FIRE MANAGEMENT NOTES

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FIRE MANAGEMENT NOTES

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HELICOPTER MANAGEMENT

A fire crew boarding a helicopter for transport to a remote spike camp or to the fireline is a common sight. The management of helicopter use, however, is an increasingly complex task. It requires training, experience, and an understanding of the larger mission of the organization. The cover photo shows a fire crew boarding but not bound for the fireline. This crew is assisting in the Big Thompson Canyon flood search and rescue effort. The management of helicopter use at Big Thompson was similar to that on a large fire. See page 13 for a discussion of this assignment. (Cover photo by Fort Collins *Coloradoan*.)

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Remote-Site Communications Via Satellite

John R. Warren

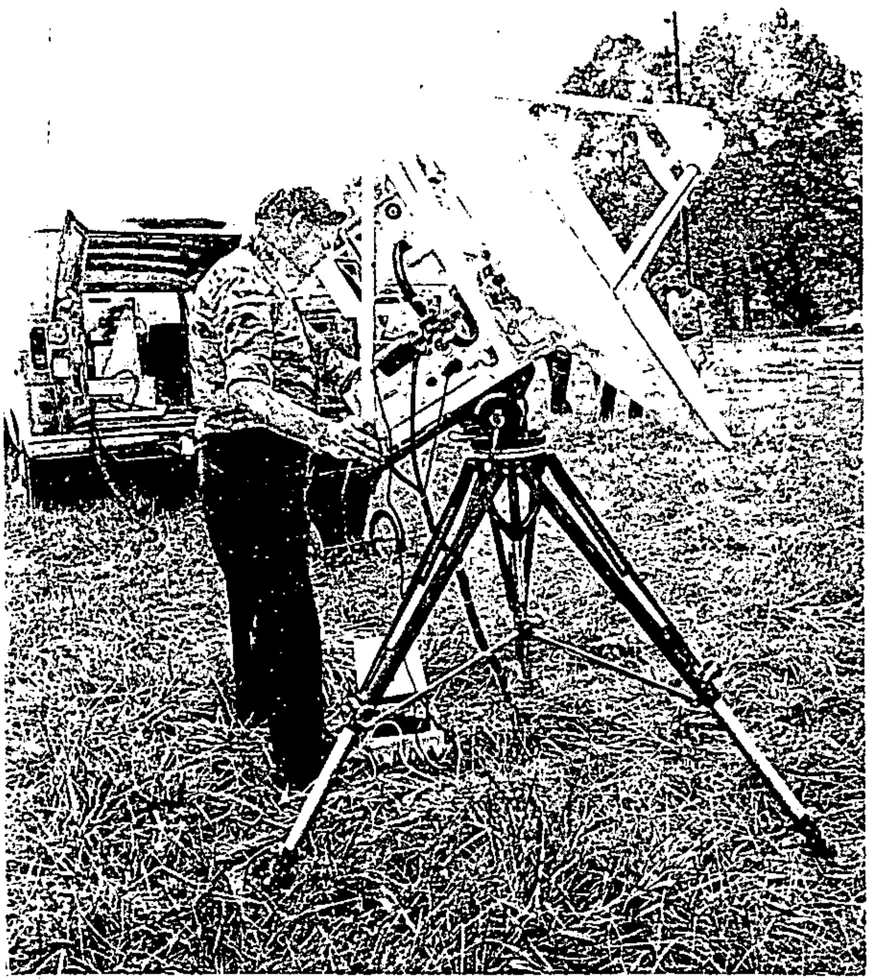

Figure 1.—Transportable earth station antenna assembly.

John Warren is an electronic engineer, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif. Mr. Warren is stationed at Riverside, Calif.

When an incident command post or fire camp is established, communications are needed. Many times the communications can be provided by radio or by commercial telephone lines brought in by the local phone company. But in a remote location, miles from the nearest phone lines and hampered by distance, terrain, or overloading of radio channels, outside communications may be unsatisfactory or nonexistent. In an interactive system utilizing fire-spread models and interagency coordination of resources and status, such as that planned for FIRESCOPE, reliable communication links are mandatory.

The use of transportable earth stations, working in conjunction with a satellite, can provide the necessary positive communications links. This was demonstrated in the George Washington National Forest near Harrisonburg, Va. on July 29, 1976. Comsat Laboratories provided the earth terminal and operating personnel. The FIRESCOPE Project of the Pacific Southwest Forest and Range Experiment Station sponsored and coordinated the activities. The Communications Technology Satellite (CTS) was used as the satellite relay.

System Description

A satellite placed in equatorial orbit at an altitude of about 22,300 miles will have an orbital period of 24 hours. It will, therefore, appear stationary from any point on earth. Such satellites are called synchro-

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nous or geostationary. There are several commercial and special-purpose synchronous satellites now in orbit.

For technical and regulatory reasons, the commercial satellites are not currently usable with small transportable earth stations. The reasons primarily involve potential interference with terrestial microwave systems in the same frequency band satellite interference caused by antenna beam width and satellite spacing considerations.

Earth stations may transmit, receive, or more commonly, both transmit and receive electromagnetic signals to and from a satellite. The signals may be used to convey voice, video, or other types of data and information. Typically, two or more earth stations work in a duplex mode (simultaneous transmission and reception) using the satellite as a relay.

The CTS is a joint Canada-U.S. experimental satellite incorporating new technology which makes it directly suitable for small earth-terminal use. The CTS uses higher power than previous satellites. It has a 200 watt traveling wave tube (TWT) amplifier and a highly sensitive, high gain parametric amplifier receiver with a tunnel diode amplifier backup. The CTS operates in the 12 to 14 GHZ band which reduces the beam width and permits smaller antenna-dish sizes.

Transportable emergency earth terminal experiments are being conducted by Comsat Laboratories as part of the CTS technology extension experiments. In all the potential applications, the main thrust is to permit the use of lower cost earth stations by a variety of users in their own disciplines.

The electronic components of the earth station used in the test were contained in a small van which pulled a trailer containing a power generator and the 4-foot dish antenna. Figure 1 shows the antenna in the foreground and the van in the background.

A single telephone link was used for the demonstration, but up to five could be accommodated. An additional phone link was used for setup and checkout activities. Two-way

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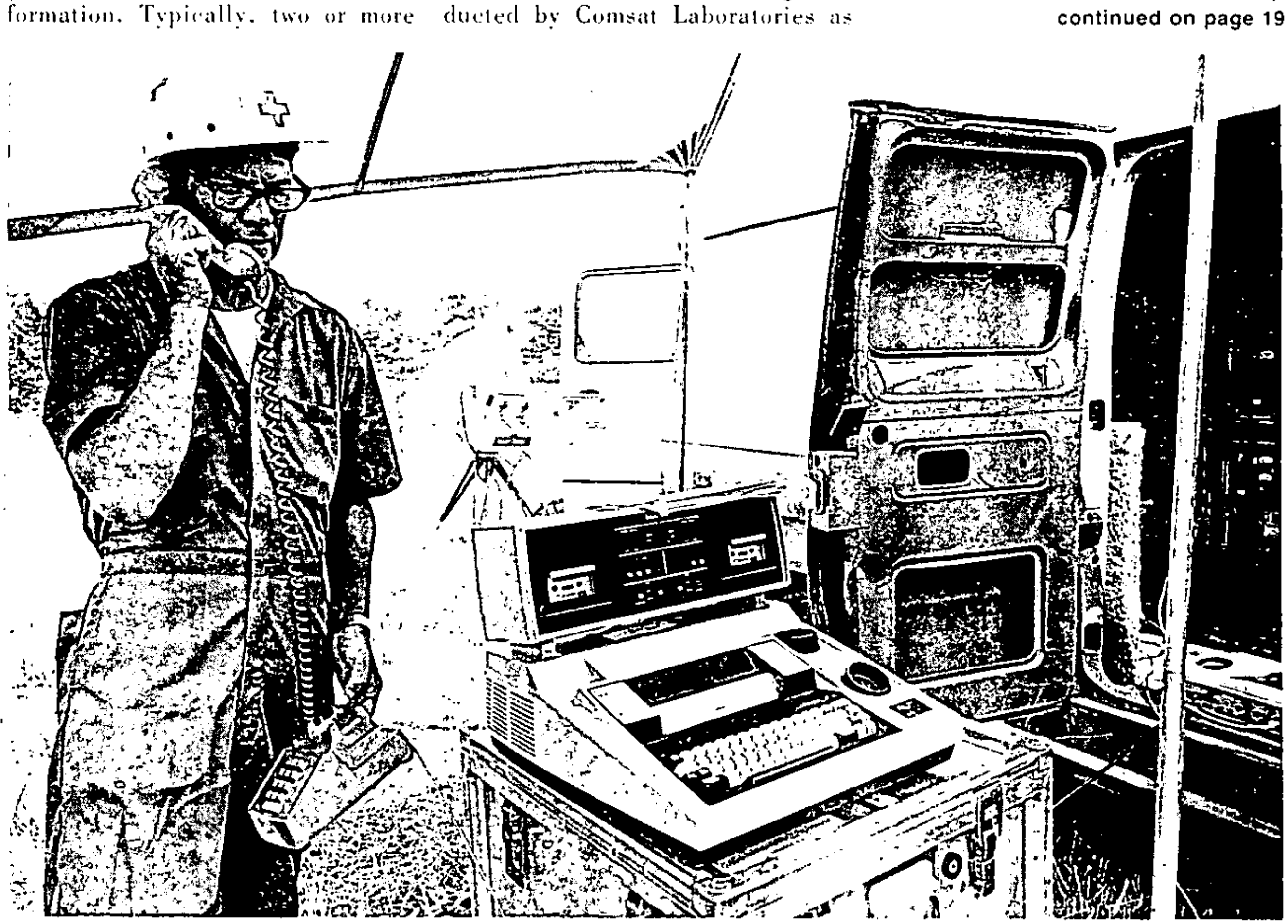

Figure 2.—Transportable earth station in field operation.

