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AN EXPLANATION OF METEOROLOGICAL CONDITIONS WHICH PROBABLY CAUSED UNEXPECTED BEHAVIOR OF THE RATTLESNAKE FIRE, MENDOCINO NATIONAL FOREST, JULY 9,1953

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During the late evening of July 9, 1953, a California brush fire (which had made its initial run and was relatively quiet) suddenly came to life and spread unexpectedly downslope at tremendous speed, trapping and fatally burning 15 fire fighters. Control action on this fire was being directed by seasoned fire generals who had had many years of experience in fighting California brush fires. Obviously these veteran fire bosses did not expect the sudden reversal of the fire, or certainly the fatally burned men would not have been working in the dangerous area.

Why did the Rattlesnake Fire burn in this unexpected manner? Probably it will not be possible for investigators to say specifically what the humidity and wind conditions were which caused the fire to "blow up", as no measurements were being taken at the fire site. However, from other data which are available, it is possible to prepare an explanation of what probably happened. It is the purpose of this paper to examine the meteorological circumstances in connection with the fire. It is the author's further purpose to suggest what he considers to be a "plausible explanation" of meteorological conditions which caused reversal of the fire. In so doing, it is hoped that other Fire Weather Meteorologists and Fire Control Specialists will critically examine the contents of the paper. From discussions and from further examination, it is hoped that a sound explanation of the radical fire behavior will result. If we are successful in this endeavor, then perhaps through training we can be instrumental in preventing a recurrence of this tragedy.

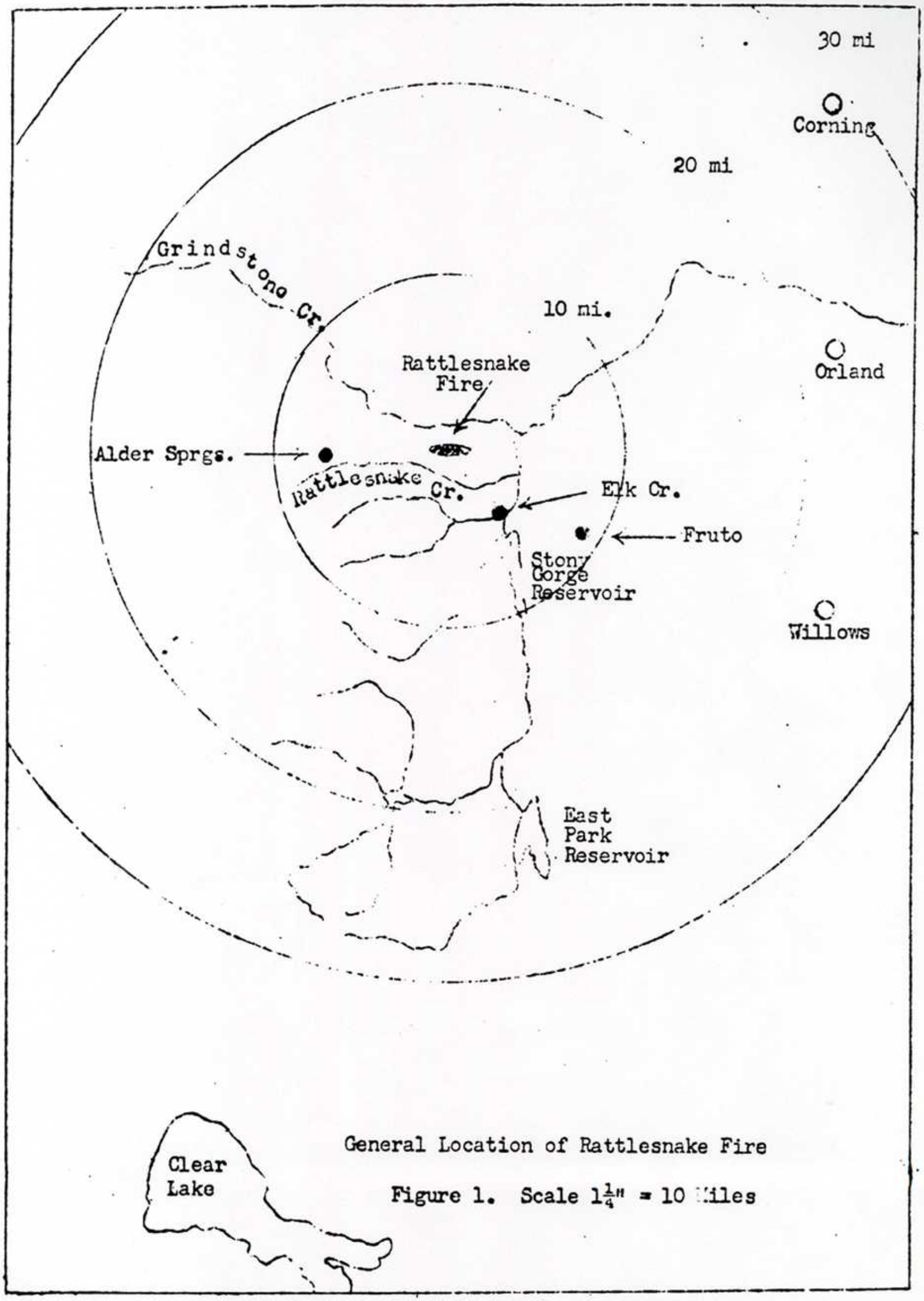
After the tragedy, a Board of Fire Review was appointed by the Chief of the Forest Service, and this Board was directed to thoroughly investigate the Rattlesnake Fire to determine what happened. These men did an exceedingly thorough job, and they produced a report (1) which gives a

(1) Report of Board of Review (USFS) Rattlesnake Fire.

vivid picture of the developments in connection with the fire and the tragedy.

See Figure 1 for general location of the fire. Figures 2 and 3 are photographs of the fire area. Figure 5 shows the spread of the fire before the "blow up". Figure 4 shows the explosive spread of the fire as it blew up. Figures 2, 3, 4, and 5 have been taken from the Board of Review report by permission of the Forest Service.

To explain the fire developments the following condensation of the Board of Review report is given: The fire was started at Oleta Point at about 1420 PST of July 9, 1953. During the first 2 hours the fire spread westward along and slightly on both sides of Oleta Ridge for a distance of about 3/4 mile to the intersection of Oleta Ridge with Rattlesnake Ridge. (See Fig. 5.) This was a normal upslope burn, and winds during this period were gentle upslope (easterly). Tactics adopted called for control of the fire along Rattlesnake Ridge on the southwest side; along Alder Springs road on the north side; and along Powder House Ridge on the expected extreme northwest tip of the fire. Burning was very hot locally at times during the afternoon along Alder Springs road, and during strong "flareups" some spot fires resulted to the north of Alder Springs road. One of these spots showed up on the north side of Powder House Gulch on a steep south slope, and about 300' below Powder House Ridge. (This spot subsequently became known as "Missionary Spot Fire".) The Missionary spot fire was manned at about 2100 PST, and the fire fighters had the spot thoroughly trenched by 2145 PST. By 2145 PST the fire had burned to approximately the confines indicated in Figure 5.



