THE WESTERN FIRE FIGHTERS' MANUAL

Chapter V

THE LOOKOUT SYSTEM

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DEVELOPMENT OF THE LOOKOUT SYSTEM

The first forest fire lookout stations were established about 25 years ago. Today there is very little timbered acreage in the entire Northwest that is not under the watchful eye of one or more lookouts.

Under old conditions each employee was given a definite territory to protect. He spent most of his time in patrolling trails or making an occasional trip to an observation point. If he discovered a distant fire outside his district, the knowledge was of no value. If he discovered one in his own territory, he went to it and tried to put it out. When he could not do this alone, it required from one to three days to secure help. All the time he was engaged on suppressive work his district had no protection.

Under present conditions lookouts stationed on commanding peaks specialize in the work of detecting, locating, and reporting fires. If properly equipped, they can determine within a few feet the location and approximate size of any fire which can be directly seen up to 20 or 30 miles away. The facts are immediately reported and in a few minutes members of the local suppressive organization are on their way. As there is no disruption of the detective agency, the territory is protected all the time. Old fires are under continuous surveillance, and reinforcements frequently dispatched on the basis of the lookout's report alone.

The lookout system has come to stay because it has proved to be the most economical method of securing early discovery and prompt action upon fires which occur at random throughout a broad territory. Ground patrol, on account of excessive cost on acreage protected, is now confined almost entirely to restricted areas of high risk such as railroad rights-of-way, heavily traveled highways, logging operations, etc.

Air patrol has been thoroughly tried out for many years. It is now clear that it can only be used to supplement and not to replace lookouts for detection work. Visibility is good and smoke which is showing up above the timber at time plane passes can usually be detected and located with a fair degree of accuracy. Their weakness for this work is that any given territory is under observation for only a few minutes each day. Occasionally they can be used to advantage for supplementing the lookouts immediately after bad lightning storms on areas which are incompletely covered. Also they can occasionally be used to excellent advantage in reconnoitering large fires.

Although the lookout system is popular in its present stage of development **it is probable that as a whole its efficiency can be greatly increased with little or no increase in personnel.** The main lines for accomplishing this are:

1. Through the completion of "a standard lookout house or tower on the most commanding point of each station." This results in securing better personnel, and more continuous service.

2. Through furnishing modern instruments at all stations. This enables the employee to furnish more specific and reliable information.

3. Through more thorough instruction of lookouts.

4. Through more extensive and stable lines of communication.

5. Through use of forms which insure securing all essential data.

6. Through development of clearing houses or better systems for handling and forwarding information supplied by lookouts including more adequate equipment for platting or solving locations of fires sighted.

7. Through closer co-ordination of detective and suppressive branches of the organization.

8. Through a more careful study and application of systems which will help the firechaser find fires on the ground.

ORGANIZATION

The lookout system, based on specialization of work with a high degree of co-operation, functions through the following units:

1. **Primary Lookouts stationed** on the highest peaks, commanding a maximum range of territory. As a rule their duties are solely to discover, locate and report fires.

2. **Secondary Lookouts** stationed on less prominent peaks which command a shorter range. Generally they are maintained only during the critical period of the fire season, and are intended to afford a more intensive control over areas covered, to some extent, by the primary stations. Usually their work is identical with that of the primary lookouts, except that **they may** be called upon to suppress any fires which lie within striking distance.

3. **Firemen Lookouts** stationed on strategic points connected with telephone and functioning primarily as firemen but used in intensifying the detective control up to the time they are needed to go to a fire.

4. **Emergency Lookouts,** who are normally employed on other work, but on approach of a lightning storm or during periods of poor visibility, are dispatched to developed and equipped stations for the purpose of intensifying detection during the high hazard period resulting from these conditions. (In some cases these men are also used for patrolling along ridges.)

5. **A Central Dispatcher** whose main functions are to look after technical work of the lookouts, plat locations, and, in the absence of the local ranger or warden, to assume full responsibility for securing immediate action on fires.

6. **Firemen** located at strategic points throughout the district and always within easy summons of the telephone.

The effectiveness of this system depends not only on the alertness and skill of the lookouts in discovering, locating and sizing up fires; but also on provision for assisting the fire chasers or suppression crews to find these locations on the ground.

The suppressive branch of the organization is usually composed of:

Firemen as described above;

Small Improvement Crews employed at strategic points and where they can be quickly summoned;

A Nucleus Overhead Organization which can be quickly assembled and transported in case of large fires.

The **Supervisors, Rangers** and **Wardens** have general supervision over all branches.

This chapter deals only with the detective branch of the organization and is divided into four parts: Lookout Improvement and Equipment, Instructions to Lookouts, the Dispatcher, and the Firemen.

I. LOOKOUT IMPROVEMENT AND EQUIPMENT

SELECTION OF STATIONS

The selection of lookout stations is a complex problem in which the main objective is to secure a combination of stations which taken together will insure an adequate degree of detection over the entire timbered region, taking into account the probability of occurrence, of spread and damage, varying degrees of hazard and probability of discovery from other sources. For this reason each station should be considered not as an individual unit but as a part of a series of co-ordinated stations. As a general rule the objective should be to obtain direct view into all parts of the territory from at least one station and to cover a major part of it from at least two stations, viewing it from different angles. This is highly desirable for the following reasons:

(a) It greatly reduces the percentage of blind areas which cannot be seen directly on account of intervening topography.

(b) It permits the securing of cross shots and more accurate location of fires that are sighted.

(c) It greatly increases the probability of early discovery.

Naturally the range of vision of any station does not end with administrative or ownership boundaries. It may be truly said that if we are to secure the most efficient utilization of the man power available, there is no phase of protection work when 100% cooperation among those responsible for the protection of adjoining territory is so absolutely essential as in the development of a series of lookouts.

Theoretically the total number and location of observation stations which are necessary to furnish adequate detection for a given territory should be determined before any improvement work is started. In actual practice, however, this has not been done for the reason that it has been necessary to develop the stations which would furnish the best immediate detection which could be obtained from the man-power and funds available. As a result of this, whenever a new station is to be added, a new combination is involved which may indicate the shifting of an old station to some other location in order to obtain the best results.

In many cases the best combination of stations is perfectly apparent to anyone who is familiar with the region, while in others it may be necessary to visit a number of peaks, possibly including the preparation and comparison of visibility maps before the best selection can be made. The use of graduated panoramic pictures in such cases are particularly helpful. The possibility of installing telephone service is always a major consideration. Areas of high hazard (such as old burns) should naturally be given more intensive detection service than areas of lower hazard.

As a general rule there should be no hesitancy in sacrificing a limited acreage in the local protective unit when a much larger acreage would be benefited in an adjoining unit.

DEVELOPMENT OF STATIONS

When the location of a permanent station is once definitely determined, plans should be made to provide substantial living quarters as soon as possible on account of extreme weather conditions which is characteristic of lookouts and in order to secure more effective service.

The one and only site for a lookout house is on the extreme summit of the peak and where a maximum view of the surrounding country can be seen directly from the house itself. The main objective is to give the man proper shelter and at the same time secure a location and adopt a type of construction which will permit a maximum view of his territory at all times and facilitate making necessary observations.

Many excellent types of standard houses and towers have been developed by protective organizations in various parts of the country during the past several years. The houses vary considerably as to size but the majority of them are either 12 x 12 ft. or 14 x 14 ft.

Certain principles in regard to houses and towers are:

1. That since houses afford an opportunity for much more continuous service than observation towers alone, the former are preferable in all cases where an adequate view exists or can be developed at a reasonable

FIG. 1

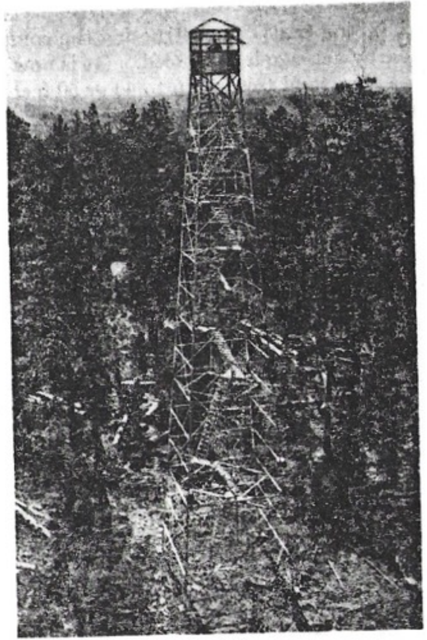

FIG. 2

cost, through falling trees or constructing the complete house on towers of modified height even though a small amount of nearby acreage is sacrificed. (It is now common practice to construct standard 12x12 or 14x14 houses on pole, timber, or steel towers up to 40 or 50 feet in height.) Figs, 1 and 2 show two types of standard tower construction; the first a low wooden tower with a standard 14x14 house, the second a tall steel tower with a 7'x7' observation inclosure.

2. That all purely observational towers should be provided with a suitable enclosure.

3. That both living and observation quarters, whether combined or separate, should be provided with maximum window space.

(a) Corner posts and window frames should be just as narrow as good construction will permit.

(b) Top of glazing should be above level of eye when in standing position. This means at least 5½ feet above floor.

(c) Bottom of glazing should be low enough to permit:

(1) Seeing major part of territory from a sitting position in any part of room.

(2) Obtaining direct azimuth and dip angle readings on any fire located more than a mile or so away from station.

See Fig. 3, page 19.*

For 12x12 or 14x14 houses bottom of glazing should usually be not more than 26" above floor.

* Usually precise readings on **close-in fires** are not essential, and it is generally better to sacrifice precision on a relatively small amount of close-in area than to go to unreasonable extremes in construction.

4. That inclosed observation towers and cupolas on houses afford the following advantages in addition to any increased coverage:

(a) The psychology of getting away from the living quarters and into observation quarters where there is less to distract one's attention tends to improve the efficiency of detection work.

(b) There is no center obstruction to view or movement in living quarters.

(c) That the smaller dimension of cupolas permits using a lower fire-finder stand, facilitates problem of dodging corner obstructions and in general affords a better and less interrupted view of territory.

5. That particular attention should be given to making floors rigid, so that level adjustments will not be disturbed by walking around instrument.

6. That all cupboards and other furnishings be kept above or below top and bottom level of windows. All chairs should be relatively high and bunks should preferably be about as high as lower level of window so as to increase height of eye while sitting.

7. That all lookout houses and towers should be provided with a standard or approved system of lightning protection. Detailed plans and specifications for protecting various types of houses, towers and telephone lines can be obtained from the U. S. Forest Service. These plans have been thoroughly checked and approved by the U. S. Bureau of Standards and are considered adequate in every respect.

FUNDAMENTAL REQUIREMENTS IN DEVELOPING A LOOKOUT SYSTEM

One of the first and most important steps connected with the building up and operation of the lookout system is:

1. To determine and map the exact location of all stations by latitude and longitude or in reference to each other by bearing and distance instead of simply by ties to some near section corner.

2. To obtain accurate orientation data for every lookout. (This is usually accomplished in conjunction with determining location of station, but in some cases it may be necessary or desirable to obtain it by means of an observation on Polaris in accordance with regular engineering practice.)

3. To improve the compilation and positioning of land lines and all other details of the base map.

This all requires systematic planning, careful work and some expense.

The first step toward accomplishing this program is to cut in and map all stations by accurate triangulation survey methods starting from two or more stations which are known to be accurately located by latitude and longitude. This is not as difficult as it might seem, since in practically all parts of the country there are a sufficient number of precisely located and well marked U. S. Geological Survey or Coast and Geodetic points to serve as base lines or starting points. On each of these stations there is a bronze tablet, marker or signal whose position has been determined with the utmost precision. We may assume that the position of these **spots** on the face of the earth, by latitude and longitude, and in reference to each other by bearing and distance is accurately known to within a few inches. By occupying any two of these stations with a good transit and using mirror flash signals, which can usually be seen for 30 miles or more, it is usually possible to cut in and locate several lookout stations with an error of not over 10 or 15 feet. The azimuths taken at this time would of course be reversed, corrected for curvature and used for future orientation purposes from all cut-in stations. They should be accurate to within one minute. This same procedure can then be repeated from the newly established stations, using preferably a transit but admissibly an accurately oriented fire-finder provided it is capable of reading angles accurately to within 1 or 2 minutes. (Frequently it is necessary or more convenient to determine location of stations by reversing this procedure; i.e., by occupying the lookout stations with a transit, obtaining a true meridian by observation on Polaris and then measuring the angular distance between two signaled U. S. G. S. points which can be used as a base for computing location of occupied station.)

When this is accomplished and the position of all lookout and other primary or secondary control stations determined and accurately mapped, the next step is to improve or correct the registration of land lines and all other drainage or topographic features which have been mapped in reference to land lines only, so that they will be properly positioned by latitude and longitude or in reference to each other and to all other topographic features which have been located or mapped by triangulation or trigonometrically controlled surveys.

This is done to a very large extent by simply tying in nearby section corners and other traverse surveys to primary or secondary triangulation control stations such as U. S. G. S. stations, lookout stations, and certain other cut-in control points.

This general type of work has been going on for many years now in connection with the compilation of all maps used in conjunction with protection work until now in most sections the precise location of practically all lookout stations has been determined, very accurate orientation data assembled, and the base maps greatly improved so that land survey lines, drainages and topographic features are fairly accurately located in reference to each other and to all lookout points.

An excellent method for preserving orientation data for a series of lookouts is to make a diagramatic layout or skeleton map giving approximate position of all lookouts and orienting points, connecting those which are to be used for orienting purposes and writing in along line the exact azimuth to be used. In addition to this there should be a record describing the specific object to be sighted on.

Extra copies of such a layout also are convenient for recording in a diagramatic way any ties to nearby section corners, etc., which should be shifted in next map compilation.

NECESSITY FOR ACCURATE ORIENTATION AND ACCURATE READINGS

The location of most fires sighted by lookouts is determined by platting the intersection of observations reported from two or more stations. In other words, it is a case of locating an object by triangulation involving exactly the same procedure as would be followed by an engineer in doing surveying work with a transit. In surveying work it is axiomatic that angular readings used in triangulation work must be made with the highest degree of accuracy, particularly in the case of long sights. In lookout work surveying methods and principles are being used and the importance of accurate angular readings cannot be over-emphasized if the best results are to be obtained from the large investments which have been made in the development and annual manning of the station.

Only three things are necessary to enable one to determine with a very high degree of accuracy the exact location of any fire that is sighted on directly from two or more stations. These are:

1. A precise azimuth reading obtained from each of the stations with accurately oriented instruments.
2. A platting map which gives the precise location of each lookout station in reference to each other.
3. Suitable equipment for accurately platting the readings as sent in from the lookouts.

The fire finder is the lookout's transit and with instruments, which are capable of reading angles within one or two minutes, it is a very simple matter to determine the location of these fires as accurately as they could be determined by a surveyor working with a transit, but in order to do this **the lookout's instrument must be accurate and precisely oriented at all times.** The desirability of using fire finders which can be kept in adjustment and will insure obtaining accurate readings, cannot be over- emphasized.

In making this statement it is clearly recognized that occasionally topography and cover conditions are such that no serious delay results even though there is an error of ½ mile or more in the platted location of the fire.

In other cases, however, particularly in connection with small lightning fires in heavy timber, there are a great many cases where delays caused by small errors in location have resulted in very large and costly fires. The argument that accurate instruments are not needed, because of inaccuracies in the maps on which platting work is done, is a fallacy. If both the map and instruments are inaccurate, there is no way of knowing which is wrong in case of discrepancies. If the instrument is accurate and properly oriented and discrepancies are found, it is perfectly apparent that the map is wrong and that corrections can be made according to the instrumental readings. Until this is done correction factors can be used for all fires located in the same vicinity. (See page 69.) Inaccurate instruments are a source of constant trouble and frequently relatively small errors pile up in a very serious manner.