Predicting Major Wildland Fire Occurrence

Edward A. Brotak and
William E. Reifsnyder

Use of Weather Maps

During a drought period when the build-up index is very high, wildfires are common. On some days, these small fires quickly get out of hand, and some become major fires. Obviously, any forecasting method which could determine when these major fires were likely to occur would be most useful. The following describes such a predictive scheme using readily available weather maps. No calculations are necessary, just recognition of certain clearly defined situations.

The original data analyzed consisted of 52 fires, each burning 5,000 acres or more, in the Eastern United States from 1963 to 1973 (see fig. 1). Of particular concern were major fire runs, periods of time when the fire was probably uncontrollable due to the prevailing weather conditions. Figure 2 is an idealized surface map showing where these major fire runs occurred in relation to the existing fronts and high and low pressure areas. Certain regions were obviously prone to large fires.

The region immediately behind a dry cold front is the most dangerous. Strong, shifting winds are the apparent cause. Strong southerly winds ahead of the cold front can also cause control difficulties. Obviously, if significant precipitation occurs with the frontal passage, fire danger will not be great.

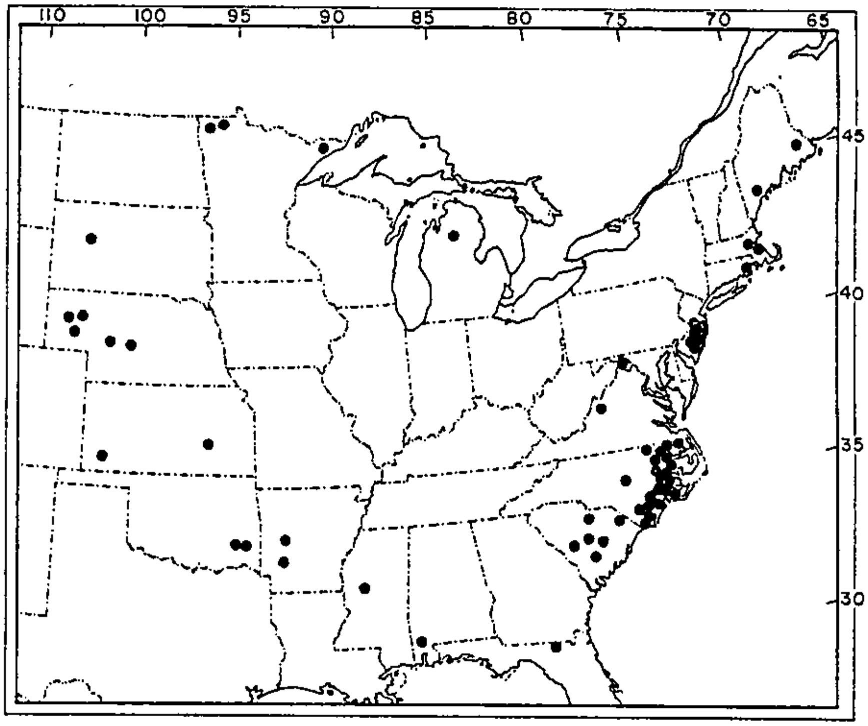

Figure 1.—Locations of all fires.

Another region of great danger is in the warm sector of a strong low pressure area (as indicated by the cluster of runs to the east-southeast of the low in figure 2). There were two different types of low pressure areas involved with major fires. One was the Rocky Mountain low which produced dangerous fire conditions in the Plains and midwestern States. The other kind of low was a storm which moved easterly through southern Canada producing dangerous fire conditions in the Great Lakes States and in northern New England. Major lows in the Eastern United States are almost always accompanied by precipitation.

If only the surface maps are available, then these dangerous situations can only be distinguished from other similar situations by a closer examination of the map. Dangerous frontal situations will be characterized by strong winds, a tight pressure gradient, and little or no precipitation with the frontal passage. Dangerous conditions around low pressure areas usually depend on precipitation occurrence.

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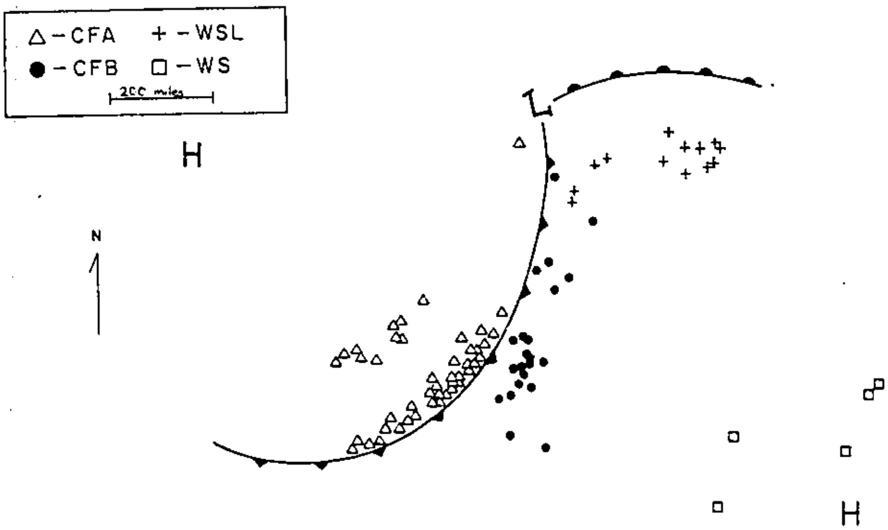

Figure 2.—Idealized surface map showing locations of all fire runs. (CFA—following cold frontal passage; CFB—preceeding cold frontal passage; WSL—warm sector of low; WS—warm sector of high).

If the upper air maps are available, these dangerous situations are much easier to determine. Strong cold fronts are distinguished from weaker fronts by the presence of intense upper level troughs, readily apparent at the 500-millibar (~ 5500 m) level. The intensity of these troughs is determined by the radius of curvature which was usually 640 km or less for the study fires. Figure 3 shows that the most dangerous conditions are associated with the southeastern portion of the trough.

The likelihood of precipitation is best determined from the 850-millibar (~ 1500 m) map. Significant moisture advection at this level in conjunction with an upper trough usually produces precipitation. Only if the dewpoint depression of the air at this level upwind of an area is 5°C or more is precipitation unlikely and major fire occurrence possible.

Fortunately, the development of major low pressure areas and the passage of strong cold fronts are normally associated with precipitation. It is on those rare occasions when precipitation does not accompany these systems and fuel conditions are severe that major fire occurrence is likely.

Use of Local Wind and Temperature Profiles

The preceeding section describes the use of readily available weather maps for the routine prediction of major wildland fires. In this section, we shall describe how to use local wind and temperature profiles to determine dangerous fire conditions. For all 52 fires, wind and temperature data from the surface to 10,000 feet (3050 m) were plotted and analyzed for one or two nearby first order weather stations for times just before and just after the fire's run. From these data, characteristic profiles were determined which could be used as predictive models.

Strong surface winds are a prerequisite condition for major wildland fires. However, an examination of only the surface winds is not adequate for predictive purposes. Observed surface winds are not always representative of actual conditions. This is especially true in the morning when the nocturnal inversion often produces weak surface winds. If the winds above the inversion layer are strong, the potential for strong surface winds in the afternoon is great. Topographic effects can also produce seemingly low surface wind speeds, but again if the wind speeds above the surface are high, strong gusts can be expected at the surface.

A wind profile characteristic of most major fire situations is shown in

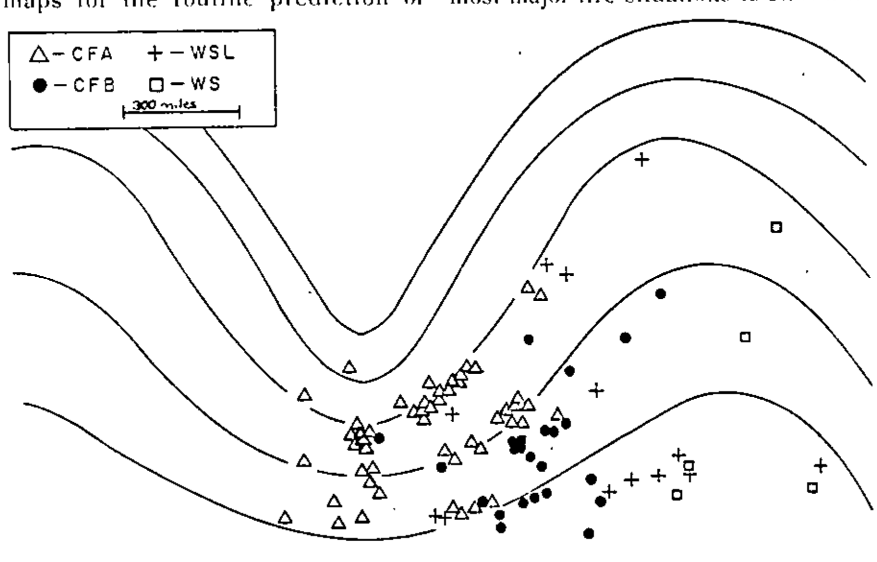

Figure 3.—Idealized 500-millibar map showing locations of all fire runs.

figure 4. Surface wind speeds always exceed 15 mi/h and are usually 20 mi/h or greater. Wind speeds at 10,000 feet (3050m) were almost always 40 mi/h or greater. The above figures can be considered as critical values for major fire occurrence.

