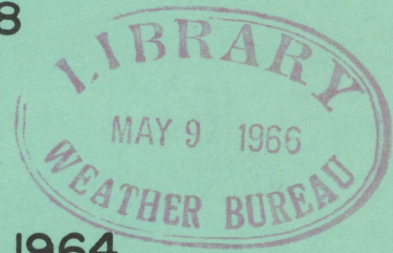


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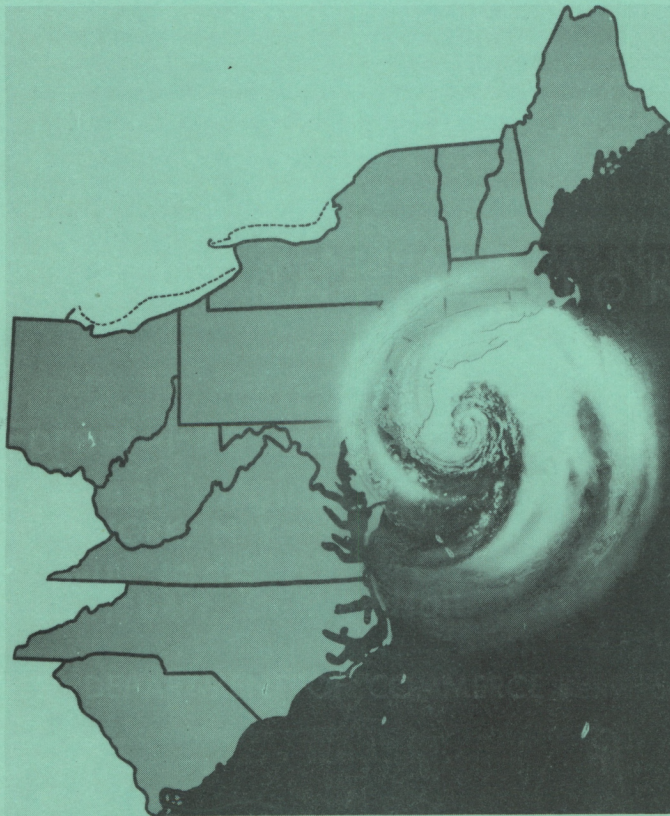
TECHNICAL MEMORANDUM No. 8



Forest-Fire Pollution Episode  
in West Virginia November 8-12, 1964

Robert O. Weedfall

TECHNICAL MEMORANDUM No. 8



E A S T E R N   R E G I O N

NEW YORK, N. Y.

April 1966

136 376

## EASTERN REGION TECHNICAL MEMORANDUM

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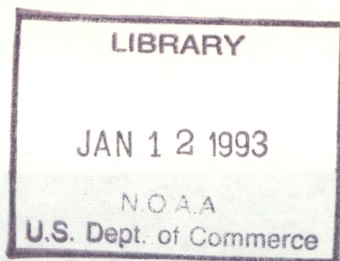
Environmental Science Services Administration

Weather Bureau Eastern Region

TECHNICAL MEMORANDUM NO. 8

Forest-Fire Pollution Episode In  
West Virginia November 8-12, 1964

Robert O. Weedfall  
Weather Bureau State Climatologist  
Agricultural Engineering Building  
West Virginia University  
Morgantown, West Virginia



Scientific Services Division

April 1966

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## F O R E W O R D

This Memorandum describes meteorological conditions that accompanied a localized air pollution episode. Both "surface" and upper-air measurements provide details of the state of the lower atmosphere during the episode. The description points up that local situations can occur that create hazards comparable with large-area stagnation situations previously documented in the meteorological literature.

It is planned that this case study presages greater attention to air pollution climatology in the Eastern United States. Research is now underway (at the ESSA Air Resources Field Research Office, Cincinnati, Ohio) that hopefully will point the way toward more precise climatological evaluations of air pollution potential in particular states and metropolitan areas.

Norman L. Canfield  
Regional Climatologist

A classic example of area-wide pollution occurred November 8-12, 1964 over Charleston, West Virginia and was noticed 200 miles to the northeast over both Morgantown and Elkins. The meteorological factors leading up to and during this episode are noted, as a matter of general interest to air pollution personnel and meteorologists.

Forest fires during the fall of 1964 were confined to the south and southwest of Charleston generally. Figure 1 shows a map of the state of West Virginia and the area where the 200 forest and brush fires were located, as of November 10. This area was delineated by the State Forester, Lester McClung, who termed the smoke across southern West Virginia as the worst since 1953. This smoke prevented the use of planes for spotting new fires in this area. Two hundred fires is normally not a large number of fires, but these were large ones, were more concentrated in area and the smoke was augmented considerably from fires in Kentucky.

Also noted on the map in Figure 1 for this area is the percentage of normal rainfall from May through September 1964. The area around Charleston had below 70% of normal rainfall during this period. Drought conditions are generally associated in areas where rainfall is below this figure. It is interesting to note that a severe late summer-early fall drought also occurred in 1953. It appears that drought, forest fires and heavier-than-normal concentrations of air pollutants go hand in hand. After a relatively dry summer, rainfall during October and the first 12 days of November in this area was negligible. Foresters had noted that most wooded areas of the state were like a "powder keg" and had ordered all forests and woodlands closed to the public on Monday, November 9.

A second emergency step taken this fateful Monday in the Kanawha Valley was that by the head of the state Air Pollution Control Commission. He said that "all leaf and trash burning be halted in the Kanawha Valley, and that unnecessary automobile driving be curtailed". He also "urged chemical plants to take extra precautions against pollution". Mr. Carl Beard reassured Kanawha Valley residents that "the murky haze of smoke did not contain any increase of chemical plant gases," and, in his statement released Monday, said:

"You are all aware that the heavy concentration of forest fires in our vicinity has compounded our local air pollution problems. Consultation with meteorological personnel currently working in cooperation with the West Virginia Air Pollution Control Commission and the Public Health Service on the Kanawha Valley Air Pollution Study indicates that weather conditions for the next few days will not be favorable for dispersion of smoke in the Valley. The continuous monitoring equipment we are using in the valley study presently shows no increase of gaseous pollutants".