Assume, for example, that a fire finder can be read no closer than 15 minutes; this means that there is apt to be an error of 15 minutes in its orientation. When a fire is sighted, there is apt to be another error of 15 minutes, which may be compensating or accumulative. This means that the reading may be accurate or in error by 30 minutes. An error of 30 minutes in readings from two lookouts on a fire 20 miles away would give an error in location of ¼ mile on a 90° intersection and an error of 1¼ miles on a 15° intersection. An error of only ¼ mile means that one would have to search over 160 acres and since one can easily pass within 300 or 400 feet of a small lightning fire in heavy timber without seeing it, such an error may easily result in a delay of several hours in arriving. An error of 1 mile may result in its not being found for days. The case cited is a very simple one.

If now the instruments on other lookout stations had been oriented by the usual foresight-backsight method, the error of 30 minutes might well be increased to a degree or more. Many of the early type instruments, instead of measuring angles accurately to 15 minutes, as in the case cited, were subject to errors of a degree or more.

EQUIPMENT OF STATIONS

The Lookout's working equipment should as far as possible include the following items:

1. **A fire-finder capable of measuring both horizontal and vertical angles** with a high degree of accuracy and equipped for shifting center to dodge obstructions without disturbing orientation more than a minute or two. A spirit level, screw driver, flat wrench, oil, extra horsehairs, etc., are necessary accessories.

2. **Binoculars or Telescopes.** As a general rule fires will be detected just as quickly with the naked eye.* However, after something is sighted which looks like smoke they are of considerable assistance in determining whether it is smoke, dust, or something else that under certain light looks like smoke. This reduces delay in reporting real fires, and reduces danger of reporting fake fires. Also they are of **great value** in bringing out details of drainage which may assist the observer in making a more accurate location or furnishing a better description of local landmarks.

3. **Colored glasses and a celluloid eyeshade** should be classed as essential. They protect eyes from strain and result in better service. Light amber glasses are considered the best of the colored glasses. Recently, however, a careful study of this subject by the Pacific Northwest Forest Experiment Station has shown that many cheap glasses are defective and injurious and that smoked glasses with ground lenses result in the best protection and vision.

4. **A dependable alarm clock** for insuring special concentrated survey of territory at prescribed periods should be classed as essential.

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* Field of vision is too small for general use in covering large territory and usually contrast of colors are not as clear as with naked eye. For the same magnification telescopes are much cheaper than binoculars, but of course have a much smaller field.

5. **A good mirror,** at least 10"x12", to serve as target for triangulation work between lookouts. (Preferably these should be framed, provided with a ¼" hole in center, swivelled both ways and mounted on a telescoping tripod. To obtain both horizontal and vertical alignment for flashes, a stick with nail in top should be set at least 20 or 30 feet away. When plain mirror is used nails in top of two sticks should be set in alignment and flash directed across both. For precise work always stand in line with center of house or tower.)

6. **A set of graduated panoramic pictures,** including names of peaks, ridges, drainages, etc., if available, is desirable for assisting lookout to learn his country and for locating fires at night or in hazy weather and for recording lightning strikes.

7. **A one-piece receiver-transmitter type of phone** which will permit Lookout to look at his map while reporting. (Preferably the phone box should be mounted in or on side of fire-finder stand. This can be done by bringing wires up through floor.)

8. **A low stool with glass insulator legs** to be used while talking over phone during lightning storms, also for purpose of obtaining better view of fire-finder map when stand is high.

9. Forms, pencils, etc.

THE FIRE FINDER

The lookout's fire finder corresponds to the engineer's transit. It is his principal working equipment. The amount and accuracy of the information which he will be able to furnish depends to a large extent on the perfection of this instrument and the degree of accuracy with which it is set up and in adjustment.

In the early days many crude home-made instruments were used largely on the basis that something was better than nothing. In their simplest form these instruments were made by simply drafting an azimuth circle around the outer margin or circumference of a map whose center is the lookout station, mounting this on a metal or wood base and providing a ruler type of alidade, one edge of which was pivoted over the lookout station.

In general, instruments of this character are subject to so many sources of error that they have been largely discarded. The only thing in their favor is their small initial cost but in the long run if one considers the drafting work involved in the replacement of maps every 2 or 3 years, they are probably just as expensive as good instruments. In the meantime the men employed as lookouts are not equipped for furnishing the information which they should and the entire protective organization is laboring under the disadvantages of partial, and in many cases, decidedly erroneous information in regard to the location of fires which are sighted.

Common sources of error which should be guarded against in any case where this type of instrument is still used are:

1. An uneven spacing of graduations.

2. An uneven expansion of the paper on which azimuth circles are drawn as this may result in an error of a degree or more on angles lying obliquely to grain of paper.

3. Inability to keep sights plumb as they are revolved on account of warpage in boards or wrinkling of paper surface on which they bear. Errors of one degree or more may result from this cause alone.

4. Inadequate indicators for reading the azimuth scale (often result in readings being made only to the nearest quarter or half degree).

5. Errors due to parallax. This is very apt to occur in any instrument where the indicator for reading the azimuth scale is not in direct contact with the scale and is caused by failure to look absolutely straight down on the indicator at time of reading. A slightly oblique view which often occurs unconsciously may result in an error of from ¼ to ½ degree or more.

6. A constant error on account of inability to originally obtain a precise orientation of instrument.

7. Inability to maintain accurate orientation either at a fixed point or when center is shifted in order to dodge corner obstructions.

8. From reading the azimuth scale counter-clockwise or backwards, as for example, making a reading of 173° instead of 167°. Unless automatically prevented this error does occur quite frequently and is particularly serious in that it may vary anywhere from 1 to 5 degrees or more.

Under present day conditions, with a better understanding of the importance of obtaining more accurate and complete information on fires sighted, most protective organizations are using precisely machined instruments which are capable of measuring both horizontal and vertical angles with a high degree of accuracy and which automatically eliminate many common sources of error in operation and also provide for shifting nter, in order to dodge obstructions, without in any way disturbing the precise orientation of the instrument.

The large Osborne fire finder which is most widely used at the present time is fairly comparable to a transit for measuring both horizontal and vertical angles. All bearing surfaces are precisely machined and its azimuth circle is engraved with the same dividing engines used for graduating transits. The spacing of graduations is therefore just as accurate as on a transit, but the large diameter of 24″, which is 4 to 5 times that of a transit, results in an open or coarse graduation that is very easy to read. The tangent scale used for measuring ve angles is based on a radius of 22″, which is 11 times the radius of the vertical arc on most transits. It is d to 10′ and can be easily read directly by eye to within 1 or 2 minutes. Standard specifications on these ments require that they shall be capable of measuring horizontal angles accurately to within at least 2 minut and vertical angles to within at least 4 minutes. Also that its orientation shall not be disturbed more than 2 minutes through shifting to any position on either set of tracks.

The Forest Service purchases these instruments each year on the basis of competitive bidding. There are no royalties involved and usually arrangements can be made so that any protective organization can obtain the benefit of the Government contract price. In addition to this, however, Leupold, Volpel & Co., of Portland, Ore., carry a surplus stock which is now quoted at $27.00 each.

General Rules for Setting Up Any Type of Fire Finder

On account of variations in numerous small details explicit directions should accompany each instrument when sent out by the manufacturer.

With any type of instrument the outstanding essentials in setting it up are:

1. That the post or stand on which the instrument is to be mounted must be extremely rigid and so firmly attached to floor that there is no possibility of its being turned or twisted.

2. That the base map is in proper position with reference to the Azimuth graduation.

3. That the complete instrument is precisely oriented to a true north and clamped or otherwise held in this position.

4. That the instrument is absolutely level.

5. That front and rear sights are both absolutely plumb and remain so as sights are revolved.

6. That some adequate provision is made for shifting center to dodge obstructions without disturbing orientation.

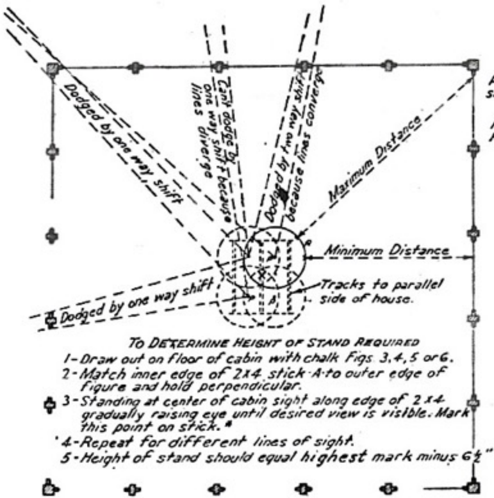
Fire-Finder Stands

The fire-finder stand corresponds to the engineer's transit tripod except that in the former case the objective is to prevent **any movement for an entire season.** For this reason it must be of extremely rigid construction and very firmly attached to floor. The slightest twist or turn will throw instrument out of orientation, any rocking will throw it out of level. The three types of construction most commonly used are well braced stands, paneled cupboards, and pedestals of wood or metal. Wooden stands are preferred as they are usually more rigid and safer in respect to lightning. An excellent type of construction is illustrated in Fig. 5, page 20.

The height of stand is also important in that it must be sufficient to permit obtaining necessary alignments through the window space provided. On account of the many variable factors involved the best method for determining height of stand needed for any given case is to make a temporary set-up or solve by method illustrated in Figs. 3 and 4.

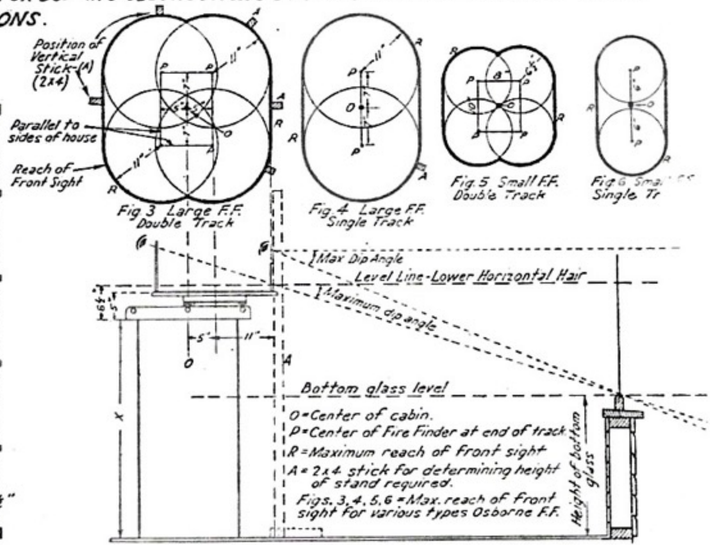
All stands should be painted to reduce swelling and shrinkage.

LAYOUT OF FIRE FINDER POSITIONS & METHODS FOR DODGING OBSTRUCTIONS & FOR DETERMINING HEIGHT OF STAND FOR ANY CONDITIONS.



R-6-1930-14'x14' L.O. House showing methods of dodging obstructions and factors involved in determining height of stand required.
* Sacrifice dip angles on small area rather than make stand too high

FIG. 3.



Illustrating a double track mount and how to determine height of stand needed

FIG. 4.

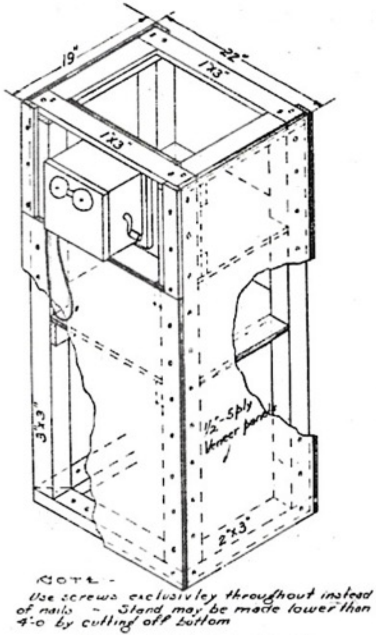


FIG. 5. Fire Finder Stand.

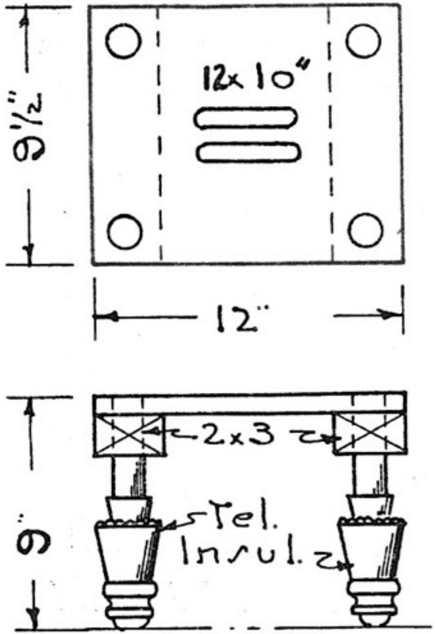


FIG. 6. Insulated Stool.

Positioning Base Map in Reference to Azimuth Graduation

The base map on any type of fire finder must be very accurately positioned in reference to its graduated azimuth circle. To accomplish this three things are required:

(a) The platted position of the lookout station occupied must lie at exact center of the graduated azimuth circle.

(b) A true North and South meridian line through platted position of lookout station must coincide with a straight line extended from the 0° to the 180° graduations of the azimuth circle.

(c) The **north** end of this meridian line must be adjacent to the **front sight** (vertical hair sight) of the instrument when its indicator or vernier is resting on 0°.*

Obtaining a True Meridian for Orienting Fire Finders

The object is to set and lock the azimuth circle in such a position that the line of sight will always be true north when the indicator or vernier is set on 0°. After this is done the reading on any object sighted gives angular distance from a true north. A convenient method for accomplishing this is to determine the absolute orientation of one instrument by means of an observation on the North Star (see any standard work on plane surveying); or by making use of a U. S. G. S. Azimuth in case some instrument happens to be mounted on one of their primary triangulation stations. All other instruments can then be precisely oriented by the usual method of foresighting and backsighting except that a small correction on account of convergence of meridians must be added or subtracted. This correction amounts to **.9′ for every mile of departure between stations** (i.e.) the distance measured due east or west from one station to a meridian passing through the other.

A convenient rule for computing the corrected backsight is as follows:

If foresight is **less than 180°, add to it 180°+.9′ for every mile of departure between stations.**

If foresight is **more than 180°, subtract from it 180°+.9′ for every mile of departure between stations.**

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* If the indicator or vernier of instrument is mounted on **front sight** the N. end of the meridian line will be adjacent to the 0° mark but if the vernier is on the **rear sight** (slotted sight) the N. end of the meridian line will be adjacent to the 180° mark.

Example

Let A = oriented instrument. B = instrument to be oriented. By measuring on the map due west from the platted position of A to a point due south of the platted position of B the distance is found to be 20 mi. The Lookout at A foresights on a mirror flashed from B and finds Azimuth to be 285°42′. As this is more than 180°. the corrected backsight from B to A $= 285°42' - (180° + .9' \times 20) = 285°42' - (180° + 18') = 285°42' - 180°\,18' = 105°\,24'$.

The Lookout at B should then set the indicator or vernier of his instrument on 105° 24′. Having done this he should **revolve not simply the sights** but **the entire upper plate of the instrument** until his line of sight cuts the mirror flashing from A. His instrument then is in perfect orientation and should immediately be clamped in place.

