THE WEATHER AND CIRCULATION OF JANUARY 1957 [1]

A Month with a Persistent Block in the Gulf of Alaska

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1. SELECTED ASPECTS OF THE MONTHLY MEAN CIRCULATION

GULF OF ALASKA BLOCKING

Blocking conditions in the Gulf of Alaska region prevailed throughout January 1957. The consequences of that aberration will be emphasized, but first it will be shown how this tenacious feature fitted into the general circulation.

Figure 1 is the 700-mb. 30-day mean chart for January 1957. The hemispheric circulation consisted of three full-latitude troughs located along the east coasts of Asia and North America and near the Ural Mountains. The pattern would have been rather symmetrical had there been a fourth full-latitude trough in the eastern Pacific Ocean. Instead, the flow in that area was distorted by two low-latitude troughs with a short wavelength, separated by a ridge of great amplitude.

The southern portion of the eastern Pacific ridge was located in an area in which a ridge occurs on the normal map for January [13]. However, that portion of the ridge in the Gulf of Alaska was highly anomalous. On the normal 700-mb. chart for January, cyclonic curvature characterizes the latter region; but in January 1957 the curvature was markedly anticyclonic, and the contour heights were far above normal.

The dotted lines in figure 1 represent the height departures from normal (hereinafter called DN). The large magnitude (+720 ft.) and extent of the height DN near Alaska overshadowed all other centers in the Northern Hemisphere. This DN center apparently started in the eastern Pacific as a small positive height anomaly early in the month. Meanwhile, the Siberian block of December 1956 investigated by Green [2] relaxed, and its associated positive height DN progressed to eastern Siberia. Thereafter, at least a portion of this DN appears to have amalgamated with and reinforced the mushrooming anomaly of the eastern Pacific.

Another indication of the anomalous flow in the eastern Pacific is given by the monthly mean isotach chart (fig. 2). Not only were 700-mb. wind speeds in this area very weak, but also the belt of maximum westerlies was split into two branches. One axis of the mean jet stream entered North America in Baja California, while the other crossed the Arctic Ocean and Beaufort Sea into northwestern Canada. The great departure of this wind speed distribution from the January normal and from the pattern of December 1956 (see fig. 3A of [2]) was a direct consequence of the persistent blocking in the Gulf of Alaska.

The mean sea level chart for January and its anomalous pressure field (fig. 3) also reflects the blocking. On the January normal sea level map [13] high pressure in the eastern Pacific is confined to the area southward from 40° N., while the region north of 40° N. is occupied by a lobe of the Aleutian Low. This month, in contrast, the eastern Pacific was covered by an extensive meridional anticyclone, and sea level pressures in the Gulf of Alaska were as much as 21 mb. above normal.

KONA STORM

The broad cyclonic sweep over the western Pacific (fig. 1) advected relatively cold air into subtropical latitudes of the central Pacific. The resulting low-latitude trough west of Hawaii was suggestive of Kona Low development. One such storm was observed in the latter half of January, and its evolution from an occluding wave paralleled that described by Simpson [11].

Thirty-day mean DN charts at 700-mb. (fig. 1) and sea level (fig. 3) show only small below normal values in the central Pacific in an absolute sense (−110 ft. and −5 mb.). On the other hand, those anomalies were appreciable when one considers the low variability of sea level pressures and 700-mb. heights in subtropical areas [4].

Copious rainfall over the Hawaiian Islands resulted from the sudden development of the Kona vortex. Heavy rains continued as the storm stagnated northwest of the Hawaiian chain. 14.19 inches of rain fell at Honolulu during January 1957, or about 60 percent of its mean annual rainfall. Other amounts ranged from 3.03 inches on leeward Maui to 18.17 inches on windward Kauai.

Qualitatively, the Kona Low was apparently effective in the transporting of tropical air into high latitudes. As cold air from Asia was transported into the west side of

[1] See Charts I–XVII following p. 36 for analyzed climatological data for the month.