The gases that were sampled were hydrogen sulphide, sulphur dioxide, carbon monoxide, carbon dioxide, nitrogen oxides, various hydrocarbons and other oxidants. Readings from the filter tapes which collect fine particulates from the atmosphere and hi-vol samplers which collect more of the larger particulates have not been processed as yet, but these tapes and samplers

were black with the additional loads of particulates collected.

Dr. Page Seekford of the Kanawha-Charleston Health Department requested valley hospitals to keep daily records of all patients seen with respiratory ailments. Charleston physician I. E. Buff, who is a practicing heart specialist with an interest in smog and air pollution, stated that the smoke was a definite hazard for people with respiratory diseases. Dr. Buff advised that anyone with asthma, chronic bronchitis, emphysema, heart disease, sinus, or even a cold should stay indoors. "The double hazard of polluted air due to chemicals and smoke placed individuals in double-jeopardy". Dr. Buff is serving on the Citizens Advisory Committee on Air Pollution in the Kanawha Valley.

A further source of smoke throughout West Virginia is that from burning coal-refuse dumps or "gob piles", several of which are in the vicinity of the Kanawha Valley. Their everyday normal contribution to the contamination of the air in Kanawha Valley has not been determined, but is probably less than one per cent, according to Mr. Beard. However, in periods of atmospheric stagnation and poor ventilation, pollutants from these smouldering and burning "gob piles" may have caused some of the forest and brush fires, according to Mr. Asher Kelly of the State Forestry Department.

The surface weather map for November 8 (Figure 2) shows that a high pressure area had developed over the State, following the passage of a weak low to the south (shown over North Carolina on November 8). The surface maps for the following days show that high pressure prevailed through November 12. Although intensity and duration of a large scale high pressure area (1000 square miles), had not reached the levels that called for the issuance of an area-wide Air Pollution Potential Alert, this meteorological situation is a good example of local air stagnation in a typical landlocked West Virginia valley, with a superabundance of air-borne pollutants.

Figures 3 through 8 show the upper air situation pictured by the daily 7:00 a.m. Skew-T plots of the upper-air soundings taken at Huntington airport, about 60 miles southwest of Charleston. Although a subsidence inversion persisted until the cold frontal passage on the 13th and the height of this inversion remained at about 4000 feet, this type of upper-air situation is fairly common in fall in the eastern part of the United States. The unusualness of this particular situation was the superabundance of air-borne pollutants combined with the light wind velocities, especially on Monday November 9. The light winds measured on Huntington's raob on Sunday November 8 at 7:00 a.m. averaged about 3 mph up to 5000 feet. Most of the pollutants were trapped under the intense surface (or radiation) inversion. On November 9 the 7:00 p.m. raob indicated a more pronounced subsidence inversion had developed during the day at about 4500 feet mean sea level. By 7:00 a.m. on Tuesday, November 10, the winds aloft below the subsidence inversion had swung around to the southwest and were much stronger, averaging about 20 mph. These southwesterly winds below the subsidence inversion gradually increased during the next few days until the passage of a cold front on November 13, and immeasurably aided in

diluting the forest-fire-produced pollutants. Table 1 shows the relation of visibility, surface and upper winds during this period. The visibility measured at the Charleston, Morgantown and Elkins airport, was quite low each morning and evening, and corresponded to the development and dissipation of the daily nighttime surface inversion. It can be seen that the surface winds gradually increased after November 9, especially in the afternoons, and further assisted in the area-wide dispersal of the pollutants. From Table 1 it can be seen that the behavior of the southwesterly surface winds appeared to be closely linked with the visibilities at Charleston, Morgantown and Elkins and also to the turbidity measurements at Elkins. These turbidity measurements reflect the suspended dust loading in the atmosphere - the more dust and particulates the less sunlight measured in the instrument's photocell, corrected for solar angle. These measurements are normally made at representative locations away from localized sources of pollutants. These instruments are in the experimental stage but are a further indication that the atmosphere during this period was truly loaded. For instance, during October 1964, the highest turbidity reading at Elkins was on October 13, when .190 was recorded, in spite of 12 miles visibility. Nearby high clouds may have affected the readings. The next highest readings were .147 and .145, with all other readings below .130. In West Virginia, October was a month which had many stagnant periods with very little rainfall.

A cold front finally pushed across the State during the early morning hours of November 13. The light rain showers were enough to help bring the forest and brush fires under control. The fresh air mass that moved in behind the cold front had better ventilating characteristics and came from areas free of brush fires. Smoke concentrations were reduced and the subsidence inversion broken.

It is to be hoped that some lessons for the future may come from the study of this incident: (1) local periods of air stagnation can be just as annoying and potentially detrimental to health as larger area stagnations that call for the issuance of an "Air Pollution Potential Alert," (2) meteorological conditions for local stagnation do not need unusual weather situations, but may occur rather frequently, especially in the fall, and (3) the air in valley locations can have a limit on the amount of pollutants it can safely hold, in order to allow normal human activities.