Leveling Instruments

This adjustment may be easily made with a spirit level. If leveling screws are provided they should be firmly locked as soon as adjustment is made. In using blocks or wedges care should be taken to insure permanency of adjustment.

Plumbing Sights

Vertical hair of front sight can be checked as follows:

(a) See that instrument is level.

(b) Hang a weighted thread or fish line from inside window frame and sight on it from bottom of rear sight slot. If hair does not coincide it is not plumb. On some instruments this can be corrected by shifting sliding bar at top of sight. On others it can best be done by shimming up the low side.

To check slot of rear sight:

(a) First make sure instrument is level and hair of front sight plumb.

(b) Now sighting on a small point or dot raise eye slowly from bottom to top of slot in rear sight. If the dot appears to move away from front hair the slot is not plumb. Can best be adjusted by shimming up low side.

Dodging Obstructions

In all cases where instruments are mounted inside a building it is desirable to have some method for shifting without disturbing orientation as occasionally corner posts, etc., will obstruct the line of sight. This can be accomplished by moving the instrument **in a straight line** in any direction but it must not be allowed to turn in the slightest degree. (See Fig. 3.)

Detailed Instructions for Setting Up and Orienting Osborne Fire Finders

1. See that stand is absolutely rigid and so firmly attached to floor that it cannot be moved or **twisted.** Also that top is approximately level and of sufficient height to permit reading necessary dip angles. (See Fig. 5.)
2. Mount baseboard on top of stand **with tracks parallel to side of house.** Using small spirit level, see that it is fairly level in both directions before screwing down to top of stand.
3. Mount complete fire finder (both plates) by fitting the grooves of lower plate to any one of the three parallel rails.
4. Adjust map to proper position in reference to the azimuth graduations. To do this first revolve sight-bearing ring D until the zero or arrow mark on vernier matches exactly with 0° of the **azimuth graduation**; then leaving the sight-bearing ring in this position, loosen the flat-headed screws around outer edge of map disk and revolve it on small center pin until the **red-inked meridian line** of map lies directly under the steel tape which extends across center of instrument and being sure that the **north end** of this line is adjacent to the **front sight "E"**. Look straight down on tape to check alignment and then clamp disk in place by tightening the flat-headed screws.
5. Level instrument as follows:
   - (a) Loosen all lock nuts on leveling screws and run them well up.
   - (b) Adjust all four leveling screws so that their lower ends protrude about ⅛″.
   - (c) Set the small spirit level furnished with all instruments on the **extreme outer edge** or **graduated**

rim of top plate **parallel to diagonally opposed leveling screws.**† Then turn both of these diagonally opposed screws at the same time, one up and one down (accomplished by moving both thumbs in or both thumbs out) until bubble rests at center. Now shift spirit level to position parallel to the other two diagonally opposed screws and level in this direction by same procedure. Then move back to first position and correct for any disturbance by second adjustment. Take out any rock by turning one screw only. Keep repeating until instrument is level in both directions and then run down and tighten the lock nuts, being careful not to disturb setting of the leveling screws. **The bottom edge of the rail-fitting grooves must never be raised above center of rail,** as reduced width would result in side play and affect accuracy of orientation. If there is not enough adjustment provided by leveling screws, baseboard must be made more nearly level by permanent wedges.

6. **To orient instrument.** Assuming that the true bearing or azimuth to a well defined orienting target (as another lookout house) has been determined or is known (say Az. 127° 25′) the procedure is as follows:*

(a) Revolve sight-bearing ring and set the vernier carefully on the given Az. (127° 25′).

(b) Leaving the venier on this setting and without touching the **sight-bearing ring,** loosen the clamp screws "S" and revolve **the entire top plate of instrument** until the line of sight cuts the designated target.

(c) Clamp top plate in this position by tightening screws "S".** Then check both sight alignment and azimuth reading; if both are correct **the instrument is accurately oriented,** and with a rigid stand and reasonable care should so remain for days or weeks. Regardless of this the orientation and level adjustment of any instrument should be checked at least once a day.

† Don't set spirit level on the sight-bearing ring "D" as shown in Fig. 9. Set it **outside of this ring** on the graduated rim.
* See page 21.
** Tightening these screws may result in a slight movement of top plate, watch out for this and repeat operation when necessary.

In special cases where accurate orientation data is not available or easily obtainable from methods described on page 21, a fairly accurate meridian can be determined by using the fire-finder for making an observation on the North Star, as follows:

1. Ascertain from an Ephemeris or otherwise the **exact local time** at which the North Star will reach point of culmination on its eastern or western swing and just what its **departure** from true north will be at that time. Given this information—

(a) String a long horsehair from front to rear sight of fire-finder by means of the small holes provided at top center of both front and rear sight (see Fig. 10, "P"). This will lie in a vertical plane with front hair and rear slot of sights and permits obtaining the necessary vertical alignment.

(b) Set vernier on the **departure** above mentioned and loosen top plate of instrument by releasing screws "S".

(c) At the exact **local time** specified revolve the entire top plate of instrument until line of sight cuts the North Star. Then clamp upper plate in this position. In case the North Star cannot be seen from center of cabin make a temporary set-up near window or outside of house. Level instrument carefully and be sure to sight on some distant object to serve as an orienting point before it is disturbed or moved back to its regular mount.

Operation of Fire Finders

All fire finders should be equipped for doing four things:

1. **Measuring precisely the horizontal angle from a true north to any object on which its sights are trained.**

2. **Automatically delineating, on an oriented map of the country surrounding the station, the line of sight through any object on which the instrument is sighted.**

3. **Scaling accurately the distance from lookout station to estimated location of fire.**

4. **Measuring precisely the vertical angle,** or the angle above or below a plane level with the observation station.

The horizontal angle from a true north or exact bearing from the lookout station to the fire is determined simply by sighting on the fire and reading the degrees and minutes as indicated by the pointer or vernier. (See Figs. 7 and 8.)

Detailed Instructions for Operating Osborne Fire Finders

After a fire finder has been set up, adjusted and oriented its operation is extremely simple. When a fire is discovered the procedure is as follows:

1. Determine its true bearing or azimuth from the lookout station by simply sighting on **center of fire** and then reading from the azimuth circle the degrees and minutes as indicated by the vernier which is mounted directly below the rear sight (see Figs. 8 and 10).

2. Measure the vertical angle from the lookout station to the fire by sighting through the small peep sight "I", Fig. 10. If the fire is **below level of lookout** slide the peep sight up or down until **the lower horizontal hair** "O" cuts the fire. The **minus** or **dip angle** is then read from a scale **on right side of slot.** If the fire is **above level of lookout** point proceed in same manner, but **use the upper horizontal hair** "N" and read from the scale **on left side of slot.*** A small scratch on sliding peep sight serves as an index point for reading the vertical angle scale which is graduated to 10-minute divisions but can be easily read to 1 or 2 minutes by interpolation.

* In cases where all fires will be below level of lookout stations the upper horizontal hair "N" should be removed and a piece of paper stuck over opening on left side of sliding peep sight. This eliminates any danger of sighting with the wrong hair or reading from the wrong scale.

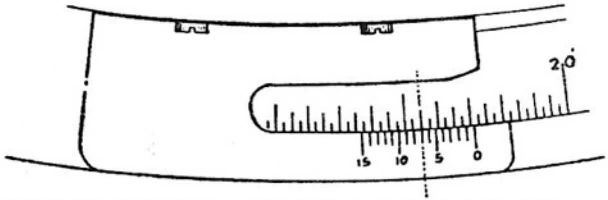


FIG. 7. 15 minute Vernier used on Instruments Graduated to ¼ degree

Correct reading 22° 52′. Rule: Use 0 line of vernier as indicator and read value of last division to right on azimuth circle (22° 45′). Note value of mark on vernier scale which matches on any line of the azimuth circle (7′) and add (22° 45′ + 7′ = 22° 52′).

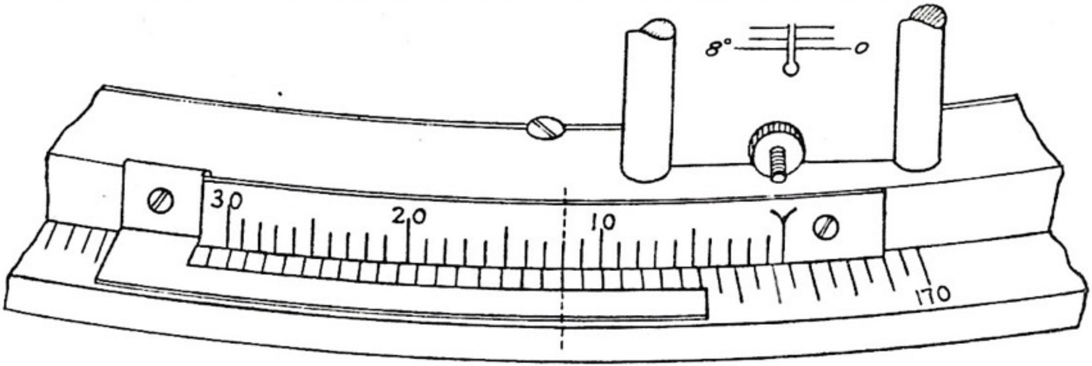


FIG. 8. 30 minute Vernier used on Instruments Graduated to ½ degree

Correct reading 173° 42′. Rule: Use arrow or zero line of vernier as indicator and read value of last division to right on azimuth circle (173° 30′). Note value of mark on vernier scale which matches on any line of the azimuth circle (12′) and add (173° 30′+12′=173° 42′).

On earlier models there is only one horizontal hair in front sight. With these the vertical angle scale attached to rear sight has a minus (—) value when the sliding peep sight **is above 0°** and a plus (+) value when it is **below 0°.**

On still earlier models vertical angles are read by means of a fixed peep sight located about ¼" above top of slot in rear sight and a movable pointer which registers on a scale attached to front sight.

3. Determine the map location of fire. To do this make sure that the sights are trained on the fire. Then leaving the sights in this position, **look straight down** on the steel tape which is stretched across center of instrument. This appears as a hair line **and will define on the instrument map the exact line along which the sights are trained.** That is **the platted position of the fire must be somewhere on this defined line.** By studying the topography along line of sight it will be observed that the fire is beyond certain known streams and ridges and that other streams and ridges lie beyond the fire. Since these streams and ridges are also shown on the map, the observer can usually determine very closely **where on the defined line of sight** the fire should be platted. **Mark this point on the map with a pencil.**

4. Measure distance to fire. This distance in inches from lookout station to **pencil mark** or mapped location of fire is simply read off from graduations on the bisecting steel tape and converted into miles in accordance with scale of map used. Always measure the distance carefully to 1/16 or 1/32 of an inch. Don't try to make an ocular guess of distance. Always **mark** location and scale distance.

5. Measure angular distance between edges of fire and compute its actual width in feet as explained on pages 44 and 45.

6. Measure difference in elevation between top of ridge and location of fire as explained on pages 47 to 49, if conditions warrant it.

7. To dodge structural obstructions to line of sight simply slide instrument forward or back along track. If this does not afford clearance lift it up and set it over on parallel set of tracks (see Figs. 3 and 10).

On certain old model instruments an apparatus for measuring vertical angles and also making a **panoramic** profile consists of a fixed peep sight located about ¼″ above top of slot in rear sight and, on the front sight, a perforated brass belt running on spiked wheels and controlled by a milled wheel and pinion; the belt running vertically carries a pointer and indicator set horizontally and at right angles to the column of sight. The indicator slides over an etched tangent graduation, attached to the outer face of the sight. The same pinion which moves the belt carries a cogged wheel, which moves a pencil-bearing rack forward and back across the upper plate of the instrument in line with the column of sight.

The **vertical angle** on any desired object is secured by looking through the fixed peep sight and bringing the pointer attached to the brass tape to bear on it, and reading the angle shown by the indicator on the tangent graduation.

By releasing a spring which brings the pencil in contact with a celluloid or paper ring which can be superimposed on the map a **panoramic profile** can be automatically sketched by sighting through the round peep and holding the tip of the pointer (or cross formed by end of pointer and vertical horsehair) on a ridge line, mountain top, lake shore, edge of burn, etc., as the sight bearing ring "D" is slowly revolved. This sketch should be inked, and names written in. Then the relative positions of any objects sighted may be secured simply by looking through the peep of rear sight, bringing pointer to bear on object and dropping pencil.

Since graduated panoramic pictures are far superior to any profile map, this model has been disconti- However, **one adjustment** on this type of instrument which should always be carefully watched **in me vertical angles is to see that the pointer and indicator are both in a line at right angles to the ve hair of front sight.** This can be checked by means of an ordinary sheet of paper having square edges.

General Rules for Sighting and Reading Any Fire Finder

1. Always use the slot rather than the sliding peep sight for measuring **horizontal angles.**
2. **Always hold eye as far down on slot as possible** as this minimizes any possible error from sights being out of plumb.

3. Always be sure that you are reading the azimuth graduations in a clockwise direction and giving the proper value to ½ or ¼ degree graduations. (On most Osborne fire finders the azimuth numerals lying to left of vernier index are covered by a guard which prevents reading graduations counter clockwise.)

4. In reading vertical angles always observe whether it is a **plus** or a **minus** angle and also the direction in which the numerals are progressing, i.e., don't read backwards on scale as —6° 20′ when it should be —5° 40′.

5. Don't lean on instrument or stand while **setting sight** for horizontal or vertical angles.

Adjustments for Errors in Fire Finder Maps

After a fire finder has been set up, adjusted and oriented as above described, the bisecting steel tape should cut through the mapped position of any object on which it is sighted. If it does not do this it is due to some error in the map. This error, however, may be due to any one of the following causes:

(a) To an error in the construction of the inked meridian line used for positioning map.

(b) To an error in centering on instrument the mapped position of the lookout station occupied.

(c) To an error in the mapped position of the lookout station occupied.

(d) To an error in the mapped positions of the objects sighted which may be the result of paper distortion, of compilation errors or of errors in original survey.

Procedure for running down the specific cause of error and for correcting therefor is as follows:

1. Make a double series of azimuth readings on a number of mapped peaks on all sides of the lookout station. One series of readings to be made by **sighting directly on the peak** and the other series to be made by setting the bisecting steel tape so that it cuts through the **mapped position** of the peak.

2. Determine and record the **angular discrepancy** in the two readings on each peak by subtraction and note down whether it is a + or a — value (i.e.) whether the readings obtained from the map are larger or smaller than those obtained by direct sighting. (In selecting peaks to sight, choose U. S. G. S. points and lookout

stations as far as practical—All mapped points should be at least 5 or 6" from center of instrument; the farther the better.)

Case 1. If the **discrepancies** in readings are **approximately the same in all cases** it indicates that the map is accurate but that the **inked meridian** line is not. To correct for this simply sight on one of the peaks and revolve map disk until the mapped position of this peak lies directly under the tape.

Case 2. If the **discrepancies are approximately the same in all but one or two cases** it may be assumed that there is some error either in the mapping of this point or in the object sighted and an adjustment may be made as in Case 1.

Case 3. If the **discrepancies are erratic** (i.e.) large in some cases and small in others or of a + value in some cases and a — value in others, the error must be due to causes "b", "c", or "d":

Cause "b" (error in centering map on instrument). This can be easily checked by comparing the disk map with an unmounted map and scaling off distance to the center hole. If this is found to be inaccurate redrill the map disk and set over to proper position.

Cause "c" (error in mapped position of occupied station). This can best be checked by the central dispatcher by cutting in the position of the lookout station in question from reversed readings to 2 or 3 U. S. G. S. or lookout stations whose positions are known to be accurate or by use of the 3-point graphic method of determining a location. If an error is found change position of lookout station and redrill disk.