General Location of Rattlesnake Fire

Figure 1. Scale $1\frac{1}{4}$" = 10 Miles

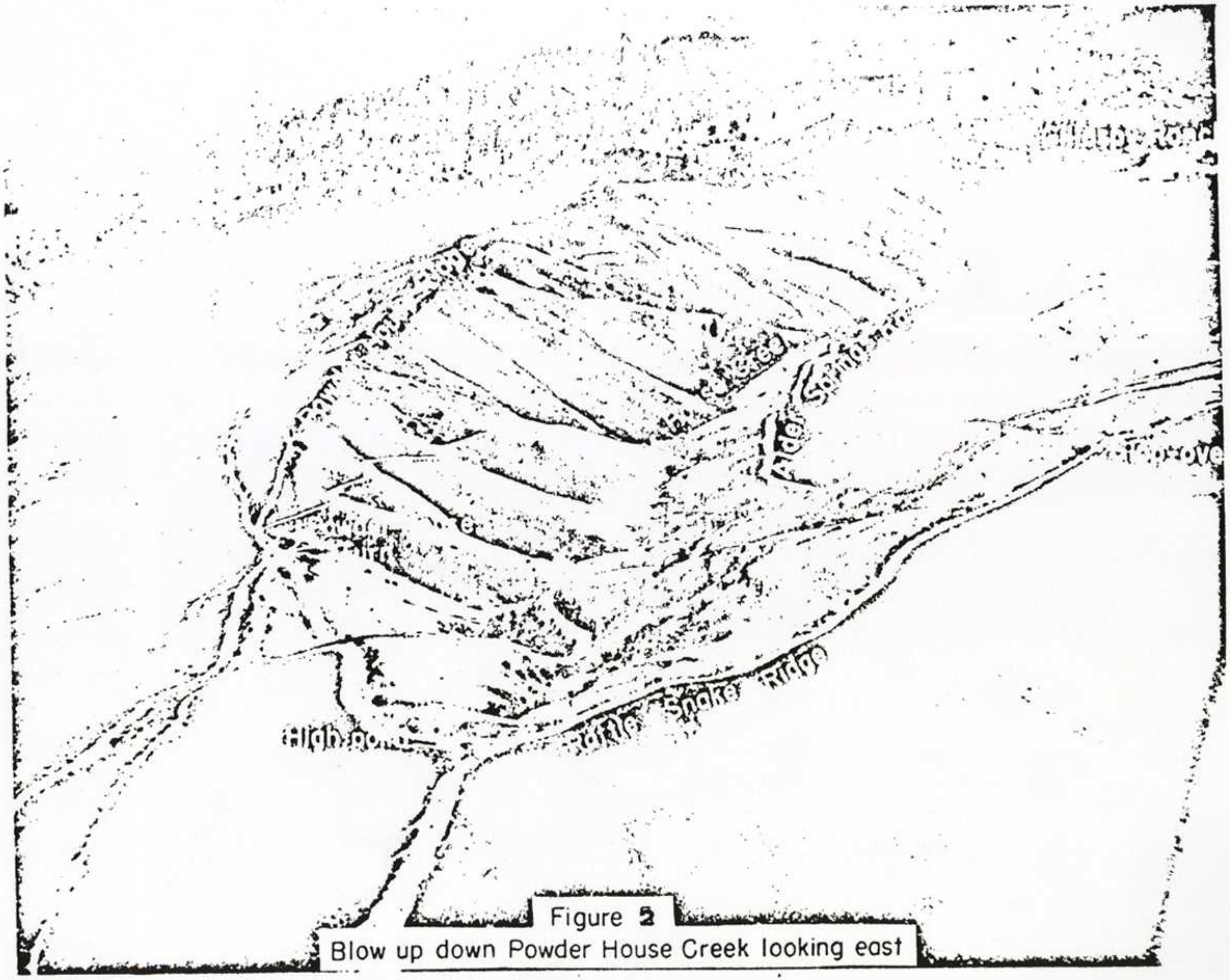
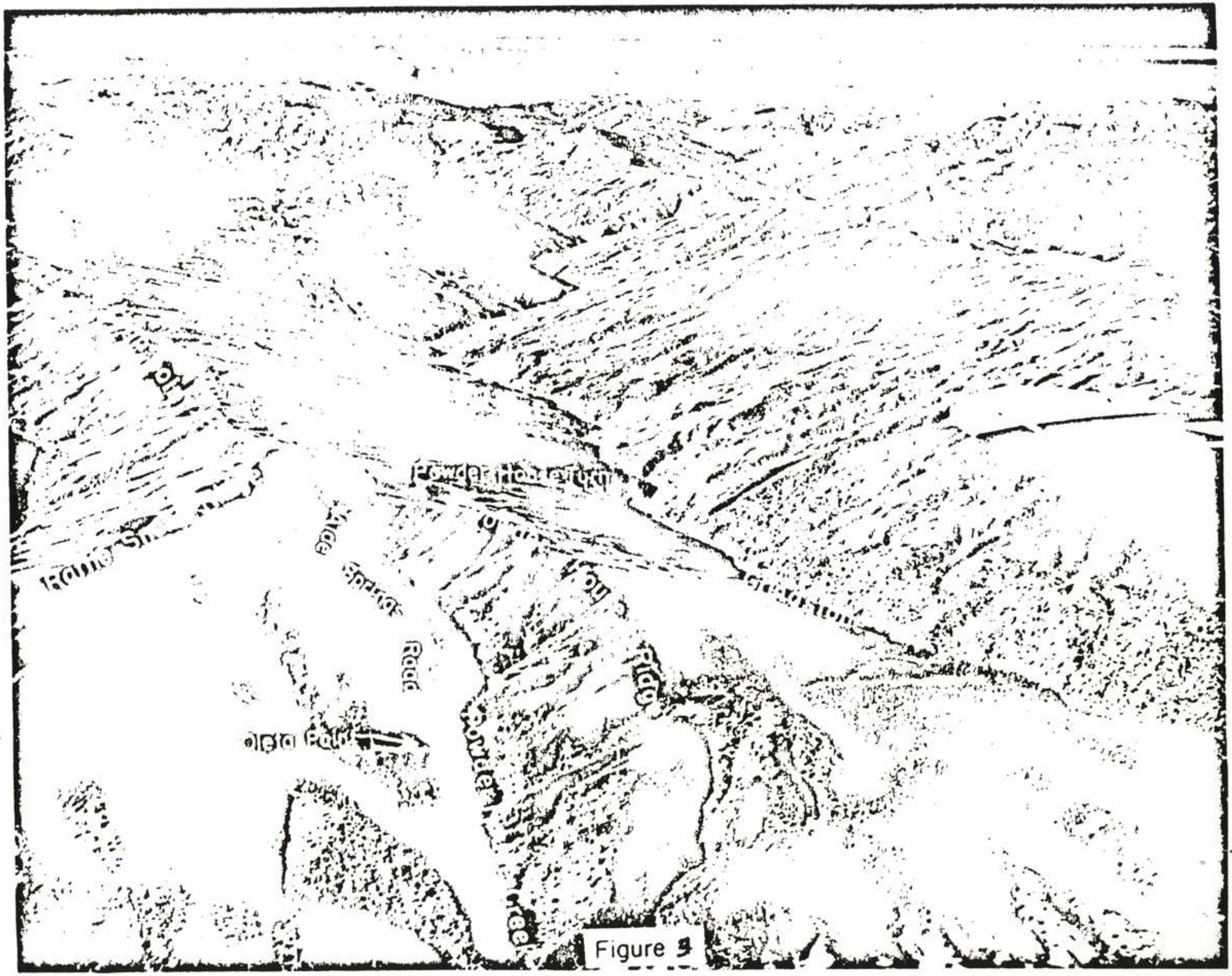


Figure 2
Blow up down Powder House Creek looking east



Powder House Creek and Grindstone Canyon, looking Westnorthwest.

FIGURE 4(Showing "blow-up" stages of Rattlesnake Fire)

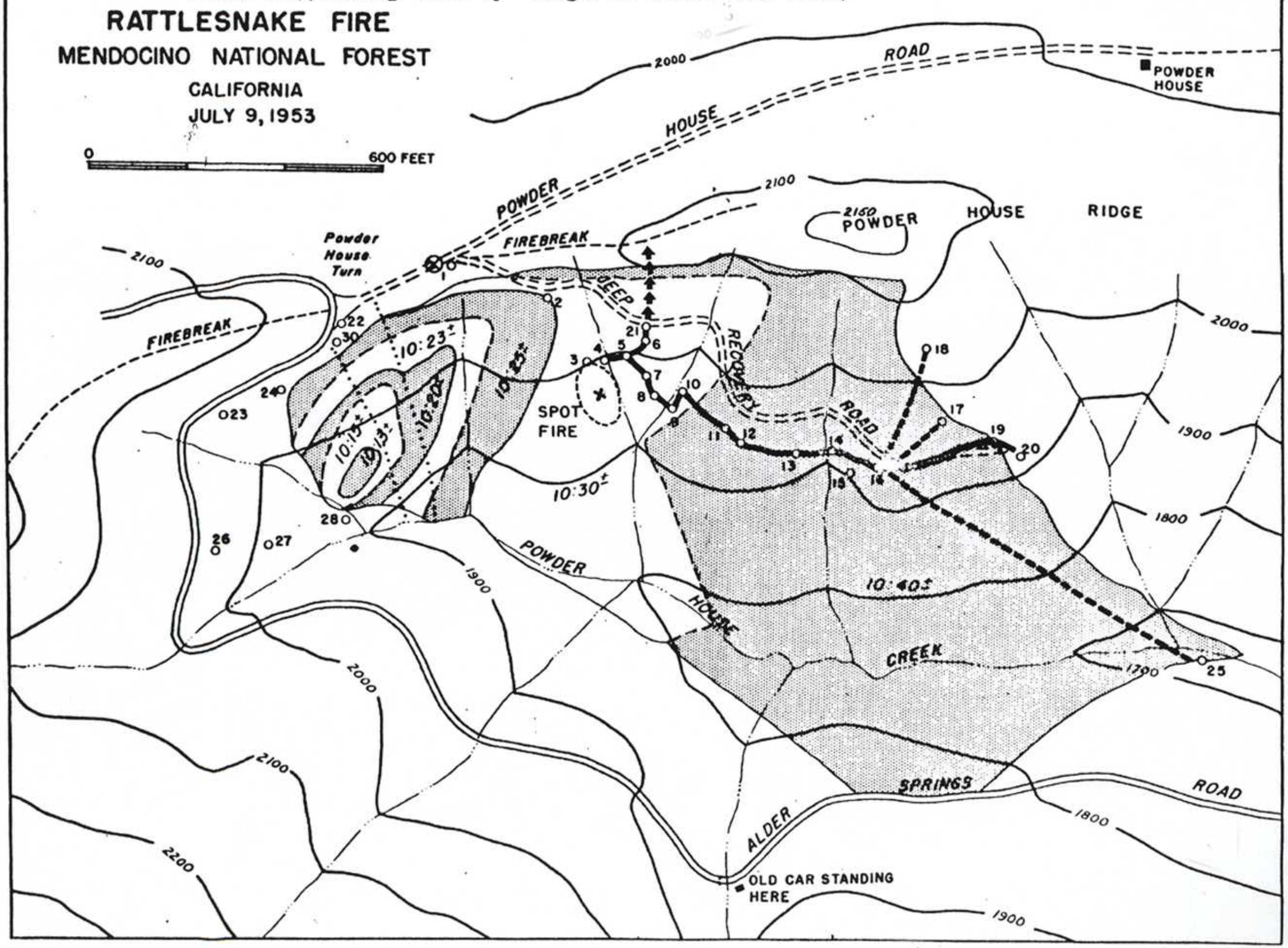


FIGURE 5

RATTLESNAKE FIRE - MENDOCINO NATIONAL FOREST, CALIFORNIA - JULY 9, 1953

SECTIONS 23, 24 AND PORTIONS OF SECTIONS 25, 26 OF R.7W, T.21N

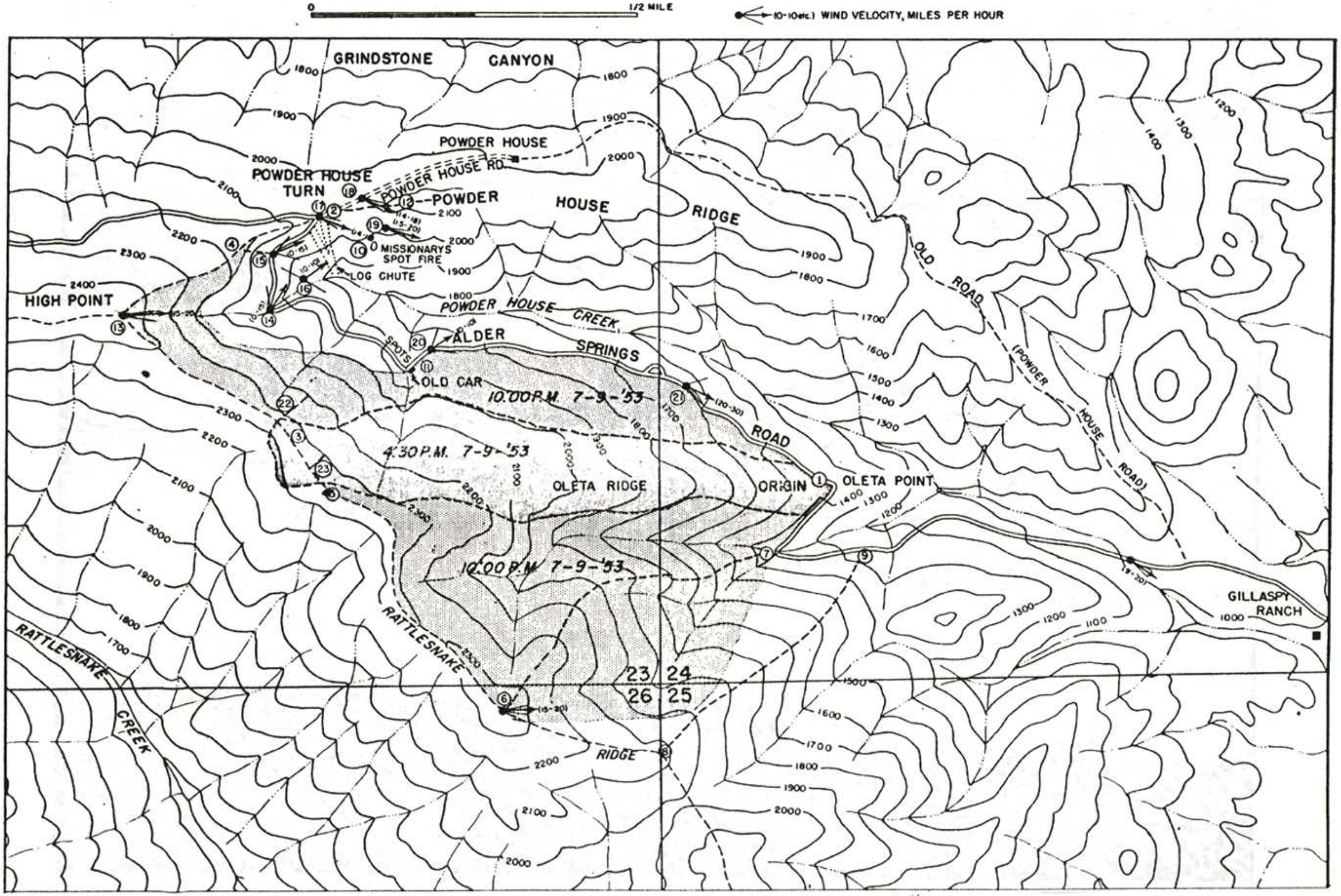


Figure 5. Showing Rattlesnake Fire before "blow-up".