#### ACKNOWLEDGMENTS

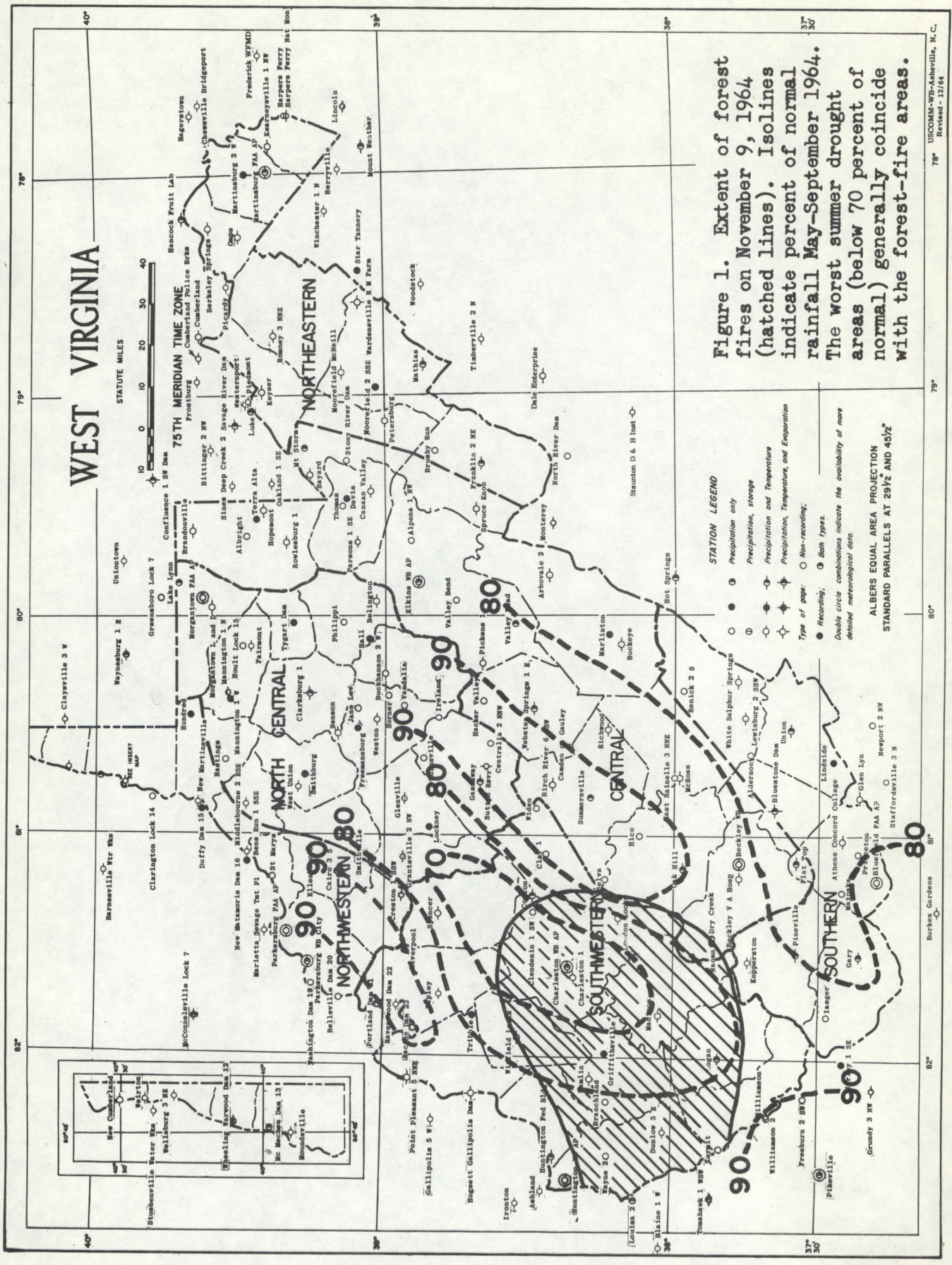
Acknowledgment for helpful suggestions in the preparation of this paper is gratefully given to Benjamin Linsky, Professor of Sanitary Engineering (Air Pollution), West Virginia University, Morgantown, West Virginia; to Carl G. Beard, II, Executive Director, West Virginia Air Pollution Control Commission, Charleston, West Virginia, and to Lester McClung, State Forester, Charleston, West Virginia. Acknowledgment for the art work on the map in Figure 1 is due Herbert Howenstein, Research Technician, West Virginia University, Morgantown, West Virginia.

Date	Time	Huntington		Charleston		Morgantown		Elkins			
		Wind*	4000' Wind*	Base (1)	Surface Wind*	Vsby. (mi.)	Surface Wind*	Vsby. (mi.)	Surface Wind*	Vsby. (mi.)	Turbidity Time Amount
Nov. 1964	E.S.T.	2000'	4000'	Base (1)	Surface Wind*	Vsby. (mi.)	Surface Wind*	Vsby. (mi.)	Surface Wind*	Vsby. (mi.)	Turbidity Time Amount
8	0700 Aftn. 1900	280/03	030/03	None	180/04 230/04 210/04	3/4 1/4 1	020/04 360/04 Calm	1 2 2	240/04 300/04 090/04	7 3 5	
9	0700 Aftn. 1900	Missing	Missing	4000'	Calm 100/04 080/03	0 3/4 1	200/03 230/05 210/02	0 3 3	310/04 310/08 140/04	3 7 4	1145 1344 .191 .121
10	0700 Aftn. 1900	250/17	280/17	4000'	050/03 220/07 160/07	0 2 1 1/2	190/03 240/13 190/06	3/4 4 3	Calm 270/09 Calm	1/8 8 7	1100 1336 .202 .168
11	0700 Aftn. 1900	240/27	260/34	3700'	130/04 220/13 150/07	1/2 4 1 1/2	200/06 220/10 190/10	4 7 4	Calm 220/07 Calm	5 12 10	0950 1404 .143 .140
12	0700 Aftn. 1900	220/27	240/45	5500'	180/08 210/13 190/08	1 4 1 1/2	190/09 200/20 200/10	6 8 4	180/02 210/15 180/05	9 15 12	1343 .160
13	0700 Aftn. 1900	270/18	280/17	8700'	230/10 250/12 260/05	12 15 15	210/07 240/10 360/05	10 15+ 15+	230/09 260/16 260/10	15 15 15	1245 1455 .091 .044

(1) of Subsidence Inversion

\* first three digits show direction in degrees; last two show speed in knots ( 1 knot = 1.15 miles per hour).