Cause "d" (errors in mapped position of objects sighted). The specific cause for these errors and the correction factors which should be temporarily applied to compensate therefor can best be determined by working in conjunction with the central dispatcher in accordance with suggestions offered on pages 67 to 69.

Orienting Fire Finders "By The Map" or By Compass Bearings

The practice of orienting Fire Finders "by the map" or on the basis of compass bearings is subject to so many serious errors and complications that it should not be permitted under any conditions.

In the first case any of the sources of error in maps as above described would result in the azimuth circle of the instrument not being properly oriented in respect to a true meridian. Results from this would be:

(a) That readings platted by the dispatchers and firemen from true meridians would not be along lookout's line of sight.

(b) That locations determined by the intersection of readings from 2 or more lookouts would not be accurate and there would be no way of establishing correction factors.

(c) That firemen would not be able to place themselves on the lookout's line of sight by reversing the lookout's reading which would of course be erroneous.

(d) That positions spotted on graduated panoramic pictures would not be accurate.

(e) That it would be impossible to run down sources of error or to make needed map corrections since one would not know whether discrepancies were due to errors in map or to the error in orientation.

In the second case it should only be necessary to point out:

(a) That under the most favorable conditions compasses cannot be read closer than to the nearest ¼ or ½ degree.

(b) That usually one does not know the exact variation that should be set off closer than a degree or so.

(c) That deflections of the magnetic needle on account of local attraction is particularly apt to occur on sharp peaks and may range from 1 to 15° or more.

Method of Preparing Maps for Fire Finder Disks

1. First ascertain precise position of Lookout Station.
2. Make a 1/16″ pinhole at lookout point to facilitate centering map on metal disk at time of mounting.
3. Using red ink draw a true North and South meridian through lookout point. Length of this line should equal diameter of map disk.
4. Write in Township and Range numbers across center of map.
5. Cut out map on radius 1/16″ less than radius of metal disk on which it is to be mounted.

Usually it is desirable to mount a ½″ scale map on one side of disk and a ¼″ or topographic map on reverse side as the lookout can easily reverse the disk as desired.

Method of Mounting Maps on Fire Finder Disks

The object in mounting maps for this work is to secure a moderately smooth mount without distorting angles through an uneven stretching of the paper with and across its grain. Many different materials and methods have been tried out but by far the best results have been obtained by mounting the map with shellac on a sheet of 22-gauge galvanized iron or tin.

The standard procedure recommended is as follows:

1. First drill a 1/16″ hold through exact center of disk.

2. Lay disk on table with a 1/16″ pin protruding through center.

3. Using a varnish brush, apply a **thin coat of shellac** to **metal disk** and also to **back of map** prepared as previously described.

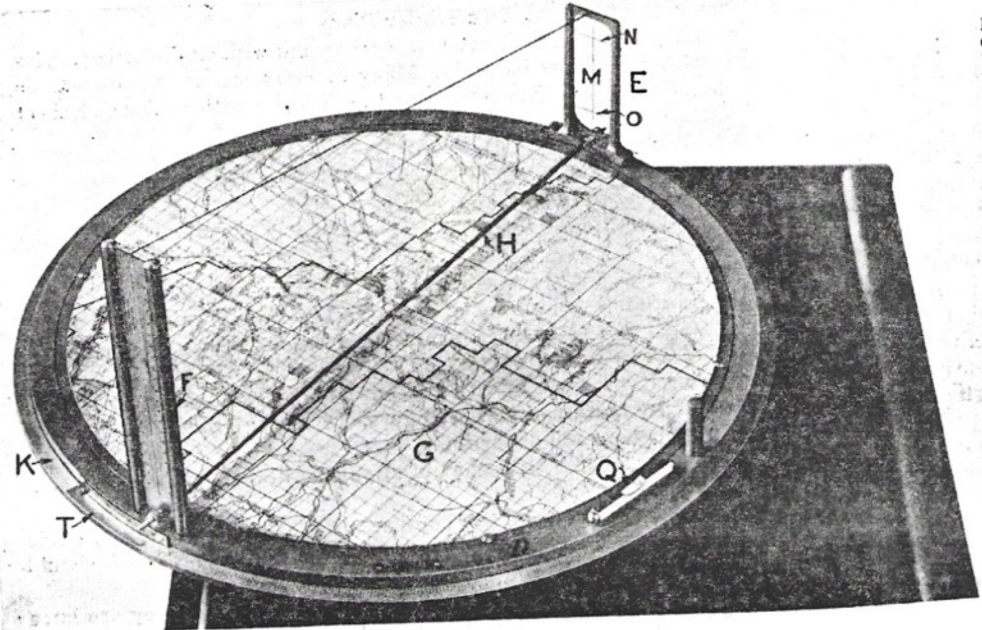
4. Allow the shellac to dry for several seconds until it becomes **slightly** sticky; then grasping map by edges center the lookout position by means of the protruding pin and hole in map, allow center to sag into contact with metal disk and then gradually lower edges so that the map falls into place without stresses. (Shellac becomes very sticky in two or three minutes, so must be worked rapidly.)

5. Work over entire surface of map, pressing it into contact with fingers. Remove swellings or air bubbles by **pricking through surface of paper** and **forcing the air out with fingers.** Don't use a roller or attempt to work air bubbles out to edge as this results in stretching and distortion.

6. For protecting **top surface** of map put on **first one thin coat of shellac.** Allow this to dry for about 24 hours and then put on one or two coats of **Spar Varnish.**

Don't use varnish for sticking map to disk or for first coat of top dressing. Varnish has a turpentine base is very apt to make paper transparent. Shellac has alcohol base and will not do this. Varnish should be used for second top dressing as shellac alone is apt to turn white when exposed to moisture.

Don't use wet paste or glue, they may give a smooth mount but usually do not last and **they are sure to cause serious distortion,** occasionally amounting to as much as 1 inch in 20.



A. Base board and track for shifting without changing orientation.
B. Lower plate.
C. Upper plate.
D. Sight bearing ring.
E. Front sight.
F. Rear sight.
G. Base map.
H. Tape for defining sight and scaling distance.
I. Sliding peep sight for measuring vertical angles.
J. Vertical angle scale.
K. Azimuth graduation.
L. Vernier.
M. Vertical hair for obtaining azimuth alignments.
N. Top horizontal hair for reading plus angles.
O. Bottom horizontal hair reading minus angles.
P. Hair used only for sighting North Star.
Q. Spirit level.
R. Leveling screw.
S. Screw for clamping top plate.
T. Azimuth guard, prevents "reading backwards."
U. Track spacer.
V. Grooves for preserving orientation when shifting center.

FIG. 9. Large Osborne Fire Finder, 1934 Model—Top View.

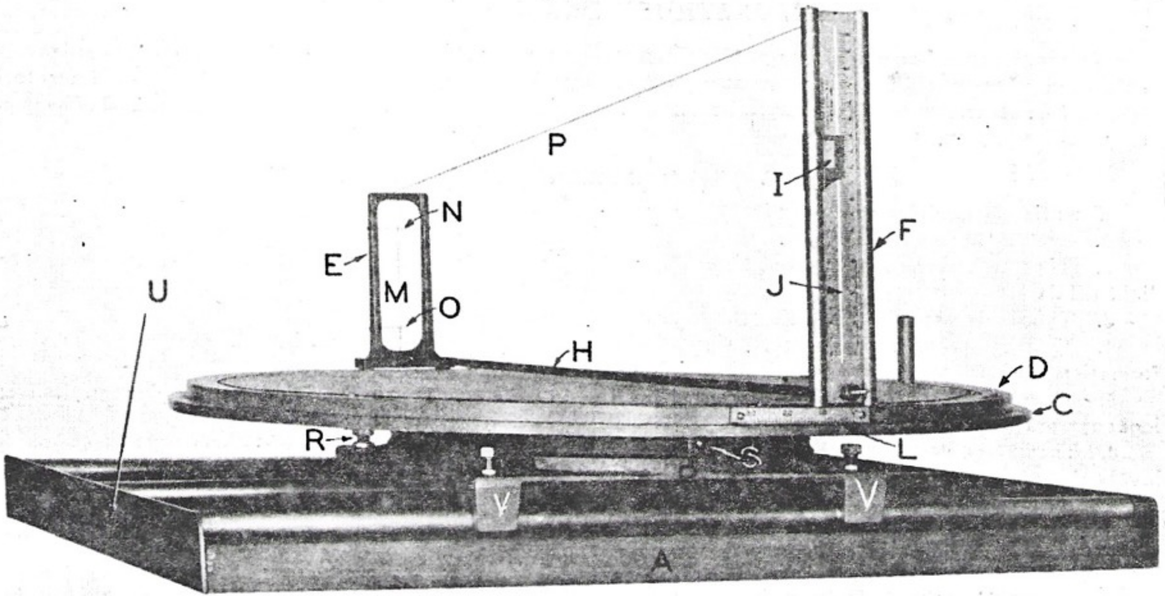


FIG. 10. Large Osborne Fire Finder, 1934 Model—Side View.

II. INSTRUCTIONS TO LOOKOUTS

The lookout is the eye of the entire protective organization. His duty is to keep the organization informed. The whole force is absolutely out of commission every minute he is off the job. Therefore he must be on the watch from daylight till dark. A man unable or unwilling to give this kind of service is not the right one for the place.

ESSENTIAL QUALIFICATIONS FOR LOOKOUT WORK

The primary qualifications for a lookout are:

1. That he have good eyesight.
2. That he be conscientious and both able and willing to render continuous detective service from daylight till dark.
3. That he be capable of learning the country visible from his station.
4. That he become proficient in the use of his instrumental equipment and in furnishing all essential information in regard to the size and location of fires sighted.
5. That he be capable of taking care of himself and able to endure the isolation usually characteristic of lookout work.
6. That he be capable of performing such other duties as may be required by the particular assignment involved, as for example the running down and suppression of fires in the case of firemen lookouts.

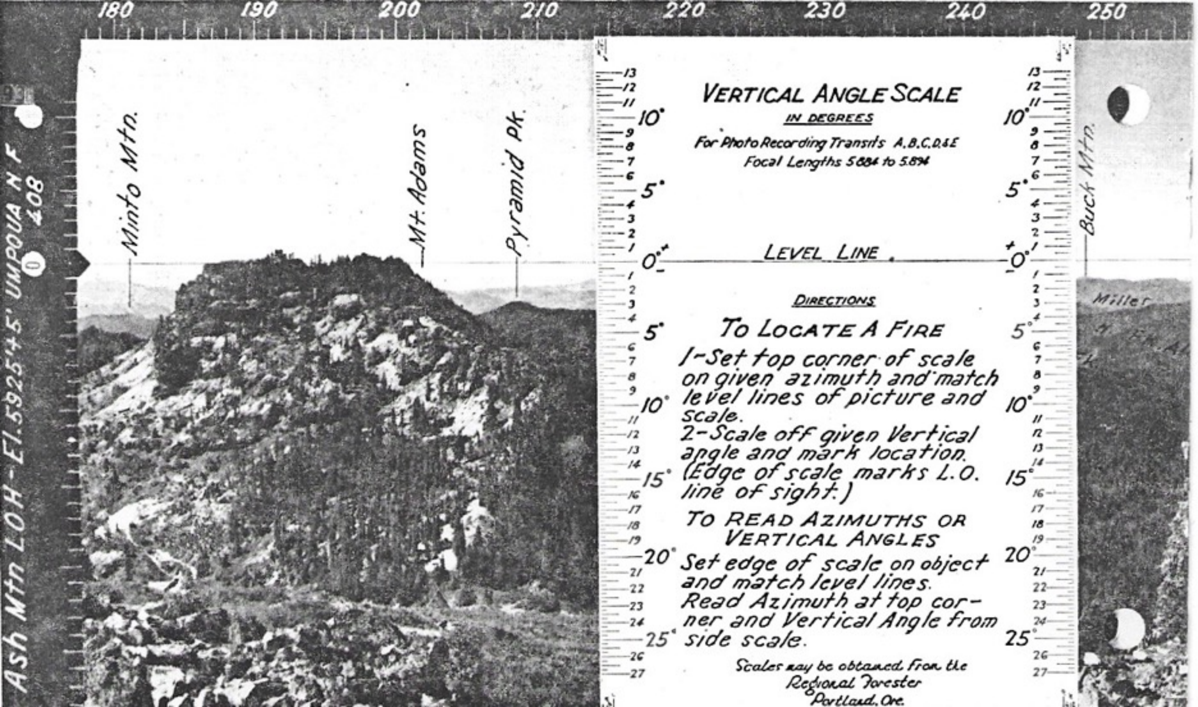
LEARN YOUR TERRITORY

It is essential that you familiarize yourself with the names and locations of all topographic features and landmarks you can see. Learn the names of all ridges, streams, meadows, lakes, etc., and identify them on the map. If they are not shown, plat them, and add other landmarks such as old burns, rock slides, patches of second growth, and any other distinguishable features which may be of assistance in determining the location of fires which may start near them. For your own convenience, and your successor's, map in and mark as "fake" any rock slides, patches of dead timber, or other objects which under certain conditions look like smoke; also any permanent mills or other sources of legitimate smoke. In mapping such data, secure a precise platted location if possible by obtaining intersections from other lookouts. When the graduated panoramic pictures are available these "legitimate smokes" and "fake fires" should also be marked on them.

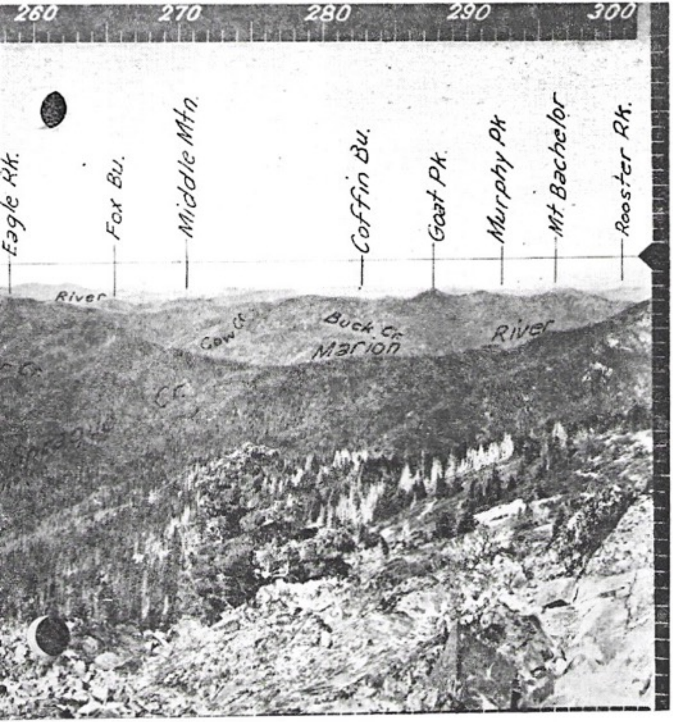
BE VIGILANT!

The lookout must be on the job morning, noon, and night. **The entire organization is depending on him to detect fires the moment they show up,** while they are **small,** before they have opportunity to **gain headway.** Small fires, and those cut off by intervening topography, can frequently be detected only by an occasional puff of smoke which rises above the timber at infrequent intervals. In order to detect such fires **promptly** he must have his territory under **general observation all the time.** This, however, is not enough. **He should be required to make systematic and concentrated inspection of every sector at fixed intervals** of from **one-half hour** to **one hour.** In making these he should start in at a certain point, say the north, and work around, carefully scrutinizing every drainage and ridge to make certain that there is no sign of smoke. These intensive inspections should be made **on definite time schedules** which are **staggered** for **adjacent lookouts** so that a given territory will be under **intensive scrutiny** from some point at very frequent intervals.

