotments with practically no increases in the regular appropriations which were cut so heavily in 1933." The 1937 Annual Report said, "Divisions of Silvics, Fire, and Forest Products are operating upon the reduced allotments which the Economy Act of 1931 made necessary. Also the emergency funds continued to decrease. This has meant either that going projects had to be curtailed at the point where very little progress could be made, or that certain of them had to be temporarily discontinued." The next year's Report was just as gloomy. The plans for CY 1938 called for a bare continuation of the work as curtailed in 1937. However, if some money did come his way, Gisborne would reinstate the vegetative burning study and initiate a full blown study of rate of spread of fire on a large scale in several fuel types. "The Station will lose (its leadership) in the field of fire research unless these studies are started soon."

The Forest Service did, however, manage quite well to maintain a solid promotion policy for its regular employees. Gisborne became a Senior Silviculturist in 1935 at $4600.

Harry Gisborne's sincerity and enthusiasm paid off in more ways than can be counted. George M. Jemison, a Forestry student at University of Idaho, had heard him give a number of lectures relating to fire research. Inspired by these stimulating lectures, Jemison sought a summer job at Priest River in 1930, even though he could have returned to the Coeur D' Alene as a fire guard. Jemison recalled that "Probably the talks that Gis gave were what really captured my interest and got me thinking about research as a career. Then the experience of the summer of 1930 working with Gisborne added to my interest. I think after that summer I'd pretty definitely made up my mind that research was where I was going to go." He received his permanent appointment in 1931, becoming the first full time professional assistant in Gisborne's fire research program. It was a good choice, as evidenced by Jemison's career. He returned in 1950 as Director of the Northern Rocky Mountain Experiment Station and subsequently became Forest Service Deputy Chief for Research.

RESEARCH FACILITIES

By 1931 Gisborne was becoming keenly aware of the complexity of integrating weather factors and the need to obtain satisfactory measurements under natural or going-fire situations. The Annual Report lists the major recognized factors influencing fire behavior as "...temperature, atmospheric humidity, wind, topography, and amount of inflammability of fuels." It continues, "In a problem rendered complex by so many natural variables it is often least costly and quickest to take the problem into the laboratory where each factor can be controlled and the results checked by repeated trials with several factors held constant. This method is applicable to fire problems dealing with rate of spread and similar items, and a wind tunnel in which fires can be created, using particular fuels arranged on simple topographic models with air temperature, humidity, and wind velocity and direction controlled, will permit the determination of fire behavior principles which can be intelligently checked on going fires."

The Report becomes more specific on the wind tunnel stating that "This laboratory should consist of a wind tunnel at least 10 or 12 feet in diameter to accommodate fuels of definite moisture content, at any desired slope, wind velocity as desired, and the air held at any selected temperature and humidity. The effect of ridges and canyons on local winds could be determined so that forecasts can be made more accurately. This need should be given high priority; nationwide significance may place this project at the Madison Laboratory.

Thanks to the availability of emergency funds, Priest River Experimental Forest headquarters was completely rebuilt between 1935 and 1938, bringing to fruition part of Gisborne's dreams. The Annual Report of 1936 recounted, "Staff members are about to realize a long-cherished hope in the new laboratory and office building that is now four-fifths complete. About three-fourths of the necessary scientific equipment is now installed and by next summer the structure will be completed." No names are named, but Gisborne was no doubt the most elated of all staff members. His

contribution to the design and construction of the buildings, especially the office-laboratory, was significant. A. A. Brown felt that the development of Priest River through the CCC days probably fell too heavily on Harry and though it was a waste of an awful lot of energy on the part of a top notch researcher, Brown said in his interview in 1976, "Even so, it faithfully reflected Harry Gisborne. Without him, it just wasn't the Priest River Station anymore." Tommy Thompson was actually more responsible than any other for rebuilding the Station. After Thompson left in 1937 Wellner had planning responsibility for the Experimental Forest, and Hayes and McKeever took responsibility for CCC and other work at headquarters. Gisborne had to resume the full load during World War II.

He did not get his combustion chamber or environmentally controlled wind tunnel. That did not come until 1960, nearly thirty years later. The wind tunnel at the Northern Forest Fire Laboratory fulfilled almost exactly the requirements he described in 1931. He settled for less in the meantime, as in about 1939 or 1940, he had summer student employees build a small portable wind tunnel, primarily to calibrate anemometers. It was about 10 or 12 feet long, 2-1/2 feet wide in the test section, bell-shaped at both ends, could be opened at the center for instrument placement, and had a two-bladed hand carved propellor driven by a variable controlled electric motor. With minor improvements its use for calibrating repaired anemometers continued until after 1970 when it was finally discarded.

Another little known attempt by Gisborne to acquire laboratory facilities occurred when the new Federal Building was built in Missoula in 1936. One large basement room (B-17) was extra deep, had a large permanently mounted electric (DC) motor complete with DC convertor and controls, and a separate chimney for dispelling smoke from experimental fires. As far as is known, the room was never used for anything except to house the little wind tunnel.

FIRE BEHAVIOR

Fuel Moisture Indicator Sticks

For some time the effect of shade and canopy on fuel moisture was measured at three separate spots, not comparable in aspect or topography - probably Larsen's old 'site factor' stations. The present well known Clearcut, Half Timber, and Full Timber inflammability station group was established in 1930 on Benton Flats across the county road from the office. These stations are all within a radius of a few hundred yards, and vary only in the density of the forest cover. The first task Jemison had when he came to the Experiment Station was to set up the Full Timber station--hack it out, fence it, and install the instruments. He built the sturdy instrument shelters, still standing at these locations. The Clearcut station had been in use since 1926 or 1927 and the Half Timber Station had just been cleared out. It was Jemison's job to take the weather measurements three times a day at these and the control station next to the office and summarize the data.

Clearcut station is still in use but Half Timber station was discontinued many years ago and Full Timber station has not been used since the large log study was terminated in 1960.

Reaction of moisture content of 2-, 1- and 1/2-inch wood cylinders to the different degrees of shading became an important and long-lasting study at these three stations. For several years Jemison had the responsibility of maintaining the records. He measured the cylinders so many times that he commented in 1976 that "I still remember the numbers. The 2-inch stick was #9, and the half-inch stick was #4. Stick #5 was a charred stick on the ground." Sticks were laid on the ground and on elevated wire brackets to simulate branchwood fuels in various positions. The first measurements did not allow for weight loss due to weathering. Subsequently they were re-dried and recalibrated each winter. By comparing the cylinder moisture contents with temperature and humidity records he found out that one could not be predicted from the other.

The one-and two-inch cylinder information was never published, but the data were used as inputs to other research work. Measurement of them was dropped around 1936. Only the half-inch sticks were used to represent branchwood in Gisborne's fire-danger rating system.

The final product of four half-inch round dowels pinned together and cut to 100.0 grams oven-dried came after much controversy. First were the two-inch natural branchwood cylinders, then the 1-1/2", 1", and 1/2" natural wood ones, followed by machine-turned dowels, none of them pinned together in sets. By 1935 'triplets' were being sent out for use at inflammability stations. Triplets were a set of three half-inch by 18 inch cylinders doweled together near each end and weighing about 80 grams. Four cylinders were doweled together by 1942 and probably a bit earlier. For the 1942 fire season and the advent of the Model Six Burning Index Meter the sets of hazard sticks were trimmed to 100.0 grams over-dry weight. They remain unchanged today.

A parallel fuel moisture cylinder development program was carried on at the Pacific Northwest Forest Experiment Station in Portland, Oregon, by R. E. McArdle (later Chief of Forest Service) and his crew. As early as 1929 McArdle evaluated two-inch pieces of branchwood, both peeled and with bark on. W. G. (Bill) Morris worked with him on the fuel stick development. PNW opted for square sticks instead of round. Jemison recalls that Gisborne was extremely critical of the square sticks because square sticks didn't occur in nature. The dispute between Gisborne and McArdle over the size and shape of sticks was friendly, according to Jemison, although "Gisborne was such a dynamic person and pushed so hard to move his program ahead that he was not one to adopt things without a very critical look." To his knowledge there was no concerted effort to get together and plan, although ideas undoubtedly were exchanged.

Gisborne won on the round versus square argument. However, McArdle's effort produced the first set of three square sticks pinned together and trimmed to 100.0 grams oven-dry in 1932 or 1933. The two-inch sticks, trimmed to 400.0 grams oven-dry were used on 25 to 30 ranger districts in McArdle's country as early as 1932,

and did not give way to the half-inch sets until 1939 or 1940.

Gisborne gave full credit to PNW for the doweling together of three and later four sticks.

Fire Danger Meters

The 1931 Annual Report states that the work of measuring the weather elements and their effects on fire danger had, by 1931, produced a large volume of records permitting the comparison of duff and wood moisture content with any combination of the various weather elements. Gisborne's Miscellaneous Publication No. 29, 1928, contains the first summary of this information. The five years' accumulation of records since those used in Miscellaneous Publication No. 29 provided information that could be used more than in the past to help standardize expansion of the forest protective organization. The Report claimed that fuel moisture and weather conditions must be fitted into their proper places with respect to other factors, such as activity of the fire starting agencies, visibility, etc., which also affect fire danger. All of these factors then needed to be integrated so that the net result of any combination could be expressed in terms of justifiable control action.

The next step was obvious, and led to the claim made by Gisborne in 1946 that "Origination of the Fire Danger Meter has probably been my major research contribution." The next step was to derive a simple and readily usable means of expressing the result of the integrated factors, rather than dependence upon several charts-one for each factor. To fulfill this need a small pocket-sized device was constructed using the idea of one type of photo-meter or exposure meter employed as an aid in photography. This Model 1 Fire Danger Meter was issued to a selected group for trial and study during the 1932 fire season. The effect of wind and slope appeared to be the weakest inputs to the meter and were not only the most urgent but the most difficult to resolve, as these data came mostly from study of large fire behavior and were all too meagre.

Jemison recounted an interesting discussion between Gisborne and Earl H. Clapp, then Director of Research, Washington, during Clapp's visit to Priest River in the summer of 1931, "I remember sitting in the old office (later sold and moved to the ranch just north of the Experimental Forest), listening to a conversation between Gis and Earl Clapp over this question of how to correlate the various inflammability factors like fuel moisture and wind-how to express these into a numerical rating that would be more meaningful to the fire protection official than just giving him an abstract reading of fuel moisture like 10% or 8% and a wind rating of 5 or 10 miles per hour. Such figures didn't give him anything that he could translate consistently or that a dozen individuals might translate consistently into some uniform expression of the actual inflammability or later what we called 'fire danger'. It was, I think, out of that discussion that there arose the concept in Gis' mind of developing a fire danger meter. The following winter he began playing around with various devices to put these factors

together and to express them into a single numerical rating scheme." His Model 1 Fire Danger Meter was a little cardboard envelope with windows and two slides "A" and "B". Effects of all the pertinent factors that were important at that time:

Fuel moisture percent (half-inch sticks)
Wind velocity
Relative humidity (if greater than 15%, read next higher danger)
Normal, or abnormal, number of people or lightning storms
Period of land clearing or peak brush burning activity

were integrated into the Danger Meter to produce six classes of fire danger both in terms of rate of spread of fire and administrative action needed to cope successfully with prevailing or probable danger.

Jemison described how Gisborne rated the magnitude of each factor as "...then he drew columns and rows on the slides, but left them blank. He handed these blank Fire Danger Meters to a half dozen individuals that included Howard Flint, Ted Shoemaker, Lloyd Hornby, W. W. White, and one or two others. He asked each one to fill in a rating on a scale of 1 to 6 (1 being no danger, 6 being extreme danger) what they thought the various combinations of the variables meant in terms of total fire danger. They did this individually, and Gis, of course, filled one out too. He took all of these and harmonized them. He then discussed the major variances that appeared among the individual ratings and smoothed out the differences. This became the first Fire Danger Meter."

A minor date discrepancy appeared here in that Jemison and the Annual Reports indicate the earliest Meter must have been in late 1931 or 1932. However, Gisborne's hand-lettered first Model 1 Meter has the date 1930 written on it in his handwriting.

The files show that since Harry Gisborne depended heavily on the knowledge and experience of administrative personnel for weighting what they considered the essential elements, they responded by buying the system with virtually no selling by him. An article in the Northern Region News, on July 6, 1932 would warm the heart of any researcher: "The first issue of the forest fire danger meter in early May has created such a demand for inflammability stations that the Experiment Station has utilized all the wood cylinders and duff hygrometers available and has not been able to equip all of the stations for which requests have been received." The same issue notes that Gisborne had just established seven fire danger stations in Region Four, as well as at least one on each of the ten western Region One Forests (18 total), Glacier Park, and Yellowstone Park.

By the end of 1933, thirty more inflammability stations were established in Region One. But the terrible summer of 1934 was the one that really cemented the use of Fire Danger Meters, and fire danger rating in general, into the total operations of fire control and its financing. The Annual Report for 1934 merely states, "It is now possible to express fire danger in easily understandable and comparable terms. This permits accurate

description of the character of each fire season for a single Forest or an entire region. It is possible to compare the results of fire control with the conditions encountered and thereby determine whether or not the fire control effort and expenditures have been efficient. Such a determination must be made by top administrators if they are to pass sound judgment upon the expenditure of funds for which they are responsible."

Gisborne religiously took his new ideas, instruments, and tools to the field to get the reaction of the men who would ultimately use his innovations. By this means Gisborne became well acquainted with C. S. Crocker in the Selway country. Crocker had spent a good share of his early career in this bad fire country and had a good handle on the many factors influencing fire behavior. Probably for these reasons Gisborne began coming to the Selway around 1929 to set up some of his first fire weather stations, most notably his fuel moisture sticks and duff hygrometer. Crocker stated in an interview that he was a willing 'goat' for Gisborne's new ideas. "He would spring them on me to see what I thought of them."

This warm relationship and feeling of mutual confidence may have been the germ of a new and advanced policy for funding the total forest fire fighting operation. Jemison talks about it as an involved bystander. The inflammability stations that he and Gisborne had put in at Pete King and O'Hara on the Selway Forest in 1933 began to show that conditions were extremely critical in the Selway Nezperce area and the station at Pete King was really showing an extreme condition early in 1934. Crocker was at the time, Acting Supervisor of the Selway. "Gisborne was screaming to everyone that 'boy, we really got a blow-up situation on the Selway.' Crocker was extremely concerned and very much in touch with Gisborne and sensitive to the fact that the measurements at Pete King and O'Hara were showing very critical conditions." A dry lightning storm on August 10 started a dozen fires and all but two were caught that night. Jemison wound up on the Pete King fire on August 11 as camp boss and line boss and "followed that fire all the way from Pete King clear up above Selway Falls trying to keep up with it." Snow finished it off on September 22.

Jemison recalled, "The fact that Gis had been predicting a blow-up situation, led Roy Headley, Chief of Fire Control and L. C. Stockdale, Chief of Operations in Washington, both of whom had had Region One experience earlier, to take some unprecedented action. They were so impressed by the fact that you could actually measure in a reliable way the buildup of fire danger that this one incident led to the policy adopted the next year, maybe the second year after, that FFF should be available for presuppression. Up to that time the only authorization you had to use FFF was after a fire started. But Crocker had been screaming for reinforcements--presuppression forces--to move into the area because of the high inflammability and high risk that he anticipated. He didn't have the money to hire additional personnel." If he had had such authorization, based on fire danger, he felt he could have prevented the Pete King-McLendon Butte fire from escaping, joining together, and burning a quarter million acres.

Based on such a mandate, fire danger meters were continutally refined through the years and altered to meet changing fire potential conditions.

Model 2, dated January 1931, on the original copy, had only one major change, which added a description of fire behavior according to fire danger classes.

Model 3, probably the one used in 1934, had a number of changes. Land clearing activities as a factor was eliminated. Lightning within past two days augmented the calendar date automatic inrease or decrease. Visibility distances changed slightly. If humidity exceeded 15%, read column to right. Seven danger classes replaced the original six. Organization according to fire danger class was added.

Model 4 was used 1935 through 1937. In it the 'Number of people in the woods' was cut out. Danger continued to change by date and if lightning occurred in past two days. If fuel moisture was less than 5%, the next higher wind class was used.

Model 5 was used from 1938 - 1941. Applied Forestry Note No. 85, May 1938, described the changes in detail. Briefly, however, land clearing was back in; visibility distances were different for the eastern Region One Forests from those of the western forests; wind and fuel moisture were in tenths instead of whole numbers; fire danger now ran from 1.0 to 7.4 instead of whole numbers. Added was 'action commensurate with fire danger class' and relates in general terms to Table X-1-c.

Model 6, in use from 1942 through 1953, had some major changes. Most importantly, it consisted of two meters: a Burning Index (BI) Meter and a Fire Danger (FD) Meter. The Burning Index Meter rated the combined effect of calendar date (according to hours of effective sunshine), relative humidity, half-inch stick fuel moisture and wind and range from 1 to 100. The Fire Danger Meter weighted Burning Index with visibility and lightning. BI was set to the nearest 6; dark ridge visibility distance replaced small smoke visibility, and lightning consideration was extended to three days. Land clearing fell out again. In liew of describing action to take, a paragraph gave an interpretation for practical purposes, emphasizing that BI and FD are relative ratings and that use of the ratings is an administrative matter.

The term used for many years to describe the relative security between seasons - Percent of Worst Probable - was first used in the rating sent to Washington at the end of the disastrous summer of 1934. Gisborne proclaimed his pride in the Forests in the November 21, 1934 Northern Region News when he said the records of the seventeen meteorological stations in the Region were "...the most complete, most detailed, and undoubtedly the most accurate statement of its kind ever submitted by this, or any other Region." He explains that "Worst Probable" would occur if every day in July and August rated half-way between class 5 and class 6 danger, or 100 percent for class 5.5. By this system, the western forests of the Region averaged class 4.73 or 86 percent of Worst Probable, only 7 percent less than the Kaniksu experienced in 1931"...when they barely saved that last acre." He summarized by saying, "Region One does not ask anyone to accept anybody's

opinion or assertion that the 1934 fire season was critical in character. We have daily measurements made at 34 stations, covering all of the major factors, to prove it."

When the ratings were extended to a scale of 1 to 100 in the Model 6 meter in 1942, Least Probable was set at Fire Danger Class of 32 and Worst Probable at Class 79 for July and August. The Clearwater rated zero in 1946 (Northern Region News, November 22, 1946).

Inexpensive Weather Instruments

The early fire-weather stations were quite simple and differed none from conventional weather stations set up across the country for Weather Bureau use. They consisted of an anemometer, wind direction vane, rain gauge, psychometer, and perhaps a maximum-minimum thermeter, and hygrothermograph. Instrumentation for these stations was provided by the Weather Bureau. These were fine instruments built to last forever, and therefore very costly. For example, a Freiz four cup recording anemometer cost about $80, which more than paid for one man to work for one month. The 8-inch brass rain gauge with a knife edge on the funnel, cost nearly $25. At fire-weather stations the duff hygrometer was, fortunately, self reading. Wood cylinders could be weighed on Harvard balances or triple-beam scales, neither of which were cheap, and in each case errors could easily be made.

The anemohygrograph (Robot) idea came into existence about 1930 partly due to the earlier development of the duff hygrometer by Gisborne and Matt Dunlap of Madison Laboratory. According to Jemison "Later on, when the idea of having numerous fire-danger stations had appeared and found practical, Gisborne was concerned over not having men available at desirable measuring points to record the readings. So he again went back to the Lab and working with Dunlap developed a fuel moisture, wind and duff measuring and recording instrument, and called it an anemohygrograph or 'Robot' for short. Hygrothermograph records of temperature and relative humidity were kept concurrently, but separately. Only precipitation remained to be measured manually. However, the Robot never got past the research use stage since it took a full-time technician to keep in accurate operating condition and the cost of a unit was over $300.

When the Forest Service wanted to establish more weather stations than the Weather Bureau was willing to equip, the search began for cheaper instruments. Since there were no records to begin with, a lesser degree of accuracy and a shorter lifespan had to be better than no instruments. Probably the first breakthrough resulted from Gisborne's practice of walking home for lunch. Jemison says, "I remember one afternoon he came into the office all excited as he'd seen one of these Pennzoil oil signs at a service station--the old S-shaped metal sign rotating in the wind-and he said, 'I've got an idea for a cheap wind gauge.' So he went to the local machine shop with a pencil and note pad and, working with a fellow there, came up with the idea for these S-shaped galvanized metal wind gauges." The blade was four inches wide and two feet long, mounted on a steel rod that fitted into a capped piece of pipe

with a ball bearing in the bottom. A target was painted on one end of the blade so the revolutions could be counted. The first four looked so good that 160 more were made, at a cost of $3 each.

Each gauge had to be calibrated individually: that job fell upon Jemison. At Priest River he mounted them along a fence and let them "run in the wind for several weeks to get the burrs worn off the working parts..." The actual calibration became a typical Forest Service family venture. Jemison clamped a wind gauge to a frame on the front of his car, and in the calm of evening, he and his wife, Bea, headed for the long straight stretch of the Jack Pine Road. Here Bea "would drive the car at 5, 8, and greater miles per hour and I would sit there with a stop watch and count the revolutions," from which a calibration chart would be made later.

Again a parallel development occurred with McArdle's group in Portland. McArdle hired a couple of young physics students from Reed College in Portland, John Bachus and George Byram. They jointly developed an excellent array of inexpensive, practical instruments by the time they graduated. Their wind gauge consisted of four cups similar to longitudinal half-sections of stove pipe mounted on horizontal arms. Geared contacts on the vertical shaft enabled revolutions to be counted on a buzzer. The gauges were calibrated in the same manner as Gisborne's and Jemison's. One hundred ten wind gauges and wind vanes were made at a cost of only a few dollars for the 1934 or 1935 fire season. This team also came out with the little hand-crank psychrometer in 1934 which was easier than the sling psychrometer for the operator to aspirate for the full two minutes to provide increased accuracy. The hand-crank psychrometer was quickly put in the field in both Regions Six and One. It was the standard until recently when the large amount of handwork outpriced it in favor of a battery operated small electric fan model. Another psychrometer innovation was the egg-beater model, in which the two thermometer tubes were attached to opposite sides of a simple beater model. The idea looked good but did not catch on for widespread use. The 'inventor' is not known, but it was used in Region One and is described, as are all the other instruments, in Gisborne's USDA Circular No. 398, "Measuring fire weather and forest inflammability," in 1936.

Byram and Bachus also developed a simple swinging beam scale that, by using the proper hanger hold, could weigh accurately and quickly either the 100.0 gm. dry weight fuel moisture sticks or the 400.0 gm. dry weight two inch cylinder. The scale read directly in fuel moisture percent. This was the Region Six scale from which the more versatile Appalachian scale was to evolve in the late 1930's. Byram turned out the Byram Haze Meter, the first instrument to attack the problem of uniformly measuring the visibility distance of a small class A fire.

They interested a local tinshop owner, F. A. Anderson, in making an inexpensive galvanized sheet metal rain gauge similar to the Weather Bureau gauge, but only about eleven inches tall. This sold for about $1.25 and was also quickly put to widespread use in both regions. Anderson switched to a stamped aluminum model for an equitable price in the mid-1960's.

When Byram and Bachus left college, the wind gauge, wind vane, and scales were contracted to Allen Chisholm of Portland. He improved both and marketed them for years. A Dozier anemometer of similar accuracy and price was made near San Francisco about then and was used widely in California.

Gisborne and M. C. Stewart of Amherst, Massachusetts mutually made improvements on Stewart's existing low cost anemometer, a four cup type with the shaft and contact gears mounted in an electrical handy outlet. The Stewart anemometer soon became the Region One standard in 1937. Two hundred thirty were purchased at $4.75 each. This development was subsequent to the Chisholm anemometer, and was probably inferior in quality but perhaps a bit cheaper. Why Gisborne did not accept McArdle's and Byram's Chisholm was partly explained by Jemison: "Gisborne was so dynamic he would push ahead on his own rather than look around and maybe accept someone else's development; he wanted to develop things himself. It was characteristic of Gisborne to push hard with his own ideas. There was not much in Gisborne of wanting the other guy to take the lead."

Fire-Danger Rating Training

The Northern Region News of May 21, 1935, reported that a conference on fire danger measurement was held at Priest River April 22-26. Twenty three men attended from all ten Region One fire forests, the Weather Bureau and the National Park Service. The purpose was to train, 'show-and-tell', and critique all aspects of using fire-danger rating techniques. A key point was Sutliff's noting that in 1935 closures, restrictions, and expanded protection forces would be entirely or largely determined on the basis of fire-danger measurements and the class of danger as shown by the fire-danger meter. When Don Mathews of PNW Station demonstrated the Byram Visibility Meter he "...could have sold a couple dozen on the spot..." but the Region One men were told that Gisborne's group would have one out soon and they were urged to look at both before buying.

USDA Circular No. 398 had not been published yet, but material in the draft was essential to conducting the training conference. Gisborne had been preparing this for some time; it is probably fortunate that its final draft did not come out until 1936 since by 1935 most of the fire-danger rating techniques, factors, and instruments had become rather stabilized. This notable publication combined background, theory, calibration and use of instruments, and field application of the principles he had been developing for fifteen years.

The second fire danger school, held April 23-26, 1940, was, according to the April 22, 1940, Northern Region News, an indication of the progress made since the 1935 school in that this time only half of the meeting would be directed to techniques, and the other half to uses of fire danger measurements.