The association of major wildland fires with low-level jets (wind maxima within 10,000 feet of the surface where the wind speed is 5 mi/h (2.2 ms^{-1}) greater than a thousand feet above or below) was a significant finding of this research. A third of the wind profiles showed such a jet. Certain synoptic situations were more favorable for the jet's occurrence. Most frequent were the prefrontal jets, southerly wind maxima just ahead of the surface cold front. Another southerly jet was often noted in the warm sector of the common Rocky Mountain low pressure area. A postfrontal jet, a northerly wind maximum behind the surface cold front, occurred on a number of occasions. Low-level jets were also occasionally noted along the east coast and seemed to be associated with the sea breeze front.

Although not a prerequisite condition, the occurrence of a low-level jet happens frequently enough, especially under certain patterns, to be an important factor. If present, the authors believe that the low-level jet will increase surface wind speeds and gustiness by downward transport of momentum. The importance of this, especially on the worst fire days, is probably to make bad conditions even worse.

It has long been believed that atmospheric instability was associated with major wildland fires. In an attempt to determine some characteristic values of this parameter, certain lapse rates were examined for each fire situation. Using the standard pressure levels given in the soundings, the lapse rates that were used were 950-850 millibar, 850-700 millibar, and 850-500 millibar.

The 950-850 millibar (~ 2000 to ~ 5000 feet, ~ 600 to ~ 1500 m) temperature (ΔT) avoids the variability of surface temperatures and the occurrence of surface based inversions, but is still greatly influenced by daily solar heating and is probably a local rather than macroscale parameter. As shown in figure 5, the vast majority of fires, 92 percent, occurred when the lapse rate between these levels was steeper than the standard atmosphere value ($\Delta T = 6.0°C$). Superadiabatic lapse rates were noted on a number of fires. Thus a temperature difference of at least 6°C between the 950 and 850 millibar levels appears to be a necessary condition for major fire occurrence.

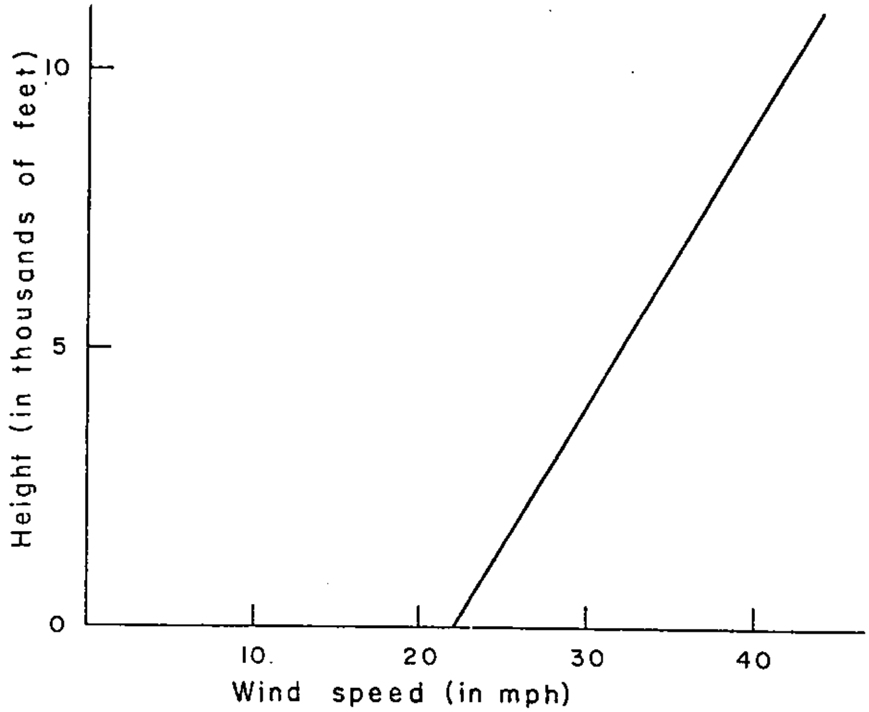

Figure 4.—Characteristic wind profile.

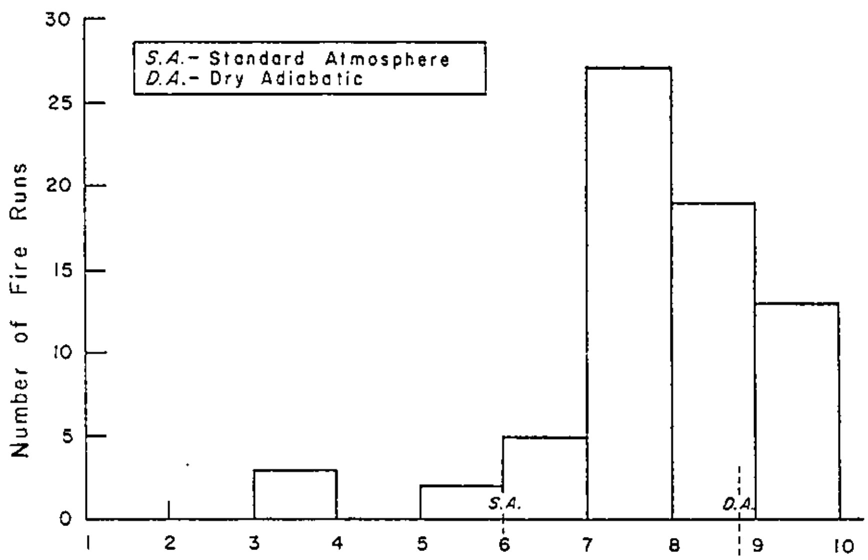

Figure 5.—950-850 millibar temperature difference for all fire runs.

The 850-700 millibar ΔT depicts the lapse rate between ~ 5000 and

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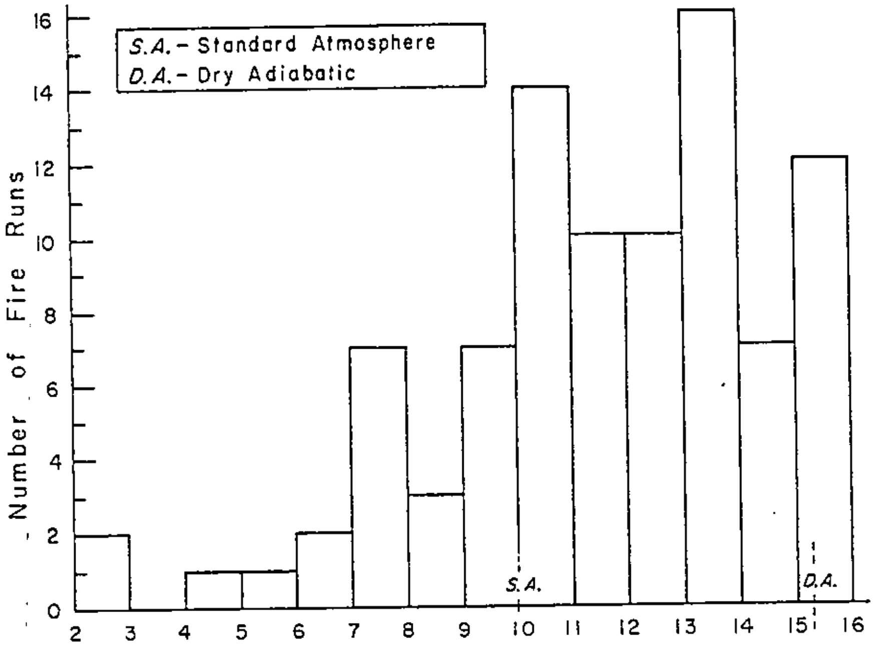

Figure 6.—850-700 millibar temperature difference for all fire runs.

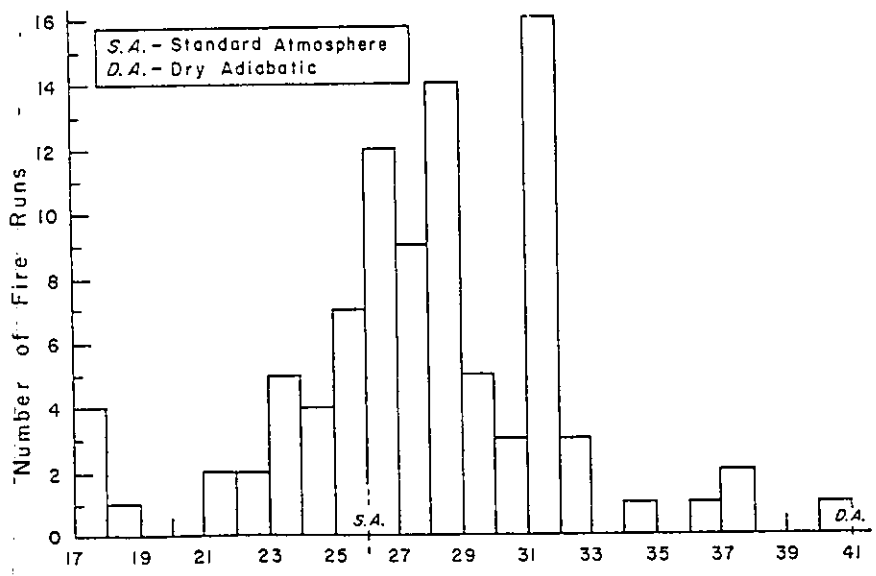

Figure 7.—850-500 millibar temperature difference for all fire runs.