Prior to approximately 2100 PST of July 9th the winds on the fire had been generally of an upslope character, and mostly light to gentle. At approximately 2100 PST these upslope air currents had subsided. This would be expected as the terrain cooled by radiation after the sun's rays had left the ground surface. Shortly before 2200 PST downslope winds became noticeable. Significantly, the Board of Review report says "At this time the fire started to burn briskly - -(at the west end between High Point and Alder Springs road) - - and soon thereafter was causing spot fires below (east of) Alder Springs road in the vicinity of Powder House Curve. (See Figure 4 for spot fires, points 22, 23, 24, 26, 27, 28, and 30). A spot fire at point 28 (Fig. 4) began to glow - - - and then moved, first to the northeast in a flanking motion across the slopes below the Alder Springs road, and then as it reached the maximum zone of westerly winds in Powder House Saddle, it swept rapidly downslope in an easterly direction". (See Figure 4 for approximate speed of the explosive spread of the fire.) The men who were on Missionary Spot Fire had a very short warning. Nine of these men climbed directly upslope to a fire break on Powder House Ridge. Fifteen of the men "contoured" to the east. All of these 15 were fatally burned in the holocaust.

On July 10th, two fire research specialists from the California Forest and Range Experiment Station of the Forest Service were sent to the scene of the fire to take wind readings at various places throughout the fire area. These men found that the winds on the evenings of the 10th and 11th shifted in a manner much like the wind shift on the 9th, and they found that significant winds blew downslope after the change from upslope movement on both days. The results of their measurements are shown in condensed form on Figure 5. (See points 13, 14, 15, 16, 17, 18, and others.) From these readings it was deduced by the Board of Review that the strong downslope winds are a normal occurrence in this area each evening, and that they may be expected to follow afternoon upslope winds. (The author believes that this assumption is only partially correct, as will be shown later.)

Before discussion of the meteorological aspects of the fire, there are several points which should be scrutinized rather carefully:

(1) The Board of Review report indicates that at 2100 PST the burning-out crews working between High Point and Powder House Curve had difficulty in getting brush to burn to the extent that "echelon burning practice had to be followed to burn the brush away from the fire line along the ridge". This would seem to indicate that the humidity at the fire had risen (with falling temperature) to a point at which the brush resisted burning. By 2200 PST it would be expected that the temperature would have fallen a few more degrees. and if the air at the fire were the same, the humidity would have risen by several percent. Is it logical, then, that after 2200 PST the fire would burn explosively if this same air were over it? This is doubted. Most fires which do burn at night under the influence of downslope (drainage) winds tend to "creep" downslope, but certainly not to crown and burn explosively. To the author this would suggest that the air changed when the fire commenced to burn fiercely shortly after 2200 PST.

(2) The downslope winds which occurred on the fire, as well as those which were measured on the following two nights are particularly

interesting because of their force at high levels. These winds have been judged to be normal drainage winds from radiational cooling process. Since radiational cooling occurs in the thin strata of air which is in contact with the earth's surface, it is obvious that the volume of air involved in this process is relatively small. As the shallow cooled air drains away to lower elevations it tends to "collect" in canyon bottoms and other low places. This leads to the assumption that the strongest winds and deepest air movement (in drainage winds) would naturally occur at the lowest portions of the canyons in question. It has been the author's observation that this is what happens "under normal circumstances". The drainages in this case were relatively short (Grindstone Cr. is about 20 mi. long, and Rattlesnake Cr. about 10 mi. long [That is, extending westward from the Fire Area.]) and hence it is assumed that such strong winds could hardly occur from radiational cooling processes alone. Furthermore, some of the highest velocities were actually measured on the ridge tops. It would be expected that winds from radiational cooling effects would be at a minimum on the ridge tops for obvious reasons. (The author does not question the wind measurements taken by the Fire Research men.)

(3) The Board of Review report indicates that when the blowup occurred, the fire spread first northeasterly until it reached a low saddle on Powder House Ridge, and from this saddle, the fire spread explosively down Powder House Gulch. Quoting the report: "The (9) survivors reached the ridge top at about 2230 PST, and at about the same time the fire spread eastward very rapidly, the east flank then becoming the head of the fire." Of special significance the report continues "The spread of the north side of the fire subsided in its northeast movement, and did not reach

the ridge top until about 2300 PST." If the air which drove the fire down Powder House Gulch came through the saddle, then this would mean that Grindstone Canyon had to be full of air which had collected from radiational cooling process in its upper reaches, if radiational cooling alone is considered to be the source of the down-canyon winds. (This deduction is not logical in the author's opinion, particularly when it is considered that all ridge top wind measurements indicated rather strong westerly winds on the following two nights). Why did the fire not burn rapidly upslope in Powder House Gulch on the north side of the canyon? Could it be that the stable air pushing down the canyon was a more powerful factor in the fire spread than the natural tendency for the fire to burn upslope? From the action of fires the author has seen when under the influence of downdrafts from thunderstorms, this would seem to be entirely likely. A stable subsiding, rapidly moving airmass can push a fire in any direction regardless of the normal tendency for the fire to burn upslope, or in response to other factors., i.e., when stable subsiding air is pushing a fire along, its force may be so strong that other influences are small in comparison, and these are partially or completely negated.

Meteorologists will not question the statement "That when a fire burns down a steep slope in a steady rapid movement, then the air which pushes the fire must be subsiding rapidly (lowering)". It is true that air which cools by the radiation process (nightly) and drains into canyon bottoms or low places is subsiding air. While there is a tendency for such air to heat dynamically as its pressure is increased, in most cases the drainage is sufficiently slow and the radiation effect is sufficiently strong that it is more important.than dynamic heating, and for this reason, the air which drains into low spots is usually quite cool with a high humidity. That is, under these circumstances, the air aloft remains much warmer. From this explanation it can be seen that it is not likely that air formed by radiational cooling was responsible for the explosive spread of the Rattlesnake Fire in a downslope direction.

At this point it might be well for the benefit of Foresters to explain the widespread subsidence which occurs from some high pressure systems at times. Meteorologists have not solved all of the problems in connection with such cases of subsidence, but we have observed the phenomenon many times, and in some cases we can forecast it. The most unusual (pronounced) cases of subsidence develop when a high pressure system moves into a position so that it exerts pressure against a mountain range, and when there is low pressure on the other side of the range. Under this condition, the temperature of the air aloft in the high pressure system is usually potentially colder than the air in the low pressure system. As a result, this potentially colder air tends to pour over the mountains (through the gaps at first) and it lowers to the surface on the lea side of the mountain range as a warm dry airmass. It is warm at the surface because the air heats by compression as it lowers at the rate of approximately 5°F per 1000 ft. Since this air is quite cold at its initial elevation before subsidence begins, it contains very little moisture. Hence it reaches the surface in a rather warm and dry state.

Most individuals are familiar with outstanding examples of extreme subsidence. Some of them are: (1) The Santa Ana winds of southern California. (2) The Chinook winds of the eastern slopes of the Rocky Mountains. (3) The feared East Winds which blow at times over Washington, Oregon, and northern California. (4) The Northerly wind conditions of the Sacramento Valley. The author believes all will agree that all of these examples of subsidence development bring about a high fire danger condition very quickly.

From a careful study of the meteorological conditions in connection with the Rattlesnake Fire, there is evidence which indicates that a minor case of subsidence has occurred in this instance. The author wishes to emphasize that he does not consider this to be an example of widespread subsidence. The evidence will not support such a conclusion. But the evidence does indicate that perhaps this subsidence does occur at times on the east side of the Coast Range of California; that is, when the pressure distribution and other conditions are right. (This has a bearing on the fact that similar wind conditions were noted in Powder House Gulch on three successive nights.)

During the summer when the Sacramento-San Joaquin valley system of California is usually quite hot, the normal pressure distribution is one in which a trough of low pressure extends from Arizona and southern California northward over northern California, over Oregon, and frequently over Washington and Idaho. When pressure is low over California, there is normally a high pressure ridge over the Pacific off-shore. This low pressure trough, and the high pressure ridge, while generally remaining in the same approximate position, do fluctuate continually, so that at times the trough may move westward over the coast, and at times the trough may move farther inland. As the low pressure trough moves, the high pressure ridge shifts also, although at times one system or the other may intensify or weaken, resulting in a steeper or less steep pressure gradient. (In the time available to prepare the initial draft of this paper, the author has not had time to check the average number of times these systems fluctuate each summer. It is hoped that this can be done in the near future, so we may have an idea of the approximate number of times each fire season this situation may be expected to occur. At this writing, let us say that it occurs several times each summer.)