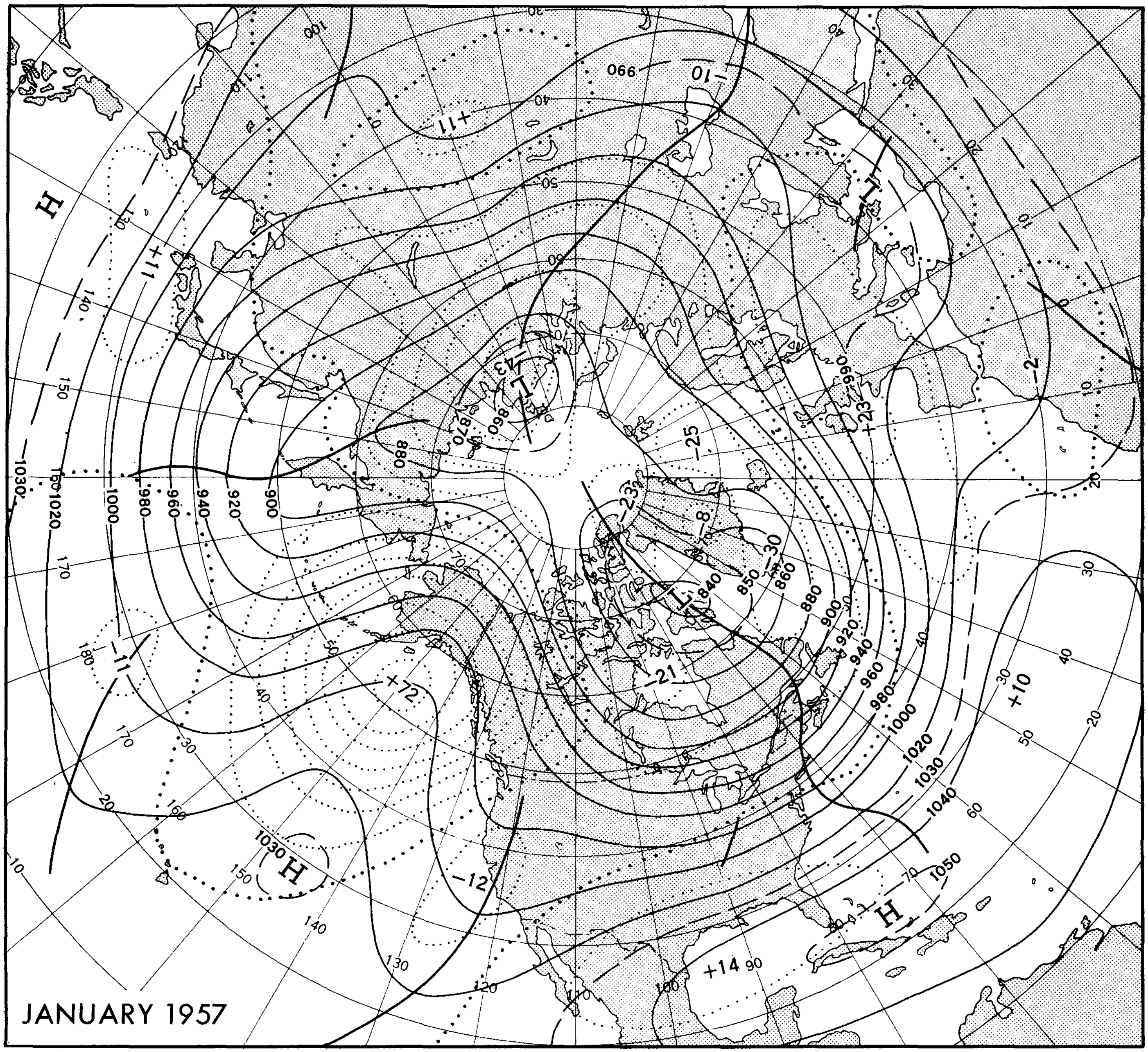

FIGURE 1.—Mean 700-mb. contours and height departures from normal (both in tens of feet) for January 1957. The most anomalous trough-ridge system was located in the eastern Pacific.

the Kona trough, the warm air stream on its east side was maintained, and the ridge over Alaska continued its growth. The circulation over North America was apparently influenced by this Alaskan block, as described below.

NORTH AMERICAN FEATURES

In some respects the circulation over North America (fig. 1) was similar to the normal January 700-mb. circulation. Principal differences in January 1957 include a westward extension of the Bermuda High into the Gulf of Mexico, a westward displacement of the California trough, and a northwesterly flow from Alaska to California instead of a moderate westerly current.

Those departures from the normal flow resulted in DN centers which were significant but were generally small in magnitude. The DN flow [3] around the −120-ft. center near California resulted in below normal thicknesses in the Northwest but greater than normal values in the Southwest (fig. 4). The +140-ft. DN center in the western Gulf of Mexico assisted the flow of warm air into the confluent zone in the Southeast. The −210-ft. center over Hudson Bay and the trough in the anomaly