~ 10,000 feet (~ 1500 to ~ 3050 m), and instability at those heights would probably be macroscale. As shown in figure 6, in general, a temperature difference of at least 10°C is associated with major fires. This value is close to the standard atmosphere lapse rate. The 15.0° to 15.9°C category encompasses the dry adiabatic lapse rate which is the maximum that could be expected for these heights.

The 850-500 millibar ΔT depicts the lapse rate between ~ 5000 and ~ 18,000 feet (~ 1500 to ~ 5500 m). A temperature difference of 26°C is the standard atmosphere lapse rate. A temperature difference of 40°C to 41°C is the dry adiabatic lapse rate and would be remarkably unstable for this level in the atmosphere. As shown in figure 7, about 75 percent of the fire runs occurred with a temperature difference of 26°C or more.

EDITOR'S NOTE

The complete results of this research project are presented in *A Synoptic Study of the Meteorological Conditions Associated with Major Wildland Fires* by E.A. Brotak, a Ph.D. dissertation at the Yale School of Forestry and Environmental Studies. Copies of this paper are available upon request to the author. The research was supported by the Atmospheric Science Section of the National Science Foundation.

Fire Behavior Research in Ontario

Brian J. Stocks

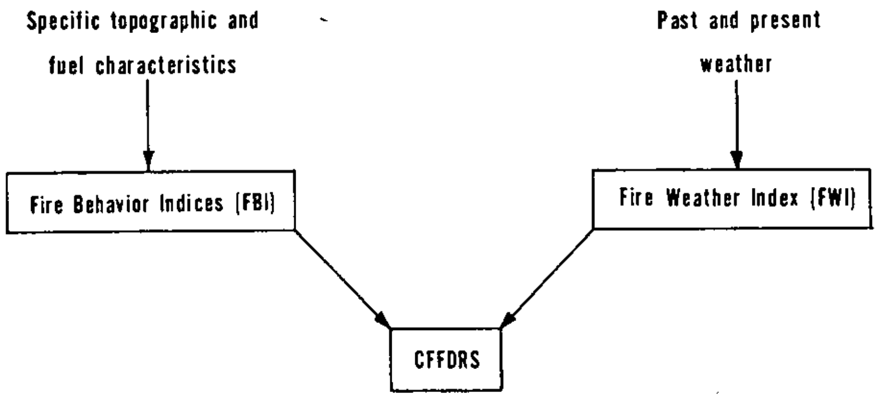

Figure 1.—Structure of the Canadian Forest Fire Danger Rating System.

At the request of Provincial forest fire control agencies in Canada, an improved system of forest fire danger rating, developed by the Canadian Forestry Service (CFS) was introduced across Canada in 1970. The Canadian Forest Fire Weather Index (FWI), which constitutes the first family of indices in the Canadian Forest Fire Danger Rating System (see fig. 1), has thus been in use nationally for approximately 7 years.

The second family of indices, known as fire behavior indices (formerly burning indices), is currently being developed in many parts of Canada as an ongoing CFS fire research effort.

The FWI (Canadian Forestry Service 1976, Van Wagner 1974) and its component codes are based solely on the effect of past and present weather on the moisture content of standardized fuels components and are used as a general planning tool (men and resource allocation) for large protection areas. A fire behavior index (FBI), on the other hand, takes fuels description and topography into account, and provides a fire manager with specific fire behavior information for major fuel types. Important fire behavior parameters such as rates of spread, intensity, fuel consumption, and crowning potential are expressed (in absolute units) in relation to the FWI and its component codes for specific fuel types. Thus, when a fire manager has a wild or prescribed fire in a certain fuel type, he can rely on the FBI to provide him with the type of fire behavior information he needs to make control decisions and to develop burning prescriptions.

Across Canada, fire behavior indices have been developed for specific logging slash fuel types (Muraro 1971, Quintilio 1972, and Stocks 1972), and work is currently underway in various standing timber fuel types in British Columbia, Alberta, and Ontario. Regional CFS establishments in these Provinces are working in fuel types considered important by Provincial fire control officials.

Great Lakes Centre's Program

In Ontario four major fuel types have been identified to date, and an experimental burning program has been underway since 1970. Jack pine (*Pinus banksiana* Lamb.) logging slash was the first fuel type considered. Twenty-four experimental burns were carried out in Kirkland Lake District in northeastern Ontario in the summers of 1970 and 1971 (Stocks and Walker 1972). In 1972, in northcentral Ontario 24 burning plots were established in a mature (75 years old) jack pine stand in White River District. In 1973, an additional 22 plots were located in a dense, immature jack pine stand (28 years old) in Blind River District in northeastern Ontario (Walker and Stocks 1975).

To date 8 plots in mature and 14 plots in immature jack pine have been successfully burned. A wet year in 1973, followed by record wildfire years between 1974 and 1976, have hampered the burning program somewhat.

Recently the Ontario Ministry of Natural Resources (OMNR) expressed concern about the potential

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Brian Stocks is Leader of the Fire Research Project at the Great Lakes Forest Research Centre in Sault St. Marie, Ont.

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fire hazard being created by large-scale spruce budworm infestations in northeastern Ontario. As a result experimental burning plots are presently being located in budworm-killed balsam fir (*Abies balsamea* (L.) Mill.) in Blind River District, and burning in this fuel type is scheduled to begin in 1977.

Location and Establishment of Burning Plots

After the identification of important fuel types for which fire behavior information is required, CFS fire researchers from the Great Lakes Forest Research Centre, in consultation with OMNR headquarters, regional, and district personnel, select mutually acceptable experimental burning sites. One-acre plots (2 x 5 chains) are laid out, and firelines are cut around each plot (see fig. 2). Firelines are ½ to 1 chain in width and are bulldozed to mineral soil to allow vehicle access. An effort is made to make plots as similar as possible with respect to topography and fuel loadings, so that observed variations in fire behavior can be related directly to variations in fire weather (as expressed through the FWI system). Larger plots were necessary in budworm-killed balsam fir areas due to the heterogeneous mixture of species in this fuel type. As a result 5-acre square plots (7 x 7 chains) were established in this fuel type.

A fully equipped weather station is located at each burning site. Observations of precipitation, temperature, wind velocity, and relative humidity are recorded at 1300 hours daily and are used to calculate the FWI and its component codes.

In order to develop properly an FBI, it is desirable to burn under as broad a range of these weather conditions as possible. In other words, fires under low, moderate, high, and extreme conditions are necessary.

Pre-Burn Sampling Procedure

In preparation for each experimental fire a detailed sampling procedure is carried out in order to fully document the fuel complex on each plot.

A 10-percent cruise is made to determine the diameter class distribution of both living and dead standing trees on each plot. Aerial fuel weights are determined by destructively sampling trees located outside the burning plots but in the same fuel types. From this sampling, a table relating the fuel weights of various crown components to tree diameters and heights is produced.

Downed woody material, such as twigs and logs, are sampled using the line-intersect method (Van Wagner 1968), and herbaceous vegetation weights are determined by systematically located square-yard samples. Understory species frequency and composition are also determined.

The depth of organic matter on each plot is sampled by removing numerous square-foot samples. These samples are then sectioned into 1-inch lawyers and a bulk density figure determined for each 1-inch depth of organic matter.

Just prior to ignition, moisture content samples are collected for various fuel categories (foilage, dead and living twigs and branchwood, litter, and duff layers) in each burning plot.

Observations During Burning Period

When weather conditions are favorable to accomplishing a burn objective and when fire control staff and equipment are available, an experimental fire is ignited. OMNR fire control personnel are responsible for the actual ignition, aerial reconnaissance, and mopup of each fire. The CFS fire research group is responsible for detailed monitoring and documentation of fire behavior parameters.