The importance of these intensive inspections is illustrated by the fact that after a fire has been discovered in a certain locality and other lookouts notified of its existence they are usually able to pick up promptly, through concentration, smokes which otherwise would not be discerned by general observation. It is not intended that these intensive inspections relieve a lookout of the responsibility of maintaining general observation of his territory between periods, but to supplement general observations by a degree of concentration which it would be impossible to maintain for any great length of time. **Each lookout should be provided with an alarm clock** to be set ahead as per schedule.



180
190
200
210
220
230
240
250
Ash Mtn LOH - El. 5925'+5' UMPQUA N F
408
Minto Mtn.
Mt. Adams
Pyramid Pk.
Buck Mtn.
Miller
VERTICAL ANGLE SCALE
IN DEGREES
For Photo Recording Transits A, B, C, D & E
Focal Lengths 5.884 to 5.894
10°
5°
LEVEL LINE
0°
DIRECTIONS
TO LOCATE A FIRE
1- Set top corner of scale on given azimuth and match level lines of picture and scale.
2- Scale off given Vertical angle and mark location. (Edge of scale marks L.O. line of sight.)
TO READ AZIMUTHS OR VERTICAL ANGLES
Set edge of scale on object and match level lines. Read Azimuth at top corner and Vertical Angle from side scale.
15°
20°
25°
Scales may be obtained from the Regional Forester Portland, Ore.



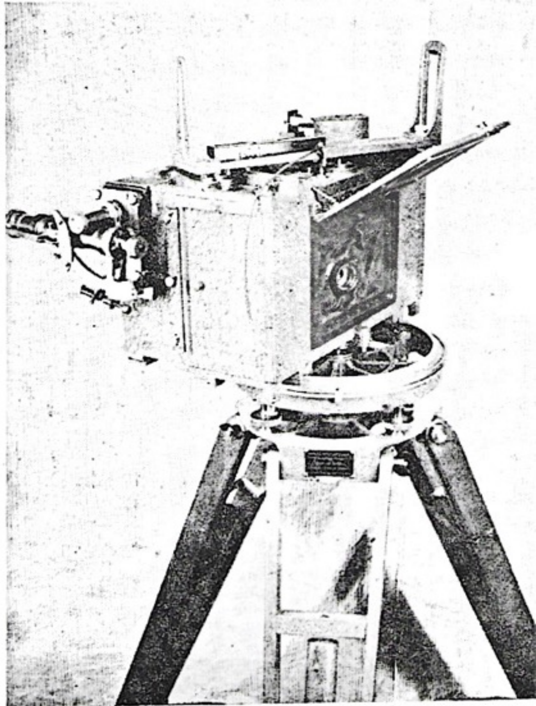


FIG. 12 Photo-Recording Transit.

Lookout should never be out of sound of phone except by permission of a dispatcher. When necessary to obtain water from a distance the time for doing this should be scheduled and coordinated with that of other lookouts.

Fires are most apt to become established during heat of day or within periods of low humidity. The most critical time of all is during and immediately after an electric storm. In many regions lightning causes from 25 to 80 per cent of the fires. Lookouts should always notify a dispatcher as soon as a lightning storm is sighted in the distance, so he can arrange for manning emergency lookout points, assembling men or having organized crews stand by. As far as possible both horizontal and vertical angles should be recorded on all points where bolts are seen to make direct hits in the timber.*

Frequently a direct lightning hit results in a distinct puff of smoke, steam, or dust. This does not necessarily mean that a fire has been established, but if this continues to show for more than two minutes the lookout should assume that a fire has been established and report it as such.

Fires sighted in the early morning, in the evening or at night give the firemen several hours to get in their work before the heat of the day, when of course they are most difficult to control.

REPORTS

The main aims of the lookout's report are to:

1. Show or furnish data for determining a precise platted location of the fire.

2. Give all additional information which will be of assistance in judging the number of men and type of equipment needed.

---

*In some cases these strikes can be marked directly on graduated panoramic pictures. The distance from lookout station to point of strike equals number of seconds between flash and report multiplied by 1100 feet or roughly a lapse of 5 seconds for every mile of distance. These points must be carefully watched, as frequently such strikes smolder for days or weeks before smoke can be detected. The angular readings and pictures enable one to keep track of exact spot to be watched.

3. Furnish all information which may help the firemen in finding the fire.

As it is of the utmost importance that this report be accurate and concise, and contain all essential data, it is recommended that a form similar to the one given on opposite page be used.

Always fill out the form as completely as possible, and **"read it off"** over the 'phone. This eliminates the danger of forgetting angular readings, and results in boiling down all essential data.

Those whom it may be necessary to notify are the dispatcher, ranger, warden or fireman, and other lookouts who may be able to secure cross shots. The first three should have a full report, the lookouts need only a description of the locality and smoke. The sequence in notifying them depends upon local conditions, and should be specified by the ranger or warden. Often two or three can be on the line at the same time. If you cannot get one party immediately, report to others, then try again.

EXPLANATION OF FORM

The following detailed explanation is given to forestall questions, emphasize the importance of various items and offer suggestions in making use of information recorded. Everyone in the organization should study it thoroughly and understand its use.

The form is for the use of lookouts, dispatchers and firemen.

The **number** at top of report serves for identification. An independent series with initial letter may be used. When all lookouts are reporting to one dispatcher, he should supply a serial number which will be used for all reports on the same fire.

Name of Fire is usually applied later by the dispatcher, ranger, warden, or fire chaser. It should agree with name used on final report.

Observed from............................ Always fill in name of station or point from which fire is sighted. The whole report is based on readings and observations made from a certain point, which the dispatcher and the fire chaser must know in order to use the information.

LOOKOUT REPORT

No.........................

Name of Fire..

Observed from..

Azimuth..**Distance**.........................Mi.

Vertical Angle— ....Estimated

Location: T................., R................., Sec................., Subdiv................;

Volume, Character and Color of Smoke..

....

Base of Smoke (**not**) Sighted; Smoke drifting from..

Crown or Surface Fire; Size.......................; Men Needed...........................

Type of Forest..

Location by Local Landmarks..

....

....

....

....

Reference Pt...Az...............................

Tangent offset 1′=1½ ft. per mile. 1°=92 ft. per mile. ½°=46 ft. and ¼°=23 ft. per mile.

	Date	Time	
Originated..........	....	....	Cause.................................
Sighted..........	....	....	to.................at.................
Reported..........	....	....	to.................at.................

DISPATCHER'S OR PLATTING STATION REPORT

Platted Location: T......................., R......................., Sec.....................

Subdiv................................; Description..

....

....

....

Note: Keep diary of subsequent observations or action on back.

Azimuth. The azimuth or bearing on the fire should always be read just as precisely as possible. It takes only a second or two longer and may save hours. It will be used in platting location and in computing tangent offsets. Azimuths should preferably be recorded in degrees and minutes (127° 12′). The sight on smoke should always be on **center of base** if visible. In case of drift smoke from an invisible base sight on edge **from which** drift is coming.

Distance in miles from the lookout station to the fire **should always be scaled off from the map** and reported. To do this first mark location on map. Should be scaled to nearest 1/16 or 1/32″ and usually reduced to miles. If preferred the scaled distance in inches can be reported provided the lookout **always states scale of map being used.** This distance taken with the azimuth reading affords the most accurate method of describing the estimated location to the dispatcher, and at the same time is an absolute check on the location as described by legal subdivisions.

Vertical Angle. Lookouts having facilities for measuring this angle should do so **on all established fires** and **also on lightning strikes**. As most fires will be at elevations below that of the lookout, or a minus angle, the minus sign is printed on the form in position to precede the angular reading. In case the fire should be at an elevation above that of the lookout or at a plus (+) angle the sign is easily changed. **Vertical angle readings are absolutely necessary** in all cases where **graduated panoramic pictures are to be used.** In other cases where good topographic maps are available, an accurate location on most fires can be secured **from one lookout only,** simply by platting the intersection of this angle with a profile of the topography lying along the line of sight. (See Fig. 5.) In still other cases they can be used to advantage in computing the relative elevation of fire in reference to ridge tops or draws.

Estimated Location. The lookout should record his estimated location of every fire sighted by township, range, section and subdivisions, down to at least quarter sections or "forties." This will be in the most convenient form for use by fire chasers in case a more precise location cannot be obtained by intersection, and as a permanent record. At the same time it gives the dispatcher a basis for checking the azimuth and estimated distance as reported and forms a rough check on his final plattings. Frequently the lookout's estimated location can be described in reference to printed material on map, as for example "the top center of first e in Mill Creek." This is frequently helpful to firemen who do not have good facilities for platting. In such cases be sure map editions are the same.

Volume, Character and Color of Smoke. The volume should be described in general terms as very small, moderate, large, etc., its character as threadlike, thin, heavy or billowy column; stratified, drift smoke, blanket smoke, etc., and its color as white, yellow, coppery, black, etc. This description is an indication not only of the size and intensity of the fire but also of the material in which it is burning. It is basic data in determining the number of men and type of equipment needed. It tells the fire chaser what he must look for and indicates the difficulty which may be encountered in finding it.

Base of Smoke (not) Sighted. Always specify whether **base** of smoke **was** or **was not** sighted by crossing out or leaving in the word (not). **This is very important.** It shows instantly how much reliance can be placed on the Azimuth reading or platted location and may be of great assistance to the fire chaser. For example, if the base was not sighted and the smoke was drifting from the east, the fire chaser knows that the fire cannot be to the west but may be to the east of its platted location. If the base was sighted, **he knows the bearing is reliable** and that **the lookout station must be visible from the vicinity of the fire.**

Smoke drifting from .... The direction should be filled in here as East, SW., etc. This serves the double purpose of assisting in finding the fire as stated above and in showing the direction of the wind which frequently is a big factor in measuring the fire hazard.

Crown and Surface Fire. The type of fire is recorded by striking out one word. It bears directly upon the number of men and kind of equipment needed.

Size.............................. This is of great importance for it bears upon the number of men to be sent in and shows the fire chaser what he is looking for. Camp fires or single snags should be recorded as such. **On all other fires which can be seen directly, measure precisely the angle between the extremities of the fire and compute its tangent, as explained in detail on page 48.** Then report it as ——— ft. wide.

Example: Assume that a fire is 12 miles away, that an azimuth on the base of the smoke at the right extremity is 154° 38′ and on the left extremity 154° 34′

$$\begin{array}{r} 154^\circ\ 38' \\ 154^\circ\ 34' \\ \hline 0^\circ\ \ 4' \end{array} = \text{angle between extremities.}$$

The tangent for 1 minute at 1 mile is 1½ feet.
The tangent for 1 minute at 12 miles will be $12 \times 1\frac{1}{2}$ ft. or 18 ft.
The tangent for 4 minutes at 12 miles will be 4×18 ft. or 72 ft.
In other words, **the actual width of the fire from your point of view is 72 feet.***

When the base of the smoke is not visible but there is a well defined column, sights on its extremities frequently give good results. Similar sights taken from two lookouts frequently furnish a fair map of fire.

At any event **the lookout must make an estimate or guess.** He is the only man who has seen it. His guess is better than that of a man who has not even seen the smoke.

If pains are taken to notify the lookouts in regard to the size of fires, type of material in which they are burning and number of men needed at different stages of progress, they will soon become more proficient in sizing up conditions by volume and color of smoke, so that their reports not only at the beginning but during the progress of a fire will be much more dependable in determining size of crew needed.

Men Needed.................................. Lookouts should always make a guess at the number of men needed. As stated above they are the only men who have seen the fire.

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*It is an excellent plan to drill lookouts on such measurements. For example, have lookout at Station B sight at mirror flashes from two different points on Station A and compute distance between. Lookout at A would flash from two points at right angles to B's line of sight and pace distance between points.

Type of Forest. This should be briefly described as "mature timber," "2nd growth," "old burn," brush," etc. Also indicates types as yellow pine, lodgepole, Douglas fir, Alpine, etc. The rate of spread and methods of suppression vary materially in different types, therefore it has a direct bearing on the number of men and equipment needed. It also may be a valuable guide to the fire chaser in finding the fire.

Location by Local Landmarks. This should describe the location of the fire by direction and distance in reference to any local topographic features or distinct landmarks which may be readily found and recognized by the fire chaser, such as streams, tops of ridges, buttes, rock slides, burned patches, edges of burns, open glades, distinctive clumps of 2nd growth or timber, ponds, etc. **State which slope of a ridge it is on and how far down from the top** or **which side of stream it is on and how far back from the stream.*** In short, give the fire chaser a picture of it; give him all the data you would naturally make use of in case you had to go yourself. **This description should be based on actual observation rather than on the map which may be incorrect. (Any discrepancies on the map, as indicated by bisecting tape, should be called to the attention of the platting agent and fire chaser.)**

It is also well to note in this space rock points, slides, etc., in the general region of the fire from which the fire chaser will be able to secure a close view of the smoke.

The importance of this description cannot be over-emphasized. In many cases it is by far the most vital part of the report. Remember that locating a fire on the map is simple in comparison to finding it on the ground, and that frequently a fire chaser traveling in the timber may pass by within one or two hundred yards of a fire which the lookout can see distinctly at a distance of 10 or 15 miles. The fire chaser must have all the assistance you can give him.

Reference Pt................................... This space is for the description and azimuth of some easily recognized and sharply defined landmark, such as a rock point, a saddle, center of a rock slide, sharp edge of burn where it

---

*Compute actual distance by formula on page 48.

crosses ridge top, etc. It should lie as **near as possible** to the line of sight on fire, and not more than one-half or three-quarters of a mile from it at most. In selecting an object for this reading, 1st choice should be given to a feature close to the fire; 2nd choice to one lying between the observation station and the fire and of suffi[illegible] elevation to be visible to a fire chaser backsighting from the vicinity of the fire.

The lookout can read with absolute precision the line of sight on a fire. If a man can place himself on this line somewhere in the vicinity of the fire, he can hit within a few feet of it by running the same compass course as obtained by the lookout, or reversing it (and running in the opposite direction). The difficulty is to place himself absolutely on this line. It is **generally** possible for a lookout to secure a sight on some point in the vicinity of the fire which a man would have no difficulty in finding. It is then a simple matter and takes only a moment to find the angular interval between this 2nd line of sight and the 1st by subtraction, and to compute the tangent offset (right angular distance) which will enable the man, by pacing from the reference point, to place himself on the 1st line of sight. Then running a compass course forward or back on this line, he is bound to pass within a very few feet of the fire. **As a last resort this method furnishes a sure way of finding even a single snag fire sighted from one station only.** It is based on actual measurements which can be read to single minutes. It permits eliminating any errors that might otherwise occur from local attraction of compass needle use by fireman and it makes use of the map only for determining approximate distance from observation station to point where offset is taken. Small errors in this estimate will have little effect on results, and errors in orientation or in the map no effect as only the angular measurement from one object to the other is involved.

As this method deals entirely with small angles, the following formula may be used for computing offset:

Tangent offset in feet = number of minutes of angular interval between lines of sight × 1½ × number of miles from observation station to point where offset is taken.

Just remember to **MULTIPLY** the **NUMBER OF MINUTES** by 1½ by **NUMBER OF MILES.** (For very precise work, the decimal 1.54 should be used instead of 1½.) If angular intervals are given in degrees and minutes **convert degrees to minutes by multiplying by 60,** or figure 1° = 92 ft. per mile; ½° = 46 ft. and ¼° = 23 ft.