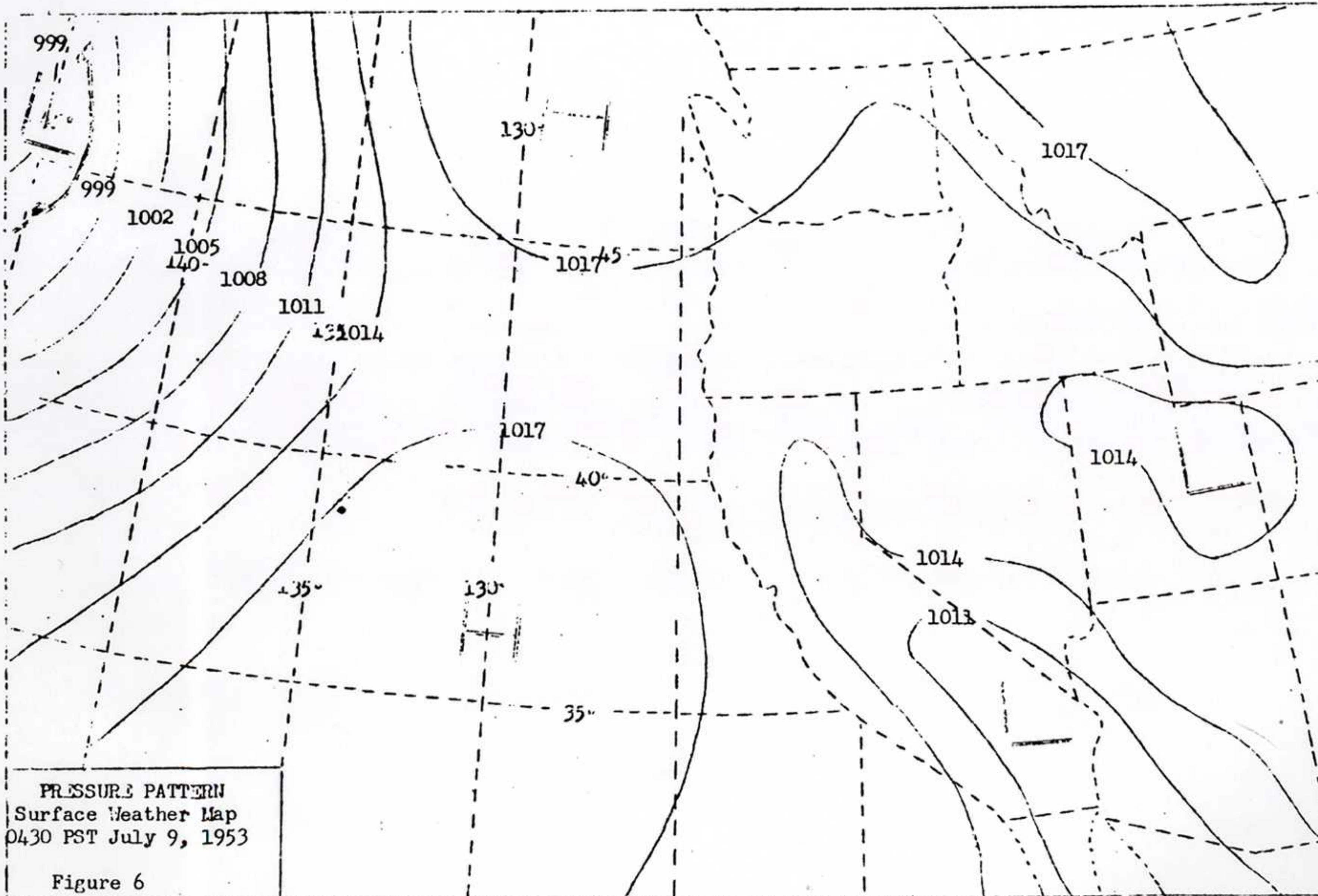
On the east side of the low pressure trough the air is usually unstable, with thunderstorms frequently forming on the east side. (Usually these thunderstorms are along the Sierras and Cascades and/or to the east.) On the west side of the trough the air is usually stable, subsiding, and quite dry. As the trough shifts from west to east, the pressure reacts accordingly. Frequently these movements of the trough eastward are marked by a shift of the winds aloft changing to a westnorthwesterly or northwesterly direction. When this happens it is an indication that potentially cooler air from the Pacific is moving inland, and of course, when the winds aloft shift to the northwest, the pressure invariably rises simultaneously.

Previously the author indicated that marked subsidence occurs when a potentially colder airmass (high pressure system) pushes against a mountain range, if pressure is lower on the lee side of the range. Thus it can be seen that at times this very thing occurs over the Coast Range of northern California. It must be recognized that this location is not an ideal one for subsiding winds to blow from a west to an east direction.

One probable reason for this is that the much higher Sierra Nevada and Cascade Ranges lie just a short distance to the east, and they probably tend to dampen subsiding winds which normally occur over a wide area; viz the Santa Ana winds, the Chinooks, and the East Winds of Oregon and Washington. However, the necessary conditions for some subsidence winds do obviously occur, and probably with considerable frequency in the area in question in the summertime.

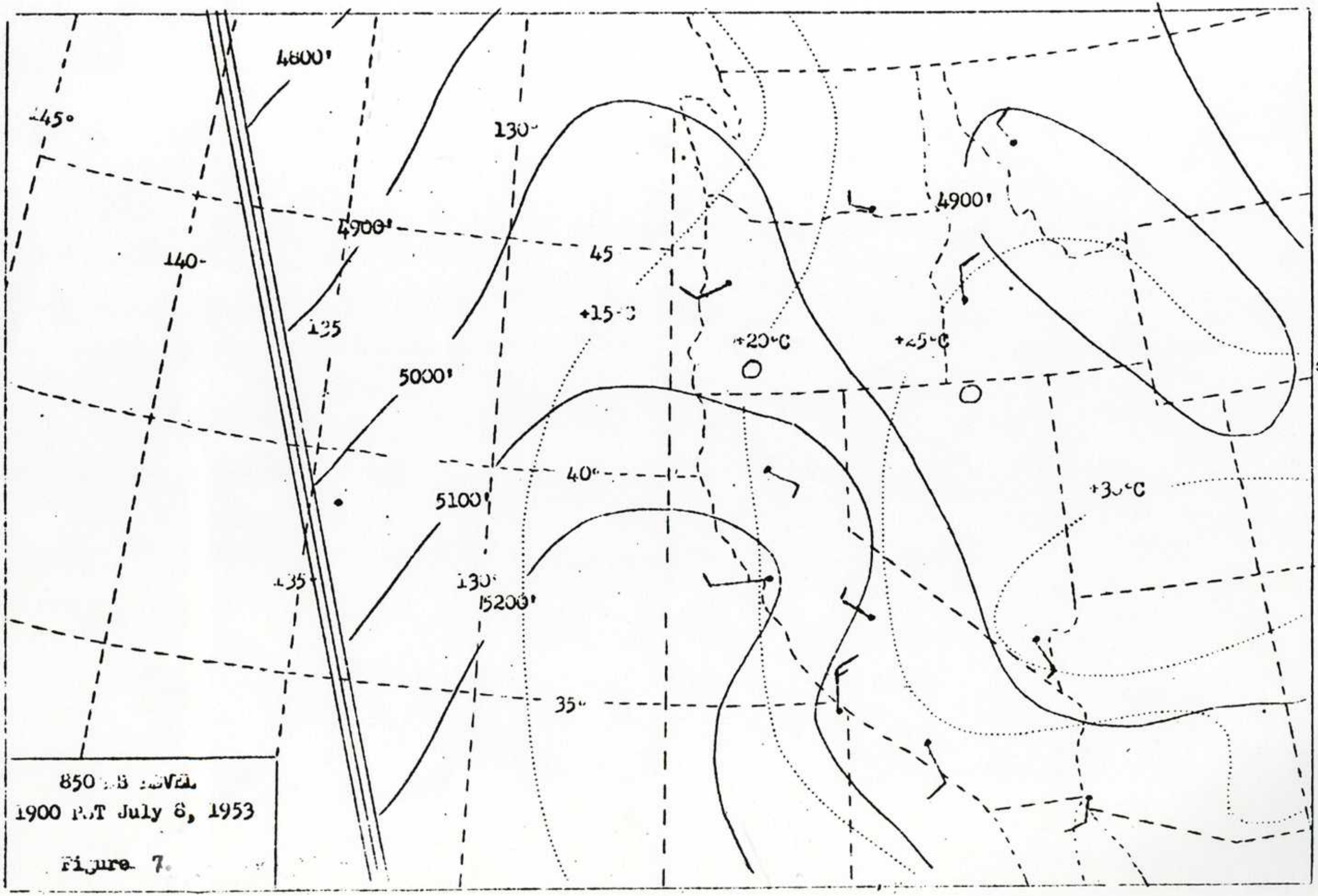
Let us look at the conditions which prevailed prior to, at the time of, and following the period of the Rattlesnake Fire. The 0430 PST morning surface weather map of July 9, 1953 (See Figure 6) shows that the thermal trough is rather well developed over California, and it also indicates that the off-shore high pressure ridge is quite weak. Notice that the 1017 mb isobar is well off-shore. Referring to the 1900 PST 850 and 700 millibar constant pressure charts of July 8th, (Figs. 7 & 8) notice that the temperature gradient aloft is east-west, with colder air over the ocean. This indicates potentially colder air to the west of northern California, and this is a normal summertime condition. Soundings through the air aloft over Medford and Oakland (observations taken at 1900 PST, July 8, 1953 - See Figures 9 and 10) indicate that the air is stable and dry.

The 1630 PST evening weather map of July 9th indicates that the trough of low pressure has deepened over California, and that it has extended northward over Oregon and southern Idaho. (See Figure 11). While this has occurred, the high pressure ridge has been building off-shore. The 1017 mb isobar now extends generally along the coast from central California to southern British Columbia, and a 1020 millibar center of high pressure has been charted over the ocean west of central California.