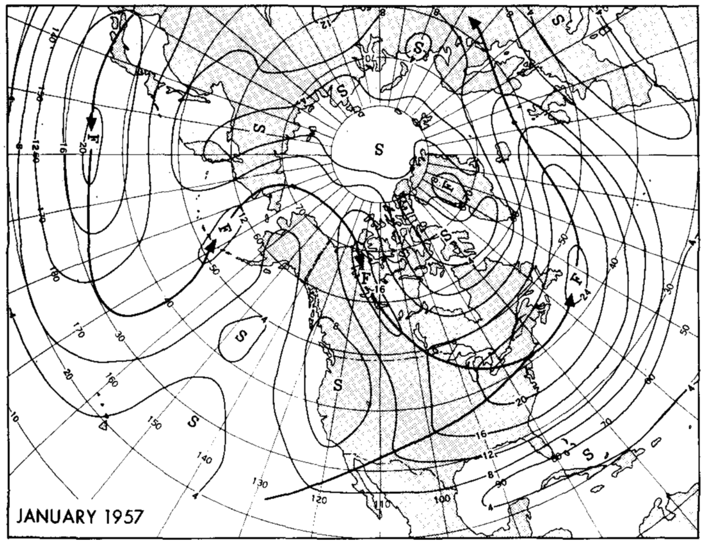

FIGURE 2.—700-mb. mean isotachs in meters per second for January 1957. Solid arrows indicate positions of mean 700-mb. jet axes. Confluence between cold Canadian air and relatively warm maritime air was associated with fast westerlies over eastern United States and over the Atlantic Ocean.

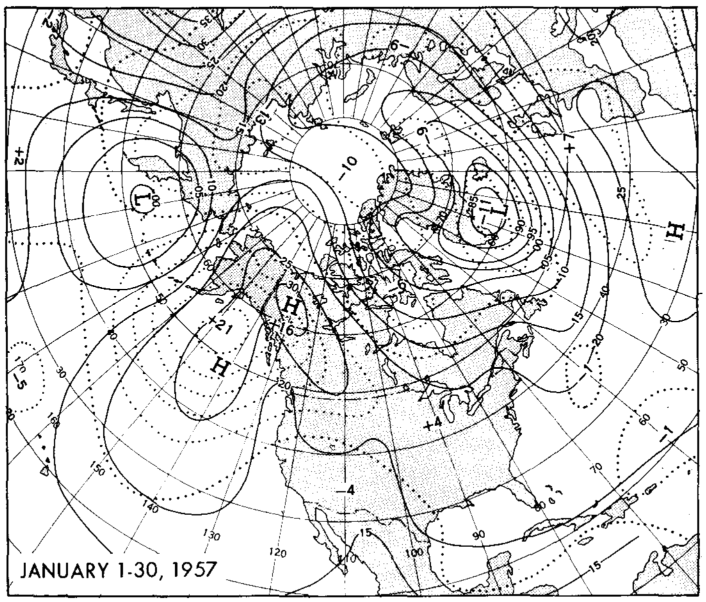

FIGURE 3.—Mean sea level isobars and pressure departures from normal (in millibars) for January 1957. The strong flow from Canada suggests successive cold outbreaks over the United States.

pattern to its southwest indicate the abnormal 700-mb. flow which recurrently deployed Arctic air into the United States. The axis of this current is well delineated by the jet stream over western Canada in figure 2. As a result mean thickness values in the layer from 1,000 to 700 mb. averaged below normal over most of Canada and the United States (fig. 4).

Sea level isobars and DN values (fig. 3) over North America show the predominance of the strong High near the Yukon and the ridge southeastward to the South

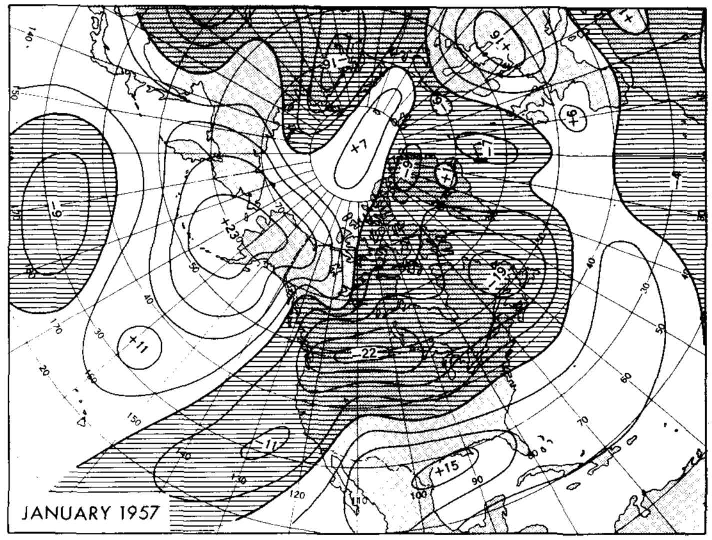

FIGURE 4.—Mean thickness departures from normal (1000 to 700-mb.) for January 1957 (in tens of feet). Below normal thicknesses (shaded areas) occurred over northern and central United States, with above normal values in the South.

Atlantic States. This pattern would lead one to anticipate the relatively high frequency of migratory anticyclones over the United States and western Canada shown by Chart IX. The strong northerly surface flow observed over central Canada was concomitant with the combination of the Alaskan block (described above) and the Icelandic Low (considered below).