Example:

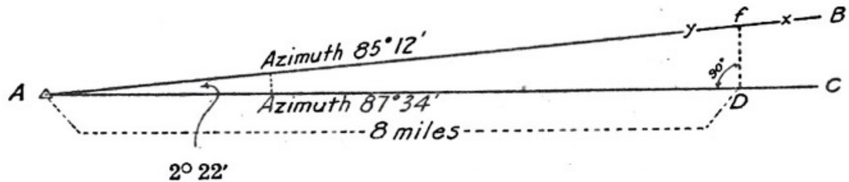

FIG. 13.

Let A = Lookout station.
Let AB = Lookout's line of sight (Az. 85° 12') through a fire estimated to be at x.
Let AC = Lookout's line of sight (Az. 87° 34') on D a second object or "Reference Point."

Assume a fire chaser has been unable to find the fire but can find D.

The angular distance between lines of sight AB and AC = 87° 34' − 85° 12' = 2° 22'.

87° 34'
85° 12'

2° 22' Converting degrees to minutes = 142'.
Scaled distance A — D (on map) assumed to be 8 miles.
Applying rule: Number of minutes × 1½ × number of miles, we have

Tangent offset $= 142' \times 1\frac{1}{2} \times 8 = 1704$ ft. = right angular distance from D to a point f on the line AB. The Fire Chaser by placing himself at D turning off at right angles from his line of sight on the lookout (DA) and pacing off 1704 ft. will arrive at f. Then a compass course N 85° 15′ E, or S 85° 15′ W, will carry him through the fire at some point x or y (i. e.) if he does not find the fire by running N 85° 15′ E, he should reverse reading and run in opposite direction.

Some of the ways in which this formula can be used are:

1. In determining the size of the fire as explained on page 44.
2. In determining roughly the distance between the fire and certain local landmarks.
3. In determining roughly the difference in elevation between the top of a ridge and the point at which the fire is located. In other words the approximate contour on which he should hunt for the fire.
4. In computing the offset which will allow a fire chaser, backsighting from the vicinity of the fire, [illegible] e himself on the lookout's line of sight through fire.

The tabulated statement covering **time of origin, time sighted** and **time reported** to platting station or fire chasers, is chiefly valuable for future reference in securing a complete history of each fire. It is, of course, in many cases impossible for the lookout to know the time of origin or cause from which a fire starts. In the case of lightning fires his opinion will usually be the most reliable obtainable. In all cases he should at least make a guess.

Dispatcher's or Platting Station Report*

This part of the report should be filled out by the platting agent or dispatcher.

Platted Location refers to the location of the fire as determined by the platted intersection of readings from two or more lookouts, or by the Vertical Angle Method. It should be given down at least to "forties" whenever section lines "surveyed" or "unsurveyed" are shown on map.

If the base of the fire was sighted and all work accurately done, this location should be mathematically correct to within a few feet and should usually take precedence over the lookouts' **estimated location.**

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* Preferably dispatchers and firemen should be provided with a special form which will serve for recording all the data received from the two or three lookouts who may report on the same fire. Assembling all reports relative to one fire on a single sheet is highly desirable.

Drifting smoke may introduce a small error which usually would not be serious, as in such a case the volume would probably be large enough for a chaser to detect easily when he reached general locality. Errors in the base map are more serious, because the platted location of the fire is correct but the topography and land lines which are really the guide to the fire chaser, are not where they belong on the map. Such errors, however, can usually be adjusted (see page 67.)

Description. This space is for additional directions in regard to running down the fire which can best be supplied by the dispatcher after a precise platted location has been determined by intersection, such as quadrant bearing and distance from a section corner, from a local peak, from the forks of a stream, etc.

If map is poor, it should only take a few moments to have **two lookouts cut in** one or two **features,** which **will be visible from the vicinity of the fire**. They can be platted in a few seconds and their bearing and distance in relation to the fire determined by means of a large protractor. If they are close, a course can be run to fire, but, even if they are several miles away, they will be of great assistance to the fireman in getting alignment on fire by use of compass.

In passing on information to the fireman it should be remembered that usually **he does not have very good facilities for platting angles and scaling distance** and that it is **extremely important** that he gets **an exact map location including platted lines of sight** from various lookouts. (See "Estimated Location," page 43.)

Diary of Subsequent Observations. This record, always including **date** and **time** of entries, should consist of concise notations in regard to progress of fire, the color, volume and character of smoke, direction from which it is drifting or direction to which fire is spreading, rate of spread, velocity of wind; time and estimated size, when it changes from ground to crown fire, periods during which no smoke is visible, etc. **All important** changes should be immediately reported to the dispatcher.

On lightning fires which do not become established, notes should show how long smoke was visible, period of watching region and date and time at which lookout considers it safe to assume fire is out.

This diary forms a valuable record. It should also be of interest to the lookout and at the same time develop his efficiency in sizing up future fires.

The platting officer should pin together all forms relative to the same fire. On the back of one he should keep, in diary form, a report on progress of fire, a record of action requested and action taken with time and date; and, as far as possible, a record covering movement of men and supplies so that he can inform the Supervisor, Ranger, or Warden at any time as to condition of fire, number of men on it, how they are provisioned, where the pack train is, etc. Always enter terms of any agreement made. Have a **written record.**

Distribution of Forms

While the above explanation is long, the form is short. The data can be written down almost as fast as a man talks. It saves time by cutting out non-essentials.

All lookouts, fire chasers and platting stations should be supplied.* It is suggested that a small supply be hung at each telephone. Unless otherwise specified, the lookouts' and platting officers' copies should be forwarded to the ranger or warden at the close of the fire season.

Protections Against Lightning

Occupants of lookout houses and towers provided with the standard system of conductors, as recommended on page 6, are safe provided the following precautions are observed:

1. On approach of storm put out fire in stove and draw embers as the rising heat is a conductor.

2. When storm is a mile or more away: if necessary to use telephone always stand on an insulated stool, do not hold receiver tight against ear, and do not touch any metal part of phone or building.

* Preferably dispatchers and firemen should have an assembly sheet which would enable them to record all data pertaining to one fire on a single sheet, i.e., include reports from 2 or more lookouts.

3. When storm is less than a mile away: throw disconnect-grounding switch on phone line;* stay away from the telephone; remain inside building and keep away from any metal objects which would tend to form a conductor.

III. THE DISPATCHER

The necessity of providing means for solving the location of fires which are sighted from two or more stations is obvious. **Whenever telephone lines permit, the best method for insuring quick action and precise locations is to have all lookouts report directly to one central platting station** (additional ones should have equipment for emergency use). This systematizes the procedure in reporting, avoids duplication, makes one man responsible for the work instead of leaving it as "everybody's job," permits furnishing better equipment and allows one man to become specially proficient. **Furthermore, if the right man can be found it may greatly strengthen the suppressive organization by making it possible for Rangers or Wardens to spend more time away from their stations and to take personal charge of more fires.**

The work should be handled at the supervisor's or warden's office. Complications in communication, the necessity for uninterrupted service, or other considerations, may make it necessary to delegate it to a special Central Dispatcher, to a ranger, or a **capable lookout** situated at a central point. The main requisites are that he understands fully all phases of the lookout's work, and be competent to solve any location problems which may come up. In addition to this, **it is highly desirable that he be thoroughly familiar with the entire area under protection, the distribution of men and equipment, and the general principles of fire fighting, including knowledge as to what fires may be expected to do on various sites under current changes in climatic conditions.**

* Refers to Type B lightning arrestor which consists of a discharge gap and combined disconnect grounding switch. The switch when thrown disconnects the telephone lead-in-wire from the line and grounds the lead-in-wire. The switch can be thrown by a cord extended to inside house.

DISPATCHER'S DUTIES

It is imperative that he be within sound of the telephone day and night, since initial action on all fires to be located by intersection must await his services.

His main duties are to:

1. Copy down lookout reports as they come in.

2. See that the ranger or warden concerned is instantly informed. (Through direct connection with the lookout if possible.)

3. Notify other lookouts and secure cross reading from them.

4. Determine as precisely as possible the location and size of all fires sighted from two or more stations, or on which the vertical angle method may be used.

5. Check carefully all reports for possible error. Apply correction factors wherever they are needed as making allowances for drifting smoke, adjustments for known errors in base map and interpreting apparent discrepancies).

6. Compute back sights, quadrant bearings, the bearing and length of tangent offsets, or any other courses which may be of assistance to the fire chaser. (See pages 47, 48 and 71.)

7. Phone final report to ranger or warden concerned "Platting Agent's Report." (See Form, page 42.)

8. See that the instruments on all stations are kept in perfect orientation and adjustment. Make sure that the lookouts thoroughly understand their work, explain any technical problems which come up. Plat the location of topographic features or landmarks which they wish to establish by intersection. In short, do everything possible to relieve monotony and improve the efficiency of their work.

9. **Arrange for immediate action on any fire whenever the ranger or warden is not accessible, and in all cases to follow up every fire from the time it is sighted until it is out. Camp right on its trail and get action from some one. If none of the regular force can be reached, hire local men to go after it.**

10. **Keep constantly posted in regard to variations in weather conditions and fire hazards on all portions of the district and inform other members of the organization as needed.**

11. **Arrange for emergency patrols and strengthening of organization as needed.**

12. **Act as a clearing house and information bureau on all protection matters for entire territory covered and as far as possible coordinate the protective work of all units.**

13. **Keep a current record on the status of all fires and as far as possible on the movements of forces and equipment.**

DISPATCHER'S EQUIPMENT

The Dispatcher's working equipment should include the following items as far as possible:

1. A precise platting map. Preferably these maps should be mounted with shellac on sheet steel and provided with an accurately inked meridian through each lookout station and drilled holes for precise centering of metal protractor.

2. An 18″ half circle brass protractor graduated to ¼ degrees, as later described.

3. A graduated straight edge for projecting lines beyond the 9″ radius of protractor as needed.

4. A supply of 4 and 6H pencils, sand pad, erasers, red ink, a fine scale ruler and assembly sheets for platting and recording lookout reports.

5. Prepared cross section paper strips and tangent scale for solving location of fires by vertical angle method. (See page 61.)

6. A complete set of graduated panoramic pictures from all lookouts, including a supply of vertical angle scales and a small magnifying glass. (See page 64 and Fig. 11.)

7. A fire map showing by symbol the location, size and status of all fires of current season.

8. An organization map showing preferably by symbols and numbered stickers the location of all numbers of the protective force, including improvement crews and cooperators. Moving personnel to be shown by pins which can be shifted. Location of all tool caches and unmanned emergency stations should also be shown by symbols. Numbers on stickers should refer to lists giving name, address, and telephone number of all cooperators and what they can furnish in the way of additional men or tools.

9. A hazard map showing timber types and approximate location and size or mapped area of all fires which have occurred over a long term of years, and giving special attention to high hazard areas and anything in the nature of improvements or otherwise that might serve as fire breaks.

10. A composite visibility map showing areas seen directly from various lookouts.

11. A diagrammatic map showing entire telephone system, including switching stations, phone locations and rings.

12. An emergency plan including organization chart and giving names, addresses, etc., of key men a specialists as cooks, packers, timekeepers, etc. Also source for obtaining equipment and transportation.

13. A hygrothermograph, hygrometer or sling psychrometer including tables, if needed, for keeping posted on humidity conditions and any other meterological equipment that local conditions warrant.

14. A chart showing seasonal precipitation record from various parts of territory involved.

15. A headset or transmitter-receiver type of phone which will permit looking at maps while talking.

METHODS FOR DETERMINING LOCATION OF FIRES

There are five ways of determining the location of a fire sighted.

A. By Delineation of Sight or Plane Table Method

Applicable on fires sighted from one station only. Location determined by lookout, see page 28.

B. By Platting Intersection of Horizontal Angles from Two or More Lookouts

1. **Trigonometrically.** The most precise way of platting a fire which has been sighted from two or more stations, is to compute the distance from one or more stations trigonometrically and then plat the bearing and distance by latitude and departure, making allowance for any shrinkage or expansion which may have distorted original scale of map. (See page 68.) Knowing the true bearing and distance between two observation points, equipped with instruments reading angles to single minutes it is possible to compute trigonometrically the relative position of an object 20 or 30 miles away to within 40 or 50 feet.

This method is not recommended for general use as it is slower and subject to errors in computation. It should be used, however, when the base (distance between two observation points) is comparatively short, as when two sighting points are established on one lookout. It should also be used, if feasible, when base map upon which platting is to be made is badly distorted.

2. **Graphically.** The method **recommended** for general use is to determine the location simply by platting the intersection of the azimuths which have been laid off from two or more stations by means of a protractor. This is simple, can be carried out in a fraction of a minute, and gives very satisfactory results **provided there is suitable equipment to work with,** and the map is reasonably accurate.

Platting Maps

Platting maps should preferably be mounted **with shellac** on a single sheet of No. 14 sheet steel or galvanized iron in exactly the same manner as described for mounting maps on fire finder disks. The **best map obtainable** of the total area under protection should be used. Preferably it should be a lithographed map on good quality paper. (Blue prints and black line prints should be avoided as these are almost sure to have an excessive amount of distortion.)

Before mounting, a true meridian in either red or black ink should be drawn through the center of all lookout stations. These are for orienting or as an indicator for setting a half circle protractor. If an 18" half circle protractor is to be used this meridian line should extend north from the station for a distance of at least 10".* This meridian line must be drawn with the utmost precision since any error in its alignment will result in a corresponding error in plattings made from it.**

* In case L. O. position is less than 10" from top of map the meridian can be drawn to the south. In this case use edge C. S. for Azimuths 0 — 180 and edge C. N. for Azimuths 180 — 360 (see Fig. 14).

** A convenient and very accurate method for drawing such a meridian is as follows: Lay the edge of a sheet of paper so that it cuts through the lookout point as a straight east and west line. Then mark on edge of paper the exact position of lookout point and of the nearest meridian line to the east and to the west. Now move paper toward top of map for a distance of 18 or 20 inches and match markers to meridian line at this point and then make dot on map opposite lookout mark. A straight line from this point through lookout will give a true meridian. On account of convergence of meridians edge of paper has to be angled slightly at upper setting. This results in proper proportional spacing to desired meridian. Don't try to draw a meridian by paralleling township or section lines. Frequently they are inaccurate.

After the map has been mounted, holes should be drilled through the exact center of each station for the purpose of centering protractor. To do this first mark point carefully with a sharp center punch and then use a **No. 28** drill provided a standard 18″ half circle protractor is to be used. After holes are drilled apply 1st one coat of shellac and then two coats of spar varnish. Then ream holes again with No. 28 drill to clean out varnish. (This method of mounting results in minimum distortion and since metal expands and contracts the same in all directions there can be no distortion after mounting. 14-gauge material costs about 20 cents per sq. ft. and is less than cost of a drafting board.)*** Various types of stands have been developed for these metal plates including swiveled tops where both a plain and a topographic map are desired.

Protractors

The best type of protractor for this kind of work is a half circle brass protractor, graduated counter clockwise and having a center projection and steel bushed center hole which permits precise centering over lookout point by means of a pin. The straight edge of the half circle should be graduated in inches both ways from center. With such a protractor the given azimuth reading is set on the meridian line from L.O and its straight edge used for platting the angle and scaling distances. Fig. 14 illustrates a protractor of this type, used in conjunction with a notched straight edge for projecting line beyond radius of protractor.

Half circle protractors of this type graduated to ¼ degrees are standard equipment with many protective organizations. With beveled edged engraved protractors of this type angles can be quickly and easily platted to an accuracy of about 3 minutes. Two grades of these protractors are manufactured by Leupold, Volpel and Co. of Portland, Ore.