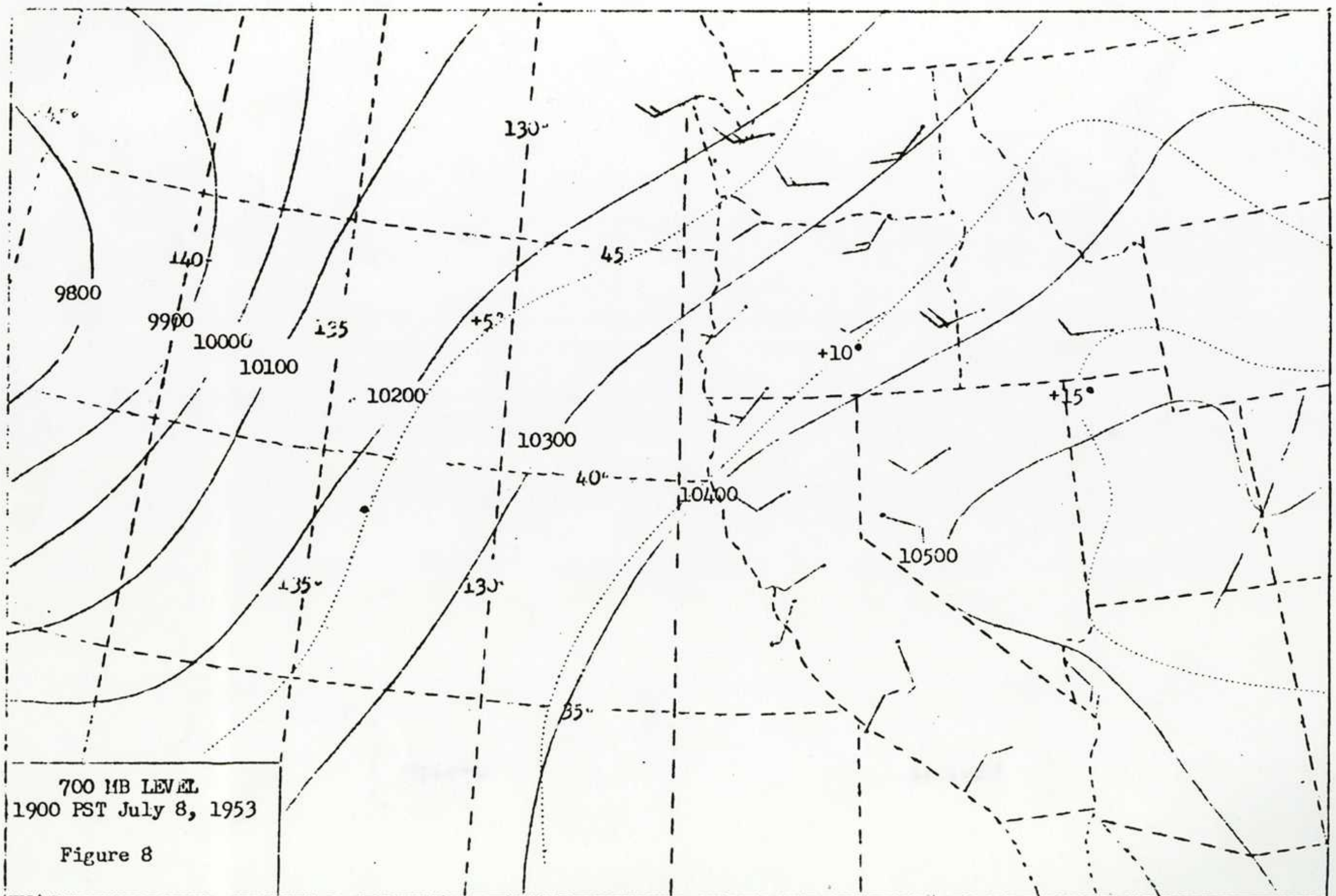
PRESSURE PATTERN
Surface Weather Map
0430 PST July 9, 1953

Figure 6



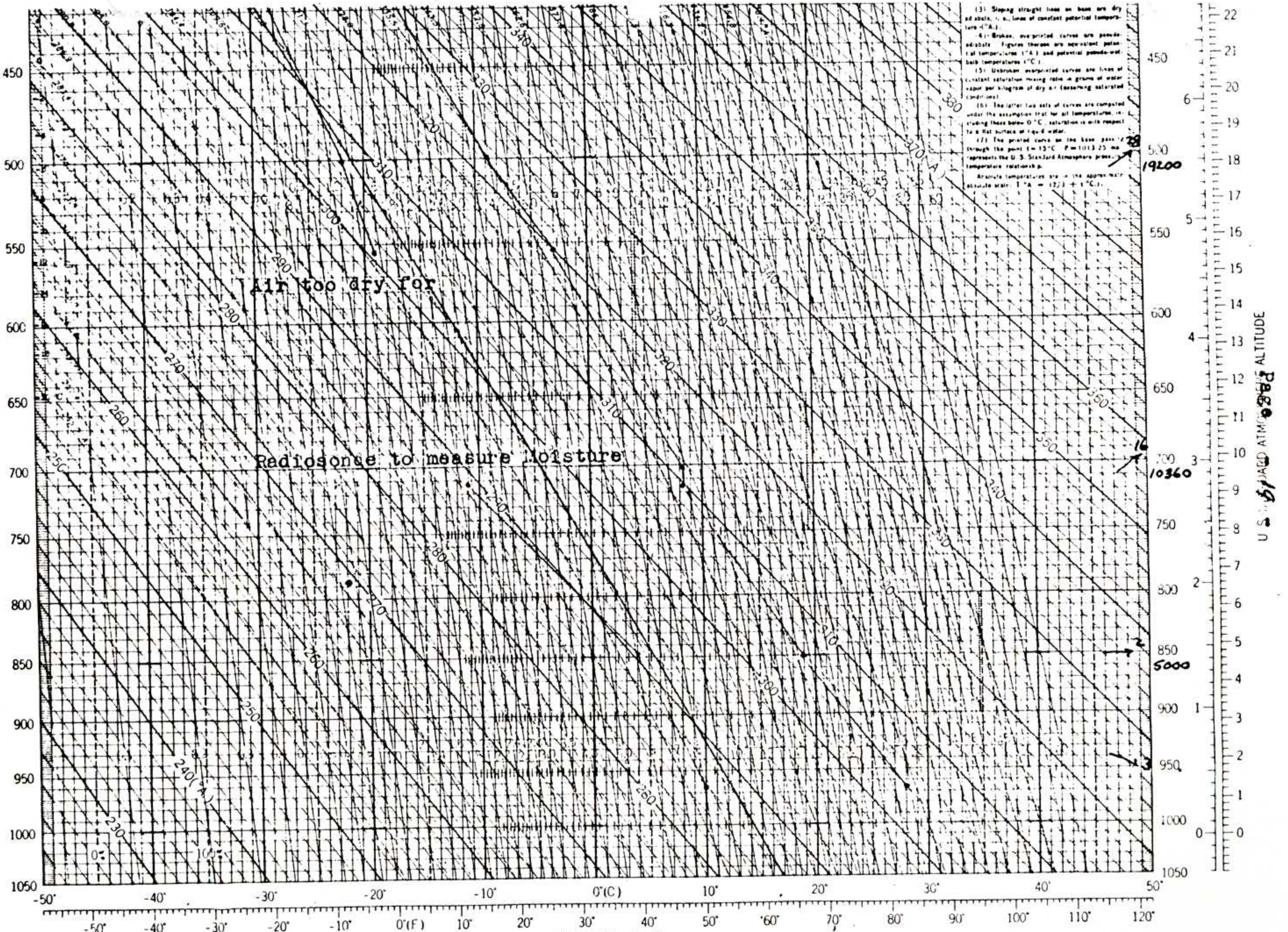
850 MB LEVEL
1900 PST July 8, 1953

Figure 7.