THE ICELANDIC LOW

The intensity of the Icelandic Low, another interesting feature of the general circulation for January, is indicated by the dotted anomalies of figures 1 and 3, which show that departures from normal for the month averaged −300 ft. at 700 mb. and −11 mb. at sea level. To its south a strong band of temperate westerlies extended from the central United States to the central Atlantic, with mean speeds over 24 m. p. s. at the 700-mb. level (fig. 2). This was associated with confluence in the east-central United States as the northwesterly flow from Canada met the southwesterly flow from the Pacific Ocean. Note the juncture of the two branches of the jet stream in figure 2 and the strong thermal gradient in the United States and in the western Atlantic (fig. 4). This was conducive to the frequent genesis of cyclones, whose intensity and daily tracks are given in Chart X. The impetus of the strong westerlies helped drive successive storms into the climatologically favored area near Iceland, where they underwent strong deepening.

Another consequence of the deep Icelandic Low was the warming which dominated Europe during January, as indicated by above normal thicknesses in figure 4. The 700-mb. ridge in that area, together with the strong westerlies over eastern United States and the western Atlantic Ocean, led to continued intrusions of mild, maritime air which produced above normal temperatures over much of Europe.

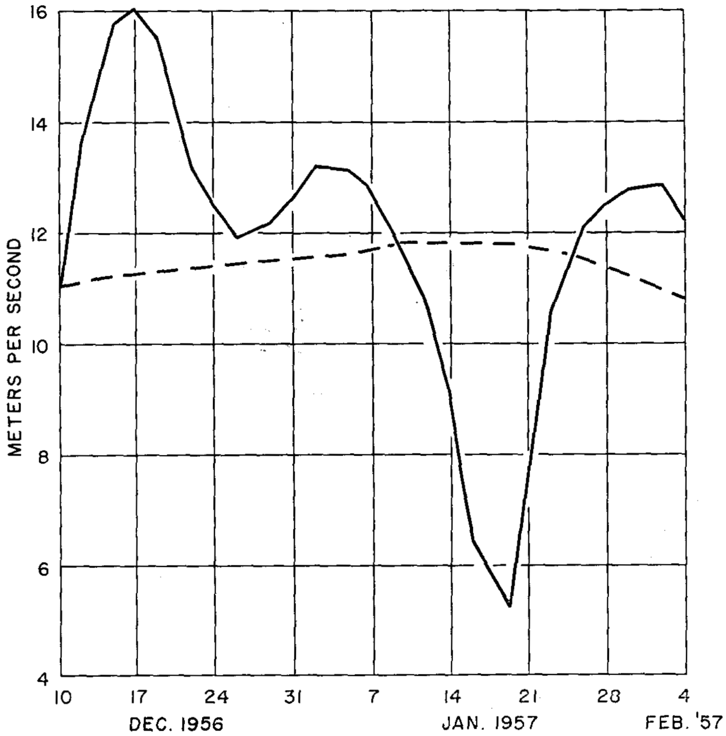

FIGURE 5.—Time variation of the temperate-latitude 5-day mean zonal index (average strength in meters per second of the 700-mb. zonal westerlies between 35° and 55° N. at longitudes 5° W. westward to 175° E.), December 10, 1956, to February 4, 1957, plotted at the end of each period. Dashed line indicates normal index values. This is a fine example of an index cycle for the Western Hemisphere. The precipitous fall of index by January 19 was accompanied by strong meridional flow on either side of the Alaskan block.

AN INDEX CYCLE

Figure 5 is a time-latitude diagram of the speed of the mid-latitude westerlies over the Western Hemisphere from mid-December 1956 through January 1957. This zonal index reached a maximum value in mid-November 1956 [1], which was the beginning of an index cycle during December described by Green [2]. The very high index of 16 m. p. s. in mid-December marked the onset of another index cycle of even greater magnitude.

The January index cycle differed from most of the primary index cycles observed by Namias [8, 9] in that the latter usually occurred in February or March and were accompanied by a clear cut southward displacement of the westerlies. The magnitude of this index cycle is shown by the fact that the zonal index changed from about 5 m. p. s. above normal in mid-December to more than 6 m. p. s. below normal in mid-January. Of additional interest is a comparison of United States temperatures for the two months. In December 1956 roughly three-fourths of the United States was above normal; in January 1957 about the same portion of the United States was below normal.

During the index cycle of January the zonal index was above normal in the first and last weeks. During the middle two weeks the index was below normal, reaching the lowest point of the cycle during the 5-day period ending January 19, at which time the United States was exceptionally cold. Subsequent to the release of cold air from the polar vortex and the transport of that cold air through the United States and into the Atlantic Ocean, rapid deepening of the Icelandic Low occurred as the zonal index increased sharply. The maximum intensity reached by a particular daily sea level cyclone was less than 940 mb. on January 26 (Chart X).