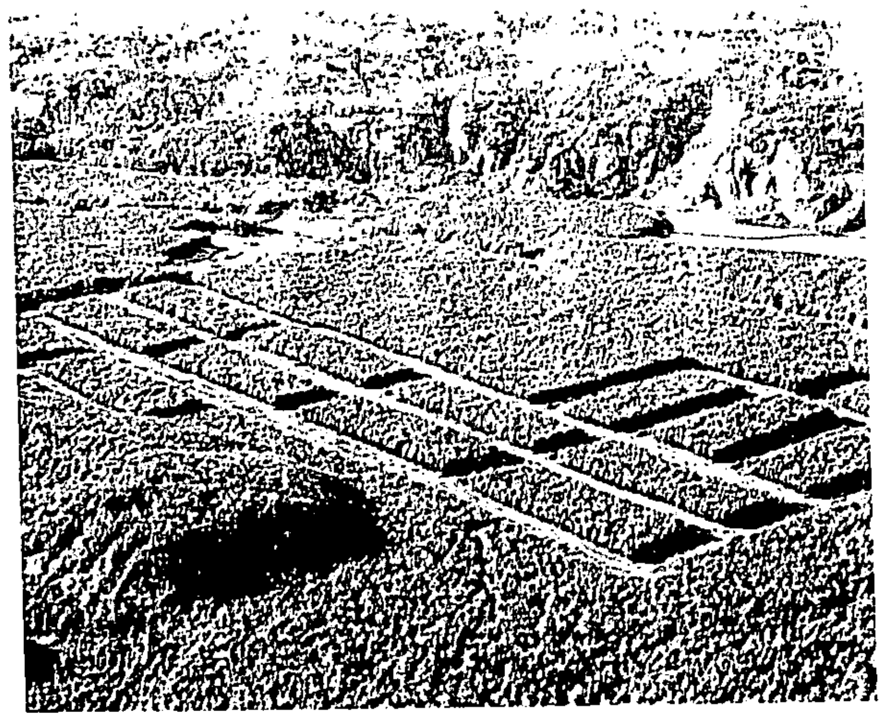

Figure 2.—An aerial view of a portion of immature jack pine experimental burning plots.

Figure 3.—Experimental crown fire in immature jack pine fuel type.

Each experimental fire is conducted in the early afternoon between 1300 and 1500 hours, when the FWI codes calculated at 1300 hours still apply. Ignition, using drip torches, is carried out in a "line-fire" pattern across the narrow end of each rectangular plot. The fire then burns with the wind (see fig. 3).

During each burn, CFS personnel monitor rates of spread on a grid system in each plot. Both visual mapping techniques and remote timing devices are used. Observations on flame height, crowning potential, and spotting are recorded. Wind speed and direction are monitored continuously throughout the burn. Each fire is well documented using still cameras, movies, and videotape recordings. Pictures taken at ground level and in strategically located scaffolds and towers allow further analysis of each fire.

The combination of wide firelines, aerial surveillance, and ample wetting-down of surrounding areas have resulted in no significant fire control problems being experienced to date in the program. Any spot fires occurring outside the firelines were quickly detected and extinguished.

Post-Burn Sampling Procedure

After each burn, aerial fuel weight consumption is calculated through observation of all individual trees within the 10-percent cruise area. Both the percentage of crown consumption, as well as the size class of fuel particles consumed, are noted. The total weight of aerial fuels consumed by the fire is tabulated by referring to the previously constructed aerial fuel weight tables for that fuel type.

Line-intersect transects are rerun in order to compute the amount of downed woody surface fuel remaining and thus the weight of surface fuel consumed during each burn. All herbaceous material on each plot is consumed by the fires.

An average depth-of-burn figure for each plot is calculated by averaging measurements from 100 t-bar pins located systematically throughout each plot. This average burn depth is then converted to fuel weight consumption using the bulk density figures determined earlier.

Ecological studies into the effects of fire behavior on regeneration, understory vegetation succession, and soil nutrient distribution are initiated after each burn. Reassessments are made in subsequent years.

Summary

The relationships between total fuel consumption, depth of burn, rate of spread, and fireline intensity, and the component codes of the FWI system are investigated in detail. From this information the fire behavior indices predicting fire behavior for specific weather conditions are developed and issue to Provincial fire control personnel.

Whenever possible, general fire behavior observations made on ongoing wildfires are incorporated with experimental data. Although logistics on wildfires do not permit the type of detailed sampling that is possible with controlled burns, monitoring of these fires often provides fire behavior data under explosive conditions when Provincial manpower shortages preclude experimental fires. In addition, it provides an opportunity to determine how representative the experimental burns are of the real-world situation.

Further experimental burns are necessary (particularly under high to extreme fire danger) in both the mature and immature jack pine plots before an adequate range of data will be available to confidently predict fire behavior in these types. When burning is complete, FBI's will be issued, and all data will be published.

As mentioned, work in spruce budworm infested balsam fir stands is just beginning. It is anticipated that the experimental burning program will be extended to include other important fuel types in the near future. Where common fuel types exist in different Provinces, CFS fire researchers will cooperate in developing pertinent fire behavior indices.

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Digital Electronic Wind Speed Indicator

Thomas R. Maskus and Greg Lusk

Wind velocity is the most influential parameter of fire spread. Changing of only this variable can cause fire danger ratings to vary greatly. Such things as manning and specific action guides, calculations of initial attack forces, estimations of fire occurrence, public awareness of burning conditions, issuance of burning permits, woods closures, and prescribed burning are all indirectly affected by wind velocity through fire danger rating systems.

To determine wind velocity in the past, anemometers were equipped with buzzers, flashers, counter-timers, or dial recorders with the wind speed determined by referring the counted number of buzzes or flashes in a specific time period to a conversion table. In later models wind speed was read directly from an electromechanical counter.

The Michigan Department of Natural Resources Forest Fire Division, and many other fire agencies still using the electromechanical wind-speed counters, consistently experience missed and double digit counts, reset assembly malfunction, and mechanical failures. Although electronic instruments could achieve the desired performance, such instruments are not available on the market. This led to the design and fabrication of the model described in this article.

The digital electronic wind-speed indicator is of comparatively low cost ($50) and of simple design. It is reliable, accurate, and compatible with existing anemometers. It operates from a 120 VAC 60-hertz source, and of great importance, is fabricated from readily available parts (7400 series, transitor-to-transitor logic (TTL) integrated circuits). With a slight change in design it could also be operated from a direct current battery.

The Circuit Operation

The indicator consists basically of two sections—the event counter with displays and the electronic timer.

The event counter transmits pulses (electrical contact closures) from the anemometer to the electronic gate that controls passage to the pulse counters and light-emitting diode displays. The time dividers, which are fed from the 60-hertz power line frequency, mainly provide a pulse at the end of a 10-minute period to control the gate. Also, one pulse per second is picked off for self-testing purposes.

By feeding these 1-second pulses into the event counter input, the display will indicate whether 600 pulses are being passed on upon completion of the 10-minute period. This provides a check of all the circuitry within the indicator.

To activate the self-test feature and to assure a full 10-minute pulse

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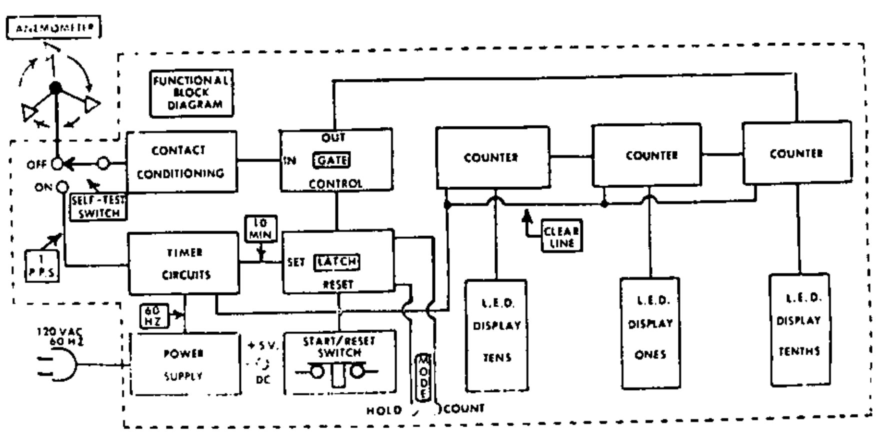
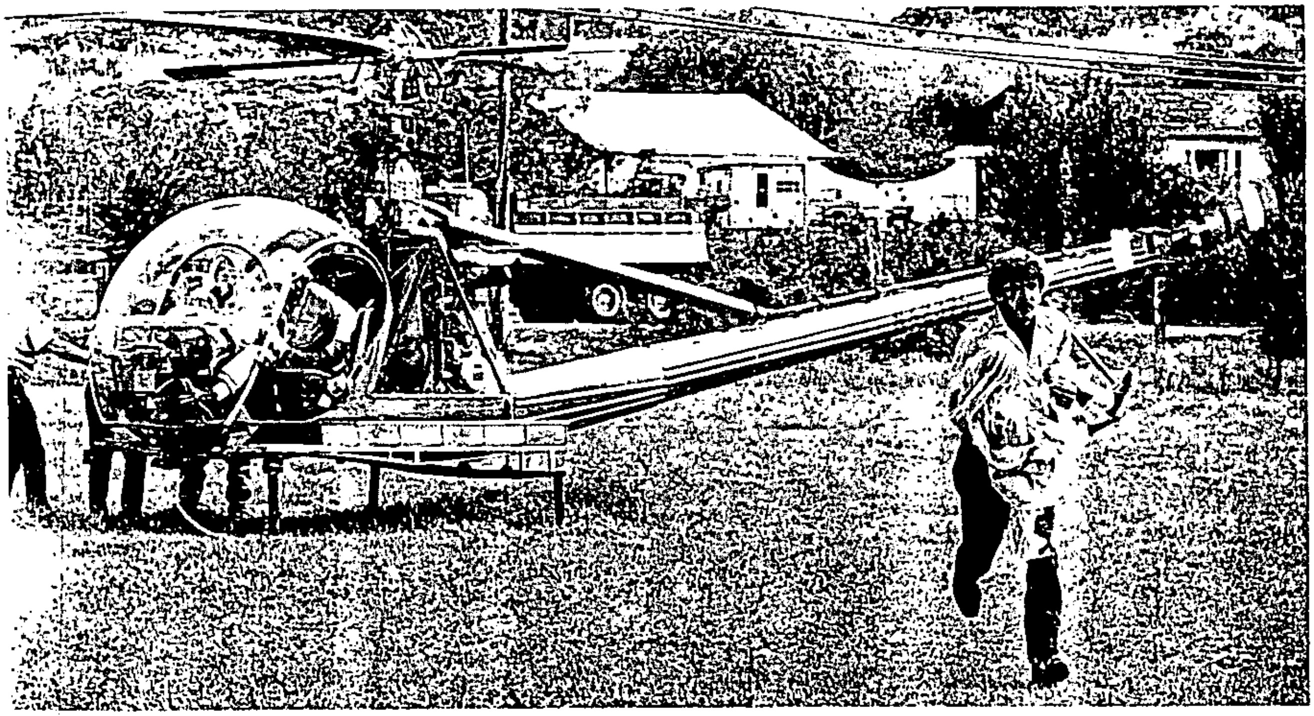
Tom Maskus is the Regional Radio Technician, and Greg Lusk is the Regional Fire Control Specialist for Region 1 of the Michigan Department of Natural Resources in Marquette, Mich.