Effect of Stand Density

Jemison's task of establishing the full-timber weather station was a prerequisite to his first formal research study, The significance of the effect of stand density upon the weather beneath the canopy, printed in the April 1934, Journal of Forestry. Gisborne had collected considerable data from open, partly canopied and completely canopied plots at Priest River since 1924, but needed more complete and reliable data from weather stations which were comparable in every way except canopy closure. This resulted in the full-timber, half-cut, and clear-cut stations. Jemison collected twice-daily records during 1931, 1932, and 1933, of maximum and minimum air temperature, relative humidity, wind, evaporation, soil temperature, surface duff and slash moisture content, as well as automatic records of relative humidity and duff and air temperature. He learned that cutting increased the average maximum temperature, soil temperature, and maximum temperature of surface duff. These cutting practices also lowered relative humidity, increased wind movement, at least doubled the evaporation, and reduced fuel moisture contents. Some of the amounts of change were astounding.

The effect of the timber canopy on fire danger was obvious. "By influencing temperature, humidity, wind, and evaporation the forest overwood makes moisture-holding conditions much more favorable and cuts down on the inflammability, hence the danger from rapid spread of fire. A full forest cover eliminates 90 percent of the critical days during July and August, while half cover cuts out more than one-half." The report declared that the contribution of temperature and relative humidity to the greater fuel moistures that exist under timber canopies may be relatively small in comparison to the effect of wind, sun, and other factors.

A statistical analysis of fire weather in 1932, showed a linear relationship existed between absolute humidity and both duff moisture and one-half inch stick moisture. This concurred with Gisborne's earlier findings that absolute humidity exerted greater influence upon the moisture content of fuels than either relative humidity or number of days since 0.01 inch of rain.

While no specific reference indicates it, the study results must have had a bearing on the goals of the fuel-typing project then just getting under way by Lloyd G. Hornby.

Measurement of factors affecting fire danger were continued at these stations until about 1941 when lack of funds caused them to be discontinued.

Indicators of Lesser Vegetation

One weak point in the early meters (and perhaps those of today) was how to account for the effect on fire danger of progression of lesser vegetation from green to cured. Jemison chose the subject for his master's thesis. He wanted to follow up on the idea that some of the critical fire seasons had been prefaced by substantial flush of growth of lesser vegetation - grasses, weeds, and even shrubs - followed by a curing period that added to the fine fuel volume.

First came a search for 'indicator plants.' One grass and several forbs and shrubs were measured in 1933 and 1934 for changes in moisture content during the growing season. Dr. Leon W. Richards, of the University of Montana Chemistry Department spent these two summers at Priest River, performing all the chemical analytical work on these plants as they changed throughout the season to determine their fiber content and extracted materials (waxes and oils) that make them more or less inflammable. Richard's work came out in an article in the Journal of Agricultural Research in 1940. His was perhaps a first attempt to explore this hitherto untouched field. He concluded that moisture content was the major variable, and calorific content second. Differences between species were pronounced. Gisborne had hoped to substitute vegetative readiness for calendar date in the Model 4 Meter to make it more sensitive to seasonal shifts from the normal. He could not quite justify it, as he noted in Applied Forestry Notes. No. 85, May 1938 by saying that this factor could not yet be measured as discretely as the other factors. The indicator plant search continued for years. Yarrow was one of the first indicator plants; at the time of Gisborne's death it was still being studied.

Another measurement in this study was that of color changes during the curing process. George Jemison bought a book titled "International Color Standards" containing about 1000 plates that classified all the tints and shades of all colors. "I remember it cost something like $20. Oh, man, the agony we went through as to whether we could afford that $20 book. By the close of the study I could almost look at a plant and match it with the book (plate and number) without opening the book." (Color film Kodachrome did not appear in stores until 1936.)

By 1937 the substitution of cumulative maximum temperature above 60°F for calendar date as a criterion of vegetative curing rate was field tested for possible inclusion in the Fire Danger Meter. No further mention of this criterion was found.

To tie the indicator plant data and Richards' results to actual fire behavior, a series of burnings was conducted in 1935 and 1936. The 1935 study was in a ceanothus brush field in Fox Creek above the road from the CCC camp. Plots were laid out to contain similar fuels underneath the ceanothus bushes and individual or paired plots were burned throughout the season. Jemison attributed the lack of variation related to the curing of vegetation to the fact that "we were too scared of touching off a conflagration and we didn't burn under critical enough conditions to get major differences." So the next year an old burn across the river by McAbee Falls was the site for a planned plot burning study where sample plots were artifically loaded with fuel early in the spring. Variation in living vegetation volumes was obtained by manually weeding and thinning. The plots then had uniform dead fuels but varying live fuels. The six plots were burned simultaneously on July 16, 1936. Jemison's article in the August 6, 1936 issue of the Northern Region News titled The effect of vegetation on rate of spread of fire stated that the fire-retarding action was evident as those plots with willow, fireweed, bracken fern, and pine grass increased in perimeter only 58 percent as fast as

the devegetated plots. He related this further to the relative manpower requirements for going fires in similar fuels as these. In an interview he said "...and Gisborne was so excited at the results he could hardly contain himself." But Jemison thought the variation was such that he said "I don't think you could conclude much more from the experiment than as if you just look around the area and said, 'well, this is going to burn faster than that one.'"

Climatological Summary

In the meantime Jemison completed a Climatological summary for Priest River Forest Experiment Station 1912-1931 inclusive in 1932 (NRM No. 7), which described the changes and averages of the air temperature, relative humidity, precipitation, wind, evaporation and soil moisture.

Modified Beaufort Wind Scale

The Beaufort Wind Scale, developed many decades ago for use on sailing ships, was not well-adapted for forest use. The 1932 Annual Report stated that an adaptation of the original Beaufort Wind Scale was produced in tentative form. Preliminary tests showed that each of several men were able to approximate the true wind velocity far more accurately by use of the new scale. This development by Jemison resulted in a single page set of descriptions and drawings that has become a standard reference throughout at least this continent. The Journal of Agricultural Research 49 (1), 1934, contains the article, Beaufort scale of wind force as adapted for use on forested areas of the Northern Rocky Mountains.

The Beaufort "Scale of wind velocity" is the International Meteorological Committee's accepted standard table of comparison of velocity equivalents corresponding to various heights above level ground free from obstructions for comparison with winds within a canopy. The committee established 20 feet or 6 meters as the standard anemometer height the world over. Jemison's chart is built around wind measured at 8 feet, not 20 feet above ground.

The Thousand Degree Burn

Not all research ventures in these days were routine hum-drum affairs. Jemison tells about the little-known 1,000 degree burn and how Gis would get involved with his work and how dynamic he was. The 10-to-15-acre patch of heavy defective hemlock right below the 'full-timbered' site had been logged of merchantable timber before it came into National Forest ownership. It was such a fire hazard to the Experimental Forest that Director Lyle Watts wanted the residual timber felled and broadcast burned to develop a site for planting tests. Kaniksu crews felled the timber in 1932 under Thompson's direction, providing a tremendous bed of fuel averaging 15 feet deep. Gisborne was most anxious to burn it and see what would happen. Jemison said, "It turned out to be a wonderful place to see a fire storm in action. We fooled around quite a

while instrumenting it, getting samples and measuring everything. The crews put a fireline around it, got pumps and hose, and had lots of men on hand. Gis got some thermocouples somewhere, put them in different places up in the slash, on the surface and under the ground, and buried the 25 to 30 foot leads over to where he fixed himself a little shelter behind a great big stump barely outside the fireline due to the short thermocouple leads. We had hygrothermographs and anemometers set up at different places. So came the evening of the burn. They touched it off in the middle first, let it get going pretty good, then quickly strung fire around the perimeter so it would suck in and not spread. Man, that thing took off! Boy, I've never seen such a fire! It really did burn! And of course Gis behind his stump, taking thermocouple readings every minute: well, he couldn't take it. It got so hot at 60 feet that he grabbed all the instruments he could. By then it was getting kind of dark. Benton Creek flows past there. He followed the creek in the dark, slipped and went into the creek. Just as his arm swung down the lid of the hygrothermograph came unbuckled and he scooped the whole instrument full of mud and water as he leaped across the creek. We got a 1000 degree centigrade reading before everything went kapooie! I don't know what ever came of that as far as any knowledge is concerned, except it was a hell of a hot fire, but you could have predicted that!"

The 'Weather Tree' and the 'Meteorological Tower'

The 'weather tree' was the forerunner of the meteorological tower. It was a green three foot dbh larch, topped in about 1923 to 5 inches diameter at 150 feet above ground and limbed for about 25 feet down from the top. Access to the top was by steel spikes. It stood at the edge of the timber back of Cottage 4. The weather tree contained at its pinnacle a recording anemometer and wind vane, and a sunshine duration transmitter, all wired into the old battery operated quadruple register in the office. (There was no electricity at the Experimental Forest at the time.) Jemison relates "and every time Gis came out, the first thing he'd do was shinny up that tree. He just loved to go up to the top. I had to climb the tree every so often to oil the anemometer and adjust the sunshine duration transmitter to be at right angles to the major position of the sun at noon. One day I went up there and one of the hand spikes pulled out right at the top. The tree top was rotted as it had been spike-topped for years. That led then to cutting 15 feet from the top of the tree and of course Gis wouldn't let anybody else go up and saw the rotten top off that tree. He had to do it. That was a great experience. He just loved doing things like that." The top was banded and the tree cabled and trussed and was used for a number of years before the CCC's built the steel tower back in the woods in 1936.

In 1934 Director Lyle F. Watts allotted the funds for construction of a meteorological or 'weather' tower, 150 feet in height, not out in the open but in the midst of a dense stand of timber. In 1936, Ed Quinn, a local jack-of-all-trades, aided by a few CCC boys and supervised by J. B. Thompson, Station Superintendent,

erected the steel for this tower without mishap, and without cutting a single tree, according to the credit section of How the wind blows in the forest of northern Idaho published by Gisborne in 1941.

The meteorological tower was placed in the woods so that Gisborne could study the effect of the forest on wind, temperature, and humidity. The 150 foot tower rose 50 to 70 feet above the canopy when it was first erected, which gave Gisborne an opportunity to compare the unobstructed air parameters with these influenced by the forest canopy. Jemison was proud to declare, "One of the final things I did at Priest River was to install a number of stations up through the crown of the forest and I built the platforms and installed the equipment."

Instrumenting the five levels was a long and financially painful job as the recording instruments were exceedingly expensive. It was not until the spring of 1938 that the complete system was ready to go. One must remember that access to the 49 foot, 83 foot, 112 foot and 156 foot levels was by means of an unprotected metal ladder fastened to the outside of the tower--a harrowing experience even for the most venturesome. Lloyd Hayes had general supervision of this project for several years, along with his altitude and aspect study and other duties. Lloyd recently confessed that "Climbing the tower was too fearful for me at first so I climbed it at night so I couldn't see the great height, until I got used to it."

The 'How the Wind Blows' study discovered a few things, and quantified many. The report states that wind is not uniform between any two topographic or fuel type situations. Even during the windiest hours of the windiest day a fire on the ground under a dense timber canopy will NOT be greatly affected by the wind. The report also draws specific conclusions as to time of day one can expect not only highest and lowest winds, but also highest and lowest temperatures and relative humidities. The report then tells how the information gleaned from the study can be utilized in fighting a fire under different canopies.

Altitude and Aspect

Some study of the effect on fire danger on north versus south slopes by elevation classes must have been hoped for prior to 1933, as that year's Annual Report heralds the refined anemohygrograph as the link making such an investigation practicable. The 1934 Annual Report refers to extending the study of fire danger differences according to altitude and on north versus south slopes. A definite relationship was known to exist for many years but no one had ever assigned specific numbers to it, especially for forest fire control purposes. J. A. Larsen presented in the March 1922 Journal of Forestry data comparing temperatures and humidities between high elevation and valley bottom weather stations. The 1924 Idaho Forester carries an article by him describing "The forest fire season at different elevations in Idaho." The earliest reference cited by G. Lloyd Hayes, who actually conducted the highly significant altitude and aspect study at Priest River Station between 1935 and 1940 was Weather Bureau Chief C. F. Marvin's Air drainage explained article in the October 1914 Monthly Weather Review.

C. Lloyd Hayes, who first came to Priest River as an Assistant-to-Technician, assigend to C. A. Wellner in silvicultural research in 1934, was switched to Gisborne's staff as Junior Forester in early 1934. Hayes' first assignment under Gisborne was to conduct the altitude and aspect study. One of his first tasks was to calibrate and make fool proof the seven or eight new 'Robots.' The anemohygrograph (Robot) was devised for use at hard-to-reach fire inflammability stations within the daily reporting system; however, because of its fickleness toward proper functioning without a highly motivated attendant, its major function in life was for this particular study. The previous summer Hayes recalls Dunlap and Gisborne slaving away reforming the first model by such ideas as attaching a buzzer to shake the frame of the instrument periodically to overcome the friction between the pens and the paper, modifying the wind recorder, etc. "But still nobody had ever made them work;" he claimed "They were very contrary instruments." Even after they were set out at the study sites, the duff hygrometer units required constant recalibration. "During long dry spells the rattan sensory elements skewed to elongate a little each day. Then I'd go up at night and insert the elements in cans of duff that were near saturation. That would restore their accuracy. Or periodically, if we couldn't understand what was going on, I'd go up with a sleeping bag and alarm clock and get up every hour all night long and check the change from one duff calibration can to another. That's why they called the instruments 'Mrs. Robot'--because I slept with them."

Hayes' work marked the first known systematic study of the daily variations of forest-fire behavior as influenced by altitude and exposure, in which continuous, 24-hour records were obtained as noted in USDA Circular No. 591, 1941. Hayes stated that Gisborne had no written study plan, but sometimes he had a few scratched notes on his desk. He probably prepared study plans for later studies when things were becoming a little more formalized and the Director was asking for them.

Groundwork for the study was laid in 1934 when six paired sites were cleared along the ridge which runs from Priest River headquarters up to Looking Glass Lookout. Each pair was placed within 50 feet of the ridge top, one on the north aspect and one on the south aspect. The two valley bottom stations were at the clearcut and half-cut plots on Benton flats at 2300 feet elevation. The three others were at 2700 feet, 3800 feet, and 5500 feet-very close to the Lookout. To attain the ultimate goals of the study, a wide array of weather and fuel factors had to be measured by an equally wide array of instruments; hygrothermograph for temperature and humidity, anemohygrograph for duff and half-inch stick moisture and wind, Forest Service and beveled orifice rain gauges, maximum thermometer for duff surface temperature, and fan psychrometer to check the hygrothermograph.

Data were kept up to date so that Hayes was able to provide an interim report. In Applied Forestry Notes No. 80, 1937 entitled Variations of some fire danger factors with altitude, he discussed August 1936 weather factors of temperature, humidity, fuel moisture, wind and expected fire behavior in terms of the

Model 4 fire-danger meter. Circular 591, published in 1941, summarized diurnal variations in fire danger factors for the full length of the study. It was based on average August data only, as the weather was most settled in that month, thus the thermal belt was most pronounced. 'Settled' weather is characteristic of severe periods of fire weather.

Hayes took a year off to obtain his Master of Forestry degree at Yale. As soon as he returned in early summer of 1940, he spent three or four weeks at each of three locations to verify the information learned at Priest River: Salmon River Canyon--narrow, deep, 1840 to 7700 feet elevations; Desert Mountain near Glacier Park--large basin at confluence of two large rivers, 3200 to 6400 feet: and Rock Creek Canyon northeast of Yellowstone Park--a precipitous, glaciated windswept gash, 7450 to 10,500 feet. These field tests showed that the Priest River principles are applicable throughout the northern Rocky Mountain Region, according to Hayes' April 1942 Journal of Forestry article entitled Differences in fire danger with altitude, aspect, and time of day. The Journal article cautions, however, that all days are not typical, and temperature inversion is not equally active in all kinds of weather.

One summer day in 1940, Gisborne inspected the Desert Mountain verification set-up of Hayes. He, Hayes, Maxwell Jacobs of Australia were coming down the mountain, checking each site on the way. Vern Cline was bringing the car down to a spot below the lowest instrumentation site. Even though the Gisbornes were very temperate people and kept no alcohol in their home, Gis did like a bottle of beer now and then. Hayes relates: "It was a pretty warm day coming off the mountain. We got to the next to the last station. Gis sat down and said, 'Boy there's just one thing wrong with this picture--if I just had a bottle of beer.'" Lloyd anticipated a general thirst and had a bucket of iced beer in the car; so he said, "There might just be one in the car I see way down there. Gisborne said, 'Let's go, let's go.' We came abreast of the last station about 100 yards off the trail. I started to head for it when Gis said, 'I can see it, I can see it!, and never broke stride."

Some very important uses came out of this study. The thermal belt principle, long known in general terms, was quantified and precisely defined. From the Journal article "The fire dispatcher does not need to act on the basis of guesses only. By use of charts showing the degree or class of danger on north and south aspects at all ordinary altitudes and for each hour of the day and night, it is now possible to interpret measurements made at an individual station into data more dependably applicable to a larger part of the adjacent typography." For years now, the dispatcher routinely incorporates these data with fire danger, fuel, and rate-of-spread tables to make his "calculation of probabilities" (now called "estimation of needs"), just prior to or immediately after sending his initial forces to a fire. When things get tough and manpower and other control facilities are at a premium, priorities are set using this system.

In discussing the vast amounts of data collected in this and other previous studies, as well as the later large log study, Hayes commented, "A lot of Forest Service research went on like

that for years and years and years, but after statistical analysis was adopted the whole planning and execution of research changed. After that, all studies were ended as soon as enough measurements were made to gain the desired accuracy." He continued, though, "The long studies provided data of continuing value. Data from the altitude and aspect study are still being used and will probably continue to be useful long after I'm gone." The data are presently being used as a base for, and a check on, attempts to develop usable atmospheric weather models.

Large Log Moisture

By the mid-thirties Harry and his assistants had studied the moisture relationship of all fuels from grass up to two-inch cylinders. Then, when Hayes came to him in 1935, Gisborne immediately assigned him the task of studying moisture regimes in much larger materials. For the first study, electrodes were inserted into dead and seasoned 10-inch and 12-inch whitepine logs. Moisture content of the wood between the electrodes was determined with an instrument called a 'Blinkometer', which measured electrical resistance. We used insulated copper wire, cut the insulation back a ways and sharpened the point. A hole was drilled to within 3/4-inch of the desired depth, and the wire driven on in. Depths were varied from 1/2-inch to nine inches in depth. Sealing the electrodes was an insurmountable problem; dry weather cracked the log and rainy weather allowed complete conductance. Even so, Hayes was able to report some significant results in respect to precipitation and moisture content, internal drying and diffusion, penetration, and prediction of moisture content from valid records accumulated between 1935 and 1939. These were a part of the thesis he prepared for his Master of Forestry degree.

Blinkometer measurements were continued through 1943. But since Hayes and Gisborne were not completely satisfied with the results, a modified large log study was initiated in 1942, to continue through both a very easy season and an exceedingly dry season. Such a study was begun in 1942 and ran through 1960, just one season short of the critical 1961 fire season. Five-foot long cedar logs 6, 12, and 18 inches in diameter were placed, three each, on the ground and on racks ten inches above the ground, at both the clearcut and full-timber weather stations. Each entire log was weighed on a platform scale at 10-day intervals.

The formal report was finally made in 1976 by A. P. Brackebusch-Gain and loss of moisture in large fuels. As usual, the information has been used many times. Other research groups used it as a guide in developing portions of their own fire-danger rating systems. Attention was given the data in working up seasonal buildup in the national fire-danger rating system. Most notably, the relationship between large log moistures and three-day running averages of half-inch sticks was used in determining the Seasonal Severity Index portion of the Intermountain Model 8 Burning Index Meter used in Regions One, Four, and Alaska from 1955 through 1965. Brackebusch states "The large fuel study did not produce a precise method for predicting fire season for fire activity. Nevertheless,

seasonal trends, differences due to cover and ground exposure, and the correlation of log moisture to major factors such as precipitation warrant serious consideration in fire planning."

LIGHTNING

The major effort of the 1920's to learn about lightning strikes and storms tapered off in the 1930's. The primary publication of results of data that were collected by lookouts and others between 1924 and 1928 was put together by Gisborne and published as A five year record of lightning storms and forest fires in 1931 in Monthly Weather Review. No further analysis had to be done until at least ten years' records were accumulated. Interest appeared to be leaning more toward study of the reason for lightning and of individual strikes. Gisborne held a brief correspondence with Mr. Edmund A. Evans of Stanford University in the early '30s. Evans was doing some lightning research work in Colorado. About the same time, Mr. C. S. Seymour of Mountain States Telephone and Telegraph Company discussed with Gisborne a lightning counter called a 'two-electrode stationary plate klydonograph', which apparently was never tested.

K. B. McEachron, in charge of General Electric Company's Pittsfield High Voltage Laboratory was interested in whether multiple or single strokes were most responsible for fires, also whether there was any knowledge of 'silent lightning', i.e. strikes without thunder. Gisborne helped him by soliciting all Experiment Station members' assistance, in a memorandum to them dated March 18, 1936.

For years big debates continued as to whether red or white lightning was the real fire starter. Gisborne, in the May 14, 1932 Northern Region News put minds to rest by quoting a Science Newsletter article by Dr. W. J. Humphreys stating that "A bolt through dry air has only the air gases-largely oxygen and nitrogen to heat and make glow and shine with a white light. When there is rain in the path of the bolt, some of the water is broken into oxygen and hydrogen and the highly inflammable hydrogen gas is red." He debunked Dr. W. J. Humphrey's short article in the December 1931 Monthly Weather Review, by saying "The good doctor's hypothesis is based on his assumption that 'red lightning, being through rain, strikes only wet objects and therefore seldom starts fires--while white lightning strikes dry fuels."

In 1933 Gisborne hired a Mr. Evans, an electrical engineer from General Electric Company's Schenectady Lab to try to measure static electricity related to lightning. Jemison and Evans stretched a 2 or 3-strand piano wire antenna from the 'weather tree' across Benton Creek to the 'Crow's Nest' tree on the ridge to the south, possibly 2000 feet, and attached it to a spark gap in the old office attic. Everytime a thunderstorm pulled into view Evans would man the equipment up in the office attic and see if he could correlate the activity of the thunderstorm with the amount of spark he'd produced from his antena. He had a similar set-up at Looking Glass Lookout. When a storm was predicted or a cloud came into view he'd hike up to the Lookout to take observations

of thunderstorm activity. Jemison related that Evans got to be in pretty good physical shape because he'd be able to hike up there in nothing flat, pack on his back, trying to race the oncoming storm--about 4 or 5 miles. Anyway, nothing ever came of this work except it was the entry into the GE Lab at Schenectady where Langmuire was. This was where Gis got acquainted with Langmuire and subsequently with Vince Schaefer more than a decade later.

Jemison and Hayes were duly impressed by Harry's curiosity and maybe his daring or foolhardiness when they accompanied him to Looking Glass Lookout one night to watch a thunderstorm move in. Jemison remembers that "he'd take a pair of lineman's pliers and grab the lightning protection system so he had a good strong contact with it. When the storm neared,the static electricity would begin leaping off the copper rods and he'd hold his hand up with the flames streaming from each finger and getting longer and brighter. He'd always get so excited and exclaim 'look at that, look at that fire.' Then there would be a discharge and the fire would go out but pretty soon it would build up again. He had me grabbing it. I don't know what would have happened if a stroke had hit the tower." Hayes described the effect of at least a near miss "When the storm was pulling away Gis was standing there waving and waving and waving his hands when one last flash of lightning came barging overhead really charging the atmosphere. Sparks started to feed into his hand from about four inches out and it just sizzled. The sound of the static coming in was like someone touched a match to the hair on his arms. He let out a war whoop you could hear a mile away."

FIRE WEATHER FORECASTING

With the prodding from and the assistance of the Forest Service, and aided by the Western Forestry and Conservation Association lobby, the fire-weather forecasts issued by the Weather Bureau became increasingly accepted. The 1931 Annual Report rated them as "...indispensable to all forest protection agencies of the Region. The accuracy of their forecasts is now so well appreciated that considerable organizational changes are made according to the danger predicted." The Weather Bureau began in 1930 to summarize the records from all stations at the close of the year and provide it to all agencies to assist them to rate "the character of the season, hence their efficiency of protection." Forecasting thunderstorm-producing weather pattern investigations continued from the 1920's to be a key research effort.

Financial problems confronted the Fire Weather Warning Service so much that on April 1, 1934, the Boise office was closed and was combined with the Spokane office. A further change in 1935 was to move the Spokane office to Missoula to produce a better and more efficient service for all concerned. Acquisition of a first-class weather station at Missoula was evidently not mere happenstance. The Missoula Chamber of Commerce received word in early 1931 that Montana Senator Burton K. Wheeler introduced an amendment to the 1932 Agricultural Appropriations bill to provide $10,000 annually for the installation and maintenance of such a station. Support

had come from service clubs, State Forester, State Horticulturists, and individuals. A year earlier a more informal weather station had been erected on top of the Federal Building roof by Gisborne and F. B. Crombie of the Spokane Weather Bureau office; Forestry School Dean Spaulding contributed equipment. Reports had to be wired to Spokane each morning for incorporation into fire weather forecasts. Mr. B. P Hugues was the first meteorologist in charge when the first-class station was finally established on July 1, 1935. Ralph Hanna, later to become Western Fire Weather Coordinator, apparently assumed this position the following year.

The 1935 Annual Report refers to a paper by Regional Forester Evan W. Kelley urging longer forecast periods. "The 'weather outlook' covering a period from 1-1/2 days to three or more days in advance would be no doubt of greater value but of doubtful dependability..." By 1936 the Weather Bureau began providing 10-day weather summaries, making more localized forecasts, and looking into forecasting the probable departures from normal of weather during an entire fire season. Perhaps the most innovative new program and one that is deemed a necessity at present, was the use of the fire-weather mobile unit.

Gisborne gave his opinion of self-made forecasters in Northern Region News, January 7, 1935, "If forest officers were frank as well as honest, they would concede that, in their private opinions, they are pretty good weather forecasters. They look at the sky, stir up a few clear memories and a lot of happy ones, give mental birth to a forecast and proceed to spend Uncle Sam's money..."