2. WEEK-BY-WEEK WEATHER AND CIRCULATION IN THE UNITED STATES

WEEK ENDING JANUARY 7

The main features of the first week's weather and circulation are illustrated in figure 6. (The 5-day mean charts in figs. 6–9 are composed of the last 5 days in each week.) Generally high index was accompanied by mild temperatures and little precipitation over much of the United States. But there were some exceptions. Below normal temperatures in the Far West were consistent with the cold trough in the area. The East and Northeast were still cold, but those sections appeared to be moderating under a weakening northerly flow.

The moderate southerly DN flow in the Southwest was partially responsible for fairly heavy precipitation totals in extreme southern California and parts of Arizona and New Mexico. Daily perturbations from the Gulf States contributed to moderate rainfall in the South (Florida excepted) and snowfall from Virginia to New England.

Of considerable importance was the change in circulation from the previous week's 700-mb. 5-day mean map (not shown here but see fig. 5D of [2]). The half-wavelength over the United States increased abruptly as the east coast trough progressed about 10° of longitude, and the High over Nevada (and its ridge to the north) retrograded about 30° of longitude to the eastern Pacific Ocean. As a result, a new middle- to low-latitude trough formed near the west coast. That was a sudden, major change in the circulation and the beginning of the Gulf of Alaska block, which dominated the weather over the Pacific and United States for the rest of the month.

The zonal index of 12.9 m. p. s. (fig. 5) was slightly above normal, but the downward trend was in progress.

WEEK ENDING JANUARY 14

The 700-mb. 5-day mean chart corresponding to the second week of January (fig. 7) exhibits a general picture of three full-latitude troughs around the Northern Hemisphere with one middle- to low-latitude trough off the United States west coast and several low-latitude troughs in other parts of the hemisphere. Most of these troughs were displaced westward from their positions of the previous week.

Of particular note were several large-scale changes. Blocking appeared over the eastern Atlantic, as shown by the closed High off Britain with 700-mb. heights 900 ft.

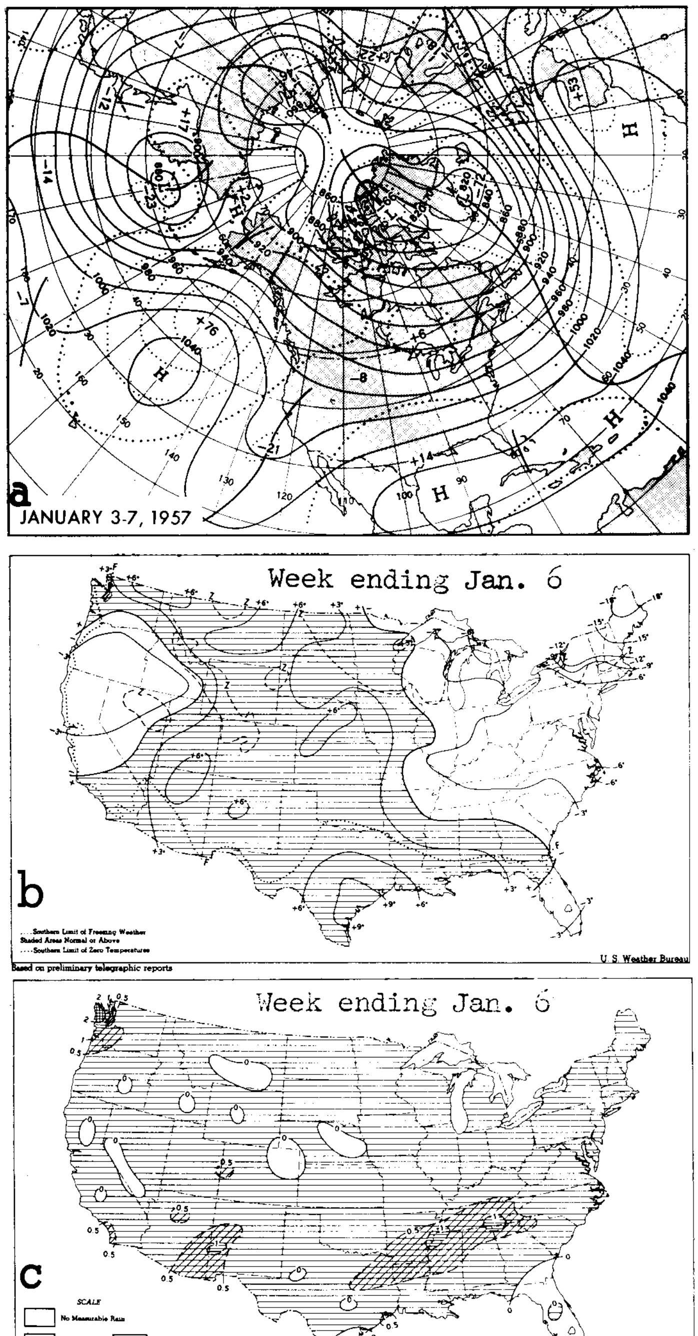

FIGURE 6.—(A) 5-day mean 700-mb. heights and departures from normal, (B) surface temperature departure from normal and (C) total precipitation, for first week in January 1957. Outstanding features of circulation pattern (A) included the mid-Pacific trough, the eastern Pacific ridge and trough, and the broad cyclonic sweep from eastern United States to Europe. As shown in (B), cold air from Canada had not yet replaced Pacific and mild Gulf air over the central half of the United States. Rain areas in (C) resulted from penetration of weak cyclones.