Table 1. Relationship Between Wind Speeds and Surface Visibilities, November 8-13, 1964.



# WEST VIRGINIA

STATUTE MILES  
0 10 20 30 40

75TH MERIDIAN TIME ZONE  
Frostburg Cumberland Police Bns  
Baltimore Springs  
Pleasant  
Luker  
Keyser  
Mt. Storm  
Gardner  
Thomas  
Parsons 1 SE Davis  
Canaan Valley  
Hancock Fruit Lab  
Cumberland Police Bns  
Baltimore Springs  
Pleasant  
Luker  
Keyser  
Mt. Storm  
Gardner  
Thomas  
Parsons 1 SE Davis  
Canaan Valley

**Figure 1. Extent of forest fires on November 9, 1964 (hatched lines). Isolines indicate percent of normal rainfall May-September 1964. The worst summer drought areas (below 70 percent of normal) generally coincide with the forest-fire areas.**

**STATION LEGEND**

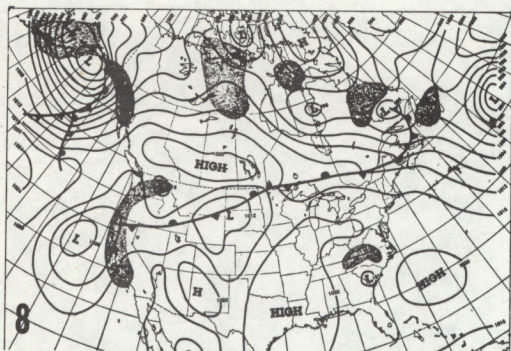
- Precipitation only
- Precipitation, storage
- Precipitation and Temperature
- Precipitation, Temperature, and Evaporation

Type of gaps: ○ Non-recording;  
● Recording; ○ Both types.

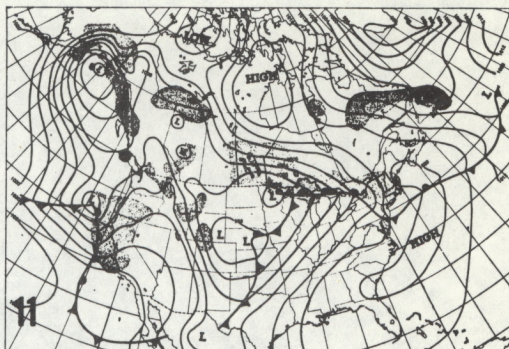
Double circle combinations indicate the availability of more detailed meteorological data.

ALBERS EQUAL AREA PROJECTION  
STANDARD PARALLELS AT 29½ AND 45½°

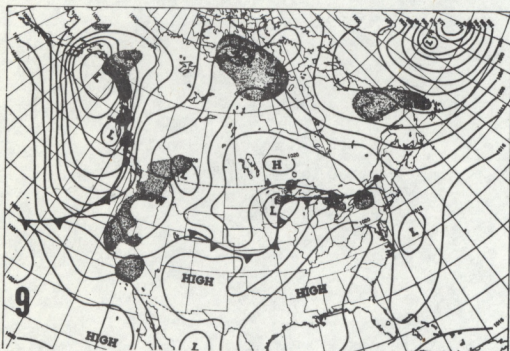
NOVEMBER 1964



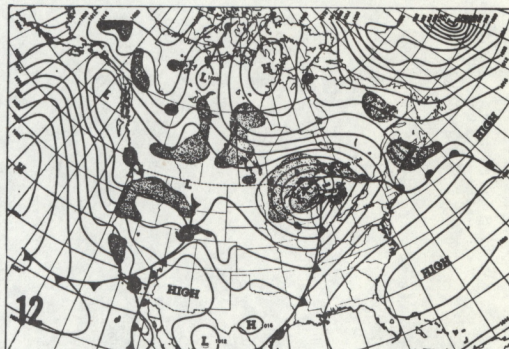
Upper low now over Va: Raleigh .60", Knoxville .54"—vast SW flow over all West and Midwest with mild temps: Moline 70°, Pierre 74°—new rains Pacific: Eureka 2.46"



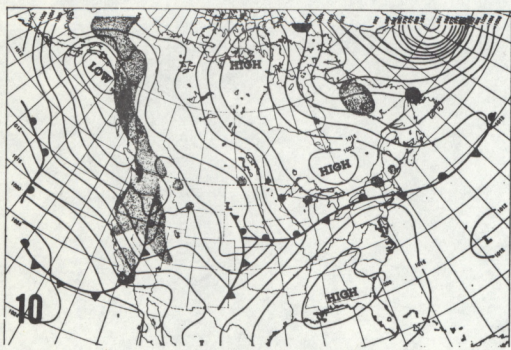
Trough moves east to Rockies, but R+ continues Pacific: Eureka .50", S.F. .23", L.A. .08"—R— cover Rockies—RW continue North: Duluth .41", Portland, Me., .12".



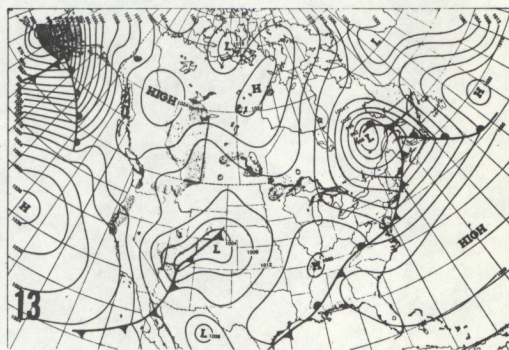
Upper trough deepens over Pacific States: Red Bluff 1.18", L.A. .49", S. Diego .23", Ely .16"—very dry Midwest/ East/South—NYC 64°, Chicago 71°, Denver 68°.