Lloyd Hayes proved one day what Gisborne said about amateur forecasters. Professor Ralph Hawley of Yale visited Priest River to gather information for a book on fire control, and really wanted to see a western fire starting lightning storms. Hayes recalls that "Hawley, Gis and I were at Looking Glass Lookout about mid-afternoon. Gis asked me if we might have a thunderstorm that evening. Well, the cloud formation didn't seem right. There were lots of clouds but they had very vertical development. So, I said 'no, I don't think so.' That evening and night lightning started a record 124 fires on the Kaniksu. Hawley missed seeing it from the lookout, on my advice!"

Actually, Hayes was far more proficient in meteorology than he let on. He accounts, "About the time the Polar Front theory came out, Gisborne told me 'you learn all about this...' So I read all that was available, and I kept on reading until I became a fairly capable climatologist and capable in some aspects of meteorology; but when it came to physics of the atmosphere, that part I didn't acquire."

As in fuel moisture sticks and inexpensive fire-weather station instrument development, there was parallel work done in the lightning and weather forecasting field between McArdle in Portland and Gisborne in Missoula. W. G. Morris tells about Reed College Physics Professor O'Day,who rigged up a lightning counter on Dixie Butte Lookout in the Blue Mountains to little avail and a radio operator named Gayle Simpson who had a similar innovation. Morris and McArdle had an uphill battle in obtaining the Weather Bureau's cooperation in getting the use of lightning and weather data for analysis purposes, particularly for Morris' storm path study.

November Precipitation Predictor

R. W. (Bob) Strong, of the Cabinet Forest, according to Jemison, had a theory he'd worked out over the years that the severity of the fire season was closely related to the amount of precipitation in November preceding the fire season. "Well, here was a fellow who was not a scientist, but he had an idea. Gis took that idea and told me to plot precipitation weekly and monthly by forests to see if there is any pattern of how November precipitation relates to subsequent moisture conditions." The map showed a rather large, extremely dry area which subsequently was the site of the McLendon Butte-Pete King fire the following season. "So far quite a while we prepared these maps as an aid in predicting where extremely inflammable areas were." Gisborne supplied more information on these 'rain maps' in the May 6, 1933 Northern Region News. For more than a decade he made a prediction (Guestimate) in a winter issue of the Northern Region News as to the severity of the forthcoming fire season. "When November precipitation for 16 stations in northern Idaho has been between 50 and 65 percent of normal, the following fire season has been characterized by fires which generally stepped out and went places. If November precipitation was less than 50 or more than 65 percent of normal, we had few, if any, 'step-outs', and more of those likeable Mae Wests, the kind that sends up an attractive curl of smoke, inviting you to come up sometime, and then lie down and wait for you to come and get it." (Northern Region News, March 6, 1941)

For at least 13 years a group of prominent Region-Oners made a game of outguessing each other in what the following fire season might hold in store for the firefighter. They were bold enough to publish their guesses in the Northern Region News. Once termed the Organization of F.D.R.'s (fire danger raters) in the February 21, 1936 issue, Roy Phillips, W. W. White and 'Crete' Urquhart got into the act in rating past seasons. White even declared 11 years as requiring no fire control organization, to which Gisborne retorted, "That is one broad statement."

In the March 6, 1941 issue, Gisborne admitted his 'guestimate' for 1940 erred by predicting an easy to average season; he should have confined his forecast to 'average inflammability' as that summer still holds the record for number of fires. But as he says, "No system is infallible and one error doesn't prove that any system is a filure" and he went on to forecast a non-critical 1941 fire season, based on his 'November precipitation' system. It was not a critical season.

On March 8, 1946, Gisborne's 'guestimate' was for a non-critical season. Phillips said it would be an easy season up high and somewhat worse than average down low. Sutliff called for a season less severe than 1945, which was average. He claimed near 100 percent accuracy since 1942 and should have quit while ahead. "But I won't, however, since Gisborne and a few of the other prevaricators would, I am sure, feel lonesome without me." The article closes by saying, "The Region will assume that all three are incorrect and plan for the worst season in twenty years. The 1946 fire season was easy.

Gisborne's 'guestimate' for 1948, as noted in the January 16, 1948 issue, was for non critical burning conditions. This was an understatement, as it turned out to be the easiest fire season on record, and one of the worst flood years. Sutliff hedged a bit in predicting 1948 to be no more than the worst season since 1940. Phillips waited for the two above forecasts, then came out in the February 6, 1948 issue to warn that 1948 would border on the critical side of average and be worse than the past seven seasons. Crocker, Chief of Fire Control summed these variations up by saying, "Now, folks, you have heard from the three prognosticators. Pick your forecaster, lay your bets, and hope for rain." At any rate, the "Big Three", all experienced fire people, had their say, added a bit of levity to the serious business of fighting fire, and also indicated a good rapport between the Forests, the Regional Office, and Fire Research.

When the wetter years of the forties and fifties settled in, the system tended to lose credence and gradually fell into disuse. But it represented another effort to devise a long-range seasonal forecast system.

DAMAGE AND VALUES/FIRE ECONOMICS

Some attempt in 1932 was made to push studies in values and damage as related to fires and the resource protected or burned. "This Station is proceeding on the theory that each service of the land protected, subject to loss by fire,must be rated. To say that we have satisfactorily determined the probable damage to wood products, recreation, wildlife, water, soil and climatic influences and to the social benefit attached to these values would be gross overstatement, as stated in the 1932 Annual Report. The only progress that year was to use the 10-year fire report analysis to show that perimeter rates in spread in chains per hour could be broken into four classes: extreme 14, high 10, medium 8, and low 6.

The next mention comes in the 1938 Annual Report, which declared that the next new and major step needed is clearly in the field of the economics of fire control; efficiency had been improved, and costs must now be reduced. It claims that while the law of diminishing returns can be applied to control of high-value areas, no principles exist today to guide the forester in determining how little effort and expense should be expended on non-commercial, little-used, low-value areas. The same criterion of satisfactory fire control is still applied on both-control by 10 a.m. the day following discovery. The Report then puts in a plea for greatly expanded funds for a combined socio-economic study of fire control. Without further resolution, the following year's Annual Report merely states, "This is no longer an academic relation adequately handled by publication of a few technical articles. It is a hard pressing practical problem of dollars and cents, or rather, thousands and tens of thousands of dollars."

FIRE CONTROL PLANNING

Evan W. Kelley, a hard-boiled administrator with a mission to lick the fire problem in District One, became District Forester in 1929. The McNary-McSweeney Act of 1928 was the impetus for the promise of increased fire research funds to begin on July 1, 1931. Men in the field were beginning to clamour for more orderly methods of detection, man-power placement, and overall fire control planning as evidenced by articles appearing in the Northern Region News in the early thirties. The planners who charted out the methods and developed the techniques had, for the first time, the satisfaction of seeing them tested and applied on an adequate scale in an unprecedented investment program as well as receiving funds for considerably expanded research.

For once, everything came together just as if a long-range master plan had been followed for years and fire control planning was just the next step. This was, in fact, not the case. J. S. Barrows stated in an interview, "They didn't do as much planning of research activities in a highly organized way as is done now. The staffs were smaller and people agreed upon a course of action, then rolled up their sleeves and went to work. I do know that Gis had some long-range goals that were sort of personal goals for him." All that Gisborne had done during the 1920's came to fruition in the early 30's - the various fuel moisture studies, weather and lightning storm analyses and determination of the key factors included in fire danger - by culminating in the first Fire Danger Meter. Jemison feels that Gisborne's fire behavior study of ongoing fires, which produced an array of variables that was impossible to deal with in those days, led to the fire report analysis and the subsequent fire control planning study.

Through Regional Forester Kelley's instigation and orders, Lloyd G. Hornby left the Supervisorship of the Flathead Forest in the spring of 1931 to assume leadership of the fire control planning project in the Experiment Station. The Region's generosity in transferring him also extended to substantial financial assistance. In modern-day terms this was to be a true Research, Development, and Application (RD&A) program. Gisborne, in addition to supervising Jemison, and later Hayes, and developing Fire Danger Meters and fire-weather instruments, worked very closely with Hornby, shaping his research inputs to meet Hornby's application needs. Gisborne was delighted to have such a capable person on board, as he relates in his Hornby's principles of fire control planning in 1939, "He brought to the task a background of training, experience, and inherent ability which was unique as it was well suited to the opportunities of this work. His training in both engineering and forestry, his 15 years of field experience from smokechaser and ranger to supervisor of three National forests, and his exceptional ingenuity, practically assured a research that would make a major contribution to forest fire control." In his "Mileposts" article of 1942, Gisborne considers Hornby's work one of the key 'mileposts.' "Perhaps his most outstanding contribution was his analytical approach to the planning problem and his re-emphasis on physical conditions on the ground as the proper

starting point for all fire plans. His concentration on fuel types, rate of fire occurrence, rate of spread, and fire danger, as fundamental, measurable factors of the fire job everywhere constitutes a sound basis for future progress. Fire control planning work is not new, but Hornby systematized that planning." Brown elaborated: "He excelled in finding the most favorable mix of factors to achieve a desired result. He was well on his way to developing a new field of research which, aided by computer science, has since become known as 'Operations Research.'"

Statistical Analysis of Fire Records

The stated object of the 'Statistical analysis of fire records' study, according to the 1931 Annual Report was to learn from this great mass of fire experience such facts as will supplement the experience and judgment of fire control officers and indicate the weakness and strength of past organization and practice as an aid in future of fire control work. Analysis of 12,056 fire records gathered between 1921 and 1930 in Region One was begun in 1930 to determine the speed and strength of attack necessary to attain successful fire control in each important timber and fuel type by the Region. It was planned along the lines developed by Show and Kotok in California. Such data were fundamental to adequate fire control and essential in any comparison of the financial needs of one Region with those of another,according to the Washington Conference of Regional Foresters and reported in the 1930 Annual Report. Data of this sort proved invaluable in the transportation and organization study being conducted by the Regional Office to provide plans for the proper distribution and abundance of roads, trails and men. The big job of coding the fire reports was accomplished by detailing 14 assistant supervisor level persons to Missoula to be supervised by H. T. Gisborne from the research viewpoint and F. J. Jefferson and L. G. Hornby from the administrative point of view. The April 30, 1931 issue mentions that Gisborne and Hornby had left for Washington D. C. to spend 4 to 6 weeks operating the new eighty-place Hollerith sorting and tabulating machine. Only the Clearwater, Nezperce and St. Joe Forests were processed this first winter. This data reduction was fundamental to the field work to be done the following summer on the Clearwater and adjacent forests by Hornby.

The 1931 Annual Report contains a three-page summary of what had already been learned about discovery time in relation to attack time, burned area, suppression cost, detection coverage, man-caused versus lightning caused differences, visibility, type and moisture condition of fuels, cover type, topography and aspect, and efficiency of detection force. By the end of that year the Region's Man-power placement and transportation facilities' study had already used the preliminary results to show the need for more complete detection, depending on fuel-types and the maximum size blind spots which good judgment would permit. Other uses were distance (travel time) allowed in respect to smokechaser location, protection standards, and fuel and weather conditions. Since the analysis soon showed that effective planning could not be based on average conditions, the Region contemplated an organization

prepared to handle the worse 10 percent of fires with due allowance for short periods of extreme danger. The analysis indicated that if allowable burn standards could not be met with reasonable cost, a decision would have to be made whether to intensify the organization or expand the allowable burned area according to the use for which the forest cover will be grown.

The completed document reporting this analysis was mimeographed in limited numbers and put to field use in 1932. Its value was tremendous in guiding the direction of fire control planning studies during the next several years, during which time research and administration worked hand-in-hand to augment each other's work and come out with sound fire control planning principles.

Hornby's Principles

Eight pages of the 1932 Annual Report are devoted to describing the study plans for which the primary objective was "By attempting to control every fire in the first work period, it is hoped to keep burned acreage within the permissable percentage-of-burned area, and ultimately to make the sum of fire-control costs and losses most economical." The 10 western 'fire forests' were the first to receive planning attention, the eastern forests were covered in the later 1930's. In addition to the fire report analysis, two massive field projects were undertaken - fuel type mapping and seen-area mapping.

Fuel type mapping was of outstanding importance because it described fuels in terms of rate-of-spread and resistance-to-control with four levels of each - low, medium, high, and extreme. In spite of the present sophisticated methods of describing fuels, one still occasionally hears the term low/medium, high/high, etc. used. Every acre of these forests was given a fuel type rating displayed on a fuel type map.

Seen-area mapping was conducted at all existing lookouts and on all other locations that appeared to be a potential lookout or patrol point. By manually arranging and re-arranging seen-area map composites, the combination of least lookouts to render greatest coverage was selected.

Transportation planning, actual road routes, and valuation zones were also subjects of investigation.

The Region, Forests, and Ranger Districts all cooperated wholeheartedly, making available every facility they had - bunks, mess halls, tents, packstock, cabins. Without this cooperative attitude the project might have failed.

In 1935 Hornby became nominal Chief of the Division of Silvics. As explained in the July 22, 1935 Northern Region News, "Unfortunately, some major publications in Fire Control Planning have not been completed and, therefore, for this season, Mr. Hornby will divide his time between the completion of this job and direction of the work in silviculture." Weidman was Division Chief, with Haig under him. Haig transferred to Washington, releasing some funds. Weidman relinquished his position to Hornby so he (Weidman) could devote full time to planting studies. Actually Ken Davis led the Division of Silvics while Hornby had the title but spent nearly full time in wrapping up the Fire Control Planning job.

The detailed report entitled, Fire control planning in the northern Rocky Mountain Region was put out as a mimeographed Progress Report Number 1, in September 1936. In it Hornby gives credit to Roy Headley for originating the concept of the minimum-cost objective (least total cost of presuppression, suppression, and damage (P+S+D) initially described in 1916. He also credits Show and Kotok for their 1930 publication of standards of detection and travel-time allowance for initial attack (designated by them as "hour control") for each California forest cover type. He naturally gives great credit for Gisborne's fire-danger rating inputs.

A heartening memorandum from Chief Forester Silcox to Director Wyckoff in early 1937 said, in reference to Hornby's recently completed report, "Comments indicate that it evidences a breadth of view and an approach that provide scientific precision which is in balance and keeping with available basin data and the elusive character of forest fire danger." "This publication constitutes an outstandingly successful instance of cooperative effort between the Regional Office and the Experiment Station, of which I sincerely hope there will be many other examples in the future."

Hornby had hardly begun preparing a shorter summary report in the spring of 1937 when he was transferred to the Washington Office to head up a nation-wide fire control planning program. As reported in the April 21, 1937 Northern Region News, "One son of the West, Lloyd Hornby, went East with a purely western technique of his own origination - intensified fire control planning. Lloyd was called to Washington by the demand for this new contribution to forestry. His job is to spread it over the whole country." He returned 4 months later to cleanuup some details in Missoula, and perhaps to take his family to Washington. The Toboggan Creek fire on the Clearwater Forest was too much of a temptation to him. On August 21, 1937 while heading up the trail toward the ridge top, Lloyd Hornby died of a heart attack, as Gisborne said in the August 21, 1937 Northern Region News "...as he probably would have chosen, with his boots on, in the field, actually on the fire line, studying methods of getting more efficient fire control at less cost."

Gisborne carried through on the summary and published Hornby's principles of fire control planning in the April 1939 Journal of Forestry. He built the article around defining and elaborating on Hornby's eight major principles, which are:

1. Held line must be built faster than the fire makes perimeter. This first, and most basic principle, recognizes the superiority of the perimeter basis instead of acreage.

2. Fuel type classification is necessary to show the two basic factors; rate of spread and resistance to control. This dual basis is a Hornby innovation.

3. Plans must be made for first-attack control before the fire commences to spot or crown except under class 6 or greater danger in the extreme fuels (Model 4 meter fuel moisture less than 5%, relative humidity less than 15%, wind greater than 18 mph).

4. Fuel type, occurrences of fires, and values at stake must be coordinated for most economical yet adequate fire control. Hornby recognized the need to include land use values as well as fuel types and occurrence rates.

5. Lookouts, firemen and crews have the dual responsibility of detection and smokechasing.

6. Transportation and communication planning should follow and be based upon fire control planning and other forest use requirements for multiple use.

7. Fire control for the 'worst first' automatically simplifies the process. By 'worst' is meant the most dangerous fuel types.

8. The conditions creating a fire problem are not static. Fire control planning is therefore a continual process of revision and refinement.

Harry Gisborne brought out the point that "The personnel factor was recognized by Hornby as vital. He stressed the requirement of both adequate numbers of men and adequate training. He confined his work, however, to developing methods and a planning procedure which would provide any personnel with facilities impersonally suited to local conditions of fuel type, occurrence of fires, and values at stake."

The 10 A.M. Policy

Gisborne was not bashful in his suspicion of the "10 a.m." policy - control by 10 a.m. of the workday following discovery. In his "Mileposts" article he states, "The so-called 'Forester's' policy of control by 10 a.m. (issued 1935) undoubtedly rates either a milepost or a tombstone. If and when that policy becomes clearly recognized as a temporary expedient, I believe that it will rate a milepost. If, however, it has already 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. Fires can be caught small and cheaply, often more 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 it might contribute something here."

In a memorandum to the Director dated March 11, 1936, Gisborne set down four reasons why Hornby had a real struggle to accomplish what he did. Two of them follow: "When Hornby developed his methods of systematic fire control planning, he was blocked or impeded time after time by existing procedures and attitudes, or by lack of certain procedures. He was forced, against his beliefs, to plan his transportation system for fire needs alone," regardless of future needs in other fields. "Hornby started his planning on the basis of least 'cost plus damage', but he was then forced to change all of his objectives to make them fit 'control by 10 a.m.', which was and is an uneconomic expression impossible to justify in low value or 'little injury' types of vegetation."

Table X-1-c

Table X-1-c was sort of a milepost in itself. The 1935 Annual Report gives credit to its beginning, reporting that the Office of Fire Control also had done a large amount of investigative work in applying research data concerning fuel types to the problem of dispatching." Clarence Sutliff had by that time, been

able, by modifying the original data, to produce guide tables and a rate of spread meter for trial use. Gisborne gives Sutliff more specific credit in his "Milepost" article, however, in stating, "One recent step which may show up as a milestone of progress is illustrated in Region by the scheme devised by Sutliff in 1938 for maintaining a standard relationship between current fire danger and the percentage of manpower on duty. The acceptance of this scheme has done for current fire danger exactly what Hornby's systematic planning did for average bad danger. Hornby's methods says that when the permanent factors of danger are thus and so, the following list of stations must be available for occupancy and use. Sutliff's Table X-1-c shows that when the variable factors of danger are thus and so, the following percentage of those stations will be occupied. These are two clear-cut, logical steps, both essential to adequate fire control at least cost."

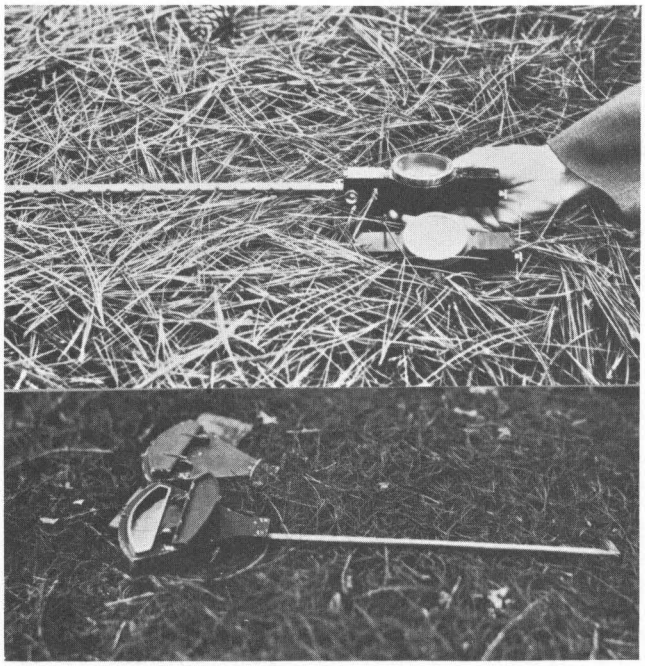
Calculating the Probabilities

Concurrent with such adaptation of research findings was the ability to finally utilize all of Gisborne's and Hornby's type of specific data to 'calculate the probabilities'. Gisborne said this was the best part of the Forester's 10 a.m. policy of 1935. "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." By incorporating new information currently, especially Lyman's and Barrows' revised rate-of-spread tables, the process of calculating the probabilities became in the early 1950's a formalized dispatching process performed just before or just after initial attack forces were sent out. The term was recently changed to 'estimating the needs.'

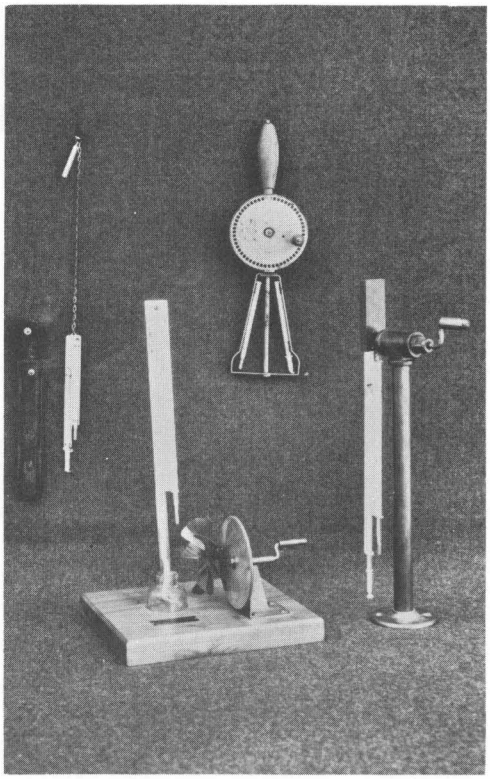
Aerial Bombing

Since fire research has traditionally been involved in aerial application of fire retardants and suppressants, beginning with water, the following report of pioneering research in this field, written for the March 21, 1935 Northern Region News by long time research cooperator and close friend of Gisborne's, Howard R. Flint, seemed appropriate at this point. It is entitled Rain from Heaven - At Will:

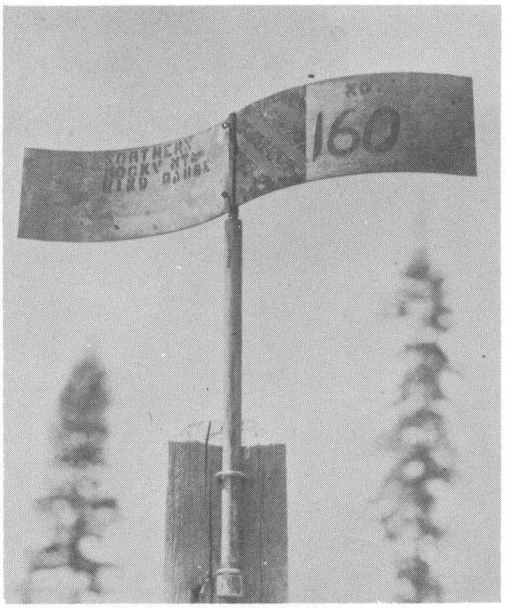
> Few persons in R-1 realize that, under the strong emotional urge created by the historic Selway fire, it was decided that henceforth we should take the matter of precipitation for forest fires into our own, self-acknowledge, capable hands. Why not carry water aloft in an airplane? It must come down. Only problems are to get it down in right time, right place and sufficient quantity. The undersigned was delegated to find out.
>
> First attempt was based on engineering plus psychology. If a well-built, oak, beer barrel would stand the shock? If smokechasers heard a rumor that beer barrels were being plunked