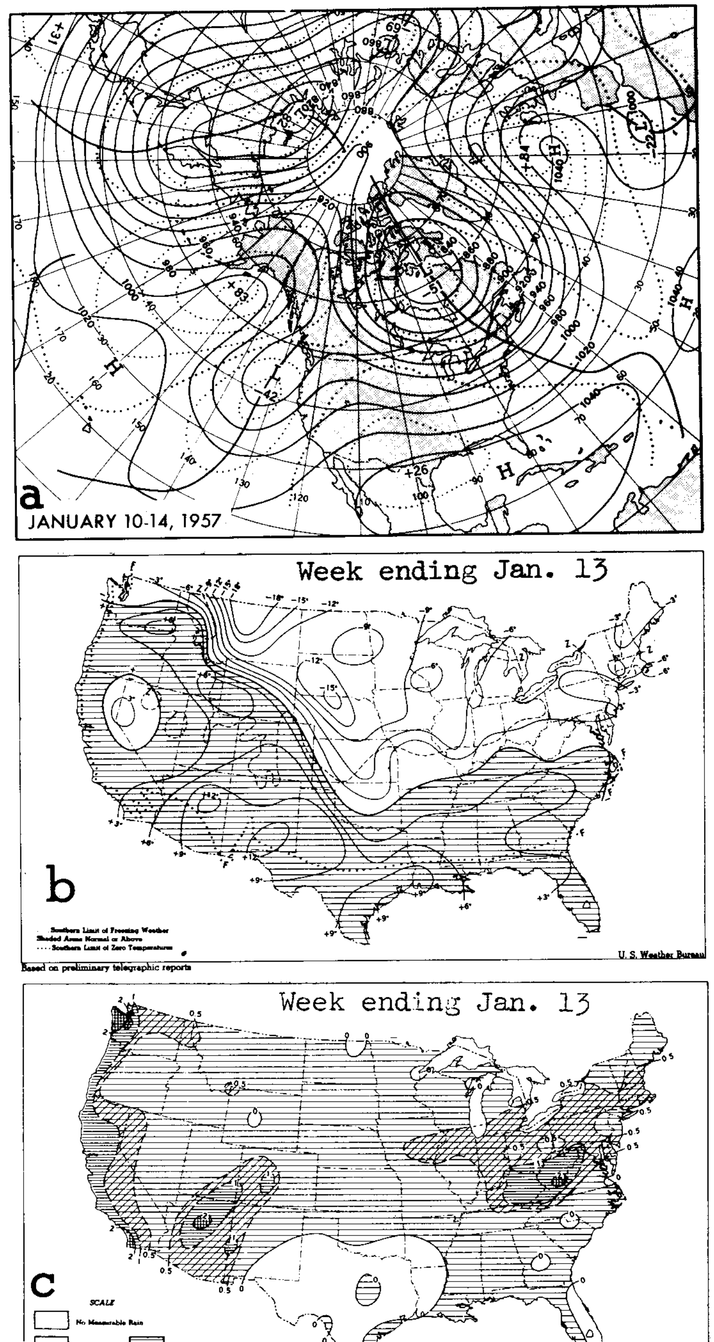

FIGURE 7.—Circulation and weather of second week of January 1957. A general intensification at the 700-mb. level showed up as increased height anomaly gradients over North America. (A) The well-established blocking in the Gulf of Alaska was instrumental in the eastern Pacific deepening which, in turn, flooded the West with mild air (B) and brought moderate to heavy precipitation along the west coast (C). Note cold invasion in North and Northeast which followed a snow-producing cyclone spawned in the middle Mississippi Valley.