Deep low upper Lakes with R/S: Moline .59", Duluth .34"—R/S continue Far West: S.F. .48", S. Diego .35", Astoria .74", S. Lake .44"—much colder Plains/Midwest.



Pacific rains continue: S.F. 1.24", Fresno 50°, L.A. .21", Boise .27", Ely .16"—cold front in North produces RW: Fargo .52", Burlington .14"—mild south of front.



Upper trough continues over Plateau—dry low over c. Rockies—widespread snows Plateau: S. Lake .24"—RW— with front over Appalachians—colder in NE.

Fig. 2. U. S. Weather Bureau surface map analyses, 1300 E.S.T., for dates indicated. Courtesy of "Weatherwise", February 1965, American Meteorological Society, 45 Beacon Street, Boston, Mass. 02108.

November 8, 1964. 0700 E.S.T. 2000 foot wind: 280° 3 knots  
 3000 foot wind: 340° 4 knots  
 4000 foot wind: 30° 3 knots  
 850 mb. wind: 70° 2 knots

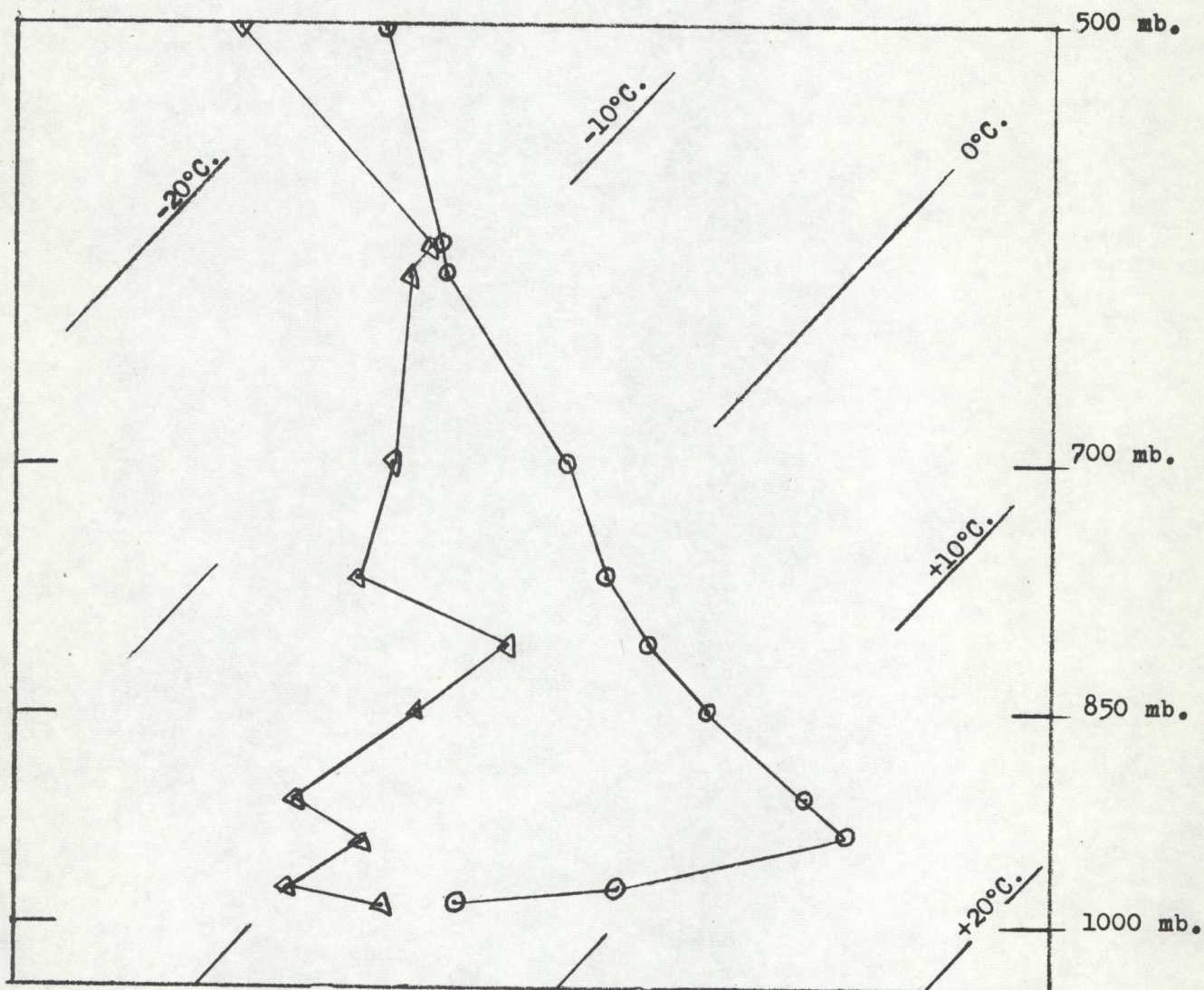


Fig. 3. Huntington raob plotted on Skew-T diagram.