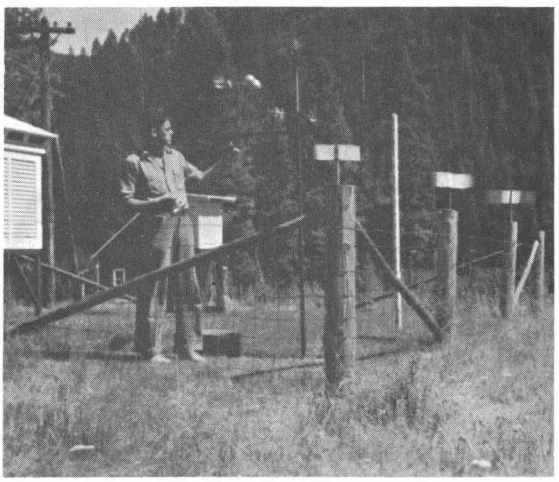
Duff Hygrometers



Psychrometer assortment

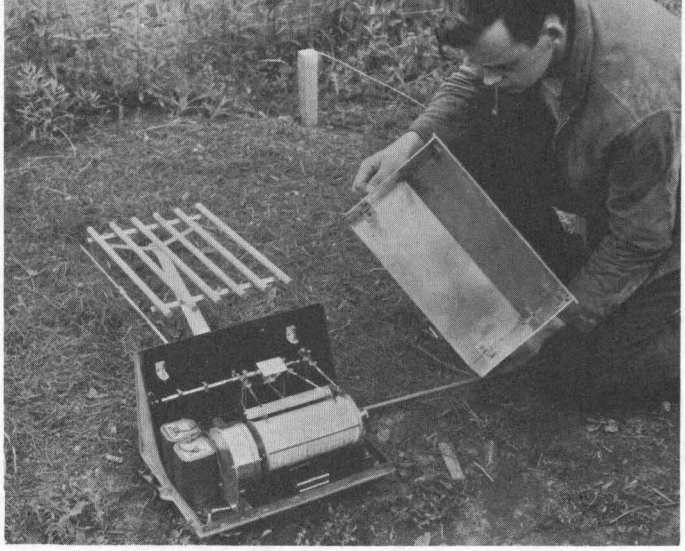


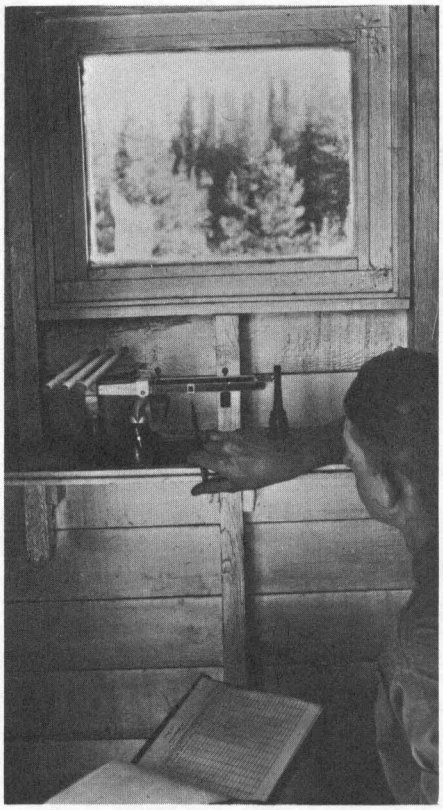
Gis' first wind gauge



Calibrating wind gauges

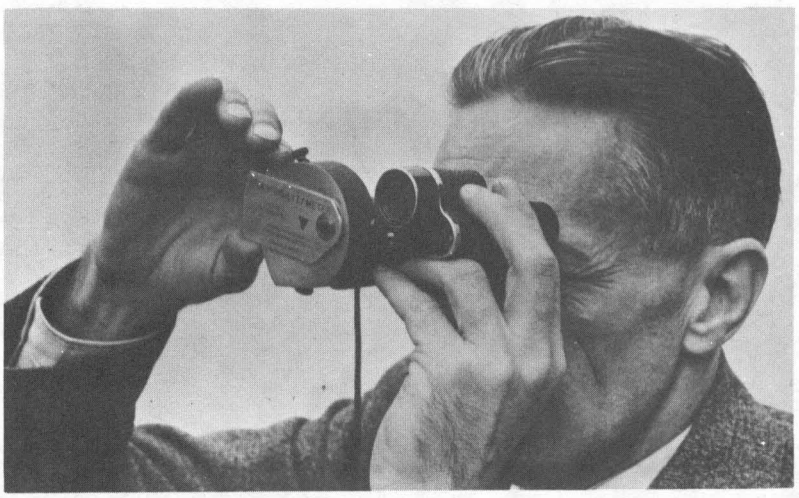
Jemison checking out an anemohygrograph (Robot)





Hayes weighing the "triplets"

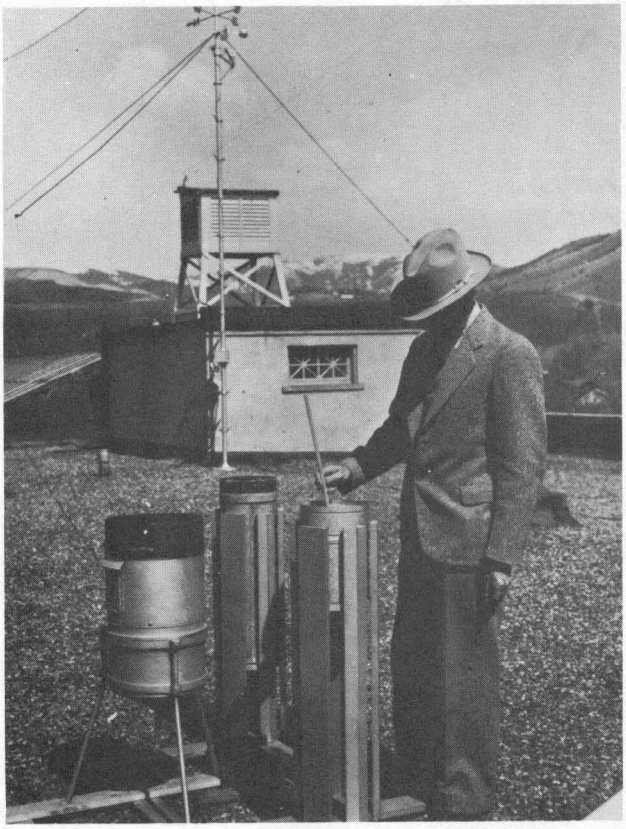
Gisborne and his Assman aspiration psychrometer



Harry and one of the visibility meters

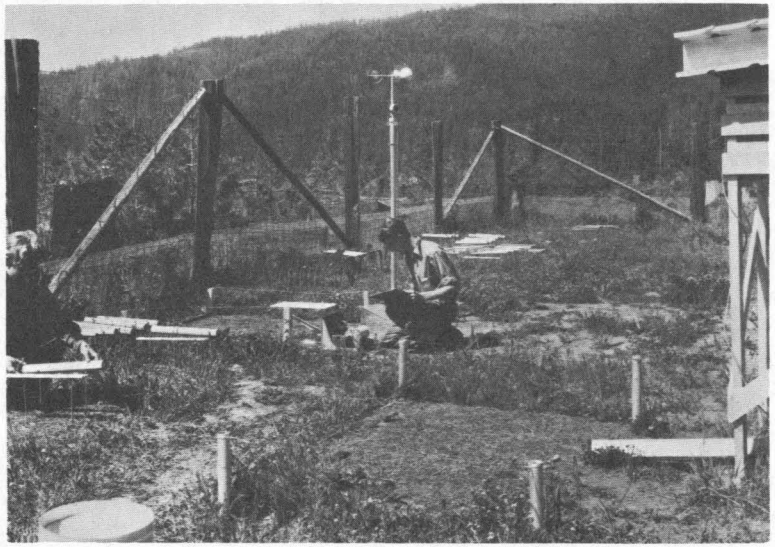
Looking Glass Lookout, 1934

New office-laboratory, ca 1938



Weather station, Federal Building roof, Missoula, early '30's

Gis topping the Weather Tree, mid '30's

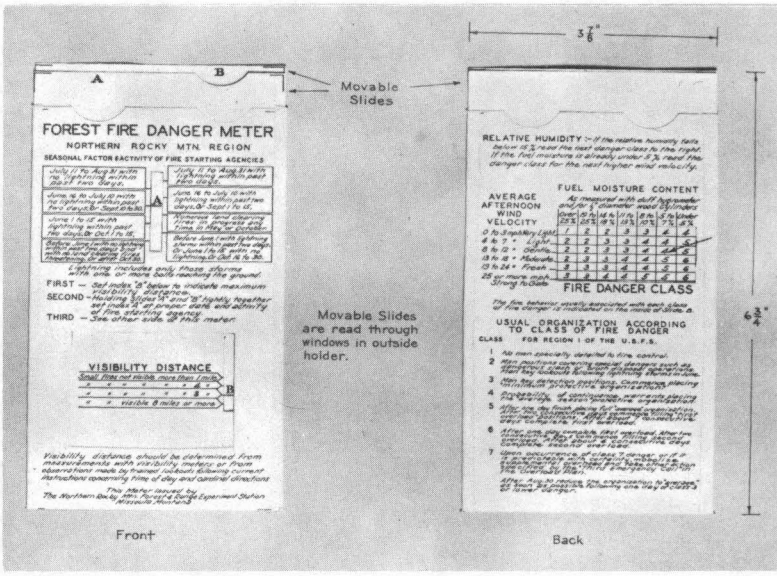


Clearcut inflammability station, Hayes

Half-timber inflammability station

Full-timber inflammability station

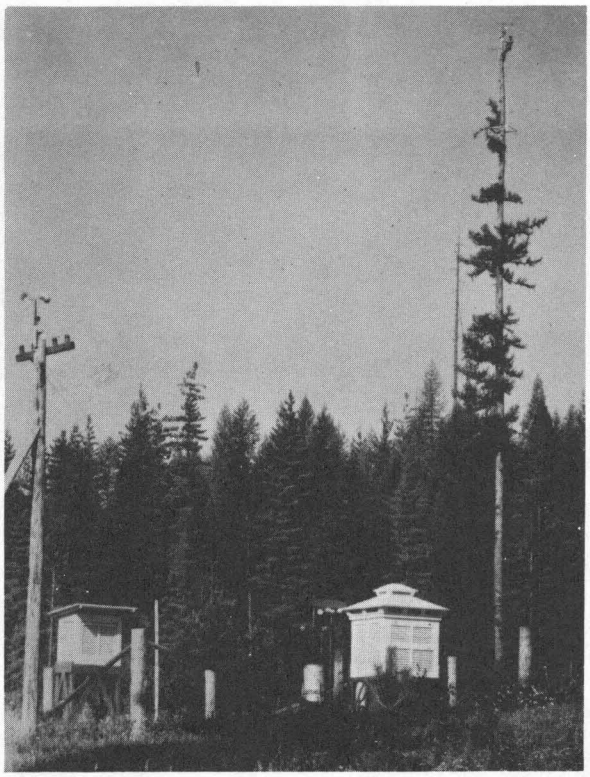
Altitude & Aspect study station, 5500' level



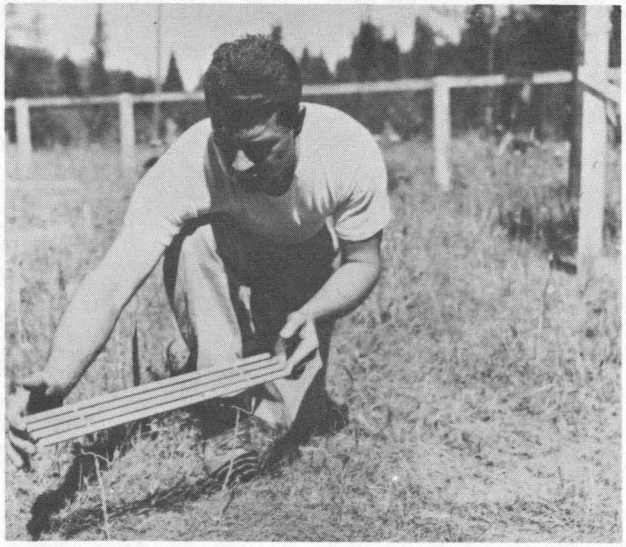
Model 2 fire-danger meter, ca 1931

Gis computing fire-danger

The Meteorology tower



Control station and weather tree

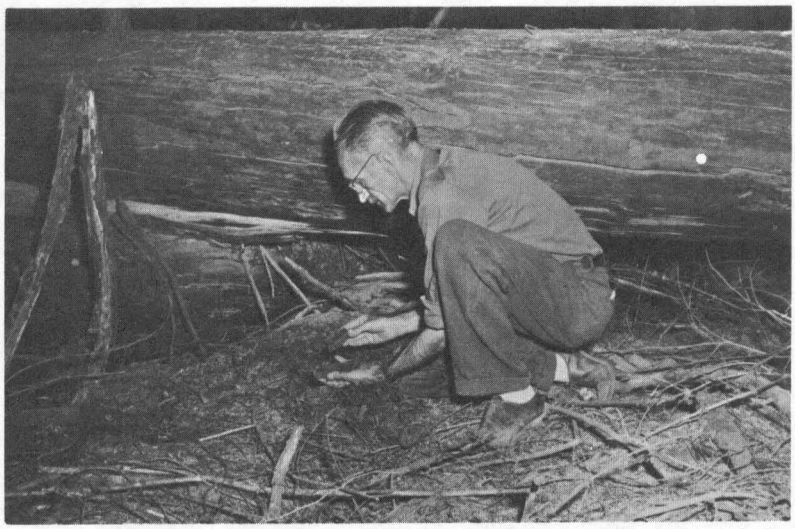


Half-inch fuel sticks, Wellner

Large log study, Blinkometer

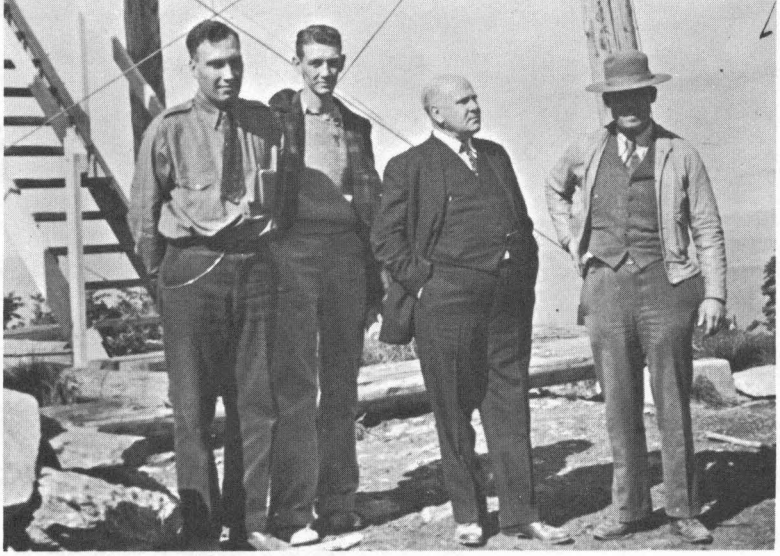
Gisborne weighing large logs with recruiting scale

Gisborne studying fuel moisture, Clearcut Station

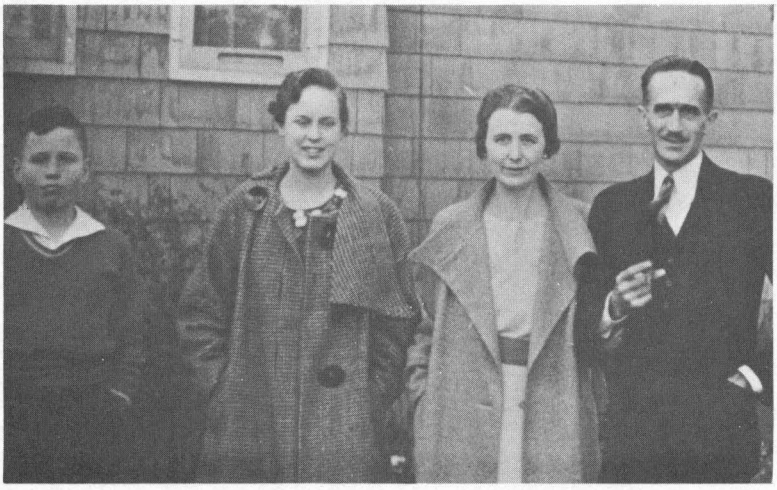


Gisborne taking duff sample in heavy timber stand

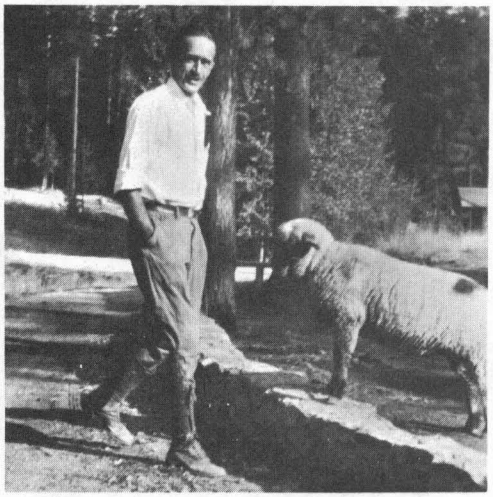
The Thousand Degree Burne, before and after, 1932



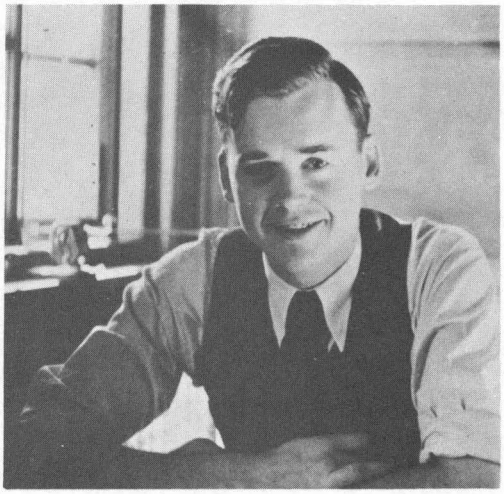
Hanna, Hayes, Calvert, Gray
Looking lass Lookout, 1935



Tug, Virginia, Alice, and Harry
Thanksgiving, 1935

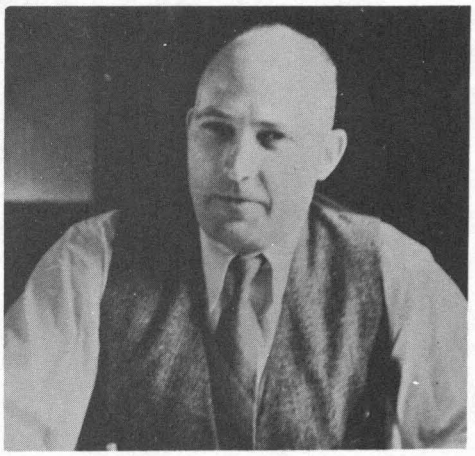


Harry and trespass sheep,
PRES, 1934

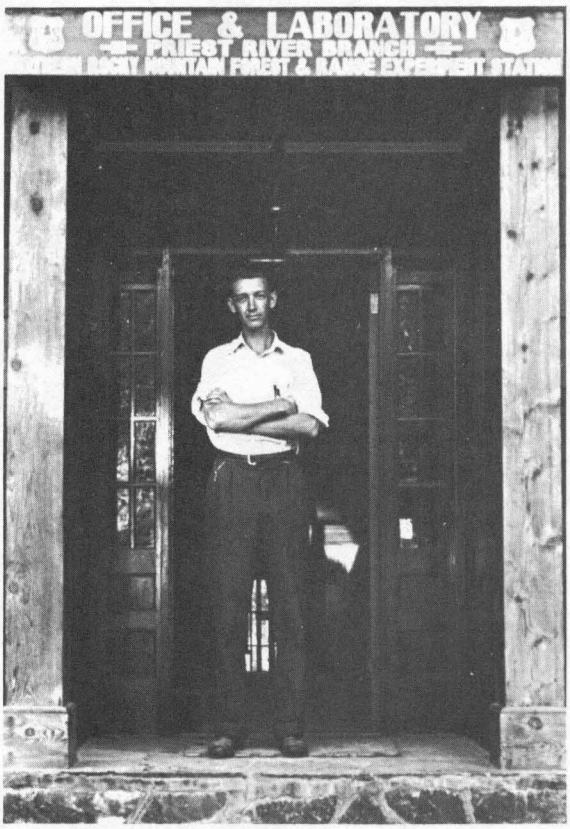


George M. Jemison ca 1933

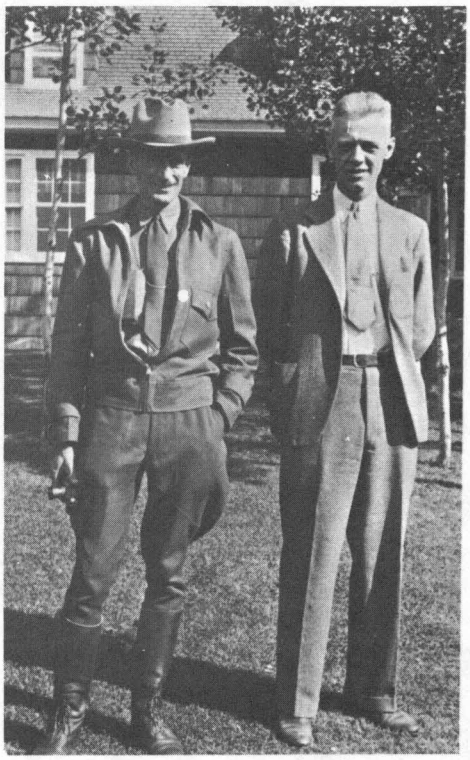
Lyle F. Watts



Lloyd G. Hornby



G. Lloyd Hayes



Harry Gisborne and
Stephen Wyckoff

down from the air on Class-A fires? Get-away and travel time must be lessened. A brand new 8-gallon oak, beer barrel was filled with water; total weight 102 lbs. About 250 feet above the airport it was kicked out of Mamer's Buhl, forward speed about 75 miles per hour. Poor keg: We gathered it up from a quarter acre, no two staves left together. On the field a hole and a wet spot - looked as if someone had tried to drown out a badger.

Next attempt, a specially built 18-gauge, galvanized iron can, brazed and reinforced at the ends, 8 gallons of water. Dropped from 250 feet, it broke like a fresh egg dropped on a concrete walk.

A simple, 18-foot, Irvin cargo parachute let down two filled 8-gallon cans in succession - beautifully, gently, right side up and close to the mark. A home-made chute of cotton sheeting with cotton fish cord suspension lines caused near-collapses among the audience. It opened, a line broke, then ten more broke in rapid succession. Poor passenger! Well, half the chute continued to function. The can punched a hole 6 inches deep in the field but was recovered still tight and undamaged. Chutes work. They are quite a lot of bother, cost something - $10 to $30 - and will be torn by trees or snags.

A specially built, welded, 16-gauge, black iron can holding 5 gallons of water stood the shock three times, bounces about 20 feet, is still good.

Next trial: the Ford Trimotor - inside, a 100-gallon tank, lever opening gate valve, 50 feet of rubber-lined cotton hose trailing out from a door opening, 30 lbs. of sheet lead wrapped around the trailing end of the hose. The hose collapsed from the air blast so that little water went through it, didn't appear such a happy thought when it threatened to wallop the tail assembly of the plane. Women would have known better than to waste time with cotton hose. Then we got a reinforced, rubber hose, put 5 lbs. of white powder in the tank to make the water more conspicuous. Fine doings. A beautiful rain out of the end of the hose. 30 feet above ground - on the grass the lightest dew, covering a strip about 8 feet wide, half a mile long. Wouldn't have phased a light, grass fire.

One more trial: evergreen timber, a bigger hose, a nozzle to help concentrate the stream, careful flying down close to tree tops. A little of the fluid reached the forest floor, not enough to wet through a silk shirt. We knew beforehand that 100 gallons of water would cover 500 feet of fire line only about 0.05-inch deep.

H. R. Flint

Hayes recounted another attempt at aerial retardant delivery. "Gis wondered if foam fire suppressant might be applied from the air. So for several hours he and a technician filled heavy kraft shopping bags with foam. I hauled them to the top of the 150-foot tower with a rope and dropped them at targets on the ground. Results were less than promising."

THE DISCOURAGING YEARS
(Late 1930's through WWII)

REDUCED ACTIVITY

The heyday was over. Allotments shrank, emergency crews and funds vanished. Projects were terminated and vacancies went unfilled. A series of easy fire years lessened the urge to produce more research and decreased the Region's interest in working cooperatively (it, too, was strapped for money and personnel). The period did, however, give Harry time to reflect and consolidate past knowledge gains, to participate in professional organizations, and to broaden his interests. He had time to promote use of wood during the war and to ride hard on the integrity of the Forest Service, the lumber industry, the journalists, and the Weather Bureau. A few significant one-man projects were conducted along the way, however. One value of this period was that he and other researchers were forced to do some long-range planning, on a coordinated basis, both regionally and nationally.

But all in all, it was depressing to Gisborne to see his research world sort of folding up all around him after the previous brilliant several year period had just passed. He became very discouraged and often even bitter.

Near-despair could be read into each year's comment on funding in the Annual Reports. In 1938 the Station was operated on fewer dollars than it had in 1934. "Fire research work was at ebb tide during 1939." The next year's regular appropriations were 30 percent lower than 1931. "We can hardly carry on a minimal program, let alone new work." Gisborne had to assume leadership of the Division of Silvics Research in addition to Fire from 1942 until 1945 because neither people nor money was available for it to stand by itself.

In 1945 he reflected, "With adequate funds, from 1932 to 1936, I had 6 to 8 assistants on fire danger measurement research, and cooperated with L. G. Hornby who was in charge of fire control planning research with 20 to 30 assistants. In 1938 (after Hornby's death) I assumed the maintenance of the control planning work, with no assistants." He had only Hayes and two assistants (Cline and Naiman) left in his regular research program. Then in 1942 Hayes went to the Appalachian Station and his assistants went to war.

The winding-down of a previous effort in a monumental joint fire research-fire control planning program was not to be reversed until after World War II was over, and then in a much different manner.

Since Gisborne was the only one left in his Division, he depended upon Elton Bentley, John Crow, Lou Whetsler and A. W. Peiffer, who served in succession as superintendent at Priest River to maintain essential measurements and records. Most of Gisborne's time was directed to current problems in advice and quidelines concerning the use of his past fire research results by various agencies.

The study effort of chemical constituents on inflammability, the morning measurement of effect of canopy density, and the plant and soil moisture study were all dropped due to lack of funds.

The large log study of Lloyd Hayes, the only one to survive continuously, was restructured in 1942 and was continued for many years after Hayes' transfer. Fire Danger Meter input improvement was a continuing feature and produced the greatly modified Model 6 BI and FD Meter in 1942, with its 1-100 scale and separate Burning Index and Fire Danger Meters; these continued in use until the Model 7 and 8 meters replaced them in 1954 and 1955. Field checking of Hayes' altitude and aspect study was conducted in 1940; the resultant reports are mentioned earlier.

FIRE-CONTROL PLANNING

Ten thousand fire reports were punch-carded in 1938 as a follow-up to Hornby's Fire Control Planning work; the hoped-for analysis would help determine the effects of increased facilities, manpower, and fire control planning, and what would be needed next to increase fire control efficiency and reduce costs. Gisborne was most anxious to get this work back on track. He had hoped to have Clarence Sutliff detailed but that never worked out. It was not until 1946 when Jack Barrows came on board that the fire analysis up-dating finally got under way.