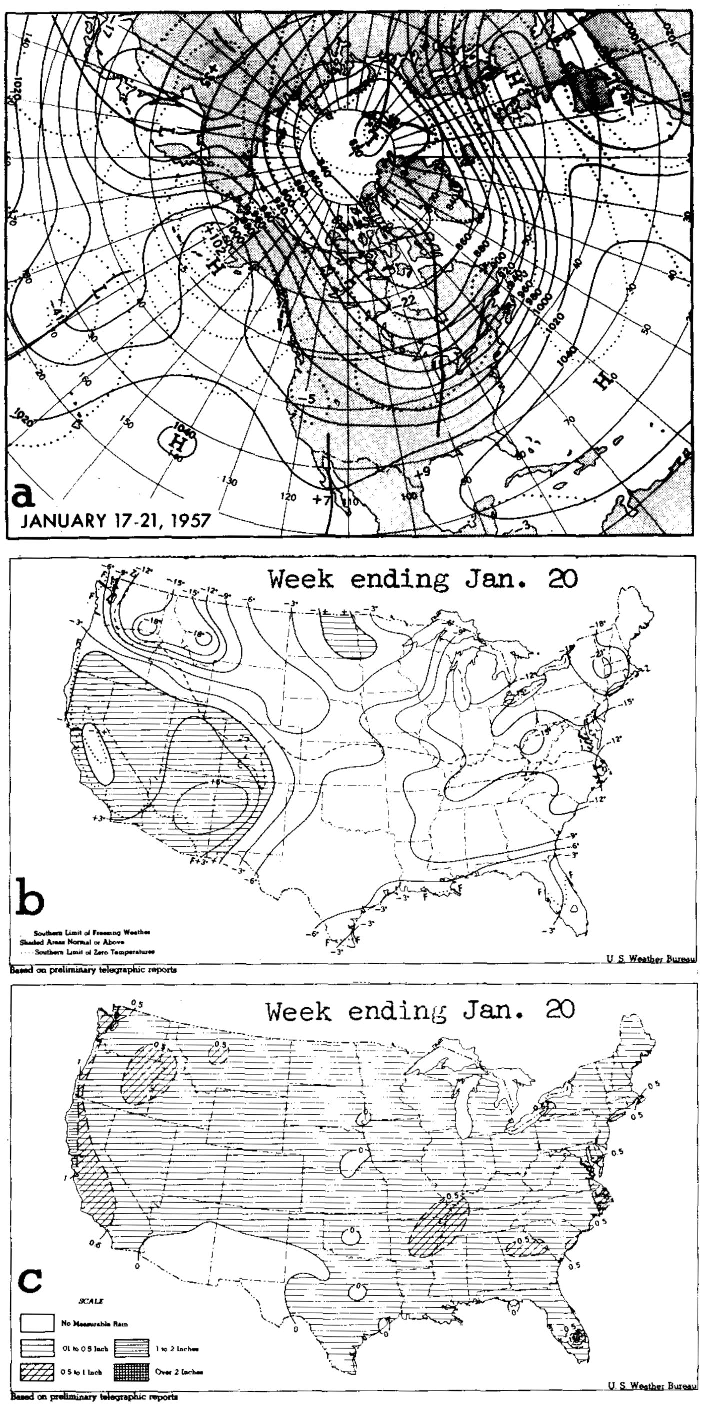

FIGURE 8.—Circulation and weather of third week of January 1957. Retrogression of the east coast trough and the Gulf of Alaska block proceeded as the west coast trough filled. Contours and height anomalies (A) show the extent and magnitude of the Kona Low as it became a major feature of the Pacific circulation. The southward and eastward progress of the polar air across the United States (B) and the generally light precipitation (C) were indicative of the lack of DN flow from maritime moisture sources.