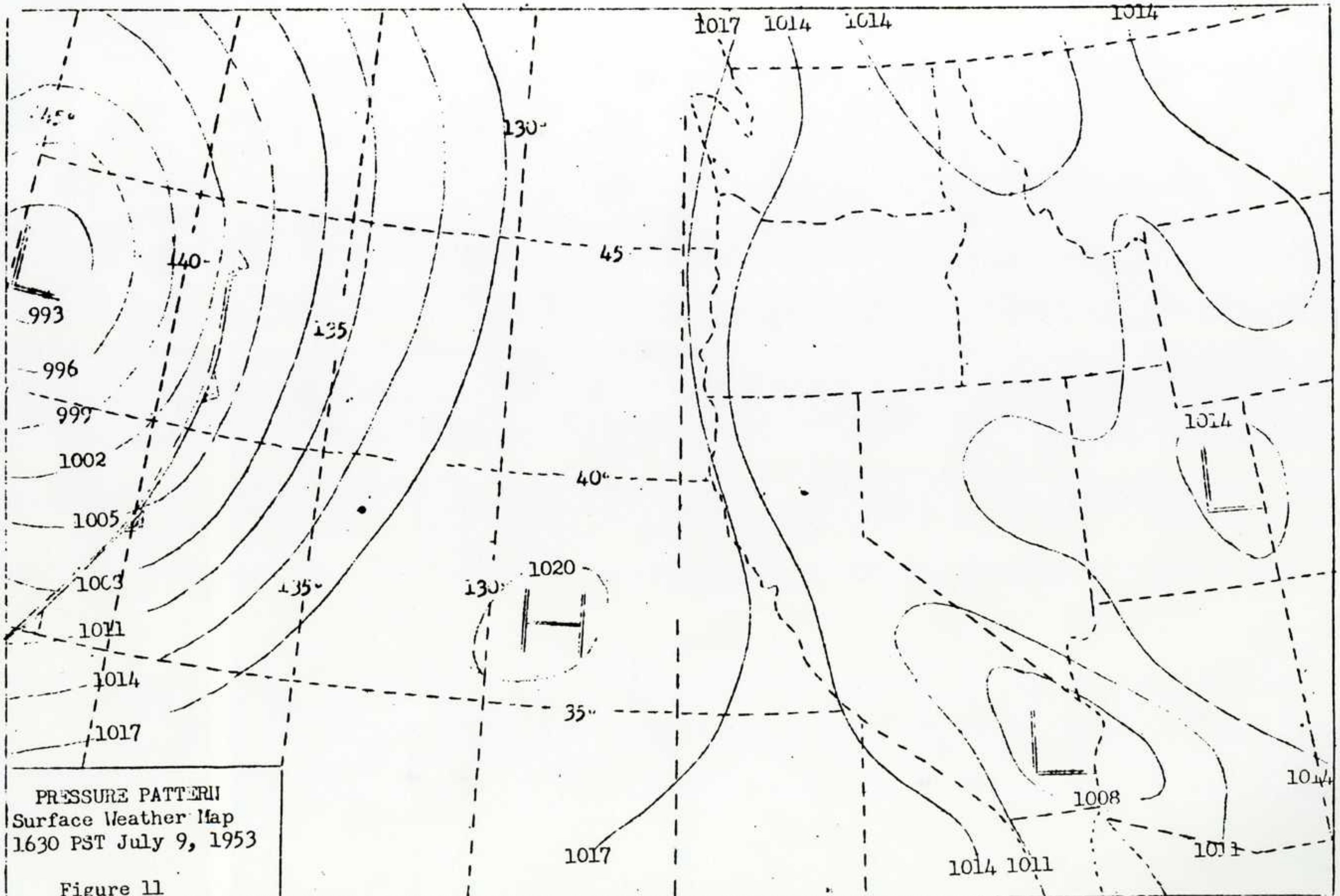


700 MB LEVEL
1900 PST July 8, 1953

Figure 8



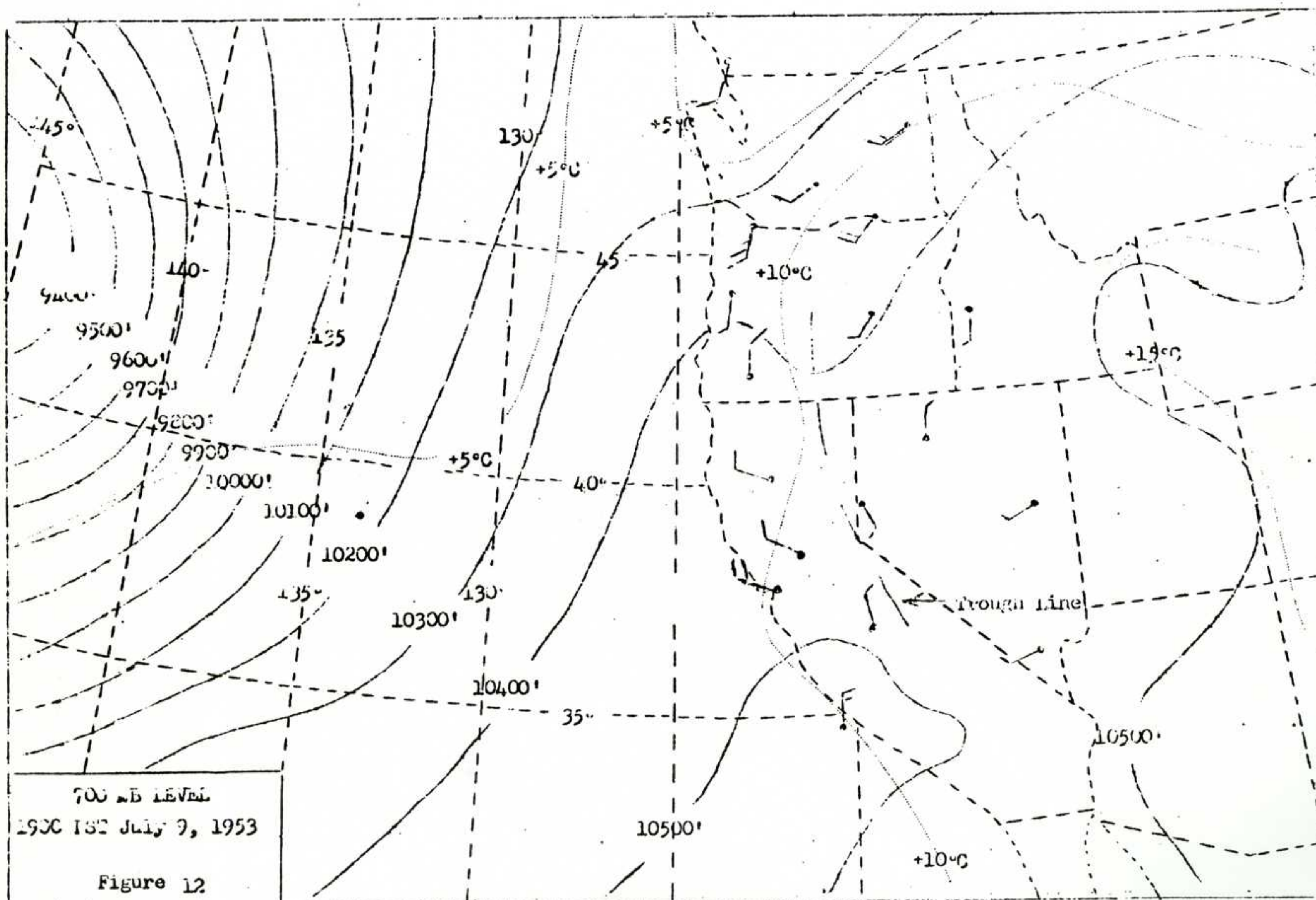
Medford, Oreg. Date July 8,1953 Hour 1900 PST Figure 9.



PRESSURE PATTERN
Surface Weather Map
1630 PST July 9, 1953

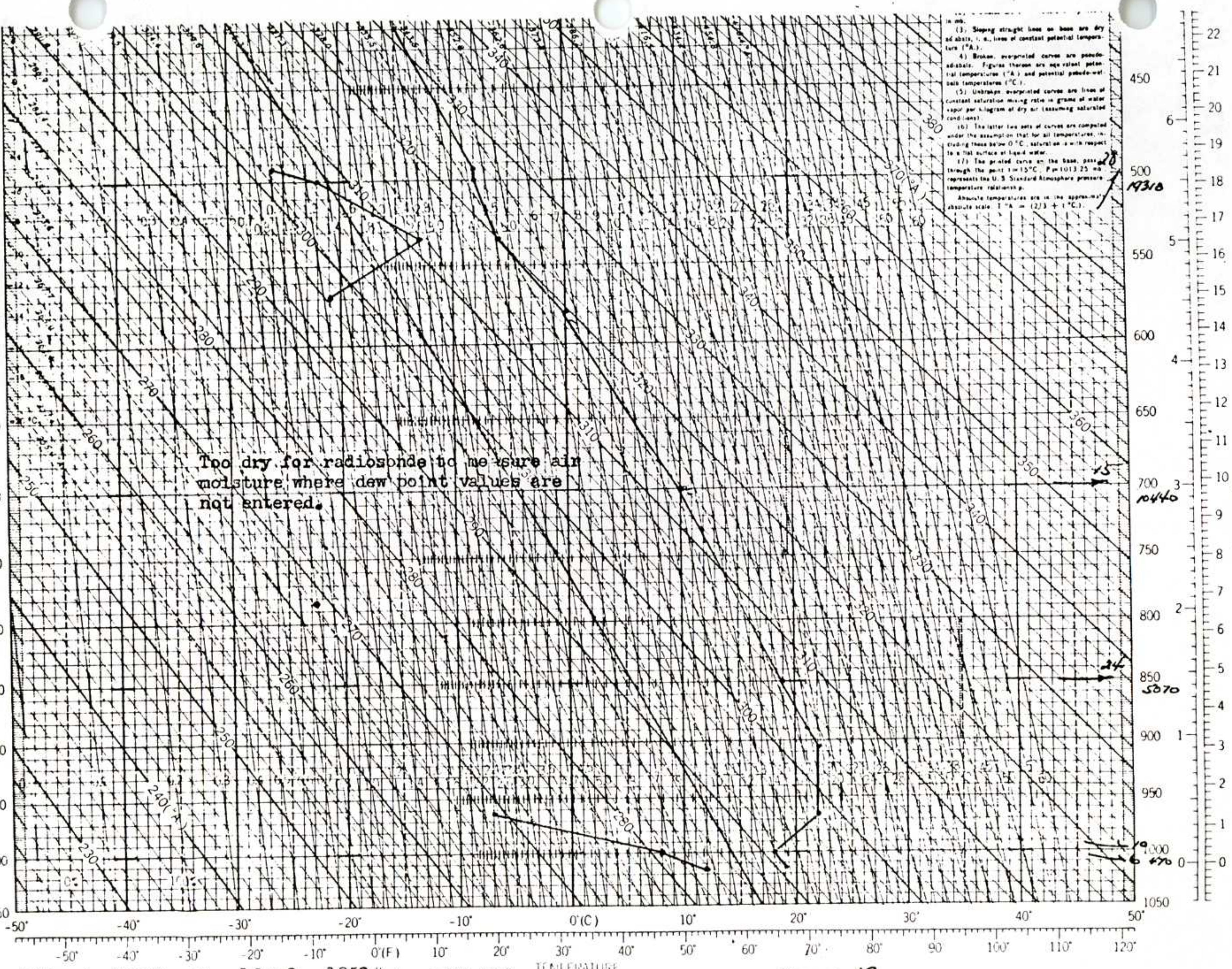
Figure 11

This means that the pressure difference between the area west of the Coast Range and the Sacramento Valley has become greater. The 1900 PST 700 mb chart of July 9th indicates a trough or wind shift line over northern California aloft (See Figure 12) and with pressure rising to the west, this trough line would be assumed to be moving eastward. The winds aloft have shifted to the northwest at Medford, Red Bluff, Sacramento, and Fresno as indicated by this chart. The soundings from Oakland and Medford (taken at 1900 PST of July 9th) indicate that the air continues to be stable and dry. (See Figures 13 and 14.) It is interesting with respect to these soundings to notice the winds at 850 mb and 700 mb. Both soundings indicate that the winds have shifted to the west or northwest. At approximately 5000', Oakland indicates a west wind of 24 knots. The shift of the winds aloft as indicated by the aforementioned stations suggests the movement eastward of the axis of the trough aloft. At the time of a trough passage the winds normally increase. This trough passage was apparently occurring sometime during the evening of July 9th. The passage of the trough could explain the sudden increase of winds on the fire. It will be recalled that earlier we indicated that generally the air is more unstable on the east side of the trough, while subsidence (stable conditions) occur on the west side of such a trough. Could it be that at about 2000 PST this subsiding drier air was raching the vicinity of Rattlesnake Fire? The author believes that this is possible, but the evidence is not strong enough to say positively. If it did occur, then the drier air, and subsiding air movement with stronger winds would have been available to push the fire downslope out of control. At any rate, the evidence would indicate that the winds on the night of July 9th were stronger than

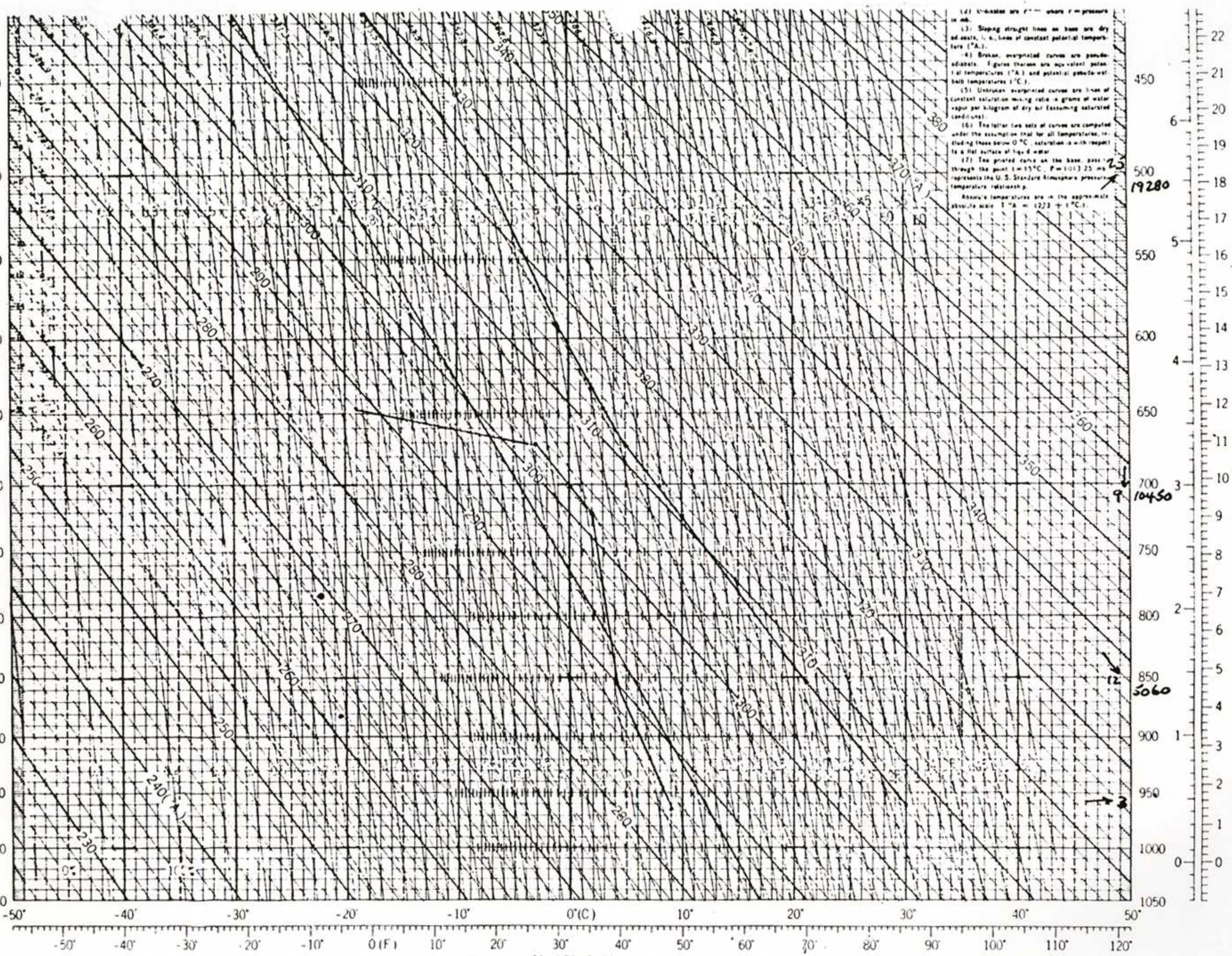


700 MB LEVEL
1900 IST July 9, 1953

Figure 12



Oakland, Calif   July 9, 1953   1900 PST   Figure 13.