Soon after fuel-type mapping was commenced, the need was recognized by Hornby, Shoemaker, Sutliff, and Gisborne for actual measurements of rate of spread and other behavior factors on free burning fires in important fuel types and on several danger class-of-day conditions. In June 1939, the Region funded and detailed C. K. (Hi) Lyman, a recent forestry graduate with practical fire behavior experience, to pursue this long hoped for follow-through to Hornby's work. During the summers of 1939 and 1940 Lyman made measurements on 74 fires and carefully determined the fuel types and classes-of-day. The results were used to verify the estimates set up in Hornby's fire control planning project. Rate-of-spread had been based on estimates and memories and proved to be generally sound; but good practice demanded their testing. Analysis of well-documented fire reports of the past three years helped in Lyman's verification of several of his measured factors. From these data Lyman constructed charts showing not only the average rates of spread but also the variation one could expect even in a specific fuel type/class-of-day situation. Gisborne stated in the 1940 Annual Report, "Obviously, either the present concept of fuel type requires refinement or the weather factors influencing fire behavior are not being adequately measured, or both." Researchers today are still endeavoring to resolve this.

Paul W. Stickel was transferred out from a fire research position in New England to work with Lyman in 1940 and carry the study on afterward. The Region was to handle his finances in a similar manner to those for Lyman, but funds did not materialize; so Stickel confined himself to desk analysis under Gisborne except for about six test fires in 1941. His position was obtained only by sacrificing an important position in silvicultural research.

Lyman returned to Harry Gisborne's staff in early 1944, again sponsored by the Region, this time to conduct a fuel reduction project. The purpose was to assemble, weigh, and integrate all the factors which should be considered in determining when and where the potential benefits of fuel reduction can be expected to exceed the costs. At that time experienced opinions varied from ten to sixty million dollars. Gisborne refers to the tangles of snags, windfalls, and debris left by past fires saying that these 'worst fuel messes' are true concerns in our forests. From them came a large percentage of our 'blow-ups'. Principles were urgently needed to determine how much fuel reduction is economically justifiable and what must be avoided as mere leaf-raking.

The exploratory study lasted 1 year. Lyman sought expert advice from a sociology and a philosophy professor and others in planning his attack. He used total or "community values" rather than mere stumpage prices in his method. The report Principles of fuel reduction for the Northern Rocky Mountain Region was issued in March 1945. One hundred copies were mimeographed and distributed for in-Service use only. In the report he identified situations where more and better fire control manpower, facilities, etc. are likely to be more economical than fuel reduction by controlled burning. However, controlled burning was concluded to be economically justifiable in high/high and worse fuels which comprised 6 percent of our area which contributed 55 percent of the burned acreage between 1931 and 1943. The effect on streamflow or water supplies was not considered. Consideration was given not only to future fire control costs but also to timber productivity, blister rust control, conversion to grazing, effects on wildlife, and to the general principle that good forestry means jobs for people, families, communities and the nation. Although not conclusive, the findings were sufficiently data-supported and definite to resolve the "...previous haze of pure opinion into recommendations usable for potential post-war work."

Lyman returned to the Region in the spring of 1945 and was assigned as district Forest Ranger. He ultimately moved up through Forest Supervisor, Regional Office positions and at retirement was Chief of the Division of Personnel in Washington D. C.

FIRE BEHAVIOR
The Mountain Transect

Jemison delineated the effect of canopy density on fire danger, and Hayes established the relationship between altitude, aspect, time of day, and fire danger. Hayes' stations were positioned slightly to the north and south of an east-west ridge. Neither fire research nor fire control people considered they yet knew where to measure fire weather satisfactorily. To answer this question the "Mountain Transect" was constructed at Priest River Experimental Forest in 1940 by CCC crews. An area 100 yards wide was cleared from the top of South Ridge, 4000 feet elevation, down the north-facing slope through Benton Creek at 3200 feet, and up the south-facing slope to North Ridge, elevation 3800 feet. The plan was for Hayes to instrument the Transect similar to his altitude and

aspect study in order to obtain data that would show the important differences in fire danger at different hours of the day and night that are known to occur in every mountain valle. Solving what Gisborne called the greatest single 'blind spot' in our vision today never came about due to lack of funds, the war, and Hayes' transfer in 1947. The 37-year old Mountain Transect now contains a beautiful stand of young trees and will probably never have the honor of fulfilling its original purpose. It has served well, however, for Helmer's snow accumulation and melt studies of 1949-1953, and as the site of thinning experiments.

The Riggins Grass Plots

Nearly all fire behavior studies had been conducted in timber fuel types; very little was known about rate of spread in grass in relation to weather factors, fuel volume and fuel moisture. Jemison had investigated ways to determine the effect of degree of curing of forbs and brush on rate of spread, but did little work on grass. Gisborne considered cheat grass, yarrow, etc. in his continued search for indicator plants. At the urgent request of Region Four and to meet the need expressed by several Region One supervisors as well as fire control men from the U. S. Grazing Service, a cooperative venture with the Nezperce Forest in 1944 set up a series of 10-foot square plots of pure bunch grass near Riggins Ranger Station. The initial purpose was simply to find out the rate of spread. Since Gisborne had no funds for this, Forest personnel did all the burning and maintained all the weather records during the season; Gisborne acted as technical director. Plots were burned on three dates in 1944 and 1945, all under similar weather conditions and the plots all contained between 1500 and 1800 pounds per acre of dry fuel. The data filled a large gap in Hornby's rate of spread tables.

One new type of measurement held promise for establishing the degree of curing and supplying a number in the Burning Index Meter for this input--use of an Assman aspirator psychrometer. As made up by Gisborne, it consisted of a set of thermometer tubes inserted in a foot long, narrow, plastic cone, in such a manner that the thermometer bulbs were at the smaller, open end and a small electric motor-driven fan was at the larger end. When the open end of the cone was placed at the root crown, the air was pulled out of the grass and past the thermometer bulbs. The wet and dry bulbs were read in the usual manner. The 1944 Annual Report notes that the original idea was to achieve a possible index of green, curing, or cured. However, Tom Lommasson of the Region's Range Management Division examined the data and found the grass root relative humidity to be a major criterion of rate of spread. He even derived an empirical formula to express the relationship. Further investigation of this method at Priest River showed that a comparison of the differences between grass root and standard 4-1/2 foot level humidities indicates a "humidity difference" that could serve to distinguish, for inflammability purposes, between green, curing, and cured. In order to verify this possible indicator for general uses, the Assman aspirator psychrometer readings were

taken for about 10 years. Unfortunately, Gisborne died leaving no study plan for this venture and since no one remained at Priest River who knew why the measurements were taken nor their potential value, they were terminated by the mid-fifties.

Another innovation commenced at the Riggins plots and repeated at Priest River was to compare the moisture content of half-inch sticks and Appalachian slats exposed both in the grass and under dense grass cover, and to relate their moisture contents with the humidity difference readings. No report on the results of these comparisons was found in the files. Either Gisborne had not analyzed the data prior to his death or he had discarded the idea.

Heat Content of Slash Fuels

In several parts of the country the presence of slash and other forest debris from fires, windthrow, etc. is of only a transitory nature as far as its being a fire control problem since it tends to rot down and decompose rapidly. Not so in the Northern Rockies. Opinions varied widely as to how much of a fire hazard they composed. Some said, "there's no heat in that stuff," while others believed "there's plenty of heat in that stuff and it comes out fast." No one knew how 'hot' 10, 30, or 50-year old slash was even though report forms for some of Priest River's old thinning plots required an indication of degree of deterioration of fire hazard caused by the thinnings; there was no way of measuring or expressing it adequately or consistently.

A study was established in 1944 which determined heat contents of slash of varying age, by means of a bomb calorimeter. The actual testing was done by Colleen McCarthy, a forestry student specially trained for this job. The study was terminated in 1945 after the analysis showed that there definitely was enough heat remaining in old slash to cause concern in control action - up to 10,000 BTU's per pound in a 57-year old ponderosa pine top. Probably the most significant result of this study was the realization that fuel typing, which has previously been on a volume and size-of-material basis, must be modified to include weight if it is to give proper consideration to heat content. "Other factors are also involved, of course, such as rate of liberation of the heat present," as noted in the 1944 Annual Report. The matter of determining rate of heat liberation was not adequately reckoned with until the 1960's when scientists of several disciplines and fire laboratories with sophisticated facilities began to wrestle with 'energy release rate' and incorporate it into fire spread models.

Thirty Year Weather Summary

When lack of funding and supporting field personnel did not permit Paul Stickel to continue gathering rate of spread and other fire behavior factors from going and test fires, he began to compile the Priest River weather records to bring them up to date on what

Jemison had done for the period of 1912-1931. Though Stickel resigned in 1943 before the work was completed the "Summary of 30 years of weather at Priest River" was in manuscript form and ready for mimeographing early in 1945. For reasons beyond the scope of this report, this summary was never published. Major summaries have subsequently been made and the records on computer cards and tape, are frequently utilized.

FIRE ECONOMICS

Research involving the economics of fire control had been urged time and time again. With the overall belt tightening of protection agencies and their loss of men, especially CCC crews as World War II approached, the matter of fire economics research came to the front once more. Gisborne stated that fire control is intended to serve all phases of forestry. Intensity of control suited to one product may be unjustifiably expensive or entirely inadequate for a different product. Adequate control at least possible cost definitely depends upon these concepts. He further stated that the term "adequate control" has never been defined although it is used in regulations and even in laws. His Analysis of the forest fire problem in Region 1, 2, 3, and 4, dated May 30, 1941 also stressed the need for fire control economics research. The Priest River Fire Control Conference of December 1941, recognized the urgency of exploratory work and the desirability of establishing economics as a separate phase of the fire problem. Harry put a wistful article in the August 21, 1941 issue of Northern Region News. "Average old timer: 'No damage, just burned up some brush.' Present-day perfectionist: 'Oh, maybe $100 of merchantable pine and $40 worth of grass.' Future forest officer: 'Yes, that fire did some damage, $100 for merchantable timber, $100 for seed trees, $75 for grass and browse, $200 for established immature trees, $200 for soil and water, $150 aesthetic and recreational, and $50 for wildlife. Total $875.'"

Gisborne's 1944 analysis of the outstanding opportunities for future fire research included economics in its detailed proposed $145,000 per year program. A project proposal appeared in the 1945 Annual Report.

No concerted research effort was ever made on this critical problem until well after Gisborne's death in 1949. A few scattered minor studies plus a one-man project at Sinkin, Missouri, filled the gap until the sophisticated sciences such as systems analysis and computer modeling came into being.

NATIONAL COORDINATION

By 1936 there became an awareness that fire research was being conducted at a number of locations in the country and that each researcher might benefit from the knowledge of the others, on a formal basis. True, Gisborne, for example, had long kept up a running correspondence with McArdle and Morris in Portland, and had from his first season at Priest River kept in close touch with Show and Kotok in California, and later with Buck, Fons, Byram and Brown. He would have been at a loss without the close

working relationship with Dunlap and others from the Madison Forest Products Lab.

But each person was still doing his own thing and proceeding down his own path. A. A. Brown surmised that this provincialism went along with the strong, independent leadership of each Regional Forester, to which the researcher units were closely allied. Each Region had its own way of doing things, and research was more or less tailored to such ways. Perhaps a Major Kelley was needed between 1929 and 1944 to get rid of some deadwood and bootstrap the entire fire control organization up to the best in the Service. It took a Kelley-Hornby-Sutliff-Gisborne-et. al combination to do it.

Better communications, more travel, and more inter-Regional transfers all helped break down provincialism both in administration and research. Tight money and resultant fewer qualified scientists helped to stimulate the beginning of coordinated national fire research planning which still retained a regional flavor.

The first fire investigator's meeting to involve all fire researchers at one time was the Shasta Fire Conference, held on the Shasta Forest, September 13 to 17, 1936. The roster of attendees,in retrospect, was impressive: Gisborne, Jemison, and Shoemaker from Northern Rockies (representing the entire Rocky Mountain segment); Jack Mitchell from Lake States; Les Harper and Ralph Nelson from Southern states; Paul Stickel from Northeast; H. D. Bruce from Madison Lab; Morris from Pacific Northwest; and Art Brown, Charlie Buck, Jack Curry, and Wally Fons from California; and perhaps others. McArdle had already resigned to become Dean of the University of Idaho's School of Forestry.

The program that was prepared and discussed pointed toward a presentation to the Washington Office, and included Prevention; Behavior-fundamental laws of combustion, effect of green vegetation on rate of spread, and effect of cover and aspect; Fire control - visibility, chemicals, economics, and human factors; and Effect of fire-soils, and tree physiology. Preceding the meeting a field trip took the group down through Oregon into California to observe Buck burn some experimental brush plots, and to visit the new Genetics research center at Placerville.

The results of the Shasta Conference had an impact on the Washington Fire Planning Conference of November 1936 that was gratifying to Gisborne. He states in the 1937 Annual Report that the widespread use of previous results of 'our' fire research became increasingly evident during 1937 as the Washington Conference recommended country-wide application of the principles of fire control planning and fire danger measurement originated by 'this' Station. The Washington Office also requested "the production of a tested and reliable danger meter system for each region", and it stated that danger meter planning is the most acceptable form of determining presuppression needs of FF funds. (This latter statement ties back to Jemison's interview comments on Crocker's and Gisborne's vocal concerns over the fire danger buildup on the Selway in 1934 and the ensuing holocaust.)

The Ogden fire meeting of February 26 to March 5, 1940, included both fire control and fire research personnel. Fire researchers included Gisborne and Lyman from Northern Rockies;

Jemison, now from Appalachian Station; Buck from California, Brown, representing both California research and Region 2, and Don Mathews from Portland. The Northern Region News of April 6, 1940 says that basic fundamental knowledge of fire behavior was seriously meagre, but scarce as it was, it's application was far more necessary than in the past. The conference proposed these ways to overcome the current weaknesses: initiate a national effort of behavior research essential to danger measurements; urge all regions to develop and improve their fire danger rating systems; base fire behavior calculations on current fire weather and inflammability measurements, and consider forecasts rather than yesterday's ratings; and do more training to inspire a more comprehensive application of existing knowledge. At a 'rump-session' the researchers decided to recommend that at least fuel moisture and wind be measured uniformly in all Regions so that interregional comparisons might be made and a national scale of fire danger eventually result.

Probably the last fire conference for 14 years involving a large percentage of fire research personnel was the Priest River Fire Conference, December 1 - 6, 1941. Attendance was from the Washington Office, each Region, and each Station involved in fire research. Researchers included Bradner, Gisborne and Hayes of Northern Rocky Mountain Station, C. C. Buck of Pacific Southwest Station, Matthews and Morris of Pacific Northwest Station, Jemison of Appalachian Station, C. A. Bickford of Southern Station, Mitchel of Lake States Station, and C. L. Forsling, I. T. Haig, K. P. Davis, J. P. Shea, and H. J. Eberly of Washington Office. Two outstanding results were the intention to rejuvenate economics research and to initiate prevention research (all previous prevention studies were by administration personnel). But these were not to be done at the expense of work on fire behavior leading to better danger ratings, better dispatcher's meters, and better understanding of the behavior of large fires. The December 21, 1941 Northern Region News account of the meeting did not mention that the conferees' desire to enter economics and prevention work was, at least for a few years, an exercise in futility, as they headed for home on the same day Pearl Harbor was attacked.

Harry Gisborne's mimeographed An analysis of the forest fire problem in Regions I, II, III, and IV May 30, 1941 was an early reply to the general desire to expand the scope of research to areas other than those within which the data had been collected and analyzed. This problem analysis, however, deals more with research philosophy and approach to solution than it does with specific, detailed problems and studies. He pleads not to tie research or control policy to existing rules, such as the 10 a.m. policy. "The 10 a.m. policy may not always be the guide to Forest Service practice. It is not so for other agencies, and forest research must consider the needs of all agencies." He also brings out the fact that topography, fuels, weather, and causative agents recognize no ownership boundaries. He scored the 'minimum damage' (Show and Kotok) and the 'least cost plus damage' (Headley) theories of fire control as each had severe faults. He believed that the approach to any problem is "to first find out how to do a thing well and then strive to reduce costs," as opposed to the then

existing policy of "hold down expenses first, then do a good job, if you can." He set forth three general problem areas or "presuppositions": approach or attitude, the choice between an abundance of all forest benefits versus a predetermined scarcity, and the delineation of the functions and responsibilities of Forest Service administration and research. His actual project program differs from that outlined at the Shasta meeting (Prevention, behavior, control, and effects) to the following. in order of priority: economics, prevention, control, and management policies.

In terms of present day research expenditures in people and money, Gisborne's estimates were either ridiculously low or blatantly optimistic: Economics - One man at each of four stations; Prevention - no work; Control - One forester at each experimentation station for fire control planning, and one forester from Region I and II for fire danger and behavior work, and one for Region II and III. 'Management policy' would be the concern of the Regions. He figures $75,000 per year for ten years would do the job. He viewed that as cheap, since Region One's annual cost plus loss already averaged about $1,310,000.

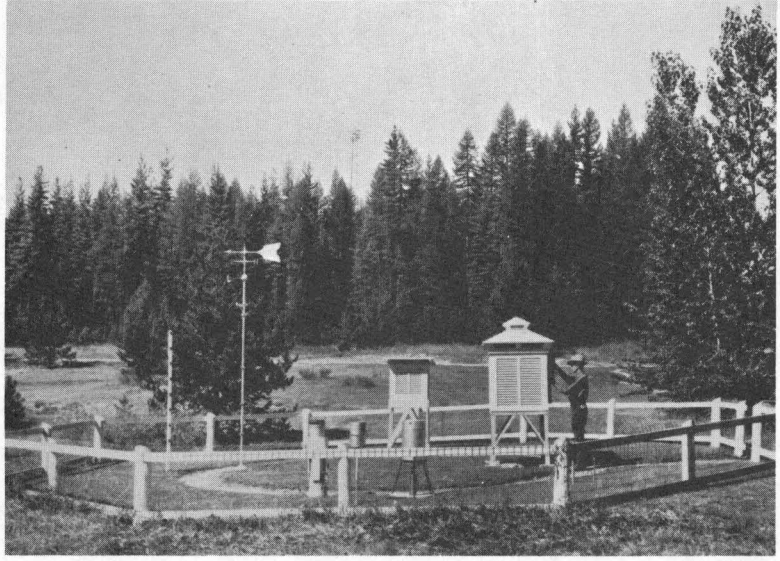
An interesting point in the records was that Gisborne was to visit Region II, III, and IV in 1942 in order to revise and update his analysis more intelligently. He had never been in Regions II or III.

PLANS FOR THE FUTURE

Late in 1944 Harry Gisborne submitted a detailed analysis of the major research areas needing action to contribute toward the regional and national goal of adequate fire control at least possible cost. The program, included in the 1944 Annual Report, should cover the fields of economics, effects and use, fire control planning, and fire danger measurement, at a cost of $145,000 per year for the first 3 years, decreasing to $43,000 by the tenth year. The following year he planned, if funds were increased after July 1, 1946 to (a) make an all-out attack on fire control planning, (b) follow-up on the fuel reduction study to produce a manual of Fuel Reduction Practices, (c) define 'adequate control at least possible cost; and (d) resume several of the studies dropped between 1937 and 1941 which would lead to a soundly based Fire Dispatcher's Guide.

In the meantime, all the research divisions prepared their Project Work Inventories (PWI) by the end of 1944 in order to be ready for the hoped-for-flood of post-war rehabilitation funds, which never quite materialized.

The files revealed another planning project of Gisborne's when he wrote a memorandum to the Director on November 1, 1946 alluding to a fire problem analysis listing these two problems needing attention: Combustion - heat content and rate of liberation, fuel size and arrangement and chemical attributes of vegetation; and Instruments and methods - improvement or replacement of those such as he and Forest Products Laboratory had developed over the years.



Control station, meteorological tower in background, ca 1939

The mountain transect

Numbskull club charter member Harry Gisborne

During the 1940's Gisborne obviously did much long-range planning. However, the goals of this planning seemed to change from year to year, as did the projected magnitude. Such lack of consistency may have been due to local pressures, changing needs, or perhaps even a frantic effort to get something going again, whatever might draw interest and funding.

GISBORNE ANA

A. A. Brown most aptly summed up the many reasons why Gisborne was acclaimed such an outstanding researcher and person: "He was one research man who never lost his little boy's curiosity." Gisborne's curiosity pervaded every facet of his total life. How he thought, how he spoke, how he wrote, how he expanded his interests, all bespoke of his life-long search for the truth.

Some personal insight to Gisborne has shown up through the text in connection with specific subjects. Since so much about him cannot be said at any one point, hopefully, this section will bring together a little closer feel of Gisborne, the individual. Here are only a scattering of ideas and comments about him and by him. For example, in spite of Gisborne's reputation of being provincial in his outlook, Brown relates that "Harry was the first to congratulate me when I transferred from Chief, Fire Control to assume the position as first Chief, Division of Forest Fire Research. Harry pledged his wholehearted support of the new division in the interest of a strong national program."

HIS PHILOSOPHY

A. A. Brown: Everyone that worked with Harry was impressed with his industry and how efficient he was in getting things done. He carried out a good many experiments single handedly that I'm sure we would do only with a good sized crew today." In reference to his pushing himself beyond the capacity of his ailing heart, Brown stated "But he himself would not listen to any (admonishment) because he said there were bigger things ahead than he'd ever done before and he was not going to be stopped."

Jemison: "He couldn't do anything without practically killing himself doing it. He had to be in action every minute. He couldn't relax and take things easy. That was his style. I'm sure that may have led to his heart condition."

A. A. Brown: "Harry was a prolific writer, an eager and effective salesman of fire research. Many have criticized much of his publications as being too empirical and much of his research as too localized in significance. But most of his research was a real pioneering job. He had no encouragement. He had to sell his program to the practitioner. He had to develop technical standards which would command respect among other researchers." His attendance and participation in National fire meetings...brought style to the fire conference." Harry's apparent provincialism could have been intense loyalty to your own, to your immediate associates, and to your boss and your immediate area. Harry was all of these things.

Jemison: "He was strong for application. This was constantly on his mind. He was not doing research just for research's sake. He was definitely problem oriented."

G. S. Hayes, in describing the difference in research approaches between California and here: "Gisborne and Hornby had had a lot of

background in actual fire control and observation of going fires. They tried to come directly to their working tools - the fire danger meter, fire control planning."

J. S. Barrows: "I think what was new from Gisborne's work falls into the area of concepts. Hornby and Gisborne working together developed the concept of classifying fuels by rate-of-spread and resistance-to-control." "He was an absolute stickler for people using and maintaining instruments correctly. He would really get upset when people mishandled equipment-weather instruments in particular."

C. S. Crocker stated emphatically that Gisborne had tremendously good rapport with field people. He had the ability to sell his ideas. He went into the field, explained what he was doing, and actually sold his research on the spot. He could simplify highly technical matters so field men could grasp the crux of the ideas without them feeling talked down to.

C. L. Tebbe: "Harry Gisborne was quite a man. He didn't tip the scales very much but in matters of the mind, he was a real heavyweight."

A. A. Brown: People like Jemison, Hayes and Barrows were all greatly influenced and inspired by Gisborne. He was the best salesman for forest research in general, and fire research in particular that we had for many years."

J. S. Barrows: "Gis was application oriented. He had a great respect for the field man's ability to tell him whether he was off the mark or not. He did have various reactions, however, when told he was off the mark. I've seen him think about it and say 'yes, he is right; we did something wrong here': I've seen him take the approach, too, that 'this guy just needs to be educated; he doesn't know what he's talking about!."

G. L. Hayes stated that top field men were keen observers but needed the scientific insight of someone like Gisborne to explain what they saw. "His formal training was not great but his personal training was deep. "He'd read all types of professional journals, and go afield in related sciences and arts looking hard for things that would apply to his job. He was a much better scientist than his training would indicate."

Gisborne in a note dated March 8, 1948, wrote about work attitude. "To some people advancement in pay or position is a controlling guide in all their actions. To them doing good work is secondary when they can get the advancement without doing good work. They have achieved their goal. To others this order is reversed. The control of all their actions is to do a good job. If from this they obtain advancement they are more pleased, of course, but they are satisfied with having done a necessary or helpful job and done it well."

He wrote Senator Mike Mansfield on December 27, 1943 protesting the trend toward granting 30 days vacation with pay. He also objected to Federal employee unions because "a good union should protect the public as well as its own members for the very good reason that union members in the first place ARE PART OF THE PUBLIC."

He objected to an article by editor M. F. Behar of Instruments Magazine entitled Goodby Incentive referring to Government employees. He retorts to Behar on February 24, 1949 "Having worked for the Government in forest research ever since the first world war, I want to assure you that incentive does not go out the window when you enter Government service nor is it damped, diluted, or destroyed by such service."

The ieda of having a morning and afternoon coffee break on official time was put to Station employees on March 3, 1949. Harry commented, "I would like to suggest that our Division of Fire Research avoid the practice of ganging up for a coffee period. That leads to excessive noise and confusion which definitely interferes with work by all those in adjacent offices and which does cause unfavorable public comment."

Gisborne reacted to a recommendation of the December 1941 Fire Research Conference that fire-danger measurement research be shelved by stating in a March 29, 1943 memorandum to Jemison: "I have not abided by that recommendation. I am still working on fire danger measurements and I am going to continue to work on it until some authority with more power than the recommendation of the Priest River meeting moves me out of the job."

In differentiating his work from the more fundamental California approach, he states in 1937, "I am assured in my assertion that our work is more complete and more scientific in studying (1) what are the factors of fire danger, (2) how to measure these factors, (3) when to measure them, (4) where to measure them, and (5) how to put those measurements together into a usable index of danger."

Attitudes Toward and By Others

Gisborne was unfailingly outspoken. No acquaintance ever went away wondering where he or his ideas stood with Gisborne. In 1941 he had apparently set up a scheme for his men to rate him as well as for him to rate them. This frankness illustrates how much they really respected him or they would not have put down such remarks as "He is inclined to be a little quick tempered and overly hasty in reprimanding some of his employees particularly in view of his failings to give adequate supervision and inspection." "I refer to his caustic nature, being extremely critical of his own work as well as that of others. He is impatient when others fail to meet the high standards he has set up." "His sarcasm may be a stimulating barb to those who are his equals or superiors in rank, but he should be careful how he uses it on his subordinates." "In my case sarcasm does not lead to a mental state conducive to effective work." Yes, Gis was a difficult man to work for.