Electrical diagram of the digital electronic wind speed indicator.

Helicopter Management

Everett M. Stiger



Flood survivor being removed to the first aid station. (Photo by Fort Collins *Coloradoan*)

On the night of July 31, 1976, the northern Front Range of Colorado was hit by a massive flash flood that left in its wake 139 dead, hundreds homeless, and damages in the millions of dollars. Helicopters played a key role in the rescue of survivors, removal of the dead, and the movement of disaster teams into the stricken area, which was completely cut off from overland vehicles. Eight hundred sixty survivors were rescued on the first day following the flood by as many as 17 helicopters, representing the Forest Service, St. Anthony Hospital's Flight for Life, many private companies, the Air National Guard, the U.S. Air Force, and the U.S. Army.

The death toll would undoubtedly have been much higher if the helicopter evacuation had bogged down because of logistics, technicalities, or jurisdictional problems. Many of the survivors had already spent a rain-soaked night outdoors in nothing more than their bed clothes. Death from exposure would have been inevitable for many if they had been forced to spend another night without shelter, particularly since the second day after the flood was shrouded in a cold, damp fog. The first day following the flood, however, was clear

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Mr. Stiger was the Air Command Operations Officer on the Big Thompson flood rescue operation. He is currently assigned as Zone Fuels Management Officer in Region 1 of the Forest Service. He is stationed in Helena, Mont.

HELICOPTER MANAGEMENT

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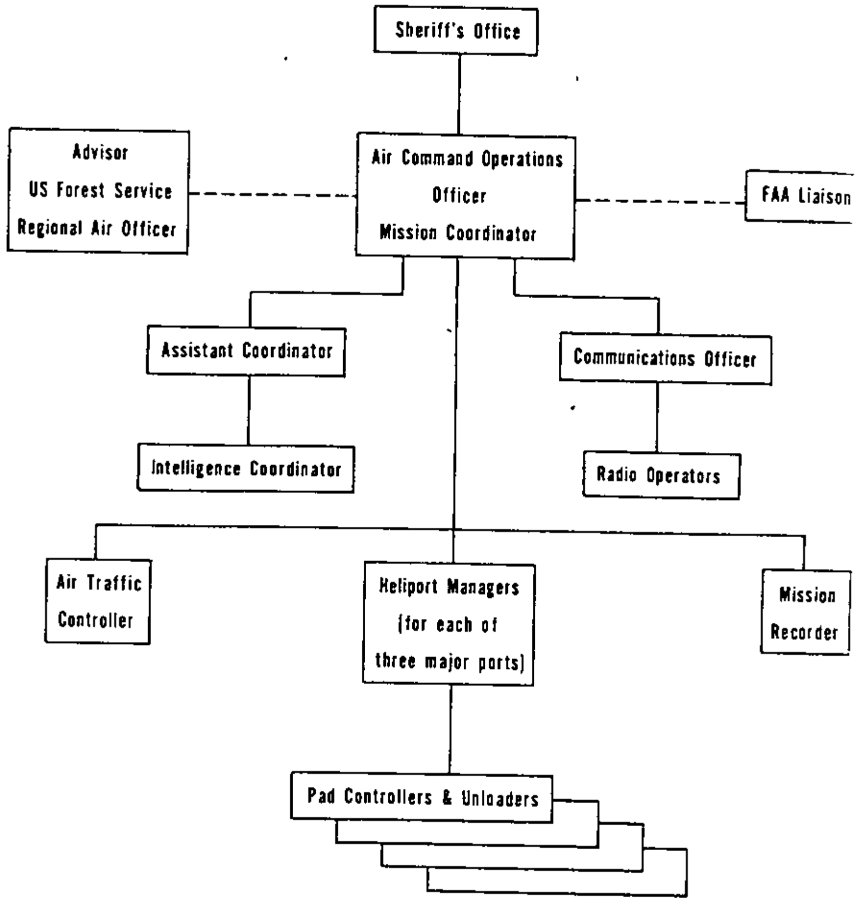
with reasonably good flying conditions.

Sheriff Has Lead

It is to the credit of the Larimer County Sheriff's Office (the Sheriff's Offices are the lead agencies in a natural disaster in Colorado) that they quickly realized the magnitude of the disaster and did not hesitate to activate the Northern Front Range Fire Alliance. The Alliance is made up of all agencies responsible for fire protection on the northern Front Range.

As a member of the Alliance, the Forest Service was requested to organize and manage the air evacuation because of that agency's experience in aviation management. Other members of the Alliance, including the Colorado State Forest Service, Bureau of Land Management, National Park Service, and Larimer County Sheriff's Offices, were involved in other phases of the operation.



Air Command

An air command was established at daybreak on Sunday morning, August 1, near the mouth of the Big Thompson Canyon in a field capable of supporting the large number of helicopters expected. Gaining control of all aircraft already in the area, and then maintaining this control as additional ships arrived, was most urgent. An air space restriction had already been requested through the FAA and was in effect by daylight. A local fire department provided a blackboard, and soon a trailer was available for the air command group.

The first job was to identify each aircraft and list it on the blackboard so that the location and mission of every ship involved would be readily visible to air rescue command personnel. This helped them to control the air traffic on rescue missions and at the heliport.

The air command group was dealing with as many as eight different helicopter groups, each with a different set of operating procedures, and with flood survivors who for the most part had never been near a helicopter. It was decided to use the Forest Service and Sheriff's Office helicopter managers, exclusively, since they were trained at the same helicopter management training session conducted by the Forest Service. This would insure standard operating procedures. Military and private companies respected this decision and followed the air traffic controller's and pad controllers' directions without question. Landings and take-offs were controlled via radio and visual contact with ground controllers.

Local firemen were given instructions in how to assist survivors off the ships and quickly became adept at handling the flood victims, recognizing the need for any special treatment required. They personally took the individuals to the proper emergency treatment facilities at the heliport. Additional qualified heliport managers were brought in from other National Forests and Forest Service Regions as the rescue operations stretched into several days.

Three major heliports were established: the operations heliport for small and medium-sized ships with emergency medical facilities, a larger heliport for the Army Chinooks, and the third for a body collection point.

The communications officer requested FAA to assign an emergency VHF channel, so all rescue ships could communicate with each other. VHF ground units from the Boise

Interagency Fire Center provided the air traffic controller with ground-to-air communications. Ships flew preplanned trips up and down canyon to prevent air collisions. The most experienced helicopter managers, both Forest Service and Sheriff's officers, were moved into the canyon to help survivors get to preselected pickup points and onto the aircraft. According to predetermined plans, small- and medium-sized helicopters were used to move isolated groups of people to pickup points where the large Army Chinooks could land.

The pilots themselves selected the helispots and provided the best possible intelligence concerning actual conditions and needs within the strickened area. An intelligence coordinator gathered information from the pilots as they arrived at the base heliport. This intelligence was cleared directly with the Sheriff's Office and provided the basis for scheduling missions. The first priority, of course, was evacuating survivors. Then came the task of removing bodies and getting disaster teams into the canyon to protect property, and of restoring utilities, commencing cleanup, and constructing an emergency road.

During the early stages of the operation, there were many violations of the restricted airspace and several near misses. An FAA inspector was assigned to the air command to observe and take depositions from helicopter pilots and other eyewitnesses to obvious violations. The presence of the FAA inspector helped deter further violations.

Recognizing the importance and need to keep the public informed, two "press flights" were scheduled each day after all survivors had been evacuated. The press was notified when these flights would be, and the flights were made on schedule. The members of the press appreciated and respected this schedule.