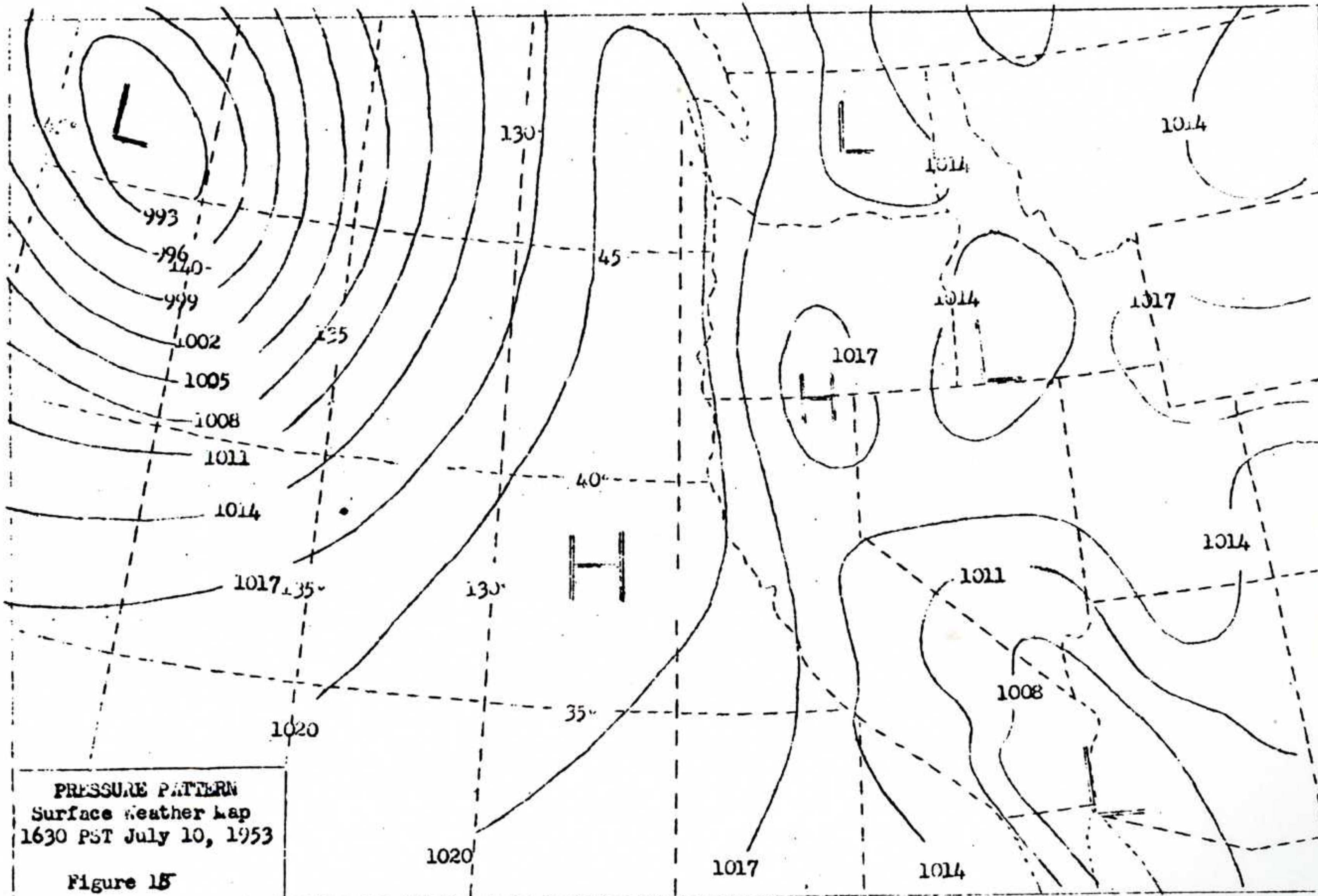


Medford, Oreg. July 9, 1953 1900 PST

Figure 14.

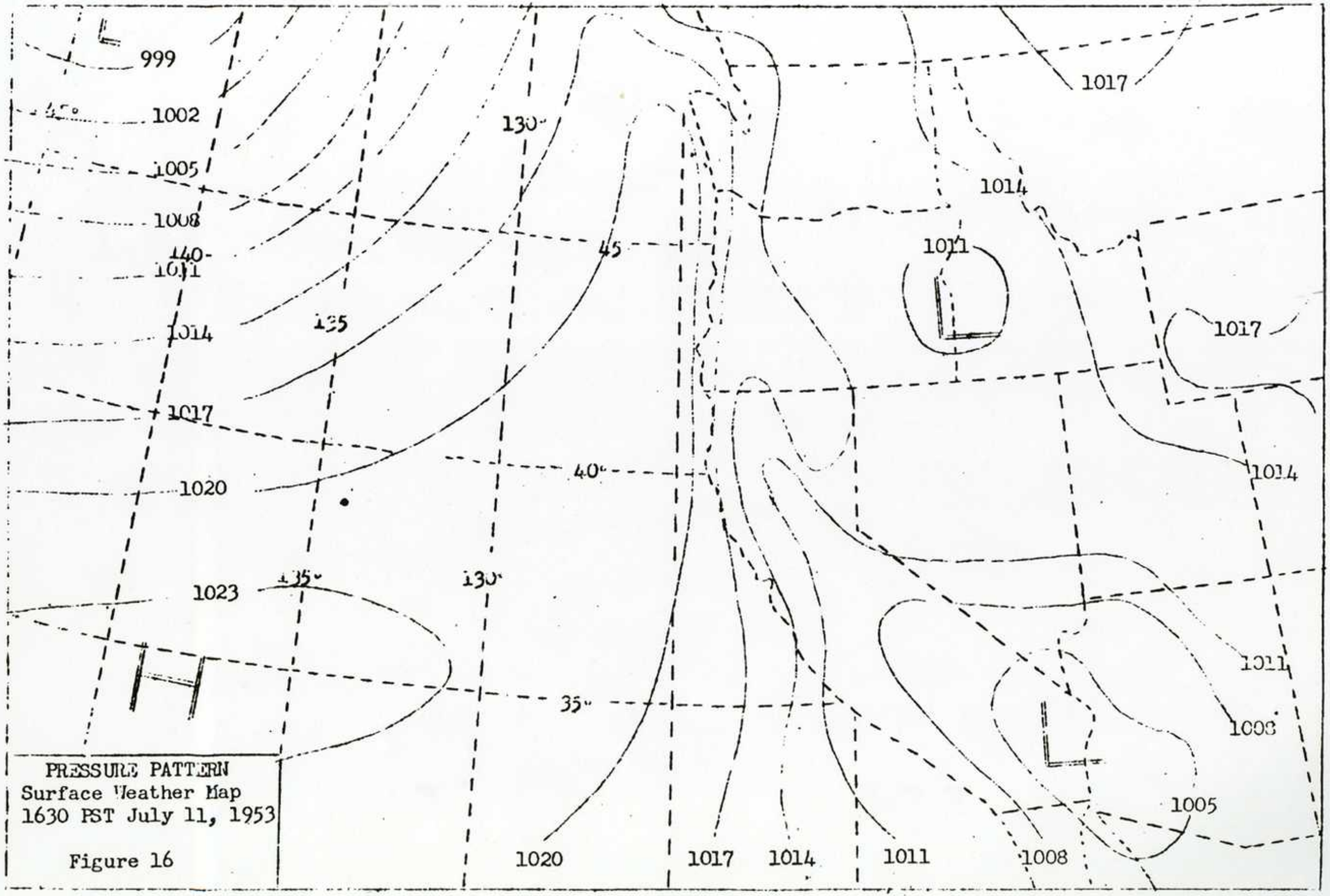
on the succeeding two nights when the research men took their wind measurements. If this assumption is correct, then the humidity would also have been lower (due greater subsidence) on the night of July 9th, than on the succeeding two nights.

The surface weather maps of the evenings of July 10th and 11th (Figures 15 and 16) indicate that the ridge of high pressure continued to strengthen to the west of the Coast Range, and that the trough of low pressure remained over the central valleys of California, and over Oregon and Washington. The air remained dry and stable over the Coast Range of northern California. Since the high pressure system was continuing to strengthen, it is inferred that it continued to exert pressure against the west slopes of the Coast Range, and the pressure remained low over the Sacramento Valley. The 850 mb charts for the evenings of July 10th and 11th continued to show an east-west temperature gradient, and this would mean that the air to the west of the Coast Range was potentially colder than the air to the east of the Coast Range. Considering these factors, it seems that conditions were such that the subsiding winds which started during the evening of July 9th should logically have continued during the afternoons and evenings of July 10th and 11th. It is a matter of record that the winds were upslope (easterly) at the scene of Rattlesnake Fire during the afternoons of these days. Certainly, considering the action of other well-known subsiding winds such as the Chinook and the Santa Ana, it is known that these winds continue to blow during the day. It is the author's theory that the subsiding air in this case was only slightly colder aloft than the air over the Sacramento Valley, and that while the tendency for subsidence was in force during the afternoons of the 10th and 11th, this tendency was overpowered during the days by the energy from



PRESSURE PATTERN
Surface Weather Map
1630 PST July 10, 1953

Figure 15



PRESSURE PATTERN
Surface Weather Map
1630 PST July 11, 1953

Figure 16

intense heating in the Sacramento Valley; i.e., the east slopes of the Coast Range absorbed sufficient energy, and became sufficiently hot to cause upslope winds (easterly) in spite of the tendency for subsiding air movement. This theory becomes more plausible when we consider that outstanding cases of subsiding winds (such as the Chinook, and the Santa Ana) are normally Fall and Wintertime phenomena, and in those cases the high pressure systems contain air which is much colder and more dense than would be found in this summertime situation. The author's theory is given added weight when we recall that as soon as the east slopes of the Coast Range cooled on the nights of July 10th and 11th, then the deep down-canyon winds set in again, with considerable wind on the ridge tops.