To help Lloyd Hayes attain a clearer and more complete conception of why he was doing some of his work Gisborne had him travel around the Region ostensibly to inspect the inflammability stations but actually to bring him into close personal contact with rangers and field men and their jobs.

Crocker said he and Gis "argued to beat the devil." He also said Gisborne would argue with most anybody most anywhere if the occasion merited debate. C. A. Wellner recalled that Gisborne once said, "I'll fight you on anything I want on a professional basis,

but it has nothing to do with our personal relationship." Wellner went on to say that Gisbornes' near-diatribes were good for the profession, for honesty, and for the Service.

Crocker cited a humorous case in point. He and Gisborne visited Ranger Irving Puphal at Kingston where Gis and Irv immediately began arguing about the merits of fire danger rating. Gisborne finally said, according to Crocker, "There's no use arguing with you. You're the most bullheaded man in the Forest Service." Crocker had to sit the two men down and cool them off. A few days later Gisborne came into Crocker's office to show him a small package just received from Puphal - a package of Tums.

Jemison said, "He was an extremely fine person to work for, although he was highly critical and could be very sarcastic and caustic if a person working on something with him or for him didn't do well or didn't try as hard as he thought he should." He didn't stop at being critical. "He would go at length to point out why or how you could have done better and would break his neck to help you do better." "He also was one of the few bosses I had in the Forest Service who really went out of his way to recognize good work. He would get so excited and so exhuberant. Gis would glow when he'd praise -- not for the work particularly, but trying to make you feel like you'd really done something; he was really stimulating in that respect."

Barrows felt that "Everything Gis did he did rather aggressively and there was never much misunderstanding on what his position would be on almost any subject that came up. He thought things out clearly and carefully and was a good communicator; he could get his points across to people."

V. J. Schaefer relates an indicent of Gisborne's thoughtfulness. After visitng the Spokane Fire Warehouse "I was very pleased as we were about to return to have Harry present me with a pulaski which he had purchased from the Forest Service and gave it to me as a gift. It is one of my cherished possessions at the present time."

Harry Gisborne was actually quite hopeful that he would not be asked to assume a position of leadership in the Washington Office. He did not want to leave his 'homeland' of Montana and northern Idaho. A longhand note dated June 2, 1941 explained his reasons, "If what I have contributed so far has been good, it is well to consider where and how I obtained the background information and attitudes - I got it by living in the field in <u>daily</u> contact with field conditions, a Washington Office position loses those contacts and that viewpoint. I am <u>not</u> a good administrator. I may see things needing doing but it <u>does not follow</u> that I have the ability to get men to do that. I am too erratic. When the work does not go very well I worry. When I worry my heart goes fast. I wouldn't last long on a Washington Office job."

He was as quick to praise as he was to criticize. For example, when Clyde S. Webb, a career Region-Oner who wound up as Deputy Regional Forester and personnel manager retired, he wrote on May 11, 1949, "In my 31 years in the Service I have never seen any other individual do so much with and for the personalities, who are the Forest Service, as you have done."

In a letter to E. L. Demmon, Southern Forest Experiment Station, dated January 17, 1944 he wrote as a former SAF council member on the overall viewpoint of forestry. "If you really lean toward a forestry that is a lot more than mere timber or tree management, you've certainly got a job to do on those Yale professors who think they know so much about forestry in your region. If Eldredge had been at the Society council meeting last May he might have told you how clearly and strongly Hawley reflected the Yale attitude that forestry is NOTHING BUT TREES, AND MOSTLY SAWLOGS."

When Jemison went to the Appalachian Forest Experiment Station to initiate a fire research program in 1937, he had mixed emotions about leaving Gisborne. "I had regrets in going and I can't recall having any special reason to go. I definitely didn't have any reason for wanting to get out from under Gis' direction; to the contrary. I missed him greatly. But it was a challenge. It was a new part of the world. I'd grown up in Region One. The reason I really left was to get new contacts and new opportunities. We were always extremely close friends as long as we ever saw one another. "I've thanked my lucky stars many times in my career for having a chance to start with a man like Gisborne."

The files contain many letter exchanges between the two men to bear out such a warm feeling. Jemison set up a research program in the new area that would capitalize on all he had learned from Gisborne - a sort of outreach of Gisborne's principles. Development of an appropriate fire danger rating system was about the first major accomplishment of Jemison's. He devised substituting the 'Appalachian Slats' for the half-inch dowels to attain the faster moisture exchange response to represent more accurately the leafy fuels.

G. L. Hayes has an interesting interpretation of Gisborne's use of his natural caustic manner. "He told me I accomplished more when I was mad. So he deliberately irritated me at times. He set himself up as an irritant to others all his life. I heard him say in meetings that the group needed to have a burr under their tails to keep them moving along and he is that self-appointed burr!"

In reference to Gisborne's inspiring people to move upward, Hayes said, "We had the kind of encouragement and training that was needed to get us going. Gis' enthusiasm was very contagious, affecting everyone around him. When he looked at something you could see his eyes expand if he recognized a potential significance."

Hayes recognized Harry as an extremely competitive person. "He wanted to get better, more positive results, and if there was anyone else working on the same kind of research, Gis wanted to beat him to the results." Since Gisborne knew that he could not learn all about every technical subject, he did the next best thing. For example, ordering Lloyd Hayes to learn all about meteorology so he could be the Station expert and keep Gisborne advised of application possibilities. However, Gisborne resented Hayes taking off a year to work for his Masters' degree at Yale, as it would mean a year's work lost. "You can't go to college and learn what we're trying to do here" was his caustic comment.

Notice of Hayes' transfer to Appalachian Station to follow Jemison's footsteps came through the back door, or rather through his mother-in-law's automobile mechanic in Spokane, who happened to be Jemison's uncle. The Washington Office, through Jemison's request, had approved the transfer but for some reason Northern Rocky Mountain Station personnel were not informed. Hayes said of Gisborne's reaction, "You know what hit the fan about that time. He was really upset." He had just gotten Lloyd to the point where he could relieve himself of the going studies and turn his attention to concepts and plans when in August 1942, he found himself absolutely alone in his Division.

Gisborne, upon hearing the 'leak' of Hayes' transfer to Asheville, immediately sought a replacement. In the memorandum to Tebbe of June 16, 1942 berating the system, said "I should like to register here a request that if and when it should be possible to obtain the services of George R. Fahnestock on fire research at this Station, I believe that I could do as well with him and by him as I did with Jemison and Hayes." Fahnestock did work for Gisborne in 1949 as a detailer, but was not formally transferred to fire research until January 1951, shortly after Gisborne's death.

A week later he wrote to Hayes. "You are ready for this change. I hope I have helped you to get ready in as many ways as I should have. Working with George (Jemison) and you for the past 12 years has been as pleasant for me as it has been profitable for our Division. I can see that I am going to have to hump to keep up with you but I won't mind at all trying to put your results into practice up here and seeing to it that you get full credit."

At Asheville, North Carolina, Hayes followed Jemison in pursuing the Gisborne approach and continued to refine the fire danger meter and get the system into widespread usage. Hayes continued to lean on Gisborne. "If I had problems, I'd just sit down and write a note to Gis, and I'd get an answer back. I guess one way or another I'll never be free from my relationship with Gis."

J. S. Barrows has about the same recollection of the degree of supervision received from Gisborne as does Jemison and Hayes. They all indicate very close watch and direction at first, gradually relaxing to the point of agreement on principles with the actual work direction left up to the underling. But Gisborne always knew exactly what was going on, and as Hayes said, "When work was in progress at Priest River he would make formal inspections. He'd look things over and get pretty critical."

Training and updating employee's knowledge was ever in Gisborne's mind. As an example, on January 11, 1949 he mentioned a particular article to Barrows and Fahnestock, asking that they read it carefully. "The article may strike you as tough reading. You can't skim through material like this, even if you have previously read in this field. If this should be your first brush with material of this type you may be inclined to brush it aside. I urge you to bore into it and try to understand every sentence of it."

The following three comments help show that Gisborne really did have a lighter, humorous side to his nature.

Jack Barrows told about 'Old Silver Top'. One day a new official car was delivered to Gisborne - a 1947 Ford sedan - E-17, black

instead of Forest Service green. Barrows, who observed the episode, stated "This irritated Gis tremendously. He drove it to Priest River, dug out some aluminum paint and proceeded to paint the top of the car aluminum. Of course this was strictly non-official but Gis just said "Any damn fool would have sense enough not to suffer through a summer in a black car like that." As I recall Gis got bawled out by the Director but it didn't bother him any. Not long after this, all Forest Service cars were painted light green with a very light gray top. Old E-17 wore its silver top long after it was sold to the highest bidder - C. E. (Chuck) Syverson of the Weather Bureau's Fire Weather Service.

A. A. Brown said, "Harry's lively sense of humor was one of his saving graces. He was thoroughly delighted in nominating some visiting forest officer to their 'Numbskull Club', for which he was eligible if he pulled a big enough boner. Harry and his associates would exaggerate a little slip to the point where he would become eligible. Harry got a lot of delight out of this; it was just another one of those little dimensions to his character that made him so likable.

C. L. Tebbe reminisced about some of the good old days long past, "The Gisborne's were really great people. Alice played the piano and accordian like a professional and was indispensable at the Experiment Station parties we used to have. In time a larger group formed around her and 'The old time orchestra' became well known and in demand. Alice carried the group on the piano, Jean Lindh and Margaret Tebbe played violins, Charlie George the trumpet, Jack Nash the mouth organ and accordian simultaneously and Agnes Crocker and Kathryn King filled in neatly with ukuleles."

WRITING

Writing was obviously a pleasant task for Gisborne, as he was prolific and he was good. He endeavored to aim his writing manner toward his intended audience. By 1929 he had published about 20 articles, mostly in journals such as Journal of Forestry and Monthly Weather Review; a few in Forest Service numbered series, and several in the newsletter, The Bulletin-Northern District. The total number of formally published articles was 46 by mid 1947. His first writings pertained very closely to the specific work he wanted to get out in front of both the research and the application audience. By the end of his first decade he was branching into more general subjects and beginning to display his somewhat provocative nature. He took to heart and put to practice throughout his career a statement in the 1921 Annual Report, which must have been one of the first articles he read in the spring of 1922. "In getting research across to the public make known the results and the value of these results. An office report, or a too technical digest of it, passed out gratuitously will do very little to obtain the desired result. A presentation of certain of the most appealing results in an interesting and popular way, and couched expressly for the purpose, will do far more good and if the effort is made in person, the greatest good of all will result."

He accepted only one level of performance in his own work and in his own writing, and this standard - perfection - was handed down to his employees in no uncertain terms. Jemison recalled "I'll never forget my first attempt to prepare a technical report which was subsequently published as about a page and a half account of the Freeman Lake Fire, 1931, in the Monthly Weather Review. The first manuscript I handed in Gisborne just tore it apart unmercifully. It deserved being torn apart, of course, but the thing I remember was how helpful he was and how he went out of his way to show me how I could do a better job of writing, why this type of presentation wasn't adequate, and so on.

Hayes, a few years later, shared Jemison's feeling, "Gis was a good writer and a sharp editor. He cut things up pretty badly. Of course I didn't take too kindly to all of that." When I wrote an early draft of Discussion of Hygrographs at Priest River, Gisborne was rather brutal in his criticism. This spurred Hayes to be "...determined that I was going to have it so precisely prepared that he couldn't scratch a single word out of it. He read it over and then came to me and had this funny expression on his face. He told me it was written so tightly that there was no place in there for a reader to rest his mind. So I considered that to be a major victory."

According to Barrows, Gisborne was at the time of his death, working in the field of fire danger rating, and had been for several years, putting together a publication that dealt with the meteorological aspects of improving prediction of fire danger. His work with Schafer and his compulsion to visit the Mann Gulch fire are indications of this interest. However, no manuscript drafts were found in his files.

Gisborne had traumatic experiences with those who attempted to edit his manuscripts. In a long memorandum written to himself on July 11, 1935 he writes, "I have just completed the final review of my report Measuring fire weather and forest inflammability as edited by Miss Jean Kerr and I want to record my reactions. Of all the experiences I have ever had in the Service that should have been helpful and stimulating, this has been the most discouraging and disheartening." Kerr had recommended a more 'matter-of-fact' manner. He retorts, "Is this the style which makes so many scientific articles dry and uninteresting and is it the style that James. H. Robinson claims are retarding general interest in scientific fact: 'the rigidly systematic presentation is almost sure to miss its aim.' I cannot make myself desire to write that way." He admits the 'Sunday Supplement' style is not appropriate for technical reports, but that "...specious logic and orderliness does appeal to the academic mind. Such presentations suit the teachers fairly well but unhappily do not inspire the readers. Publications intended to influence the actions of field men are seriously weakened by use of the academic style."

He stressed this writing philosophy throughout his career. He commented to Director Tebbe in a March 10, 1948 memorandum pertaining to the March 8, 1948 Time Magazine article "Story of an experiment," (to which he had apparently contributed heavily) that he had been reluctant to submit such a naively written article," just obviously

long winded, verbose, amateurishly scientific, and far below research standards of organization, grammer, etc." The excellent comments he received indicated that he had never been so wrong. "I believe that it was solely the telling in such a way that its hearer will take it in and be able to use it."

From the literary standpoint, probably his article, A forest fire explosion, first published in the November 1929 issue of the University of Montana's quarterly, 'Frontier' and later reprinted in several other journals and books, represents the near-ultimate in poetic description of a horrifying scientific phenomenon. If only one of Gisborne's writings was to be read, that would be the one to select.

PARTICIPATION IN ORGANIZATIONS

Many people felt the same as Crocker who said, "Gis was a loner." He tended to do his own thing with just a few, or often no, helpers. However, Gis was gregarious in many way, notably in his interest and participation in professional organizations, many of which he joined, serving as officer or distinguished member in most.

The list reads as follows:

Society of American Foresters. Joined in 1920, became a Senior member in 1924, and a Fellow in 1939. He was Northern Rocky Mountain Section chairman in 1930, and a Society Councilman for two terms between 1940 and 1943.

American Meteorological Society. Member in 1922.

Northwest Scientific Association. Charter member 1924, President in 1946, and Chariman of board of trustees 1947-1949 (at time of death).

Montana Society of Natural History. Member 1936.

American Association for the Advancement of Science. Member 1937, Fellow 1939. He really appreciated this honor until he commenced inquiring among the local membership as to who else might be a Fellow. "I had difficulty finding someone who was not. Apparently most everyone publishes a paper if he lives long enough."

Author's Club. A local group of authors from Missoula- mostly University and the Bitterroot Valley. He probably joined sometime in the 1930's.

Western Interstate Snow Conference. Member in 1938 and on the Executive Board from 1940 to 1948.

American Geophysical Union. Member in 1938 probably in respect to becoming a member of the Snow Conference.

Montana Druids. 1947. A local Forestry School honorary dedicated to current and potential service to the school and profession. Men having attained high professional stature in their work are often inducted as honorary members.

HIS WIDE INTERESTS

Gisborne was never specifically involved in blister rust control (BRC) work, although he took a great interest in it and had many opinions, both verbal and written, concerning the program and the manner in which some of the results were presented. He took

particular exception to the reports of Hutchison and Mathews. He responded in memorandum to the Regional Forester on May 8, 1946 to reference made at a BRC meeting in Spokane, to the gooney attitude of uninformed critics, skeptics, and doubters. He questioned whether he and others were "...exactly uninformed through any fault of our own but maybe the BRC has fed us all the good information and attempted to minimize or withhold not so good facts which we have observed for ourselves." He called one report, in a pencil memorandum to himself on March 6, 1948 "...an unabashed whitewash reeking with soft soap, and failure to accentuate the true significance of many of the facts." In at least one case in 1949 he did have to, on Director Tebbe's orders, go back through a publication and verify all his claims.

He had many personal ideas on proper silvicultural treatment and harvesting policy. In one handwritten note headed 'Silviculture' he looked far forward when he stated "Our main objectives should be (1) growing sound wood fibers in maximum volume per acre per year and (2) growing multiple purpose stands and forests - not just presently marketable species."

As early as 1929 he discussed in the article The industrial revolution and forestry, the changing viewpoints from saw timber to cellulose and stated the need to modify forestry and silvicultural practices to meet these new demands better in terms of cellulose rather than full grown trees.

A 'Missoulian' newspaper article in May 1945 indicated Timber Management Chief Axel Lindh felt that lack of roads, not lack of silvicultural research to air pre-harvest cutting and removal for sanitation purposes was the key problem. Gisborne agreed wholeheartedly in saying "There is damn little silvicultural research required."

In reference to a mill scale study in 1942 he wrote, on December 19, "I recommend that all the data and compilations so far made be returned to the products file and no further silvicultural time be spent on this study. I am opposed to pouring even a dribble of money down rat holes that have as many vents as this one."

Many memorandums and letters testify to the fact that Gisborne was most conscious of the need to consider all facets of the forest, and not just timber and fire for timber's and fire's sake. He explains his feelings and hopes for a broader outlook for forestry in a memorandum he wrote to A. A. Brown on May 12, 1941 in reference to broadening the scope of Journal of Forestry articles, "Foresters throughout the country are beginning to appreciate the fact that all the techniques of silviculture, in fact of all phases of forestry, are less important than policies which will express and determine where and how much of those techniques should be used. Techniques are a means to an end--what bothers us in Fire Control is where the hell are we headed? Which end or ends? Commercial timber alone? Recreation alone? Water control alone like the cock-eyed Californiacs contend in Fire Control Notes for January 1941? Or a reasonable blend of these?" "This is a perfectly natural period we are going through; a transition from an even-age stand of one species - silviculturists - to a mixed-age stand

with a few more species. One thing we seem to be scrapping about is: which if any of the new species are 'weeds'?" "Maybe if we talked to the silviculturists in this language they would respond better (move over and make more room) than if we talk bug language and merely try to eat the bark off them! Anyway, it's an interesting period." Sounds familiar in 1976.

In the Northern Region News, June 21, 1941 Gisborne wrote about "evaluating the intangibles" in a discrete fashion. He suggested that putting values on recreation, wildlife, streamflow, and even aesthetic damage in the same manner as we evolved the fire-danger rating system one might produce a valid rating scheme for these factors. First comes agreement on what features are most important, then application of some sort of scale of degree in both pluses and minuses, and finally mix in commercial timber values, then, "...and gentlemen, we may waltz to the tune of lots bigger appropriations for fire control, because in many cases these so-called 'intangibles' are worth far more to the public than all the commercial timber you could grow in all of Region One."
In line with the above, mention must be made of Gisborne's open attitude toward fire in the forest. During the course of his career he spoke out vehemently against many policies as being short sighted and not considering the total forest. He wrote a memorandum to himself on January 22, 1944 listing some of these existing forest policies:(1)fire is always detrimental to foresty, (2) fire exclusion is good watershed management, (3) logging should not be permitted in city watershed, and (4) forestry is the growing and harvesting of trees.

Through Harry Gisborne's efforts, much of the climatic and streamflow measurements at Priest River came into being. When the U. S. Army Corps of Engineers set up its Snow Lab in Marias Pass on the southern edge of Glacier Park, he became quite interested and very soon quite critical of their methods, archaic instrumentation, and lack of interest in utilizing the Priest River data--the most complete year-round data in the northern Rockies. His activities in the Western Interstate Snow Conference since 1938 gave credence to his opinions. The Forest Influences Project and the Columbia Basin Study both originated in about 1948 or 1949; they found a gold mine of data at Priest River to give them a fast beginning.

Gisborne became involved in the Montana Study, in charge of the committee on Montana Resources in 1945 and 1946. The purpose was to gather material for a book concerning the natural, economic, social, recreational, and human resources of the State for school and general use.

He was an avid proponent of a broad curriculum for forestry students. He figured that only one percent of the graduates need all the sciences they can get; therefore why train the remaining 99 percent in something they are not going to use when they could spend time in preparing themselves to be more total, professional people? (letter to Forestry Dean Dana, University of Michigan, January 27, 1945).

During World War II he had built up a large file entitled "Cases of deceit, unfair and illegal practices by the lumber industry." He tackled Tree Farmers, Amercian Forestry Association, Western Pine Association, and American Forest Products Industries. Behind it all was his sincere desire to see more lumber produced by all sizes of operators for the war effort. He again overstepped his bounds and got stepped on a few times.

He also wrote several articles during the war, only a few published, explaining and encouraging the use of wood for heating homes. As late as 1948 he submitted an article to the Farm Journal entitled Wood for fuel, which beings: "Our coal and oil resources are diminishing at an alarming rate." The article was rejected because it was too technical and detailed for readers' consumption--of all things for him!

When Gisborne saw a reference to television in Fortune, December 19, 1942 he scribbled a footnote stating, "A fireboss can stay on the ground and look at his fire from one lookout or scanning point after another, or from an aircraft." That one is still being worked on, but the potential was immediately evident to him.

A combination of enthusiasm, impatience, and tremendous loyalty to the Forest Service often got Gisborne into predicaments. For example, in early 1946 he wrote an official letter to a magazine editor that had possible political overtones. Director Bradner had to tell him in no uncertain terms that all official mail went through all official channels.

Barrows figures that Gisborne exhibited his loyalty to the Forest Service through wearing his uniform in an impeccable manner. He continued, "He wore chokemore pants and boots quite often, but I don't think we should leave the impression that Gis was afraid to get his hands dirty. He wasn't the least bit; he just dove right in. He never shunned hard work or dirty work at all."

NEW DIMENSIONS
1946-1949

The title, 'Division of Fire Research' was a long time coming - 1946 in fact. It was not until 1937, under Director Stephen N. Wyckoff, that the Division system of organization was set up. Gisborne then became Division Chief of Forest Protection Research. Although fire was the only component then, diesease and insect protection research came later after Gisborne's time, and then as separate units. Due to the crunch for money and people during the war, Gisborne had to assume leadership of both the silviculture and fire programs in 1942, as the Division of Forest Management. Russell LeBarron came in 1945 to take over the silviculture work. This led to Gisborne's Division becoming the Division of Fire Research, and later, in 1949, the Division of Forest Fire Research.

Harry Gisborne was classified as Senior Silviculturist until 1947 when he became a forester at $7102 per year. In April 1949 the title was altered to Forester (Fire Research), P6, at $7672 per year, becoming GS-13 at $7800 just a couple weeks before his death.

Although Gisborne was a very ambitious person, he had no aspirations for positions of power. Nonetheless, when Director Melvin S. Bradner died on July 6, 1946 he was appointed Acting Director to serve until Charles L. Tebbe assumed Directorship in January 1947.

BARROWS COMES ON BOARD

Following Lloyd Hornby's death in 1937, Gisborne tried hard to find and fund a person to carry on the fire control planning work. He was unsuccessful for his bid for Clarence Sutliff in the early '40's. Paul Stickel's interests and temperament were not conducive to his filling this increasingly essential post. The 1943 attempt to get C. A. Gustafson(who later became Chief of Fire Control for the Forest Service) also failed. Then a series of unexpected circumstances worked together to put fire research back in the mainstream where it has remained and flourished ever since.

The war ended. Money and people were again available, as were new warborn ideas, techniques, instruments, equipment and facilities.

Jack S. Barrows had conducted fire control and fire behavior workshops for several years as a staff member of the National Park Service prior to World War II. He often had Gisborne join him in the training sessions, especially at Yellowstone and Glacier National Parks; they became close friends and Jack gained many insights into the problems and opportunities in forest fire research. Barrows said in an interview that he formed an opinion of Gisborne at their first meeting in 1937 and that "...this was certainly a man that I wanted to know and be associated with because he was obviously way ahead of his time. His concepts, his thinking, his vigorous approach to problems was absolutely infectious to people. He inspired me to do things."

Before Barrows was released from the military he wrote both Gisborne and C. S. Crocker, the new Fire Chief for Region One, about working with them in fire control planning and research problems. He was readily accepted and reported for duty on July 1, 1946, his salary coming from both fire research and fire control funds. Gisborne's delight was expressed in a memorandum, "Thanks to a fortunate break, actually a couple of slips on the part of our and the Washington offices, we now have a man assigned to the job of fire control planning and research, Jack Barrows, who has a background of experience, imagination and initiative, and the ability to think straight which I believe can pick up Hornby's work where he dropped it and carry it through to publication."

AERIAL BOMBING PROJECT

During this period something else was brewing that would ultimately lead to a revolutionary new method of forest fire attack and control. David P. Godwin, Director of Fire Control, Washington Office, and Hap Arnold, Commanding General of the USAF, were close friends due to mutual military association. They put together a cooperative program to test some World War II techniques in bombing forest fires with water and chemicals. Eglin Air Force Base, a research and development group, accepted the challenge enthusiastically and was ready to start the project almost immediately. According to Crocker, "They said they were coming and the Region had no one nor the money to head up the work. But Godwin merely said, 'good luck.'"

So, after less than a month's work in preparing to analyze a huge backlog of fire reports (929's), Barrows was detailed to lead the 2-year-long Aerial Bombing Project. His wartime experience as a Lieutenant Colonel in the 20th Air Force made him a natural choice as liaison between the Army Air Force and the Forest Service.

According to Godwin in the July 26, 1946 Northern Region News, the purpose of the project was to develop a method that could be used effectively in the organization scheme of fire control. The war-developed bomb sights, modern aircraft, and other innovations would improve the chances for a high degree of accuracy; hopefully selection of an ideal drop height would also be found. The bombs were made from 165 and 310 gallon surplus aluminum wing tanks fitted with guiding fins. Some would burst along the fireline on impact while others would contain proximity fuses to cause rupture at 30 to 50 feet above terrain. In the latter case, it was reasoned that the air concussion might render enough wind pressure to extinguish some flame. Godwin emphasized that the Project was of a pioneering nature and certainly not operational at that time.