A very simple half circle protractor of this type can be easily made up from the large cardboard protractors as carried by drafting supply houses. The cardboards have a full circle graduation without numerals. They

*** Maps mounted in this manner will usually remain in good serviceable condition for at least 4 or 5 years. It is common practice among many dispatchers to place a large red ink circle around all going fires including their serial or report numbers as such marking can be easily wiped off with a damp cloth when desired.

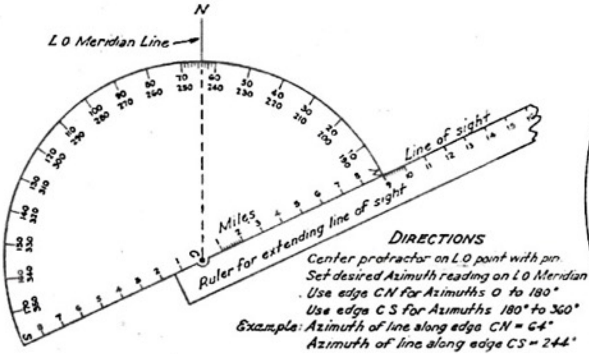


FIG. 14. Half Circle Protractor and Straight Edge.

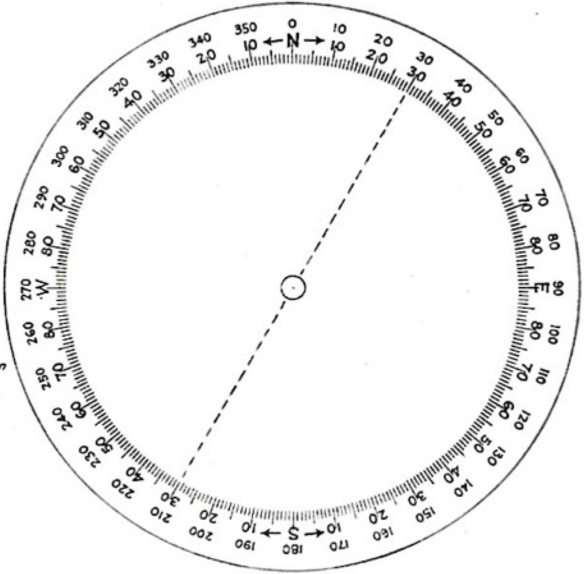


FIG. 15. Graduated Circle with both Azimuth and Quadrant Numerals. Convenient for converting readings.
For example: Az 210° = S 30° W.
Backsight for Az 210° = Az 30°.
Backsight for S 30° W = N 30° E.

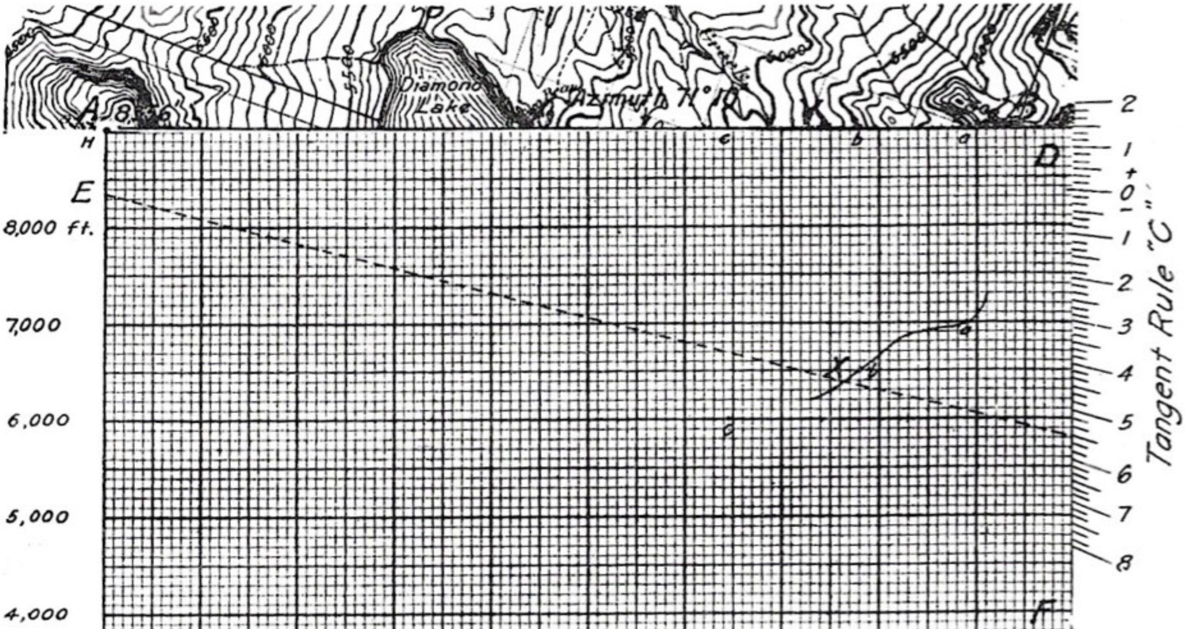
would have to be cut out and the numerals and straight edge graduations would have to be written in. Such protractors are not very durable but they are much better than many of the smaller protractors generally used. In general, any protractor used for this type of work should be of large diameter.

In doing any kind of fire platting work the dispatcher should use a **moderately hard pencil** with a sharp **chisel point** and be sure that **the platted line coincides exactly with straight edge.** This requires no more time than crude work but crude platting work with a soft dull pencil may result in very serious errors in location.

The practice of drawing a pen and ink protractor around each station is usually unsatisfactory on account of too much overlapping with protractors on other stations **if they are of adequate size to give good results.**

Thin paper protractors are very apt to be inaccurate, especially after they are mounted, and should be used only as a rough check.

Don't use a small protractor. The larger the protractor the more accurately it can be set. Theoretically, the radius should at least equal the length of lines to be platted, however a protractor with 9″ radius and graduated to ¼ degrees will permit setting to 2 or 3 minutes.



Diamond Lake
Azimuth 71° 10'
A 8,156'
B
D
E
F
H
a
b
c
X
8,000 ft.
7,000
6,000
5,000
4,000
Tangent Rule "C"
2
1
+
0
−
1
2
3
4
5
6
7
8

FIG. 16

C. By Platting Intersection of Vertical Angle with Profile

Assume that a piece of cross section paper is prepared as shown in Fig. 16 with eachhorizontal line representing an elevation of 100 feet.

Let E = elevation of lookout station (8356 ft. as given on topographic map).

Let tangent rule C be placed on the perpendicular line DF, 5 inches to right from edge with the 0° mark opposite E.

A small stub and pin hole at H permits centering sheet over platted position of lookout station A.

With this equipment the location of a fire can be determined very rapidly as follows:

Assume that lookout at A sights a fire Azimuth 71° 10′ Vertical Angle — 5° 30′.

1. Draw the azimuth (AB) on topographic map.
2. Lay off on the cross section paper the vertical angle by drawing a straight line from E to — 5° 30′ as shown on the tangent scale C.
3. Center the hole H over the platted position of station A, and revolve sheet until its upper edge matches on the line of sight AB. Fasten in this position.
4. A profile for any portion of the line of sight is made merely by reading from the map the elevation of each contour line crossing the line AB, dotting this elevation on the cross section paper by carrying straight down, and then connecting the series of dots. The point at which the profile intersects the vertical angle line gives the location of the fire on the profile, at X. The location on the topographic map is then secured by carrying straight up, and spotting it on the line AB at Y.

As a rule it will not be necessary to spot more than 6 or 8 elevations in order to determine the intersection. With experience it may be done by eye without dotting any elevations.*

One sheet of cross section paper can be used many times, as the small section of profile used to locate any fire can be erased.

* This method can also be used to excellent advantage for preparing visibility maps not only for direct control but also for indirect control as for example areas where smoke must rise from 1 to 600 ft. to become visible.

If it is necessary at some platting station to use vertical angles read from several stations, the same sheet can be used for all of them by platting on the left hand margin the elevation of each station, and sliding the scale C up or down along the line DF until the 0° mark is opposite station from which angle is to be drawn.

On sights over 15 or 20 miles a correction for curvature and refraction is usually desirable. The easiest way to accomplish this is to determine point of intersection as illustrated in Fig. 16, note its distance from station and then draw a new section of profile dropping the elevation of each point by an amount equal to the required correction. The intersection of the vertical angle on this corrected profile should give true location of fire.

The correction for curvature and refraction in feet can be secured from tables or by multiplying (distance in miles) ^{2} by 0.574. A convenient method is to draw at bottom cross section sheet a curve showing correction for any horizontal distance.

Preparation of Equipment for Platting Profiles

It is always desirable to exaggerate the vertical scale of the profile at least 4 or 5 times over that of the horizontal scale. This is accomplished by the choice of cross section paper. The ratio which results from giving each horizontal line of cross section paper a value equal to the contour interval of the map used, is determined by dividing number of feet represented by one inch on map by the number of feet which each inch space of horizontal lining represents. Having this ratio, the scale in inches for laying off vertical angles is ascertained by multiplying ratio x natural tangent x length of base (or distance in inches from left margin of paper to vertical line on which scale must always be set). For example, in Fig. 5 the scale of map (U. S. G. S.) is 1″ = 125,000″. Contour interval is 100 feet and cross section paper has 20 divisions to inch, therefore giving each division the value of 100 feet, 1″ = 2,000 feet. 125,000″ = 10,417 feet. 10,417 divided by 2,000 = 5.208 or ratio. 5.2 × nat. tangent 1° × 5 = .45″ or length of 1° when scale is set 5″ from margin of paper.

The following table shows kind of cross section paper recommended for use with maps of various scales and with various contour intervals, the resulting ratio between horizontal and vertical scale, and the length of base or distance to right from margin of sheet at which the universal scale (Fig. 17) **must be set** (see Fig. 16 DF).

Table I.

Scale of Map	Contour Interval	Kind of Cross Section Paper Recommended	Resulting Ratio of Horizontal to Vertical Scale	Length of Base or Distance at which universal scale should be set
1″ = 250,000″ U. S. G. S.	100 feet	20 div. to 1″	1 to 10.4	5″
	200 feet	20 div. to 1″	1 to 5.2	10″
1″ = 125,000″ U. S. G. S.	50 feet	20 div. to 1″	1 to 10.4	5″
	100 feet	20 div. to 1″	1 to 5.2	10″
	250 feet	8 div. to 1″	1 to 5.2	10″
1″ = 62,500″ U. S. G. S.	25 feet	20 div. to 1″	1 to 10.4	5″
	50 feet	10 div. to 1″	1 to 10.4	5″
	100 feet	10 div. to 1″	1 to 5.2	10″
	250 feet	4 div. to 1″	1 to 5.2	10″
1″ = 63,360″ or 1″ = 1 mile	25 feet	20 div. to 1″	1 to 10.4	4.93″
	50 feet	20 div. to 1″	1 to 5.2	9.86″
	100 feet	10 div. to 1″	1 to 5.2	9.86″
	250 feet	4 div. to 1″	1 to 5.2	9.86″

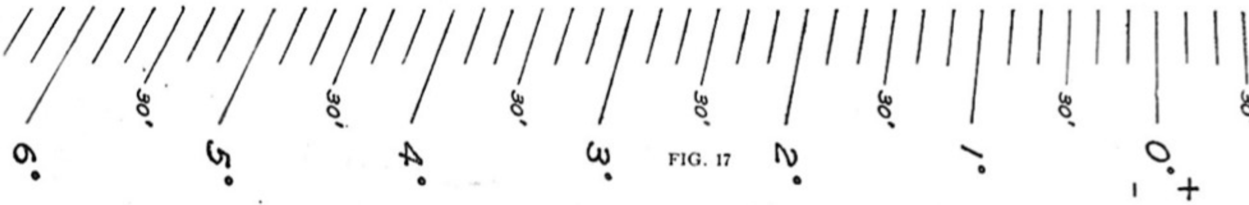


FIG. 17

The above scale (Fig. 17) is a sample of the universal scale referred to on page 61 and in Table I. A longer scale printed on both bristol board and white paper and ranging from +2° to −13° can be obtained on request from the Western Forestry and Conservation Association, 949 Henry Building, Seattle, Wash. The use of these scales as recommended in Table I eliminates the necessity of drawing up special scales at each platting station.

D. By Location on Panoramic Profile Method

Relative location is spotted automatically simply by sighting on fire and dropping pencil. (See page 29.)

E. By Photo Survey Method

With this method graduated photographs are secured from each lookout station and the names of peaks, drainages, and other landmarks written in as illustrated on page 38. Given a picture of this character and a detached or **movable "Vertical Angle" scale** for defining line of sight and scaling off vertical angles, anyone can determine in a few seconds and to the accuracy of a needlepoint the exact location of any fire or other object that the lookout reports by azimuth and vertical angle.

For example, refer to Fig. 11 and assume that the lookout has reported a fire at azimuth 247° 50′ and Vertical Angle —4° 15′.

The procedure would be as follows:

1. **Set top corner of the movable Vertical Angle Scale flush with the azimuth graduation** 247° 50′. (A small vernier at corner of scale is divided to 15 minutes and permits setting or reading to an accuracy of from 2 to 3 minutes by interpolation. Either edge of Vertical Angle scale may be used.)

2. **Match the "Level Line" or 0° points on BOTH EDGES of the Vertical Angle scale to the black level line which has been drawn horizontally across picture.** (This results in two things. It plumbs edge of scale so as to define lookout's line of sight and sets it at proper point for scaling off vertical angles.)

3. **Scale off —4° 15′ below the black level line of picture and mark point with needle. This gives exact location of fire.** (— angles are scaled off below level line of picture and + angles above it.)

4. **Use small magnifying glass for bringing out local details.** (Tests indicate that with a good picture and a magnifying glass one can normally see details almost as well as the lookout can see them under clear conditions but without glasses.)

Firemen should draw a fine line along edge of scale from bottom to top of picture. This marks lookout's line of sight and may cut important landmarks which he can use for lining himself in. He should carry picture with him in going to a fire in all cases where it will be of assistance. To prevent wear they should be carried in a mailing tube or film can.

For surveying work the procedure is simply reversed. To find the azimuth and vertical angle to any object on picture one simply sets edge of scale on object and plumbs by matching level line of scale with level line of picture. The azimuth is then read from top corner of scale and the vertical angle from side of scale.

A comparison of horizontal and vertical angles obtained from these pictures, with transit readings on the same objects will show a maximum discrepancy of not over 2 or 3 minutes.

In applying this method a complete set of pictures is secured from each lookout station. (Three pictures to each panorama.)

One or more complete sets are retained for administrative and mapping purposes. Then all members of the protective organization, including rangers, dispatchers, and firemen, are supplied with such pictures or sectors as cover territory lying within their protective unit.

The pictures from each lookout station (1 to 3 in number) should be placed in a folder marked with name of lookout. The folders should then be filed alphabetically and include a supply of vertical angle scales.

When a lookout reports a fire, all three of these men are able to spot its location to a needlepoint on their photographs. They see photographically the exact spot at which it is located. A 25-cent magnifying glass brings out a remarkable amount of detail and they can see for themselves its exact location in reference to ridge tops, lateral spurs, draws, rock slides, deadenings, etc., all vitally important landmarks in helping them get to with minimum delay. Also, they can actually see the steepness of slope, aspect, and possibly cover conditions, all vital factors in governing the probable rate of spread and consequently the number of men needed to insure control.

We might say that this is, in effect, applying television to protection work. Actually it is better, for the pictures have been taken during clear weather so that frequently the location can be seen much better on the pictures than from the lookout. In the case of fires sighted at night, these pictures in effect turn night into day.