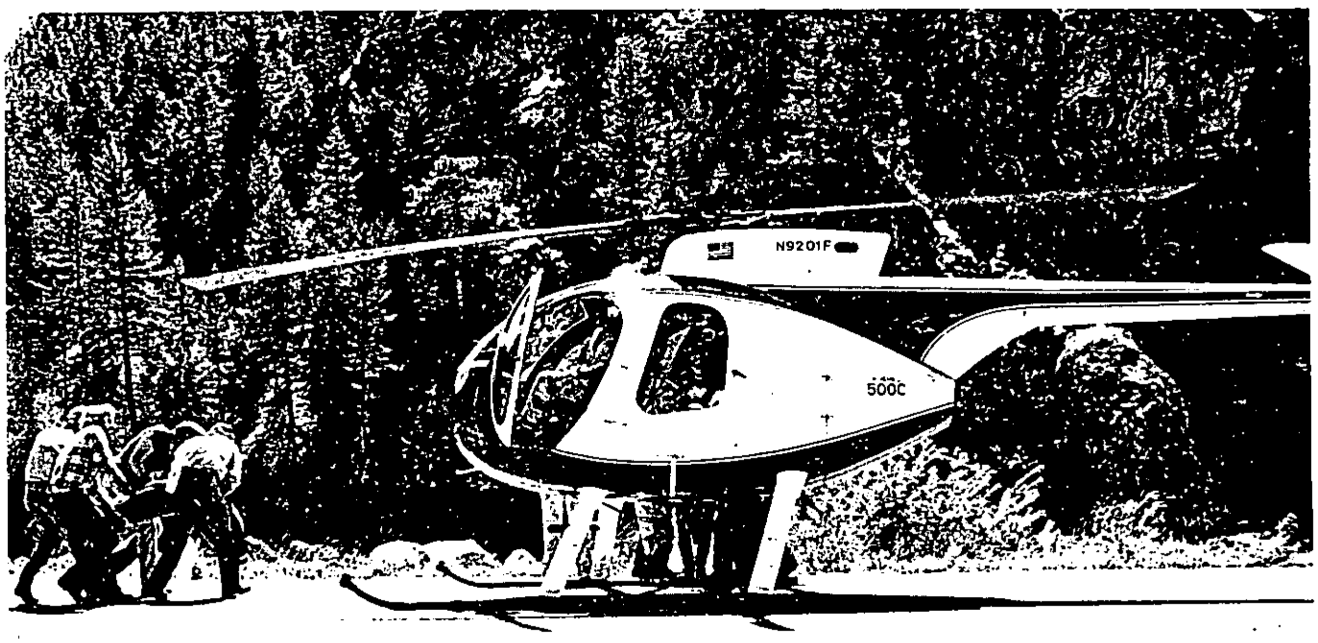
A pilot and heliport personnel debriefing was held each evening, and a briefing of the day's planned activities was held in the morning, with all helicopter units paraticipating. This provided an opportunity to discuss problems and safety and to ascertain that all personnel understood procedures.

One of the problems that arose was that the completion of missions was not being logged in writing. The Sheriff's Office determined mission priority, and the assignment was made in writing and hand-carried to the pilot upon his return to the heliport. However, no accomplishment record was being kept. This resulted in several duplicate missions, because it was not known whether an assignment had been completed or not. The problem was corrected by having the pilots return their mission sheet and then get a new mission sheet. The completed assignment was kept on file in the air command center.

The Air National Guard and Civil Air Patrol provided personnel familiar with air operations to assist in enumerable ways. Local fire departments provided engine companies for possible heliport emergencies.

This safe and successful rescue operation can be attributed to five major points:

- Aircraft control
- Qualified personnel
- Well-defined organization
- Uniform procedures
- Mission control.



A flood victim being loaded onto helicopter for transportation to the body collection point. (Photo by Fort Collins *Coloradoan*)

Reporting Near Fire Starts

Lloyd Anderson

With the arrival of the 1977 fire season many fire managers begin thinking about implementing some form of a prevention program. Many are returning from a multitude of meetings, conferences, and workshops, all of which have systematically taught them how to prevent fires. The first task, that of defining the problems, seems easily accomplished. One can choose from a vast array of fire causes ranging from arson to escaped warming fires. Certainly, statistics have repeatedly pointed to these "classical" problem areas as being most worthy of the prevention dollar, and perhaps this is justifiably so. Unfortunately, in order to become a statistic, and thereby qualify for attention, a fire has to be the consumating factor. There is little doubt, at least in my own mind, that we are experiencing many more fires than those actually being reported.

Sometimes, for example, certain models of chain saws can start a fire. These fires are usually detected and easily extinguished. They are seldom reported, however, since no one wants to admit having started a fire. Consequently, these fires never become statistics. Each one of these "near fire starts" could have resulted in a holocaust had the conditions been right.

If a conflagration had occurred, would our 1977 prevention programs be addressing the root cause in an attempt to prevent a recurrence? Probably so. However, when trying to design a total fire protection regime for

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Mr. Anderson is a protection forester with the Weyerhaeuser Company in Longview, Wash.

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NEAR FIRE START REPORT

Many technological advances that have resulted in safer equipment (e.g., spark arresters) have come from input by cutters, yarder engineers, etc. If you have experienced a near fire start or know of potentially hazardous practices, please fill out this card and send it to the Longview office. You will be assured of anonymity and prompt follow-up.

- A fire (any size) was caused by ______________________
- I believe ______________________ is hazardous and has the potential for causing a fire.
- Comments, suggestions or ideas ______________________

FORM 811 1/77

Front and back of Weyerhaeuser's "Near Fire Start Report." These reports permit employees to help with the fire prevention job, and yet remain anonymous if they wish.

With distribution accomplished, we must then decide what to do with the incoming cards. No doubt there will be some derogatory replies, but for the most part we expect sincere, constructive comments. Therefore, if we expect to keep this a viable means of communications, we must be prepared to follow-up promptly on each and every suggestion that comes in. If an employee feels that something is important enough to sit down and take the time to fill out one of these cards, we certainly owe him a response. One way of doing this is to print the results of follow-up investigations in a monthly newsletter or in the minutes of monthly safety committee meetings.

We are looking forward to favorable response to this trial project. Certainly, if it is well received we will be one step farther down the road to preventing wildfires.

an industrial logging operation, "after the fact" fire prevention programs can be expensive. Certainly it would be more realistic to address a problem area before it becomes a statistic. Aside from the classical problem areas, we are sometimes at a loss as to how to go about figuring out what some of these potential problem areas are. We could devise some method whereby the actual man on the ground—the forester, the logging foreman, or the woodsworker—could anonymously, and without fear of criticism or of losing his job, convey his first hand experiences with fire starts that never really materialized into anything larger than a spot. Then we would have a better idea of where we should spend our prevention dollar.

One possible method for obtaining this input is to use business reply cards that would be made available to everyone who works in the woods. During the 1977 fire season, Weyerhaeuser Company's Southwest Washington Region will test this concept by making such cards available to all woods personnel.

The card will contain a line for reporting fire starts of any size, a line for reporting potentially hazardous situations, and room for comments, ideas, or suggestions.

The blank cards will be located in crew buses and in the various camp offices. They can either be filled out and left at camp or be taken home and returned via Postal Service mail with no postage necessary. To get these cards into the hands of the person who doesn't want to be seen picking one up, they may also be placed in the employees' paycheck envelopes.

Recent Fire Publications

Albini, Frank A.
1976. Estimating wildfire behavior and effects. USDA For. Serv. Gen. Tech. Rep. INT-30. Intermt. For. Range Exp. Stn., Ogden, Utah. 88 p.

Arno, Stephen F.
1976. The historical role of fire on the Bitterroot National Forest USDA For. Serv. Res. Pap. INT-187. Intermt. For. Range Exp. Stn., Ogden, Utah. 29 p.

Christiansen, John R. et al.
1976. Organization factors in fire prevention: roles, obstacles, and recommendations. USDA For. Serv. Res. Pap. PSW-116. Pac. Southwest For. Range Exp. Stn., Berkley, Calif. 13 p.

Davis, Paul O., Charles O. Dotson, and D. Laine Santa Maria.
1977. Effect of fitness on field performance among firefighters. Int. Fire Chief 43(4):12-13.

Edwards, M. Boyd, Jr.
1976. Weight prediction for 10 understory species in central Georgia. USDA For. Serv. Res. Note SE-235. Southeast. For Exp. Stn., Asheville, N.C. 3 p.

George, Charles W., Aylmer D. Blakely, and Gregg M. Johnson.
1976. Forest fire retardant research. USDA For. Serv. Gen. Tech. Rep. INT-31. Intermt. For. Range Exp. Stn., Ogden, Utah. 22 p.

Green, Lisle R.
1977. Fuelbreaks and other modification for wildland fire control. Agric. Handb. 499. U.S. Dep. Agric., For. Serv., Washington, D.C. 79 p.

Hartigan, Arnold.
1977. Fire radio cache: mobilized for instant response. Communications July 1977:18-24.

Helmers, Austin E.
1976. Fire access in the Alaskan interior. IN Surface protection seminar Proceedings., USDI Bureau of Land Management. Alaska State Office, 1976. p. 169-175.

Henley, J.W., and E.H. Clarke.
1976. Forest residues: a manageable problem. IN Land application of waste material, Soil Conserv. Soc. Am., Ankeny, Iowa. p. 98-111.

International Fire Chief.
1977. Pre-season assessment of fire danger in 1977. Int. Fire Chief 43(4):3-8.