The first season was devoted to fitting the bombs with fins and fuses, and preparing the actual fire site on a ridge near Lolo Hot Springs Lookout about 20 miles from Missoula. A B-17 stood by for test runs but none were made.

June through August of 1947 saw lots of excitement. A B-29 Superfortress and two P-47 Thunderbolts arrived from Eglin Air

Force Base and made many practice runs on level ground first and later on mountainous burned areas and timber stands. The Air Force pilots considered these the toughest bombing chance they had ever experienced. The B-29's role was to make precision bombing runs from several hundred feet above fires burning in rough mountainous terrain. The P-47's role was to make glide bombing runs on tough fires burning in remote and inaccessible places. Holding spread until help came, not extinction, was the goal. Several paired fires were set so that one was attacked by the bomber and the other served as a control.

Dropping two 165 gallon tanks from the glide-bombing P-47's performed satisfactorily on the test fires, according to the 1947 Annual Report. It further stated that the B-29 sequential drops of eight 165 gallon airburst bombs -1320 gallons total - showed that clouds of fog and water vapor could be created to cover a 1,000 foot length of fireline. The P-47's bombed a few wild lightning fires near the close of the season; the results are not known.

This was probably the most publicized fire research endeavor ever to occur in this Region. At a public ceremony at Great Falls the mayor christened the B-29 the "Rocky Mountain Ranger." A press and public demonstration at the test fire site attracted 70 people. The Northern Region News of July 25, 1947 mentions that at the field demonstration "The B-29 dropped a new type of 4,000 pound bomb never used before in this experiment. The crowd had a chance to observe some of the difficulties encountered in aerial fire bombing." Frequent newspaper and Northern Region News articles kept the public well posted on progress of the Project. Three documents resulted from the Project: A limited distribution of a 13-page illustrated progress report by Regional Forester Hanson and Director Tebbe, August 1947; a 3-page statement issued by the Aerial Bombing Evaluation Board, late August 1947; and an 83-page illustrated document presenting all important details, recommendations, and conclusions, prepared jointly by the Air Force Proving Ground Command and the Experiment Station, late 1947.

Further work was contemplated in 1948, such as better and larger bombs, use of foam and chemicals, hitting a large fire head with bombs, and formation bombing. This did not come about for various reasons. Crocker blamed the Forest Service, stating "There were too many Forest Service men that were back in the horse and buggy days" and did not want this kind of work continued. Other than some attempted contained water drops in Ontario, Canada, in 1948, the next big attempt involved free-falling or cascading uncontained water from TBM's in California as a part of Operation Firestop in 1954. Since then, aerial fire attack has become a mainstay among fire fighters.

Brown shed some light on the subject: "At a meeting in the Pentagon, called at their request, I got the feeling that the junior officers were interested and sympathetic toward continuing the program, but the senior officer, who was new, and presumed to represent the Secretary, was very adamant that orders from above were to discontinue it. I never learned exactly why."

Gisborne was enthusiastic about the Aerial Bombing Project but turned over the entire operation to Barrows. He rendered advice and counsel from time to time for which Jack was very grateful. While Gisborne had participated in a number of large scale cooperative ventures, they were mostly of a long-planned for and long-lasting nature. High-ball, massive, fast-moving enterprises were really not Gisborne's bag. He was glad he had Barrows to handle the project permitting him to continue his own type of research and application procedures. At the termination, however, he was reluctant to go along with any broadsweeping conclusions as to its physcial or economic success based on so little data and experience. In a memorandum to the Director of August 12, 1947 he mentioned several flops due to premature conclusions or inadequate evidence. He stated that even casual discussion of the economics of bombing must be recognized as "...mere speculation until after feasibility has been thoroughly tested. Such care is essential to the scientific method."

An interesting, but sad, side comment is that Dave Godwin, who promoted the Aerial Bombing Project and was an avid backer of all aerial fire control activities, was killed in a commercial airline crash on June 20, 1947, during the peak activity period of this project.

A TYPICAL DAY AT PRIEST RIVER

While Barrows was completely occupied in managing the highly visible Aerial Bombing Project, Gisborne, apparently fully confident of Jack's ability, spent much of the summer of 1947 at his beloved Priest River tending to the myriad of details that added up to a total research excellence that would lead to his Superior Service Award later in the year. Following is Gisborne's account of a typical day at Priest River, as told to Tebbe on one page of a four page memorandum dated July 22, 1947:

> Thursday the 17th I checked the morning "sequences" of radio reports from the Forests to Missoula, picked up two bad practices on the part of two Kaniksu rangers, notified the Kaniksu dispatcher of these faults and listened for the regional weather forecast as issued by radio from Missoula. The latter was 8 minutes late in coming on the air, and the operator was so ignorant of meteorological terms that he told the world that the minimum humidity would be "between 20 and 25 degrees." Humidity is expressed in percent.
>
> I then showed Olson how to test the fire hoses in the office, lodge, and cottages. We tested one as a demonstration. Afterwards the shuf-off valve would not close and we spent an hour repairing it.
>
> The rest of the morning I spent going through Superintendent Peiffer's files. They are in terrible shape. Either Miss Pershina or Miss Halbasch should be detailed over her to eliminate the obsolete material (Forest Service Scaling Instructions, issue of 1917!) and make new file folders with proper designations. Three or four days' work will be required.

In the afternoon Olson and I went to the Looking Glass Lookout to check the lookouts fire danger and weather measurements. My car, E-2, barely made it up the mountain, due to a worn out clutch. We also had to stop twice for water to get the radiator temperature back down, below the boiling point. At the lookout I filed the contact points on the anemometer, repaired a faulty pen on the hygrothermograph and checked all of the fire and weather reports and records. They were in very good shape. While on the lookout I received I. V. Anderson's phone call from Missoula stating that our Fire Research appropriation for F.Y. 1948 will be $2,400 less than we had planned on.

After supper Olson and I were about to chase some more cattle off the grounds when C. E. Syverson of the Missoula office of the Weather Bureau arrived, unannounced. We therefore spent the evening showing him our meteorological stations, instruments, and facilities for calibrating thermometers and hygrothermographs. Our facilities and ability to get accurate measurements are better than those of the Weather Bureau in this region.

On the 18th, after getting breakfast for Syverson, Olson, and myself, and after Syverson had followed Olson through his series of morning measurements from 7:30 to 8:30 a.m. I spent the rest of the forenoon with Syverson discussing fire weather forecasts. I pointed out to him some of the many ways of improving these forecasts, the Forest Service use of these forecasts, the fact that neither Krumm, Monson, or Leggenor have ever been thoroughly coached (trained?) in either our use of the weather forecasts or in our methods of fire danger measurement, and a few other facts of life. I purposefully "gave him a rough time." It seemed to register. In the afternoon he went to the lookout, to cool off and "to check the lookout's records" which I had checked yesterday! At 4:30 p.m. Syverson accompanied Olson on his round of measurements at the Clear Cut and Control stations and his telephoned reports which end at 5:30 p.m. each day, Sundays and holidays included. Syverson is learning fast.

This is being written while Syverson and Olson are on those "rounds." Tonight I mop, wax, and polish the kitchen floor in the Lodge, vacuum the living room rug, and pack my personal belongings. Tomorrow I drive 235 miles to Missoula as I must be there Monday to prepare for the Bombing Show. On the way to Missoula I will deliver indicator sticks to the Antelope Ranger, so that he can correct one of the errors I picked up on the radio.

Missions 1, 2, and 3 on this "trip to Priest River" have therefore been accomplished. Mission 4, the job of making twelve 6-inch logs, twelve 12-inch logs, and twelve 18-inch logs, and determining their oven dry weights will have to be done on my next (?) "trip."

FIRE CONTROL PLANNING/FIRE CONTROL ENGINEERING RESEARCH

Harry Gisborne must have been a bit disappointed when, after waiting so long to re-institute a viable program in fire control planning research, Jack Barrows was redirected into the aerial bombing study. Nevertheless, Barrows was not one to let anything stand still if he was convinced it should start moving. During his first winter, he prepared a detailed working plan and got under way the machine compilation of about 23,000 punch-carded National Forest fire reports. The specific objective of this work was to determine the principles, methods and techniques of planning adequate fire control at least possible cost - much the same as Hornby's goals 15 years earlier. The problem was to generate a design for fire control systems that would capitalize more fully on new knowledge of fire behavior in the Northern Rockies and new equipment and techniques available to field forces.

Subsequent to Hornby's analysis, great changes had taken place in the entire fire control picture. Accelerated timber harvesting left large areas of highly flammable slash, even into higher altitude stands previously considered noncommercial or 'minor types'. Expanded road systems, aerial delivery of smokejumpers and supplies, the promising advent of aerial delivery of water and retardants, and aerial patrol were all making former detection and attack methods obsolete. Rate of fireline output had also been drastically increased by improvement and proliferation of tank trucks, bulldozers and other mechanical developments. These changes were revolutionizing fire suppression strategy and tactics.

Gisborne had been gravely concerned that decisions in fire control operations were getting way beyond the foundation that research was expected to supply. In the 1946 Annual Report Gisborne reported that administrators are making changes based "...on judgment, estimates, and even guesses without benefit of research analysis. The program is too big, the expenditures too large, and the stakes too high to be safeguarded by such tactics." However, he stated in the 1947 Annual Report that "This year fire control planning research made a start towards regaining the lead it lost because of the greatly curtailed activity during the war." For a beginning, the fire report analysis would provide new and up-to-date information on fire load, fuels, prevention, detection, communications, transportation, initial attack, reinforcements, fire behavior, and cost and damage. He hoped to coordinate the analysis results with renewed field efforts. He tried mainly, in a memorandum to A. A. Brown, April 30, 1948 to have either Lloyd Hayes or Hi Lyman return, "Either Hayes or Lyman could go to town on reclassification of fuel types using the excellent data Barrows is compiling..." The project was, by this time, renamed 'Fire Control Engineering Research', and the 1948 Annual Report proudly proclaimed this program had "...entered the most aggressive and productive phase of the last ten years."

The disastrous 1948 Columbia River floods prompted fire research to assist a special flood control survey board in determining the causes of the disaster. Meteorological conditions combined with the observation that snow on burned areas was converted to water by the rain sooner than unburned areas were deemed primary reasons for the massive flooding. Slow recovery of subalpine types suggested the

need for further study of burned area objectives in the noncommercial timber types. From then on the fire analysis work did concentrate more on fire-watershed value relationships in order to improve fire control planning in connection with river basin developments. Since Gisborne was then on the Western Interstate Snow Conference executive board, he took a particularly keen interest in this work, and also became quite critical of the U. S. Army Engineers' Snow Lab on Marias Pass. He told Meyer Wolfe, R-1 Chief of Watershed Management, in a September 25, 1947, memorandum, "Frankly I have yet to be shown that this Snow Lab is anything but a gesture to pull certain archaic engineering chestnuts out of the fire." He urged that the long term streamflow and 150 foot tower data at Priest River be utilized. It was also about this time (November 1948) that the Division of Flood Control Surveys was established at the Station, and that this new group assumed responsibility for operating and maintaining the year-round streamflow and snowcourse measurement work at Priest River. Gisborne had initiated this work many years earlier. The 1948 Annual Report noted that fire research had commenced, 15 years earlier, snow surveys, springflow and streamflow measurements, and even sponsored some thinned and cleacut strips to study the interrelations of weather, fire danger and streamflow.

A plea for greater fire research funding was made at the March 22, 1948 Regional Foresters and Directors meeting. Gisborne developed some points for 'Topic H' in a memorandum to Tebbe on March 3, 1948. He felt that the current five-year program which would culminate in a $350,000 annual national fire research budget was grossly inadequate. He outlined a 5-point fire research program he hoped would be adhered to provided financing became adequate: (1) Determine safe and effective conditions for all kinds of prescribed burning, (2) Produce a Fire Dispatchers' Guide, (3) Improve the uniformity of presuppression planning and practices in all Regions, (4) Improve each Regions' fire-danger rating system and correlate them all into a National scale, and (5) Commence broad-scope fire damage studies in all Regions. Most of these goals have not been reached or are being studied intensively in one form or another.

Research on fire fighting equipment and techniques of aerial fire detection were not actively conducted. Gisborne believed, however, that research should assist in such phases as optimum height to fly, patrol routing, sun angle, and similar specific areas. Fire Research and the Region co-sponsored a student, A. L. Haines, to conduct such a study as partial fulfillment of a master's degree at the University. In 1949 the emphasis on aerial fire control research was on principles and methods of planning for employment of aerial services on fires.

Barrows' fire analyses brought out clearly that fuel type classification methods needed a second look. For example, grassy fuels exhibited a much more rapid rate-of-spread and lower resistance-to-control than did timber that rated Extreme. In 1949 George R. Fahnestock was detailed from a ranger district to work on this subject. The Regional Office loaned personnel, including C. K. (Hi) Lyman, to help out. In 1950 or 1951 the work resulted in a new way to look at rate-of-spread. It was presented in key-

form for seven major cover types, and included a 'Flash' fuel rating for grass. These data, modified by time of day and position on the slope (from Hayes' altitude and aspect study) and Burning Index information rendered an estimate or prediction of fire behavior through the process that became known as "calculating the probabilities" - a long sought goal that Gisborne was not to live to see.

FIRE BEHAVIOR RESEARCH

While Barrows and others were pursuing the major studies of fire analysis, fire control engineering, and aerial bombing, Gisborne was assimilating these results with ideas of his own to fine-tune the entire fire danger rating and fire behavior prediction system.

In the process of evaluating the accuracy of the Model 6 meters, Gisborne admitted, in the 1946 Annual Reports, that "Testing the accuracy and dependability of any fire danger meter is as difficult as the development of such a device." He resorted to using the measured actual rate-of-spread in various fuel types, and experienced opinion. He also felt that empirically bending and rebending the danger class-manpower curve (Table X-1-c) through cut-and-try methods was no longer adequate to use as a balance between reduced costs and increased risks.

He was hoping the fire analysis results would produce information to strengthen this curve as well as to incorporate Burning Index measurements with each fuel type and weather condition. He felt that the primary function of danger rating is to rate danger. He also felt that manning according to prevailing danger, and the financial organization for any predetermined strength are altogether separate functions. "They are believed to be jobs for administrative solution." He pursued the use of fire danger measurements for presuppression action and continued to push the preparation of a Fire Dispatcher's Guide for small fires. His persistent agitation for better fuel type classification and maps to go along with fire danger measurements did have a profound influence on the design of fire control systems.

Data from the large log study were beginning to indicate differences between easy, average, and critical fire seasons. As soon as a critical fire season occurred, this study could then show whether or not a class 70 fire day is significantly different between a wet season and a dry season. Such an indication would be another way to verify the Model 6 fire danger system.

An analysis of weather conditions from 1903 through 1946 failed to show any statistically significant probability of the occurrence of critical fire season or periods. The probability of rain of different amounts per ten-day periods was computed for Priest River which illustrated how trends in precipitation may be considered in predicting current probabilities. Results were published in The Timberman in 1948 under the title Calculating Precipitation Probabilities.

Gisborne could not resist making jabs at the strictly enforced '10 a.m. policy.' He states in the 1947 Annual Report, "Apparently the objective of control by 10 a.m. can be sought so vigorously that costs will be skyrocketed beyond balance with the small additional reduction in acreage burned."

A lecture Gisborne gave in 1947 to a 40-man fire boss school, Fundamentals of Fire Behavior became a classic for training purposes for many years. It appeared in the January 1948 issue of Fire Control Notes. He closed his lecture by emphasizing the need for combining scientific measurement of parameters with the sound judgment of experience to make the correct fire fighting decisions.

When the use of the half-inch fuel moisture stick became universal for fire-danger rating purposes, the manufacturing job was taken on by the California Region (R-5), about 1942. Records show only that the job was transferred back to Gisborne's group in 1948. Informed sources indicated that Gisborne became very critical of the appearance, accuracy and increased cost of the California-made sets. His demands had become so difficult to satisfy that R-5 gave up trying to satisfy him. So, one day the freight agent at Priest River informed Gisborne that a large shipment of ovens, scales, dowels, and other items had just arrived from California for him; how soon would he pick them up? Thus, he was immediately burdened with making about 1,500 sets per year. By modifying and improving the equipment and procedures his group at Priest River was soon able to reduce the cost from $1.87 to $1.50 per set and to guarantee an accuracy of 100.0 grams, within 0.5 grams. The Spokane fire warehouse assumed the operation in 1951, with the technical of Gisborne's successors, and continued turning out high quality sticks for many years.

CLOUD SEEDING

Immediately after World War II, Drs. Irving Langmuir and Vincent J. Schaefer of General Electric Company's research laboratory in Schenectady, N. Y. discovered that when dry ice (frozen carbon dioxide) was dropped into a freezer containing a fog cloud, snow would result and the cloud would vanish. In an article in the March 1947 issued of Electronics, Dr. Langmuir attributed the fortunate discovery to 'serendipity' because it was an unlooked for bonus in a routine investigation. As a result of the new interest in rain-making, a Western Forestry and Conservation Association resolution to urge investigation of this possible new resource management tool, and Gisborne's previous meeting with Langmuir in 1933, he was prompted to strike up a correspondence with Schaefer. Barrows said that on learning about the new work Gisborne, "being the pioneer that he was, just sparked immediately", and proceeded to find out if it could become a tool in fire control. He managed, in early February 1948, as a part of a multi-purpose eastern trip, to spend several days seeking Schaefer's advice and help relative to whether something could be done about thunderstorms and cloud seeding activities. As a result, Schaefer spent a mid-summer month at Priest River with General Electric's blessing. Free use of the Lodge for Vince and his family was the Forest Service's only expense. At that time the Forest Service did not want to become actively involved in cloud seeding research because other agencies had already bought in. Therefore the arrangement was most informal.

Schaefer and Gisborne immediately understood each other. Schaefer tells about his first request, which was to mount a 'corona' or millimeter on some high place. "Gisborne, his eyes twinkling, said 'come with me', and took me to the base of the 150 foot meteorological tower. Again with a twinkle in his eye, he said, 'would you like to go up and install the corona point on top of the tower?' My answer was 'sure', and up I went carrying all my gear on my back,hand over hand on that outside ladder. I sort of thought this was some type of test he was putting me through but I didn't let on. I later learned this was so, and apparently the way the visitor or newcomer would climb the tower was in indication to Harry of some of the characteristics of that individual. Well, I guess I came off with flying colors. But I didn't tell him I had worked four years with the Davey Institute of Tree Surgery and was used to swinging from tree to tree by ropes.

Schaefer, Gisborne, and Barrows spent considerable time together that brief period in 1948, at headquarters and at Looking Glass Lookout, recording lightning, taking lapse-time movies of cloud life cycles, and discussing the theories of mountain thunderstorms and means of subduing them. On one occasion Schaefer manned the recorder on the ground and Barrows, from the top of the tower, yelled out strikes and their bearings. They later traced that vicious, fast moving storm and learned that its intensity was so great that several people were struck and killed by its lightning a few hours later.

A C-47 was on alert all summer, with a dry-ice hopper ready, to go up and seed a cloud near Priest River. Plans called for two similar clouds to develop about 20 miles apart; one would be seeded, and both observed, photographed and their activity recorded. No such situation occurred, perhaps since the atmospherically unusual summer proved to be the wettest and easiest fire year on record.

Schaefer could not come west the next summer but Gisborne had everything in readiness to do some seeding and recording if the proper cloud pairs showed up. The C-47 was made available by the Region and was rigged with a dry-ice hopper and oxygen tubes (naked tubes, no masks) leading to the rear of the cabin where the crew would chop and cascade the dry ice. He was compelled to make a test flight to be sure everything was working properly for the real tests which should be coming soon. The opportunity came when Brown was in Missoula on an inspection trip and a single towering cumulus cloud appeared a few miles northwest of the airport. The Johnson Flying Service's C-47 took off from Missoula with Ormand LaVoie and Bob Johnson in the cockpit, and Gisborne, Brown, Elmer Bloom (the Regional Photographer), and Walley Mathies (Johnson employee) in the stripped down rear of the fuselage, to intercept the top of a cloud and destroy it with dry ice. The aircraft door was off for easier dissemination. Brown wore heavy winter clothes donated by Barrows. Each man was tied by a rope in case he fell out the door (only to find out later the rope was long enough to let him dangle at least ten feet below the fuselage). They had instructions on the use of oxygen. Bob Johnson, who is now in his eighties, gave his hilarious version of the flight.

"We got to 26,000 feet but the darned thunderhead was moving up pretty near as fast as we were. We finally got into and almost on top of it and they started letting loose the dry ice. But in the deal somebody back there either stepped on the oxygen tube or kicked it loose, letting it run all over the plane. I don't know what, but they had no oxygen and all at once Gisborne came busting up to the cockpit yelling 'go down, go down, go down', we got no oxygen.' Gis' face was purple, But anyway we took the nose down and we came down pretty fast - a lot faster than we went up." Brown's hands became so cold he could not handle the instruments, but does remember the temperature "was down to 30 or 40 below." Mathies said Gisborne was so excited he was just running around and dancing up and down, and "If he had stayed put like a normal human being the oxygen line wouldn't have gotten all fouled up."

Snow fell on the highway on Evaro Hill near Missoula, just a short distance downwind from the seeding site, so they all declared that the world's first flight to eliminate lightning from a thunderhead was a huge success.

The C-47 was not a suitable aircraft for that type of venture. Fairchild Air Force Base, through Barrows' contacts, provided a B-29, with a specially built ice hopper and Forest Service radios, on standby the rest of the summer. A couple dry runs were made near Priest River, but no adequate cloud pairs ever appeared. Gisborne wrote in a memorandum to the files on August 21, 1949 that he was getting heavy pressure to get busy and do something, go up and ice a cloud, any cloud, and see what happens, but "I am not going to do that. I am not going to try to plug the gap by pulling a stunt instead of conducting an experiment, as much as I would like to go up and see what we can do." By mid-September the study was called off for the season with hopes of doing some effective seeding in 1950.

Schaefer's report in January 1949, The possibilities of modifying lightning storms in the Northern Rockies summarized his efforts to date and proposed a rather detailed procedure for conducting further research on cloud seeding for fire prevention purposes. He stated in an interview, "It was Harry Gisborne, along with his young assistant Jack Barrows, who planted the seed in my mind for the development of the full blown research endeavor which became Project Skyfire," Both Langmuir and Schaefer were at Priest River in 1952 to help conduct the first training school for lookouts who would keep track of lightning storms and make cloud surveys. Project Skyfire became a formally organized Forest Service research program in 1953, thus ending what Barrows described as "a sort of bootleg effort."

FIRE WEATHER FORECASTING

During the 1920's, Gisborne applied pressure to the Weather Bureau to supply weather forecasts germane to mountain fire conditions. During the rest of his career he spent much time, energy, and 'spleen' in obtaining better and better forecasts. Western Forestry and Conservation Association had for years (and still does) passed along strong resolutions to the Weather Bureau and congressmen urging adequate funding for fire weather forecasting and research purposes. When funds were finally set up for this work in the amount of about

$200,000 per year, the user agencies had to keep constant vigilance so that the funds didn't get lost or diverted into other functions. Gisborne was right in the middle of all this. At one time a suggestion was made that a fire weather man be detailed to the Upper Columbia Snow Lab located in Marias Pass during the winter. He stated in a memorandum to the files October 14, 1947, that it is bad business to divert fire weather funds for any airways, fruit, frost, snow study or similar use while so terribly much yet needed to be done to improve fire weather forecasting.

The war years were not the time to complain about forecasts, as little money and few men were available to do anything about it. Mention of sun spots for forecasting purposes was made in the Northern Region News, November 6, 1939 and again in the 1948 files, but the possibility was never pursued. Ralph Hanna had been Meteorologist-in-charge (MIC) in Missoula since about 1940 and had established good working relations with both forest administration and research folks. Even though Hanna was one of those few who had a knack for interpreting weather charts and data, he was still prodded by Gisborne to do a better job, especially in the field of localization and in making more accurate extended forecasts. He was urging the field to use fire-danger rating factors in conjunction with fire weather forecasts to predict tomorrow's fire danger, but without accurate weather forecasts the plan could not work.

Relations changed in 1944 when Hanna became the Western Fire Weather Coordinator in San Francisco and W. R. (Bill) Krumm became Missoula's MIC. Gisborne knew that new, more sophisticated forecast methods developed during the war were now available for civilian use. He also knew there were hundreds of military-trained professional meteorologists probably looking for jobs. He urged the Weather Bureau to raise the professional level and pay for forecasters in order to attract more highly qualified personnel. At the same time he realized that in the past there had been very few professionals and that most of those in responsible positions had come up through the ranks. He therefore became more and more anxious for rapid and drastic improvements in the reliability of fire weather forecasts. Krumm's forecasts had not satisfied Gisborne, who felt their quality was slipping.

This set the stage for a 4-year campaign to improve forecasts that turned into a 4-year running battle between two dedicated men-Gisborne and Krumm.

Permitting a technical or professional matter to affect personal relationships was not Gisborne's way of doing business. Barrows indicated that the problem started even before Krumm became MIC, because the Weather Bureau did not appear to be up to date with the state-of-the-art in meteorology. Gisborne's goal was always excellence and he didn't see excellence there. But "Krumm was there and was an obvious target." Gisborne was equally critical of the Chief of the Weather Bureau. Barrows did feel that it was unusual for Gisborne to fight on such a personal basis; he "could get caustic and some people could take it to be very personal. You had to know Gis' personality, and those who didn't might be a little upset. He could be abrupt and use very spicy language and some people would misinterpret that. But it would be an understatement

to say merely that Bill and Gis didn't see eye to eye." Crocker also felt that "both were good men but Krumm perhaps felt that Gisborne was digging him personally while actually Gisborne was goading him to do a better job and get better facilities."