For studying the effectiveness of control from individual or combined lookouts, a set of these pictures is in many respects far superior to any visibility map that can be made. Where such maps are also required, they can be made from the pictures just as well as they could be made from the lookout. Prints with the names of ridges, peaks and drainages written in are ideal for assisting new lookouts to learn their country.

For general reference purposes, a complete set of pictures from all lookouts furnishes a wonderful source of information.

For example, if one desires to obtain information on a certain section of country he simply glances at map and notes the names of commanding lookout points and the approximate bearings to section in question. This gives folders and pictures needed. **Any map showing location of all lookout points is a perfect key to the files.**

Other uses in connection with protection work are, for making map corrections and checking fire-finder orientations; for illustrating special hazards, and for use as irrefutable evidence in damage suits.

Method of Obtaining and Preparing Pictures

The pictures are obtained with a recently developed special camera or photo recording transit. Briefly described, this instrument is in many respects similar to a transit. It includes a leveling head, full azimuth circle and vernier, an open sight alidade (which may be replaced by a telescopic alidade if desired), a high-grade magnetic needle, a one-minute spirit level and a Smith solar attachment which enables the operator to obtain a true meridian and precise orientation from any set-up without recourse to other instruments. All interior scales and adjustments are accurate to within one or two minutes of arc.

In operation the instrument is set up, oriented and adjusted in the same manner as a transit. An exposure is then made. The resulting negative, which covers an arc of 126 degrees, will be precisely graduated and numbered in azimuth along its top margin. On the two ends of the exposure there are level line markers and a vertical angle scale, in degrees.

As soon as the negative is developed a level line is scratched across its face. This is simply a straight line connecting the above-mentioned markers. If made on emulsion side it prints black, if on glossy side it prints white. The name of the lookout is then inked in on an end margin and the names of peaks, ridges, an[illegible]ges as desired. Naturally all of these markings are reproduced on all prints.

Most pictures to date have been taken with Type 2 Aero Panchromatic films with red filter and have been unusually clear, but very recent tests indicate that much better results can be obtained with "Type D" Infra red films and a dark red filter; hence the latter is recommended for this type of work. This film and filter is also best for cutting through hazy atmosphere.

The vertical angle scale is simply a tangent scale based on the focal length of the camera used, given the focal length any draftsman can make a scale in three or four hours. It can then be reproduced and used on all pictures taken with that camera.

ADJUSTMENTS FOR ERRORS IN MAP TO INSURE CENTERING THE LOOKOUT POSITION

In some cases certain adjustments for errors in the map are necessary in order to determine the true position of the fire in reference to mapped detail. In order to make them, the causes of errors and their effect should be understood. Briefly stated, there are three causes of error:

Distortion through uneven expansion or contraction with or across grain of paper on which map is made.

Inaccuracies in measurement of township lines which upon compilation have been carried all the way ..oss the map.

3. Lack of any accurate survey.

1. Distortion

This may result from an uneven expansion or contraction of the paper on which the original draft of map is made, of the tracing, or of the Van Dyke, and especially in mounting. It can be kept at a negligible factor by making lithographs direct from original without intermediate step of tracing, and by using precautions in mounting.

If expansion and contraction occurred evenly in both directions, there would be distortion of scale of course, but none in the angles between mapped points and the locations secured by the platted intersection of angles would be accurate.

With uneven expansion, which usually occurs, angles are distorted. Methods of detecting this are:

(a) By scaling distances between parallels of latitude and adjacent meridianal lines and comparing with actual distances.

(b) By scaling known distances such as the length of lines between U. S. G. S. triangulation stations.

(c) By comparison with the original map or unmounted copies.

(d) By measuring the conventional scale showing the number of miles represented by a certain line (these scales should be long and constructed with and across grain of paper).

(e) By comparison of platted locations with location in reference to section corners as tied in on ground.

Knowing amount of expansion or contraction in the cardinal directions, N. S. E. and W., true plattings in reference to local topography, land lines, etc., can be made as suggested on page 55 or normal plattings adjusted by laying off a certain bearing and distance.

2. Accumulative Errors

When error results from compilation of erroneous land line measurements they can be detected by platting location of a few well defined points by triangulation, and then comparing these with other platted locations of the same points in reference to section corners, etc., as determined by actual measurements made on the ground. **The bearing and distance between these points give the correction or adjusting factor.**

In short, this is a very simple method of determining a correction factor which may be applied to all [illegible]s within a certain region. Example: Suppose two or three fires have been located in a township and upon checking up on the ground it is found that all have been platted ¼ mile east of their actual position in reference to land lines and section corners. Future fires would then be platted by usual method and the point arbitrarily set over ¼ mile to west.

3. Lack of Any Accurate Survey

Location of topographic features are in this case unreliable, especially in the case of streams. In such cases it is a simple matter to replat well defined points which can be seen from two lookouts, thus forming rough guide for correcting drainage. Sights down streams or on junctions also afford opportunity for making corrections. Fires located by intersection really amount to triangulation stations which may be used for making local corrections of drainage, etc. These things should be done by lookouts and platting agent. Until they are done, the location of streams, etc., may not be in correct relation to a platted location of a fire and the mapped relation of the two will mislead the fire chaser. In such cases, he must depend upon the lookout's description of fire in reference to local landmarks and to the use of methods advocated on pages 46 to 49. A record of relative locations as found by fire chaser may lead to a crude correction factor which can be applied to any fires within a radius of several miles.

The above discussion is simply suggestive of some of the many ways in which the platting agent may overcome the handicap of poor maps. He must study his map and become familiar with its flaws. Knowing them he can make adjustments.

IV. THE FIRECHASER

Duties and Equipment

His main duty is to run down and suppress small fires in their incipiency. When the emergency arises any man in the organization may become a fire chaser; but he whose chief work it is, should be thoroughly familiar with the various methods of running down a fire both with and without compass. The effectiveness of his service depends upon quick action in starting and getting to a fire. He should therefore always be within summons of a telephone. His supplies and equipment should be prepared in advance, and should usually consist of:

Small supply of lookout-report forms.

Map of country in which he is working.

***Good compass** (preferably one on which the magnetic variation is set off) and which can be used with a Jacob staff.

Small ruler and protractor.

A set of graduated panoramic pictures including vertical angle scale and carrying tube.

Shovel and axe, or **hazel hoe and axe**—according to character of country or standard instructions.

Prepared pack containing supplies and cooking equipment, and blanket if desired.

When a fire is reported it is very important that the data furnished by the lookouts and platting officer **be written down in full,** and the location as described accurately **spotted on a map.** A few moments' delay in securing the full reports, on the whole, will save a great deal of time finding the fires on the ground. No one can tell how difficult this will be till he gets in the vicinity, and then it is too late to ask further directions. Remember small fires in heavy timber are usually hard to find. Even a large fire may be hard to find in the evening or early morning when the smoke is not rising.

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* Dials on ordinary box compasses can be set by taking out brads and moving dial to desired position.

Quick action is demanded, but do not make the error of rushing off without the information necessary to find the fire when you arrive in the general neighborhood. **Take complete notes. Grab your outfit. Start day or night, and go as far as you can.**

Methods for Finding Fire

There are four ways of finding a fire on the ground:

1. By means of the lookout's general description of its location in reference to local landmarks which may or may not be shown on map but are either known or easily recognized by the fire chaser.

2. By first getting into the general vicinity of the fire and then climbing a tree or getting on a local peak, rock slide or reverse slope which will command a direct view of local territory, for purpose of obtaining a local sight on smoke and then follow a compass course to it.

3. By bearing and distance to the platted position of the fire from nearby section corners, mile posts, bridges, peaks, or other accurately mapped points as determined by means of a protractor and scale.

4. By the alignment method, i.e., by placing one's self on the lookout's line of sight through the fire and then following a compass course either forward or back along this line. (See Fig. 13 and Fig. 18.)

In connection with the alignment method there are three ways by which a fire chaser can place himself on the lookout's line of sight.

A. By the tangent offset from a **reference point** in the vicinity of the fire **as computed by the lookout** from his measurement of the angular distance between the fire and the reference point. (See page 48.)

B. By means of **backsighting on lookout point** with a **compass** from **anywhere** in the vicinity of fire and offsetting to lookout's line of sight by either estimating or computing the necessary tangent offset. (See Fig. 18.)

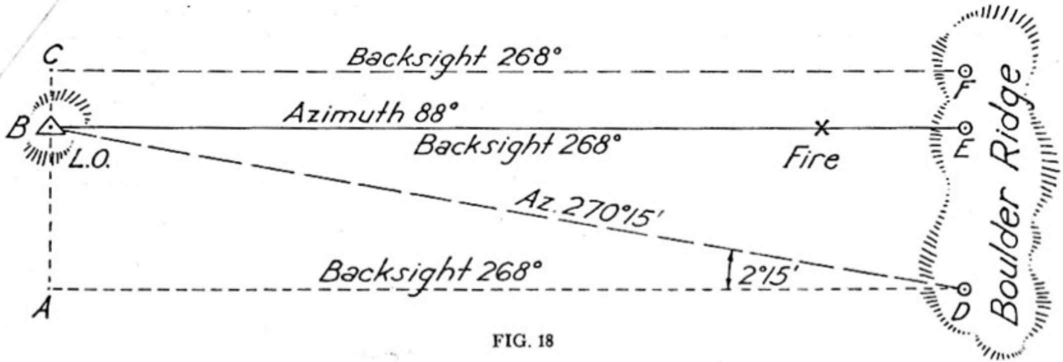

FIG. 18

C. By noting the exact point at which the platted lookout's line of sight passes a mapped point or crosses a nearby section line, road, or trail in reference to the mapped position of section corners, mile posts, stream crossings, etc., and pacing off required distance from these points.

Methods 1 and 2 are extremely simple and should of course be used in all cases where topography and cover conditions permit. Often they can be used to some extent in conjunction with the other methods. Frequently n heavily timbered regions and particularly in connection with very small fires which often do not show up above tops of trees except at rare intervals, methods 3 and 4 are the quickest and in many cases the only methods which will enable a fire chaser to find the fire.

Certain general rules in regard to the application of these methods are:

1. That in backsighting on lookout point the compass should always be rested on a Jacob staff or some other support as both the alignment and the compass reading must be carefully made.

2. That whenever a fireman is able to secure a local view of the smoke he should mark his position on ground for possible future reference, take a compass bearing on fire and usually follow straight through on this line.

3. That in connection with fires sighted from **one lookout only** the **alignment method should always be used in preference to the bearing and distance method.** The reason for this is that the alignment can always be determined very accurately by the lookout, but his estimated location of the fire along this line is subject to considerable error which would result in erroneous courses as determined with a protractor from section corners, mile posts, etc.

4. That in the case of fires located by intersection from two or more lookouts, either the alignment or the bearing and distance method is usually satisfactory although the former is preferable in cases where the registration of land lines on the map are known to be inaccurate.

5. That in connection with the alignment method certain points which should be kept in mind are:

(a) That procedure A is preferable to procedure B in all cases where a satisfactory reference point exists. Reasons for this are that the angular measurement on which the tangent offset is computed can be made much more accurately by the lookout with his fire finder than by the fireman with a compass which cannot be read closer than a half degree and also may be subject to errors on account of local attraction which for some reason is particularly apt to be encountered on sharp ridges. With method "A" local attraction has no effect on computed offset and a backsight from reference point to the lookout will reveal the existence of any local attraction which might have to be considered in running course after arrival on lookout's line of sight.

(b) That alignments from lookouts who can see **base of fire** or which coincide with course of drifting smoke are better than those where converse conditions exist.

(c) That in case a fireman fails to find the fire after following along lookout's line of sight for an adequate distance in both directions, he should offset and run parallel strips on the side **from which** smoke was drifting when reported by lookout.

(d) That in special cases where a fireman is equipped with one of the new transmitting-receiving radio sets, he can get in communication with a lookout who can sight on a mirror flash from the fire chaser and then tell him the direction and distance of offset which must be made to get on line of sight through fire and also the direction and approximate distance which he must travel along this line.

Figure 18 illustrates two methods of placing one's self on lookout's line of sight by backsighting from any point in vicinity of fire.

In this example the fireman arrives at some point D in general vicinity of fire. He sets his compass on backsight reading 268°. Then looking through the sights he sees that the lookout is to the right of his line of sight D — A; therefore, he must offset to the right in order to more nearly approach the lookout's line of sight B — E. There are two methods for accomplishing this, as follows:

In case 1, where country is open so that frequent backsights on lookout point can be obtained, he would simply estimate by eye as nearly as he can the distance A — B, which of course is the same as D — E, and pace off this distance on a course at right angles to his line of sight D — A. Arriving at a point F, he again sets compass on backsight reading 268°, and on looking through sights finds that the lookout is now to the **left** of his line of sight FC. Obviously, he has gone too far and must now retrace his steps to the left a distance equivalent to C — B. By repeated observations he ultimately arrives at E directly on the lookout's line of sight, then runs a course on backsight reading 268° until he arrives at fire.

In case 2, where conditions are such that other backsights cannot be obtained on the lookout he should compute instead of guess the distance A — B which is of course equal to the distance D — E which he must offset to the right in order to arrive at "E". To do this he simply measures the angle ADB by taking a compass bearing from D to B. Assume that this bearing is 270° 15′. The angle ADB would therefore be 270° 15′ — 268° = 2° 15′. Assuming that the approximate distance from B to D is 12 miles as determined by reference to map the distance AB would be solved as follows:

Tangent offset for 1° in 1 mile = 92 ft.
Tangent offset for 2¼° in 1 mile = 92 x 2¼ = 207 ft.
Tangent offset for 2¼° in 12 miles = 207 x 12 = 2,484 ft.

Now, by offsetting to the right and at right angles to the line of sight D — A for a distance of 2,484 ft. the fireman should arrive at point E directly on the lookout's line of sight through the fire, which could then be found by following compass course on backsight-reading 268°.

Markers for Assisting Firemen

During the last few years great strides have been made in the construction of roads and trails which facilitate getting to the vicinity of reported fires. There is however a very urgent need for establishing definite markers along these routes of travel which will enable a fireman to know his approximate position at all times in reference to the mapped position of fires.

There are 3 methods of accomplishing this:

1. By reblazing all section line crossings so they can be easily picked up.
2. By putting up signboards at all section line crossings which show the numbers of sections involved and the distance to nearest ¼ or section corner.
3. By the **establishment** and **mapping of permanent mile posts.** Methods 1 and 2 have been carried out rather extensively and are proving of large assistance to fire chasers.

.d 3 has been less widely used but is obviously by far the best and should undoubtedly be considered ..imate objective to be obtained in the case of all roads and trails. Rough compass traverses are adequate . this purpose if they are tied in every 3 or 4 miles to a section corner or by triangulation. Mile posts are of no value for this work unless they are shown on the map. If mapped they constitute ideal reference points for enabling firemen to know their position, to place themselves on the lookout's line of sight or to find any desired section line crossing. Anyone can find and recognize a mile post and if that post is marked on his map he knows which direction and how far he must go to get on the lookout's platted line of sight or to find a section line crossing.

CONCLUSION

The whole aim is to get results. This means landing an adequate number of men on the fire with the least possible loss of time. If a lookout knows positively that it is a small one-man fire and is contiguous to the southeast corner of Jack Smith's clearing, it is a waste of time to even read the azimuth. Let the fire chaser start. Such cases, however, are rare. Intelligent use of the information called for on the "Lookout Report" Form will in the majority of cases result not only in more competent action being initiated but also in an actual saving of minutes, hours, or even days in arriving at the fire.