The force of these subsidence winds (as indicated by measurements on ridge tops near the fire area) deserves some further clarification. There is reason to believe that the topography of the main ridge of the Coast Range may well have been responsible for higher winds than would have occurred if the main ridge were of uniform height. So long as barometric pressure were rising to the west of the Coast Range the stable air would be lifted some in reaching the summit. In the terminology of the meteorologist, this would result in convergence, and this would give the air a greater tendency to move rapidly through the low gaps in the Coast Range; i.e., the velocity of the air movement through the gaps would be increased by "venturi effect". Since the air would then flow on down the easterly draining canyons which headed up at these gaps in the Coast Range, it would have little tendency to slow down appreciably in these canyons.

An examination of Figure 17 shows how the air flowing through the gaps or passes in the Coast Range might affect the area of Rattlesnake Fire. Following Grindstone Creek drainage northwestward to the Coast Range divide, it can be seen that this drainage "heads up" directly under Mendocino Pass, and that in this pass there is a rather broad gap with elevation of about 5000 ft. above sea level. If the high pressure system were pushing against the west slopes of the Coast Range, the air would tend to pour through Mendocino Pass (at an accelerated speed due venturi effect) in considerable volume. In other words there would be a veritable "river of air" through Mendocino Pass. This explains how Grindstone Canyon could have been "full to overflowing" of rapidly moving subsiding air, and this would also explain the high winds thru the "saddle" and on the lower ridges. On the basis of this theory, it is probable that Rattlesnake Creek did not contain as much of the subsiding air as did Grindstone Canyon. The reason for this is obvious when we notice that Rattlesnake Creek "heads up" about 10 miles west of the fire area in a place where the Coast Range is somewhat higher. (See Figure 17.)

The author has information which indicates that small boats on Stony Gorge Reservoir were nearly capsized when strong winds hit the reservoir area on the evening of the Rattlesnake Fire disaster. This information further strengthens the theory indicated here, because there is a gap which is wider and slightly lower than Mendocino Pass a few miles to the westsouthwest of Stony Gorge Reservoir.

The author has theorized considerably in the preparation of this paper. This has been necessary to explain what happened in the absence of

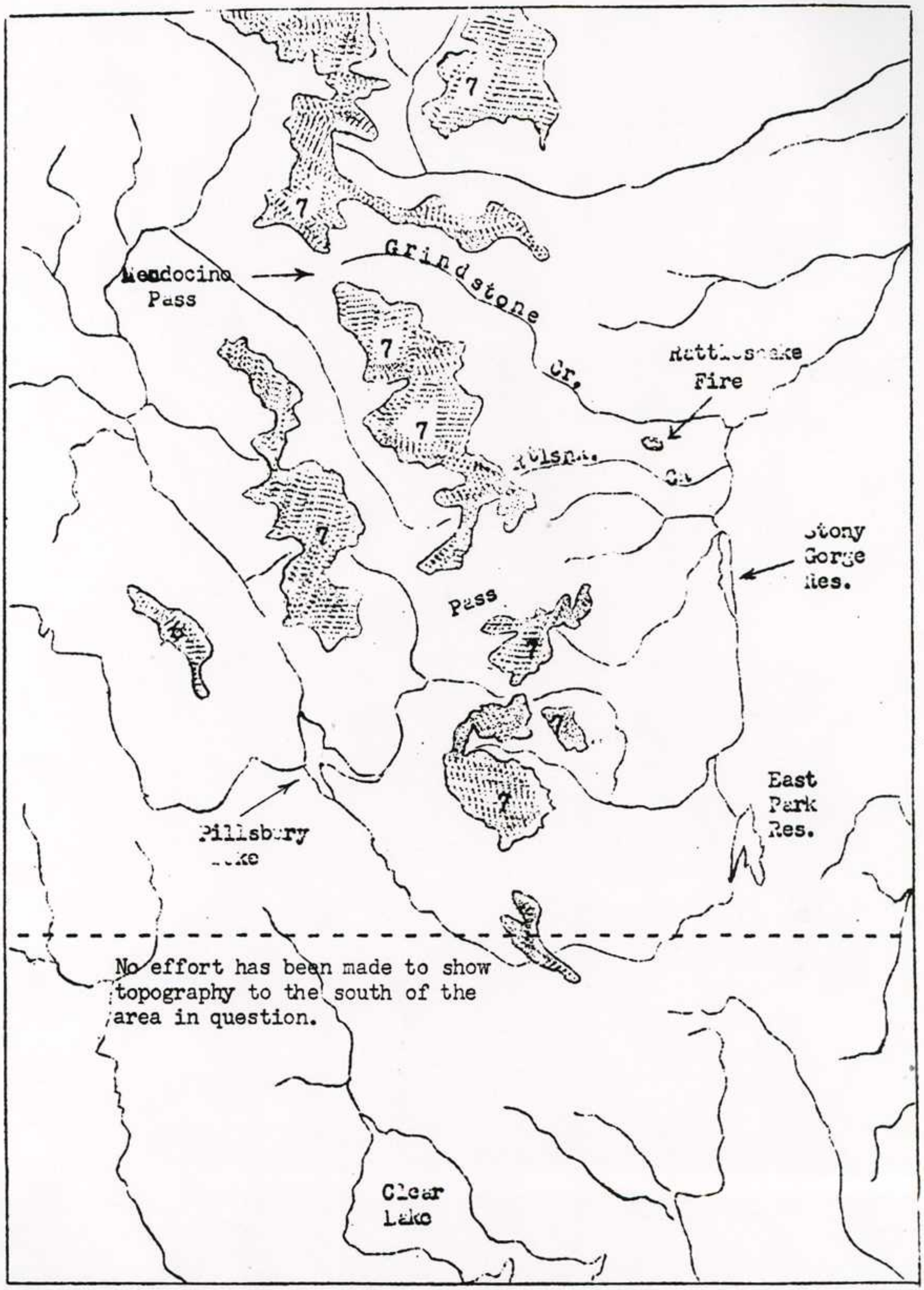


Figure 17. (Showing topography in vicinity of Rattlesnake Fire. 5000 ft. contour encloses shaded high areas. Single figure in shaded areas shows approximate highest elevation in thousands of feet.)

factual data. It seems entirely possible that the theories presented are correct. Fortunately, however, it is possible to perform an experiment which will prove or disprove the thesis presented here. That experiment is as follows: There is no question but that the air which drove the Rattlesnake Fire down-canyon was subsiding rapidly. This subsiding air could have come from only two known sources. The first possible source is through radiational cooling of the air which was in the area on the east side of the Coast Range. (This source has been discounted by the author). The only other known source would be through subsidence of stable air which has flowed through the mountain passes. There is a road from the scene of Rattlesnake Fire directly to Mendocino Pass at the headwaters of Grindstone Creek. It is suggested (that during the 1954 summer when a pressure pattern similar to the one at the time of Rattlesnake Fire occurs) that an observer be sent to Mendocino Pass at about 2030 PST. Another observer should be located at the saddle (near High Point) through which the strong winds flowed. At about 2030PST both of these men should take observations of wind direction and approximate velocity. Also both men should take dry and wet bulb readings <u>very carefully</u>. If the air is pouring through Mendocino Pass from the west, and if moderate to strong westerly winds are flowing through the saddle near High Point, then there should be a mathematical consistency in their readings. If the air is subsiding (as has been visualized in this paper) it will heat dynamically at the rate of about 5°F per 1000 ft. of lowering. That being the case, the temperature at the saddle should be about 15°F warmer than the temperature taken at Mendocino Pass at the same time. (Elevation of Mendocino Pass is estimated at 5000' MSL and elevation of the saddle at 2000' MSL.)

Furthermore, if the air is the same at both locations, then the dew point values will agree. The dew point temperature increases at the rate of about 1°F per 1000 ft. of lowering even though no additional moisture is added to the air. This means, then, that the dew point temperature at the saddle would be about 3°F higher than at Mendocino Pass if the airmass is the same at both places, and if the air is flowing directly from Mendocino Pass to the Saddle. This experiment should be performed. The author would like to make the experiment personally. At least he would like to instruct the observers who take the observations, and he would like to indicate the day when he believes the pressure pattern is favorable so the experiment will be conducted under conditions similar to those prevailing at the time of the Rattlesnake Fire.

If performance of the aforementioned experiment proves the points in this case, then there is much to be learned from the Rattlesnake Fire.

FOR THE FIRE CONTROL MAN:

(1) The most important lesson is that when this type of wind change occurs, there is absolutely no visual warning which can be observed from the fire. Fire Control men are learning to "look to the skies" for cumuloform clouds from which rain is falling so they can direct their crews safely around downdrafts from these clouds. In a case of this type there are no such visible signs which may signal the danger. Therefore, this is a strong argument for obtaining special fire weather forecasts on all fires as soon as possible; i.e., the Fire Control men should force these situations on the meteorologists. Give the Fire

Weather Meteorologists experience with these situations (and other radical conditions) and we will learn to forecast them. Only through experience and study will this desired state be achieved.

(2) If the theories presented in this paper are substantiated, then it seems that the Mendocino National Forest could "chart" or map the areas where these severe evening wind shifts occasionally occur. At this time it appears that the Grindstone Canyon area, and the east slopes between Stony Gorge Reservoir and the pass just east of Pillsbury Lake are the most suspicioned areas. If these critical areas could be mapped, then the Mendocino Forest would naturally use a plan of attack which would take this danger into consideration when fires occur in the "red flagged" areas.

FOR THE FIRE WEATHER FORECASTER:

(1) It appears that the northern California Coast Range is the area in which this situation would develop with greatest frequency. However, the author is suspicious that this same type of development might occur with less frequency on the east slopes of the Coast Range which face into the San Joaquin Valley; that is, in those drainages which "head up" under relatively lower passes in the main Coast Range ridge.

(2) We should recognize that a similar development could occur in any Fire Weather district when a potentially colder airmass (high pressure system) exerts pressure against a mountain range. When this happens we should be carefully studying the possibility

of strong down-canyon winds at night in those leeward drainages which "head up" under low passes.

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The author wishes to make it clear that this paper has been written after careful study of the Rattlesnake Fire situation. In writing the paper, he has had all of the advantage of "hindsight".

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This is a preliminary rough draft of a study which is continuing. Much work has yet to be done, and there are numerous data the author wishes to study before this paper can be readied for release to any publication.

WRK