Quite a file of "Krumm's crumby" forecasts was built up over this period in hopes of bringing the issue to a head some day. To underscore his true objectivity he stated in a May 10, 1945 memorandum to Crocker, "I am almost ready to conclude that Krumm is the best personality and the poorest forecaster that has ever been assigned to 'cooperate' with us." Krumm evidently did not take all this criticism passively. In a memorandum from Gisborne to the Director and Regional Forester on Auguat 17, 1948, in relation to a discussion of rating forecasts "...he (Krumm) blew up. When Krumm blows up he raises his voice and practically yells. Two of the men across the hall still kid me about the bellowing bull I had in my office one day. I hung up on him; I may even have told him to go to Hell." Krumm stated several years later that he hated such a deterioration of relationships and felt that Gisborne had gone off the deep end in his vindictiveness; he felt very bad about it all and summarized that Gisborne's attitude had stretched beyond his ability to control it.

For years the Forest Service had been trying to get reliable forecasts up to 36 hours for the benefit of planning manpower and strategy for the next day. Since the 36-hour forecast had not proved as reliable as hoped for by the Regional Office, the decision to eliminate the 36-hour in favor of retaining only the 24-hour forecast was about to be made after discussion between Fire Chief Crocker and MIC Krumm. This really made Gisborne feel that the whole forecasting program was retrogressing to the dark ages, which would take years to overcome. He wrote a caustic memorandum to Crocker on May 15, 1948 stating that if the 36-hour forecast is dropped, "Let the record show that it was done despite my protest and in opposition to my most carefully considered opinion." He continued, "This is it. From here on I will refrain completely from offering any advice, comments, or criticism of any feature of the daily weather measurements or the forecasts. I will confine my efforts entirely to fire danger rating and fire control planning up to the point where weather forecasts should be used. There is no rancor on this, merely deep disappointment." He received almost instant feedback from Crocker on May 25, 1948 who agreed that pressure must be maintained to achieve improved forecasts, but then "However, Harry, we are wide apart concerning the methods. You advocate (and practice) needling, aggravating, fighting and antagonizing the Bureau. That approach over the years has brought us nothing that could not have been realized through other more ethical means." That, from one of his best friends, does not quite do Gisborne justice and does not recognize the gains he had made. This exchange did not hurt the personal relations between these two long-time colleagues. Crocker understood Gisborne and talked about how he was always anxious to get going on things and continually pushed whatever he was working on. Crocker died while this manuscript was being prepared; shortly before his passing he stated in admiration, "Harry was impatient, but God damn it, that's what made him great!"

In other than his dealings with Krumm, Gisborne was very straightforward in his analysis of fire weather forecasting problems, policies, and solutions. For example, one needs only to read his "Statement of Policy and Practice" memorandum of October 29, 1946 and his very objective article "Opportunities for Improving the Fire Weather Forecasts in the Northern Region" dated March 4, 1948.

One spin-off from wartime development was noted in the November 1, 1946 Northern Region News. Gisborne reported 34 weather search (WSR) radar units were being transferred to the Weather Bureau from the Navy. Gisborne was instrumental in gathering support for placing one of the sets on Mt. Spokane for increasing the accuracy and localization of fire weather forecasting. The Northwest Scientific Association wholeheartedly backed the drive. As president of NWSA in 1946 he had appointed his long time friend and associate C. A. Wellner and Dr. Phil Church of the University of Washington Meteorology Department to head up the organization's drive to make the request a fact. They were both familiar with radar and forecasting through their military assignments. He even wrote a personal letter to U. S. Representative Mike Mansfield asking him if he would "...engineer a little action to aid this cause of the NWSA and of all the timber protective associations and agencies in this region?"

As a result of this concerted drive, one of these weather search radar sets was assigned to the Missoula area; it was placed on Point 6, a few miles north of the Weather Bureau airport station, and dedicated on November 1, 1961. (A good example of persistence.)

The fire-danger rating system suffered general deterioration during World War II. Some fire-weather stations were no longer manned, instruments were not performing accurately, and weather observers were careless, or more often ignorant, of the proper way to measure and record events. Realizing that when the basic inputs to the forecaster are faulty, the resultant forecast is also faulty, he made a plea to Fire Control on March 28, 1947 that when a weather station is inspected, not only should the instruments be checked, but the ranger, alternate, and weather observer all be trained or re-trained in proper procedures. Crocker agreed and set up a program for his staff to join Gisborne and Barrows in making a concerted effort to upgrade the entire fire-danger system including danger station distribution (Memorandum from Crocker to Gisborne, May 15, 1947). This surge for accuracy could not be done fast enough on a casual basis by research, Regional Office, or Weather Bureau personnel. In 1951 a forester from the Kaniksu Forest, C. E. (Mike) Hardy, was jointly sponsored by fire research and fire control to spend a major portion of his time upgrading the entire system over a several year period. Thus began the writer's own fire research career, culminating in his need to record this history.

THE MANN GULCH FIRE

"On August 5, 1949, a crew of 16 firefighters, 15 of them smokejumpers, became entrapped on the Mann Gulch forest fire on the Helena National Forest in Montana. As a result, 11 men were burned to death and 2 additional men died the next day from burns. Three members of the crew, one the foreman in charge, escaped

without serious injury." This brief bit of fact is the first paragraph of the Board of Review Report dated September 29, 1949.

Gisborne did not go to the fire site; he was standing by at Priest River for cloud conditions to develop for seeding, as a follow-through to the Schaefer visit of the previous summer. The worsening of his heart problem at that time also caused his superiors and co-workers to discourage him from undertaking such an arduous mission. His interest was whetted by the apparent abnormal behavior of the fire. His first questions to Barrows in Missoula had to do with fuel and weather conditions. On his copy of Crocker's August 17, 1949 Chronology of the Catastrophe, he asks in marginal comment, near the statement that one man was sick enroute, "air extremely bumpy, updrafts and downdrafts?" At the end of the 5-page account, he wrote "No evidence from Dodge, Rumsey, Salley or Jannson concerning wind velocities or shifts in direction. If there was a large storm cloud nearby, at 1600 or 1700, that might explain wind shifts and high velocities. Jumper foremen and spotters especially should know all they can be taught about cloud types and winds." Writing to Crocker on August 30, 1949 he says "My point is my belief that this Mann Gulch catastrophe resulted from certain conditions which can be identified." He compared this fire to the Quartz Creek Fire, Kaniksu Forest, in 1926, and the Half Moon Fire, Flathead Forest, in 1929 (His "A Forest Fire Explosion" described the latter), and then presented a theory about why the fire behaved as it did. But at the bottom of a memroandum from Region Two dated October 27, 1949 to Gisborne asking for more behavior information, are penciled notes from Director Tebbe to Gisborne, wondering if "we would want to be quoted on this...", to which Gisborne replied, "Had I given anyone the impression that I know the answers? I've been digging for an answer, but haven't got it yet."

In a memorandum from Tebbe to the Chief, dated November 8, 1949 Tebbe questions how the Board of Review's recommendation to devote more time and energy to the "explosive" end of the fire behavior scale would be implemented in light of the already over-full work load of Gisborne. He continues to state that Gisborne was assembling information about Mann Gulch and "he is, today, on the area to obtain as much evidence as possible (it was actually November 9 - ed.). The facts from all sources will then be assembled and examined by a group of men with experience on blow-ups to conclude, if possible, just how this fire behaved."

This day, November 9, 1949, did not follow the scenario Tebbe expected. He stated in a recent interview that Gisborne was the most obvious and logical person to inspect the site and provide valid answers. He said "Harry was not a young man. Moreover he had a heart condition and knew it and his limitations, and was prudent about what he undertook. Reluctantly I approved the trip but on condition that he made it and the inspection of the area and the fire line by jeep." Wellner and others were aware of his heart condition since as far back as 1936. Gisborne strove to exert just within its limitations. He seldom referred to it. However, as early as April 29, 1939 he wrote a note to himself describing a shouting hassle he had had with an Administrative Officer, stating "Arguments of this kind happen to knock my heart action - which has been off for the last several days - and had to calm it down. I asked to be

excused for a minute because I had had a bum night last night and arguments like this get my goat." People protected him more than he liked to acknowledge. One tale relates to the time Director Tebbe met Gisborne at Priest River and Gisborne said he was going up the 150 foot tower. The Director told him flatly he was not to climb the tower anymore. "Gisborne got red in the face," Barrows recounted, "and stood on one foot and then on the other and finally he turned to Charlie and said, 'You just told me to quit'." He actually did reduce his climbing, and never tried it when Tebbe was present.

Lloyd Hayes was concerned over Harry smoking so heavily in light of his heart problem. But stopping smoking "would have upset his concentration. You can't concentrate when the desire for a cigarette is chewing on you." Crocker and Gisborne travelled throughout Region One together many times, each doing his own thing at the ranger stations they visited. Crocker hastened to add that Gisborne did not go along on hiking or horseback trips because of his heart; he even doubted that "Gis could even get on a horse and ride it."

In the 1940's, Gisborne often spoke of organizing his work in order to accomplish major goals by the time he retired. The last paragraph of a February 24, 1944 memorandum to C. S. Crocker dealing with research programs states, "I want to keep my eye on the ball; the two main balls (fire-danger rating and fire control planning), and if possible to have these two big projects neatly packaged and pretty well sewed up by the time I retire. The Forest Service should make me do that if they want to come nearer getting value received out of my 22 years salary already invested in me as a fire researcher. I have only 9 years to go. I have to hurry and keep my eye on the ball or I will not make it. My fear is that we will not even get half the funds asked for. Then we will not make it." In another memorandum to Washington about 1947, he asks for an understudy "to head up fire research at the Station when I retire, resign, or pass out." The most definite plans for retirement were found in memorandum to Tebbe, dated March 24, 1948. He says, "I am nearing the end of my official work for the Forest Service. I expect to retire at age 60 or in November or December 1953. These five years will be gone before I clean up my work unless we make plans pretty soon." He then had four specific jobs to accomplish: (1) pass on to others the various contacts he had slowly and personally built up over the past 25 years: Barrows - Weather Bureau and GE; Helmers - Western Snow Conference; Wellner - Northwest Scientific Association. While these contacts were ostensibly official, "They are effective almost in proportion to the degree to which they are personal", (2) complete his Chapter IV for the forthcoming Society of American Foresters book, Forestry in the U. S., 1900-1950, (3) the biggest job, that of putting into manuscript form a general roundup of the many separate parcels of information on fire behavior and fire control that filled office file drawers. If not accomplished, "I will take the information with me across the River Styx." If accomplished, "the Forest Service will collect a fair sized dividend on its investment in my salary and expenses for 30 years", and (4) he would currently

continue to push and supervise fire-danger measurement and fire control planning research.

Gisborne and Bob Jansson, the ranger on whose district the Mann Gulch fire burned, left Helena in a jeep on the morning of November 9, 1949, with the intention of driving to the pass at the head of Mann Gulch, and to walk generally on a contour through the upper fire area from there. Greasy, wet gumbo prevented that; so they drove back to the river and then to Rescue Gulch, next to Mann Gulch. From there he insisted on walking up through the critical area and back down before the day was over, much to Jansson's consternation, reasoning that winter would preclude any further attempts at seeing the area that fall. He promised Jansson he would stop every 100 yards to reduce any stress on his heart. Jansson's description to Tebbe, November 10, 1949, and his statement for insurance purposes dated November 18, 1949, both gave a detailed account of the day's movements. Gisborne, the keen observer, made many notes and found many clues. At one point he exclaimed that all his theories on the fire were blasted by some discovery he had made. By late afternoon Gisborne was still hot on the trail of clues and Jansson kept reminding him they had to get off the mountain and back to the jeep before dark. They finally got down to the trail just up a little from the river and decided to take one more break before heading for the jeep. Gisborne said "Here's a nice rock to sit on and watch the river. I made it good. My legs might ache a little tomorrow, though." He started to say "let's go", half rose up, then fell forward. Two short gasps and Harry Thomas Gisborne was dead.

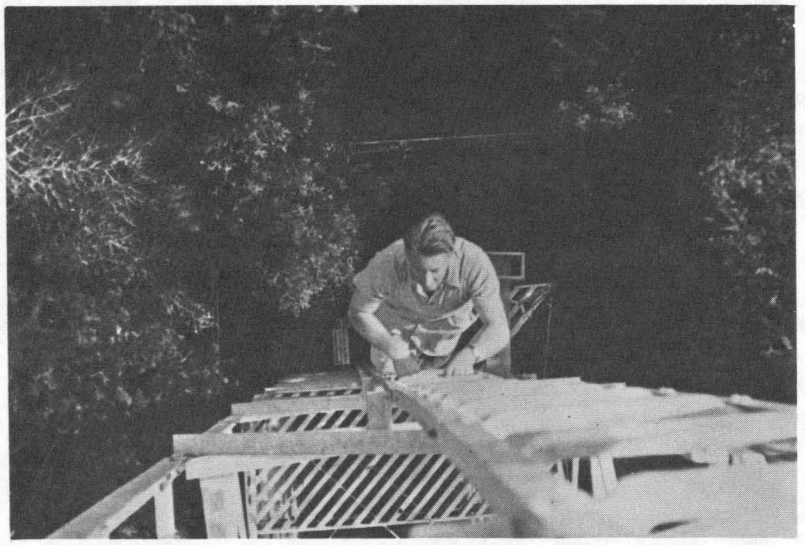
GISBORNE MOUNTAIN

Les Voyageurs, the University of Michigan forestry honorary society to which Gisborne was elected in May 1914, eulogized him in its 1950 yearbook, saying "In his death Les Voyageurs suffered a great loss as does the Service and does his host of friends." It quotes an editorial that summed up the feelings of most of his acquaintances: "Perhaps many of us who saw him every day were deceived by his modest manner but we should know now that Harry Gisborne was one of the great scientists of his day and that all of the nation should be grateful to him for what he has done to protect one of our greatest resources."

The Idaho Forester in 1950 dedicated its annual to Harry T. Gisborne in respect to all he had done for the school and its students.

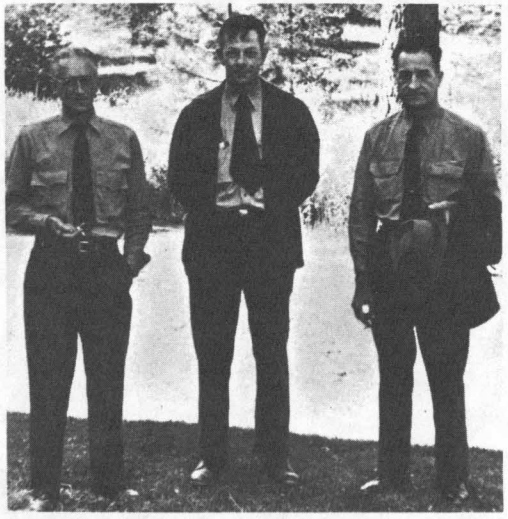
C. L. Tebbe told of the incidents leading up to Gisborne's death, then said, "We were all stunned. I proceeded to do what he had asked me to do if anything of the kind ever happened. He had given me a key to a desk drawer he had always kept locked. I was to open it and destroy several folders (he was a great one to make notes and record impressions he regarded as private). But right on top was a large photograph of the south end of the Mission Range. It had been taken from the west side of the valley and showed a realistic profile of a reclining person. There were notes and pen lines all over the picture which gave the viewer specific instructions respecting just where he wanted his ashes to be cast - 'right in the old man's eye'."

Harry Gisborne and Vince Schaefer 1948



Vince mastering meteorological tower, 1948

Gis atop tower

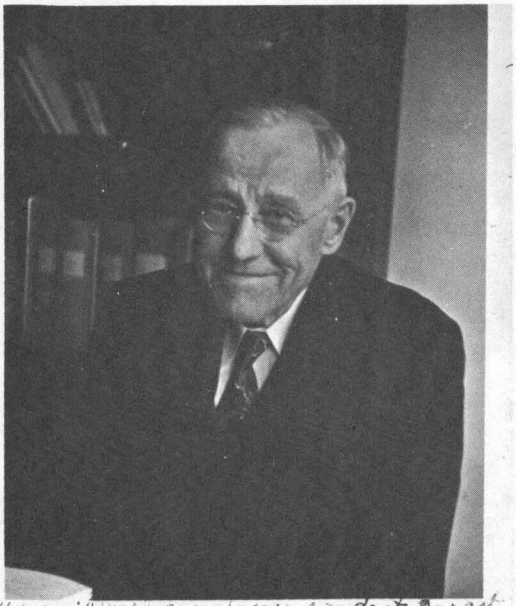


Gisborne, Tebbe, Brown ca 1949

Barrows speaking at
Christening Ceremony,
Great Falls, Montana
1947

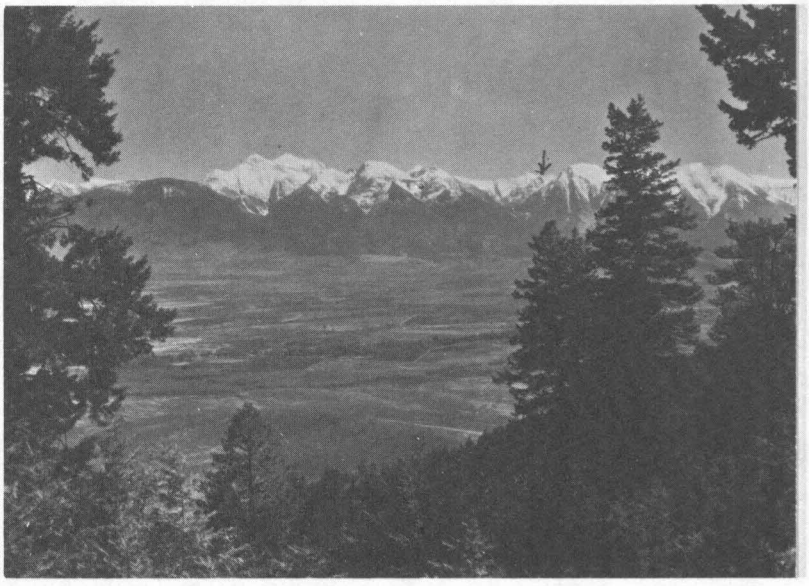
Jack directing aerial bombing
project, Lolo Hot Springs
Lookout ridge 1947

Air burst, Lolo Hot
Springs Lookout area
1947



Harry: "Well, maybe you can do it. I've got confidence in you! Why shouldn't I have? Many years--many memories of you--all good to have. Roy Headley. Aug., 1949

Harry: Well, maybe you can do it. I've got confidence in you! Why shouldn't I have? Many years--many memories of you--all good to have. Roy Headley. Aug., 1949



"Hit the old man right in the eye."

Alice and Harry

Gisborne Mountain

C. A. Wellner was also given specific instructions for disposition and preservation of his personal files. From these well-guarded documents has come much of the truly living part of this report.

And 'right in the old man's eye' is just what Charlie Tebbe, Clayton Crocker, and Forest Service pilot Floyd Bowman did on the bright early morning of May 26, 1950.

The Region One News of June 9, 1950 contained the following article: "Gisborne Mountain Named. Recognizing the eminence achieved by the late Harry T. Gisborne of the Northern Rocky Mountain Experiment Station in the field of forest fire research, the U. S. Board on Geographic Names has chosen Gisborne Mountain as the name for a mountain ridge located about 14 miles north of Priest River, Idaho. Hitherto unnamed, unofficially the mountain was called Looking Glass Mountain after Looking Glass Lookout situated on the peak."

One year later, the July 13, 1951 Region One News contained this article written by Edna Campbell, Gisborne's secretary for several years: "On Sunday, July 8, midst the white brilliance of one of the most beautiful displays of beargrass in full bloom ever seen, Gisborne Mountain on the Priest River Experimental Forest was formally dedicated. A bronze plaque bearing the inscription,

HARRY T. GISBORNE
1893-1949

Inspiring, Enthusiastic, Far-Seeing
Pioneer in Forest Fire Research

was placed in solid rock at the summit of the mountain. The plaque was unveiled by A. A. Brown, Chief of fire research from the Washington Office, at the conclusion of a simple ceremony during which Director Jemison, Northern Rocky Mountain Fire Research Division Chief Barrows, and Mr. Brown spoke of Harry Gisborne and his great contribution to the field of forest fire research and to forestry in general."

Alice Gisborne, Harry's widow and a truly great and gracious lady, who was at the cermony, wrote to George Jemison, "I want to thank you, and all of the members of the Experiment Station who did so much to make the dedication of Gisborne Mountain such a beautiful and memorable occasion. The plaque is just right - simple but lovely. I feel that it is a great honor to have a mountain named for one -- this is truly Harry's mountain as he had spent so much of his time there in connection with his work. My deepest appreciation and thanks to all." Years later, Alice passed away in Portland, Oregon. Her ashes too were strewn alongside Harry's in their beloved Mission Mountains.

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Addendum, March 20, 1978, to

The Gisborne Era of Forest Fire Research

Charles E. Hardy

The Addendum was prepared to assist researchers and historians in locating specific text items that cannot be found in the formal list of publications related to the Gisborne era of forest fire research. These additional references are:

1. Joint Experiment Station - Region One Investigative Council Annual Reports. Bound copies for 1914-1935 are on file at USDA Forest Service Forest and Range Experiment Station, 507 25th Street, Ogden, Utah 84401

2. Northern Rocky Mountain Forest and Range Experiment Station Annual Reports. Bound copies for 1936 till present (except for 1942 and 1943) are on file at USDA Forest Service Forest and Range Experiment Station, 507 25th Street, Ogden, Utah 84401

3. Interviews and discussion with close associates of Gisborne. Tapes and transcripts are located at the office of C. E. Hardy, 512 Benton, Missoula, Montana 59801. Expected to be archived in library, University of Montana, Missoula, Montana 59801

   a. Taped interviews with typed transcripts:

      Jemison, George M., Feb. 14, 1976, Corvallis, Oregon
      Hayes, G. Lloyd, Feb. 27, 1976, Fort Collins, Colorado
      Morris, William G., Feb. 13, 1976, Portland, Oregon
      Barrows, Jack S., Feb. 26, 1976, Fort Collins, Colorado
      Johnson, Robert R., Apr. 28, 1976, Missoula, Montana
      Wellner, Charles A., Apr. 22, 1976, Taped telecon, Moscow, Id.

   b. Taped remarks with typed transcripts:

      Brown, Arthur A., May 14, 1976, Charlotte Harbor, Florida
      Schaeffer, Vincent J., Summer 1976, Schenectady, New York

   c. Oral interviews with typed notes:

      Crocker, Clayton S., Apr. 27, 1976, Missoula, Montana
      Wellner, Charles A., Feb. 4, 1976, Personal visit with typed notes. Moscow, Idaho

   d. Typed remarks:

      Tebbe, Charles L., Apr. 28, 1976, Missoula, Montana

4. Region One newsletters. Bound copy on file at USDA Forest Service, Northern Region, Federal Building, Missoula, Montana 59806:

   1920. D-1 Bulletin
   Oct. 1922. The Bulletin, Northern District, beginning with v6:10
   Oct. 31, 1929, Northern District News
   Oct. 1931 to present, Northern Region News

5. Forest Service file material. Correspondence, manuscripts, and administrative material is mostly in official custody of C. A. Wellner, USDA Forest Service, Forestry Sciences Laboratory, 1221 So. Main, Moscow, Idaho 83843.

   Research data files are mainly at USDA Forest Service, Northern Forest Fire Laboratory, Drawer G, Missoula, Montana 59806

   Both are expected to be archived in library, University of Montana, Missoula, Montana 59801

REF. NO.	PAGE	LINE	
14	5	26	See list of publications, number 125
15	5	30	Annual Report, op. cit., 1923, p. 26,27
			Ibid., 1924, p. 16
16	5	35	Ibid., 1925, p. 35
			Ibid., Letter to H.B. Rowland, May 16, 1927
17	6	3	Gisborne, H.T., Letter to L.H. Nichols (RS, PF, B-5) July 10, 1929
			Ibid., Memo to Director R-Patents, General Dec. 3, 1945
18	6	18	Ibid., Memo to Paul W. Stickel, Apr. 3, 1926
19	6	37	Ibid., Letter to H.B. Rowland, May 16, 1927
20	7	11	Annual Report, op. cit., 1926, p. 14
21	7	15	Ibid., 1927, p. 16
22	7	17	Ibid.
23	7	21	Ibid., 1926, p. 14
			Ibid., 1927, p. 15
24	7	38	Ibid., 1922, Attached study status report RS, PF-6, D-1, Jan. 11, 1923, Working plans RS, PF-6, D-1, June 24, 1922
25	8	18	See list of publications, numbers 105, 110
26	8	31	Annual Report, op. cit., 1929, p. 19
27	8	45	See list of publications, number 82
28	9	8	Jemison, op. cit., p. 18
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3	2	1	Form 375, Rough draft by Gisborne, Oct. 12, 1935; USDA Office of appointment clerk action, Dec. 11, 1919, Apr. 1, 1920, June 16, 1920; USDA Office of personnel action Mar. 13, 1922, Mar. 19, 1923, July 24, 1924, July 31, 1928, Nov. 18, 1935, Aug. 20, 1947, Oct. 31, 1949, Oath of Office, Apr. 8, 1920
4	2	25	Gisborne, H.T., Application for Senior Silviculturist, June 29, 1928
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139	66	17	Handwritten draft (2 pp.), apparently of an application. Undated Miscellaneous notes, memos, and letters in files, including: Letter from Gisborne to K. McDonald, July 1, 1936 Letter from Gisborne to J.W. Hungate June 6, 1936 Letter from Gisborne to Sec. of AAAS, Dec. 8,1934 and June 23, 1942 Letter from (unknown) to Gisborne, Jan. 1941 Letter from M. Huberman to Gisborne, Sept. 2, 1939
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