⊙ temperature trace  
 △ dew-point trace



November 10, 1964. 0700 E.S.T.    2000 foot wind: 250° 17 knots  
 3000 foot wind: 270° 19 knots  
 4000 foot wind: 280° 17 knots  
 850 mb. wind: 280° 17 knots

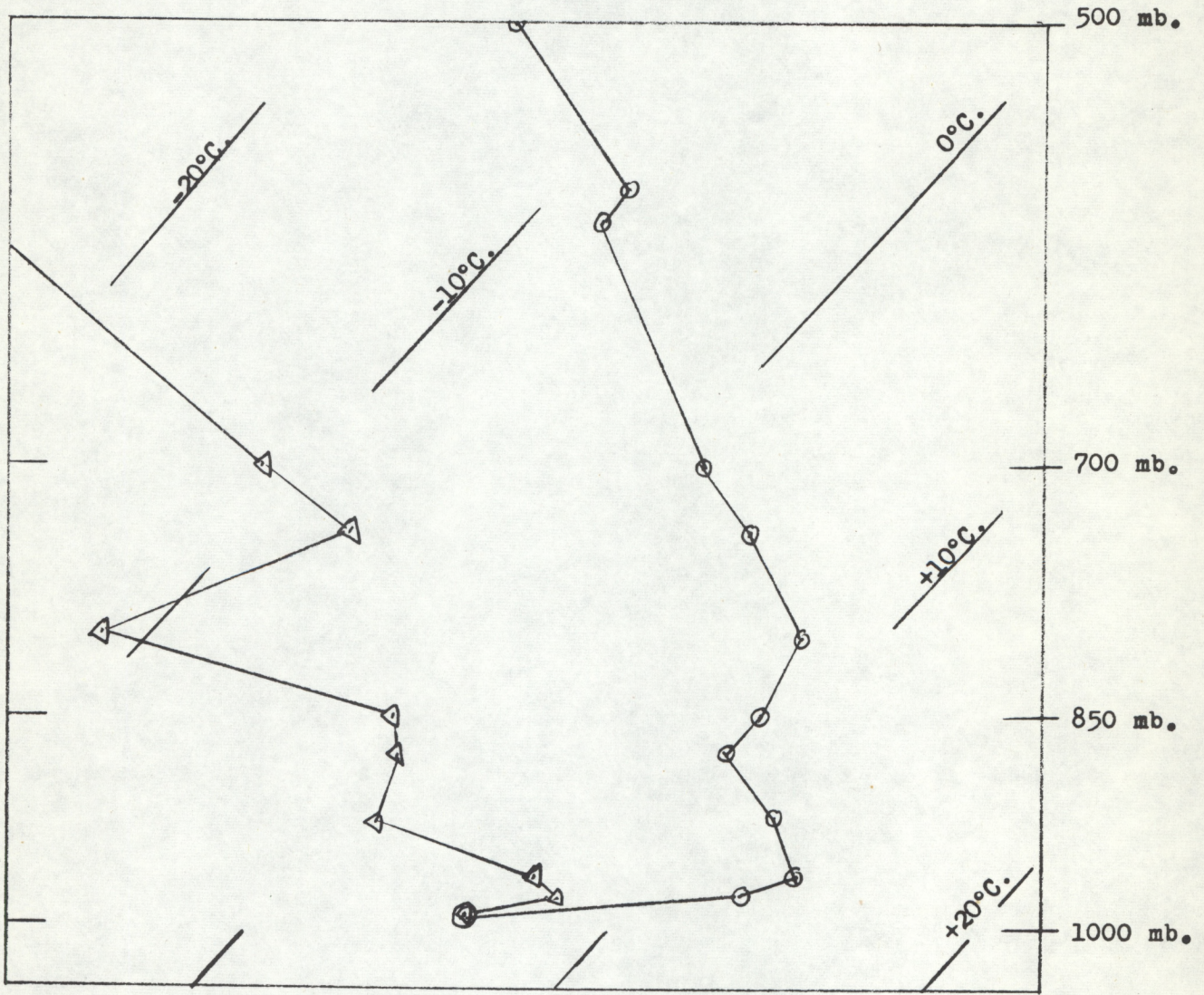


Fig. 5. Huntington raob plotted on Skew-T diagram.

⊙ temperature trace  
 ▲ dew-point trace

November 11, 1964.

0700 E.S.T.

1900 E.S.T.

2000 foot wind:	240°	27 knots
3000 foot wind:	260°	35 knots
4000 foot wind:	260°	34 knots
850 mb. wind:	260°	31 knots