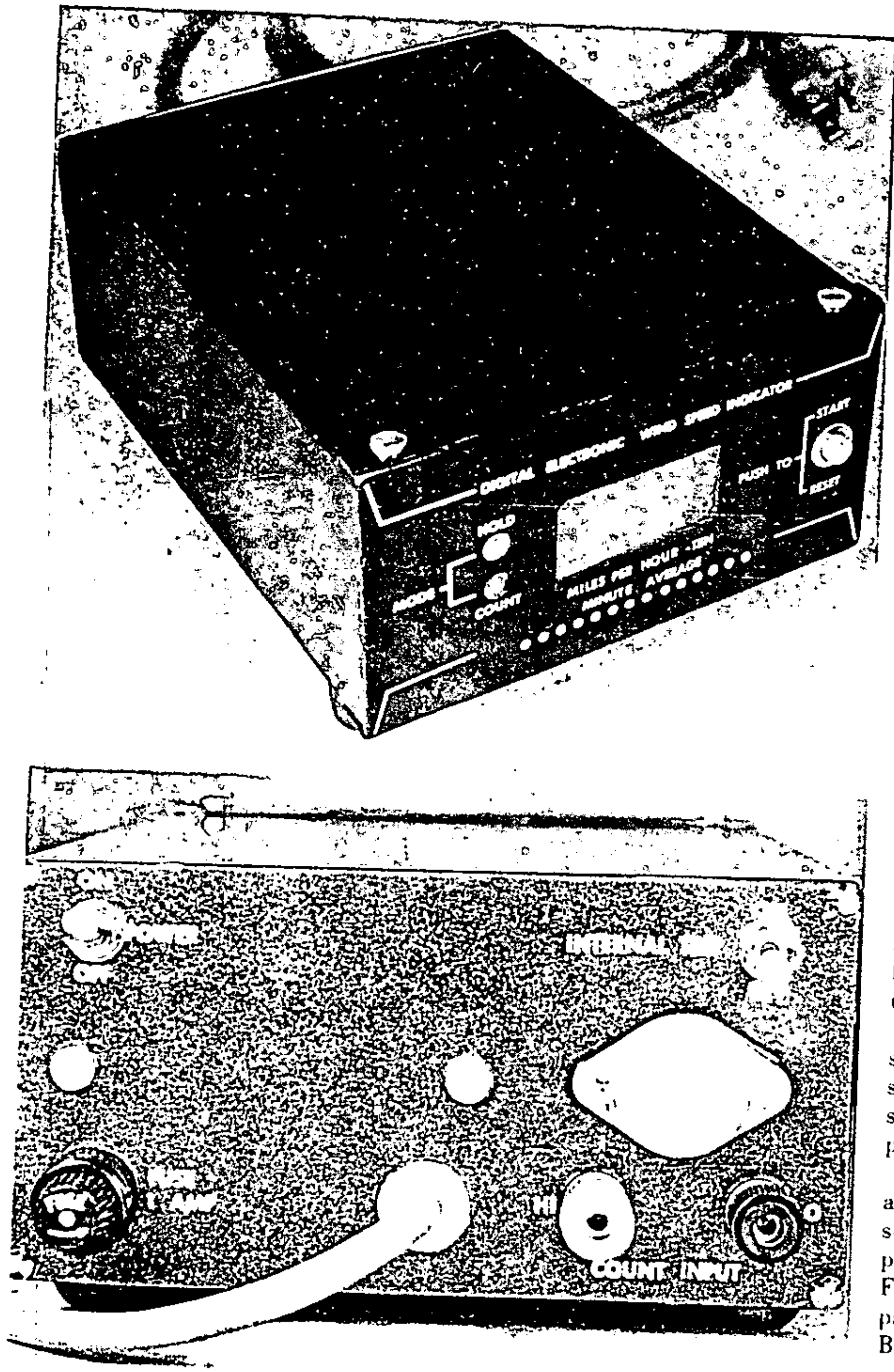
International Fire Chief.
1977. Rural community fire protection program. Int. Fire Chief 43(4):10-11.

King, Rudy M., and R. William Furman.
1976. Fire danger rating network density. USDA For. Serv. Res. Pap. RM-177. Rocky Mt. For. Range Exp. Stn., Fort Collins, Colo. 4 p.

Martin, Robert E., Dennis W. Pendleton, and William Burgess.
1976. Effects of fire whirlwind formation on solid fuel burning rates. Fire Technol. 12(1):33-40.

DIGITAL ELECTRONIC WIND SPEED INDICATOR

From page 13



Front and rear views of the indicator.

count, the power and the self-test switch must be turned on *before* the start/reset switch is pressed.

When the power is turned on, the start/reset button must be pressed momentarily to reset the displays to read "zero." Then a new 10-minute time period starts, and the counter begins the counting and display of pulses from the anemometer.

At the end of the 10-minute period, the count indicator goes off, the hold indicator comes on, and the total wind speed count is held on the displays as long as the power is on or until the start/reset switch is pressed to begin a new 10-minute period.

Although the prototype involved use of a predrilled universal type circuit board, bulk quantities of the final unit should have custom type boards fabricated by qualified companies for speed of assembly and economy.

The indicator uses 14 integrated circuits of the 7400 series of TTL. They are inexpensive, give adequate performance, and are readily available from electronic supply houses or electronic hobby stores. The three-display readouts are of the Mansanto MAN-1 type. This type was chosen for its high brilliance and readability under bright daylight conditions.

The prototype was field tested at several Department of Natural Resources stations under variable wind speed conditions with no operational problems encountered.

Readers interested in obtaining additional information, including schematic diagrams or sources of printed circuits, should write to: Forest Fire Division, Michigan Department of Natural Resources, P.O. Box 190, Marquette, Mich. 49855.

ONTARIO RESEARCH

from page 11

Canadian Forestry Service.
1976. Canadian forest fire weather index tables. Dep. Environ. Can. For. Serv. For. Tech. Rep. 13. 65 p.

Muraro, S.E.
1971. A burning index for spruce-fir logging slash. Can. For. Serv. Pac. For. Res. Cent. Suppl. BC-3, Can. For. Fire Danger Rating Syst. 16 p.

Quintilio, D.
1972. A burning index for lodgepole pine logging slash. Can. For. Serv. North. For. Res. Cent. Suppl. NFRC-1, Can. For. Fire Danger Rating Syst. 4 p.

Stocks, B.J.
1972. A burning index for jack pine logging slash Can. For. Serv. Great Lakes For. Res. Cent. Suppl. Ont-1, Can. For. Fire Danger Rating Syst. 2 p.

Stocks, B.J., and J.D. Walker.
1972. Fire behaviour and fuel consumption in jack pine slash in Ontario. Can. For. Serv. Great Lakes For. Res. Cent. Inf. Rep. O-X-169. 19 p.

VanWagner, C.E.
1968. The line intersect method in forest fuel sampling. For. Sci. 14:20.

VanWagner, C.E.
1974. Structure of the Canadian Forest Fire Weather Index. Can. For. Serv. Dep. Publ. 1333. 44 p.

Walker, J.D., and B.J. Stocks.
1975. The fuel complex of mature and immature jack pine stands in Ontario. Can. For. Serv. Great Lakes For. Res. Cent. Inf. Rep. O-X-229. 19 p.

REMOTE-SITE COMMUNICATIONS

from page 4

communications were established from the remote, transportable station via the CTS to the Comsat earth station in Clarksburg, Md. and thence into the commercial telephone system. Thus, communications were achieved from the remote site in the George Washington National Forest to any place in the country having commercial telephone service. There were no physical connections at the remote site to telephone or powerlines. The terminal is completely independent and self-contained.

Demonstration

The site selected was representative of a fire camp or command post site. It was a clear, flat area off the main road and near forested wildlands. The Comsat earth terminal equipment had not been tried in this location or any place near it previously, so the situation was a realistic field demonstration and not a laboratory experiment.

The equipment was set up in less than an hour. The satellite was then located, a lock on the main antenna beam was achieved, the link to Clarksburg was established, and the telephone patch was completed. In less than 2 hours from the time the van rolled into the site, the complete setup and checkout were accomplished, and the telephone calls were being made.

Calls were placed simply by dialing the area code and number (operator intercept was only for long distance charges). Calls were placed to the FIRESCOPE Operations Coordination Center (OCC) in Riverside, Calif., the Boise Interagency Fire Center, and other locations from the east coast to the west coast. The line was quite clear at all times (better than some office-to-office calls). Those who were not aware of the demonstration were surprised when told of the routing of the call.

Copies of a map and a situation report were telecopied from the remote site to the FIRESCOPE OCC. The adequacy of the link for sending such information via telecopies was clearly shown. Teletype and other terminals compatible with the telephone system may also be used. Figure 2 shows a terminal and telephone adjacent to the van with the antenna in the background.

Fitting Accomplishment

According to Bill Morton, Leader of the Forest Service Washington Office Communications and Electronics Group, last year marked the 60th anniversary of Forest Service field communications. It is fitting that this first direct use of a satellite for field communications by the Forest Service was accomplished in 1976.

Summary

The technical and operational feasibility of using a transportable earth station for reliable communications from a remote site in Forest Service applications has been adequately demonstrated. The remote terminal can be packaged in a land vehicle, or it can be airlifted.

There is still considerable effort required in determining operational satellite availability, channel availability, frequency allocations, licensing, regulations, and completing necessary agreements before the system can be made available for routine or emergency operations. Developmental work is underway in research, working in conjunction with the Forest Service's Washington Office Communications and Electronics Group on the allocations and regulations, to provide such a system.

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