210°	15 knots
210°	19 knots
210°	21 knots
220°	23 knots

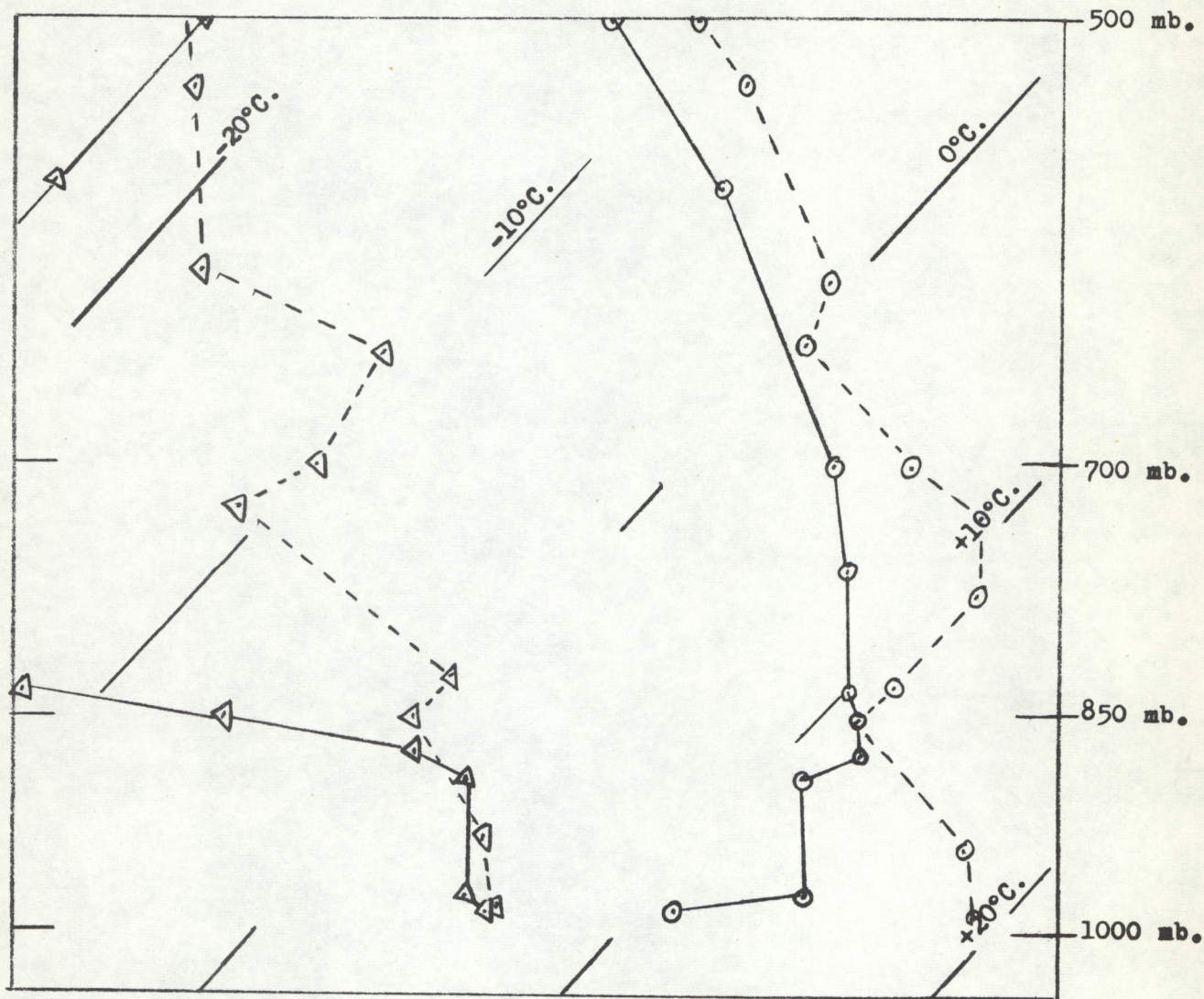


Fig. 6. Huntington raob plotted on Skew-T diagram.

— 0700 E.S.T. raob  
- - - 1900 E.S.T. raob

⊙ temperature trace  
◁ dew-point trace

November 12, 1964.

0700 E.S.T.

1900 E.S.T.

2000 foot wind: 220° 27 knots  
3000 foot wind: 230° 37 knots  
4000 foot wind: 240° 45 knots  
850 mb. wind: 240° 45 knots

210° 23 knots  
210° 28 knots  
230° 30 knots  
240° 32 knots

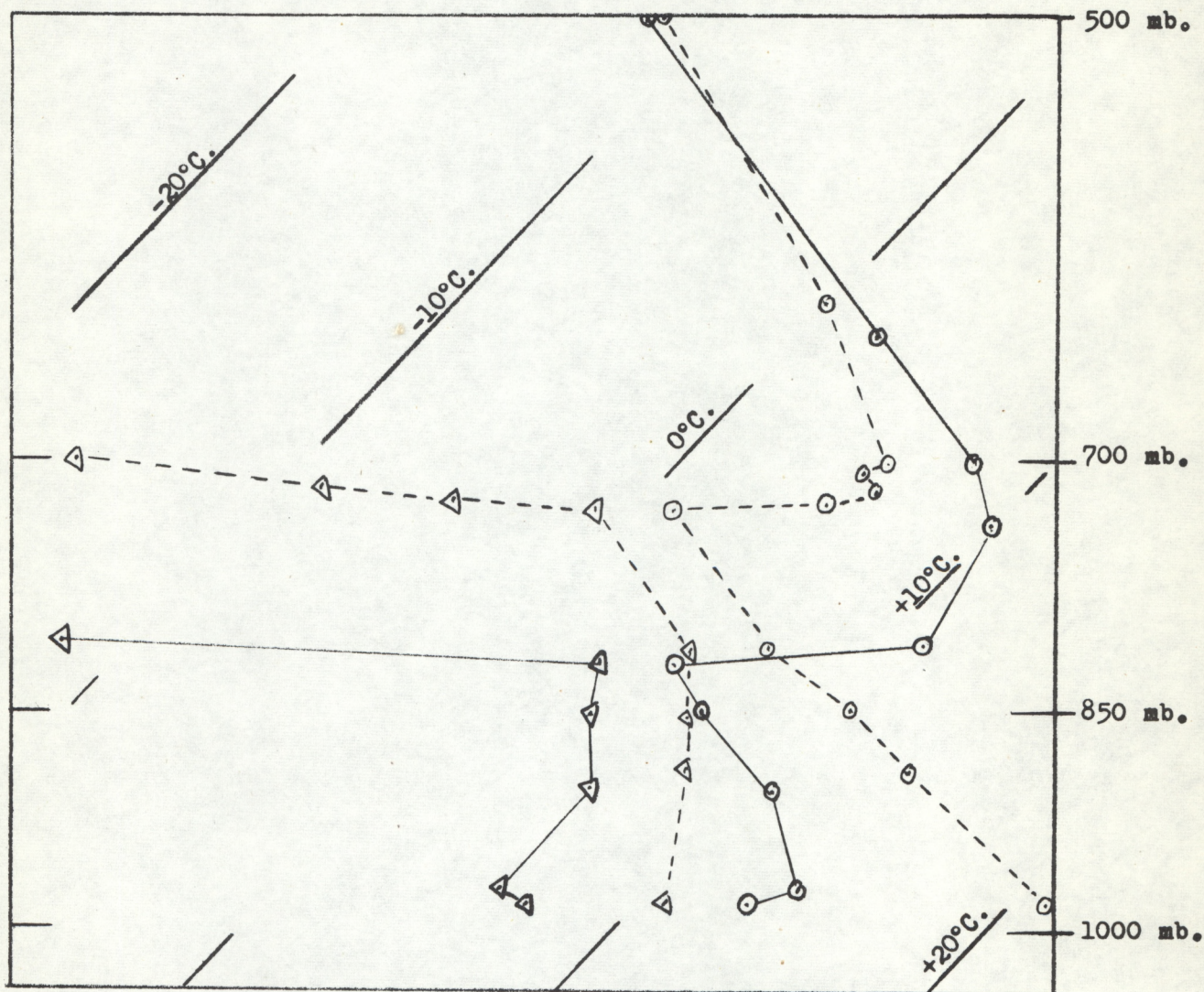


Fig. 7. Huntington raob plotted on Skew-T diagram.

—— 0700 E.S.T. raob  
---- 1900 E.S.T. raob

○ temperature trace  
△ dew-point trace

November 13, 1964.

0700 E.S.T.

1900 E.S.T.

2000 foot wind: 270° 18 knots  
3000 foot wind: 280° 18 knots  
4000 foot wind: 280° 17 knots  
850 mb. wind: 270° 20 knots

290° 11 knots  
290° 13 knots  
290° 14 knots  
290° 16 knots

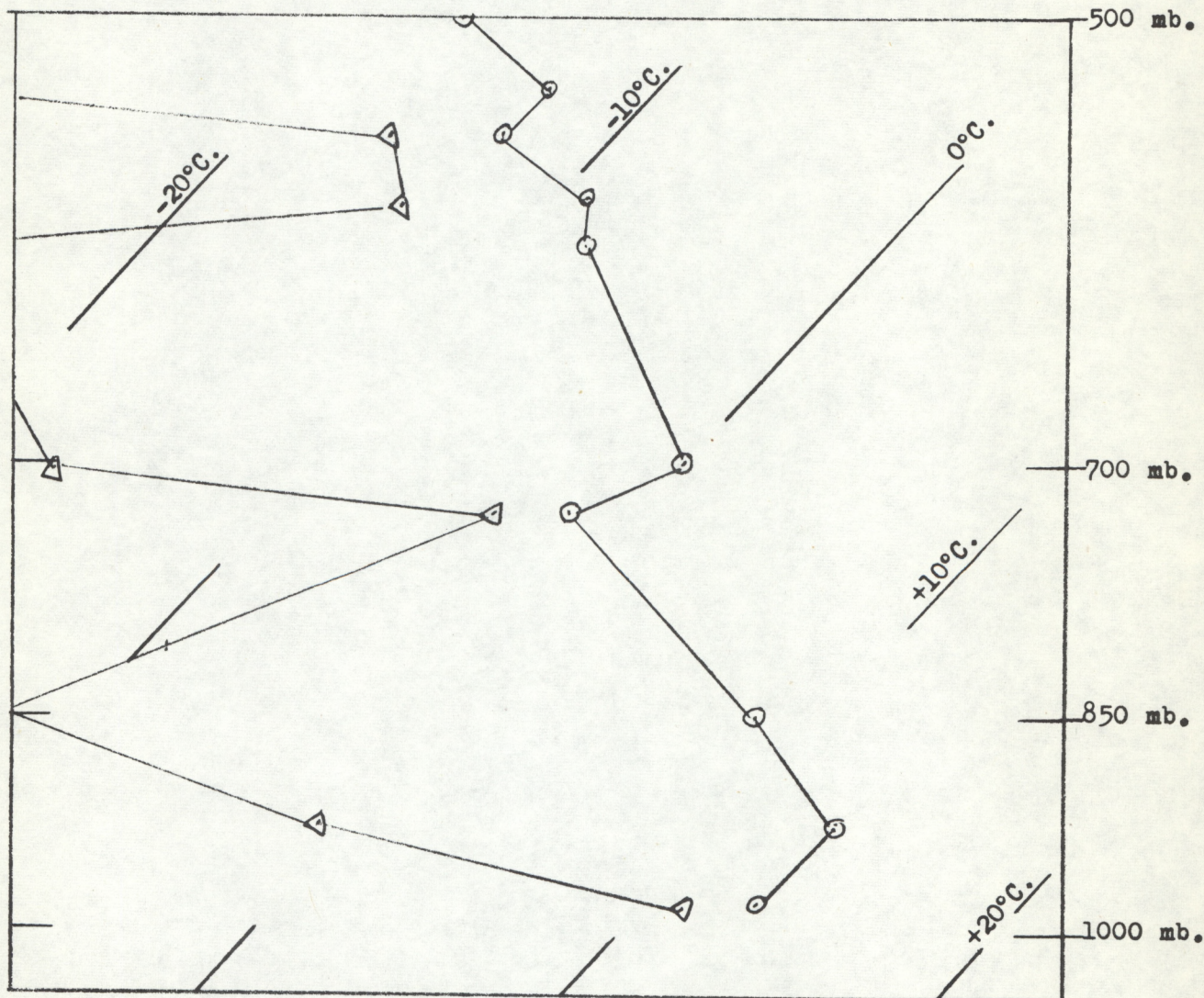


Fig. 8. Huntington raob plotted on Skew-T diagram.

⊙ temperature trace  
◁ dew-point trace

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- No. 1 Local Uses of Vorticity Prognoses in Weather Prediction. Carlos R. Dunn. April 1965
- No. 2 Application of the Barotropic Vorticity Prognostic Field to the Surface Forecast Problem. S. G. Simplicio. July 1965
- No. 3 A Technique for Deriving an Objective Precipitation Forecast Scheme for Columbus, Ohio. Robert Kuessner. September 1965
- No. 4 Stepwise Procedures for Developing Objective Aids for Forecasting the Probability of Precipitation. C. R. Dunn November 1965
- No. 5 A Comparative Verification of 300 mb. Winds and Temperatures Based on NMC Computer Products Before and After Manual Processing. S. G. Simplicio. March 1966
- No. 6 Evaluation of OFDEV Technical Note No. 17. Richard M. DeAngelis. March 1966
- No. 7 Verification of Probability Forecasts at Hartford, Connecticut for the Period 1963 - 1965. Robert B. Wassall. March 1966