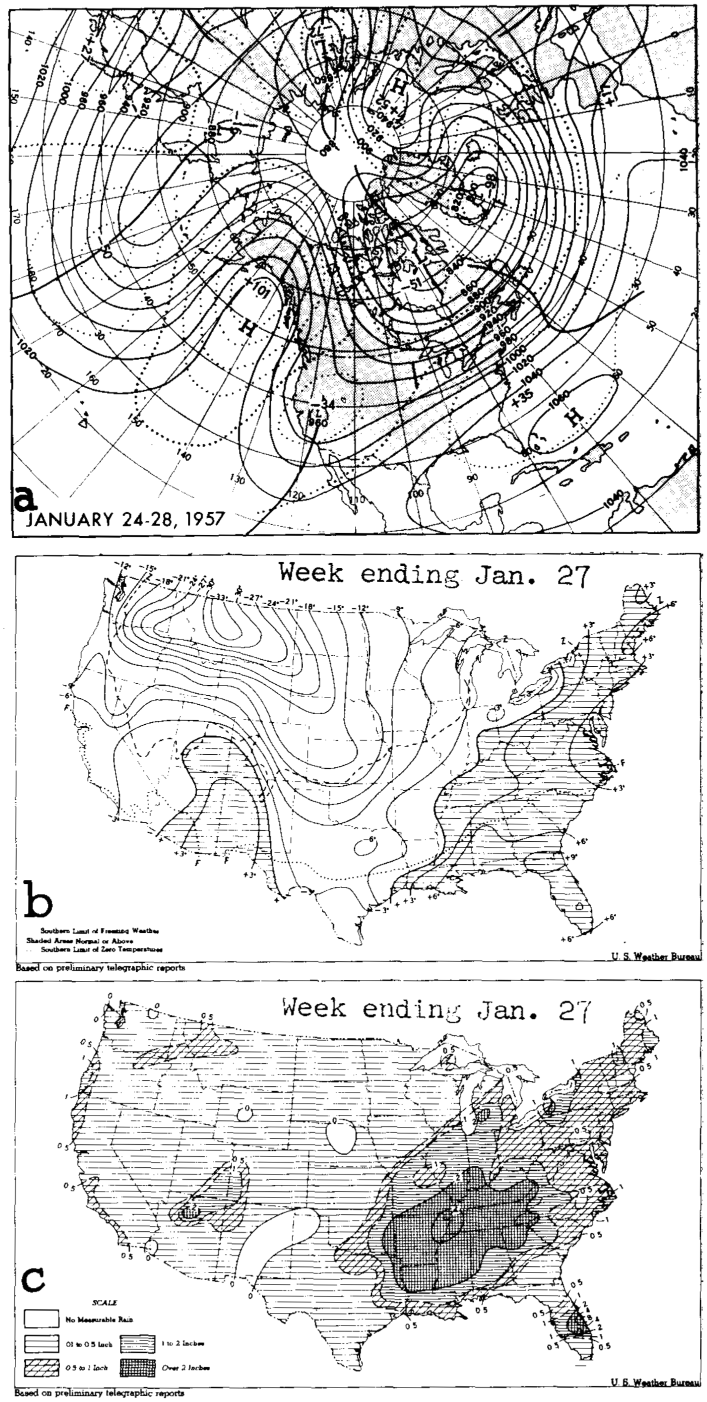

FIGURE 9.—Circulation and weather of the fourth week of January 1957. Mid-tropospheric circulation (A) was marked by progression and intensification of major features. The north-south rearrangement of the Gulf of Alaska ridge was conducive to redevelopment of the California trough. The increased strength of the Bermuda High resulted in a strong anomalous 700-mb. flow from the Gulf of Mexico. The warming (B) and the increased precipitation (C) in the eastern United States were consistent with the increased DN flow from the Gulf of Mexico. The intense cold outbreak over most of the West and Midwest caused all time low record temperatures at several stations. (See table 1.)

above normal. This occurred concurrently with a marked westward displacement of the Icelandic Low. Simultaneously, the block in the Gulf of Alaska became more pronounced. The result was a strong advection of cold air into the United States, where intense cold was widespread.

The intensification of the west coast trough was followed by moderate to heavy rainfall in the Pacific Coast States. Drought conditions of several weeks in California were relieved. As the southerly DN flow became stronger, it effectively transported more maritime air into the Southwest, where Arizona and nearby areas again received heavy rains. Considerable precipitation in the Ohio Valley and Middle Atlantic States resulted as warm Gulf air released its moisture in disturbances which originated in the west coast trough.

During this week the zonal index was 9 m. p. s., some 3 m. p. s. below normal (fig. 5). A continued decrease in the index was suggested by the fact that blocking regimes in both the Pacific and Atlantic Oceans were well-established, with extensive positive DN centers to the north of sizeable negative DN centers.

WEEK ENDING JANUARY 21

Changes in the North Atlantic Ocean and over eastern Canada occurred at about the same time. Cold air surged from northern Siberia across the North Pole toward Greenland, as shown by figure 8. The apparently well-established blocking in the North Atlantic retreated to the southeast, as Arctic air continued southward beyond Iceland. 700-mb. 5-day mean heights fell as much as 800 feet at Iceland, as the ridge was eroded. Meanwhile, the vortex over northern Quebec essentially lost its identity.

Another prominent circulation change took place in the eastern Pacific Ocean. The meridional flow resulting from the development of the Kona Low reinforced the Alaskan block. The ridge in the eastern Pacific Ocean at lower latitudes became more extensive as the ridge over southwestern United States disappeared. As that occurred, the northern portion of the west coast trough sheared and progressed to the Great Lakes area; the southern part of the trough progressed more slowly.

Extensive cold weather over the United States resulted from the evolution noted above. The East and the South became much colder, as is seen by comparing the temperature anomalies in figures 7 and 8, and several new low records were established (table 1). A general warming in the Northern Plains States followed a surge of warm air from northern Alaska which could conceivably be traced back to the central Pacific Ocean (see DN flow in fig. 8). A detailed account of the activity associated with the rapid deepening off the west coast is given by Norton and Kulawiec [10] in an adjoining article in this issue.

Precipitation decreased considerably during the third week. Areas of prolonged drought in the central and southern Plains States received no more than 0.05 inch of rain. In the Far Southwest rains diminished as the Pacific trough moved inland. Westerly winds aloft and a negligible DN flow discouraged further sizeable amounts of precipitation. The rain area over the Ohio Valley also diminished as cold air drove southward to the Gulf of Mexico. At the same time, the Bermuda High retreated eastward from the Gulf of Mexico.

The zonal index (fig. 5) reached its minimum of 5.2 m. p. s. during the 5-day period ending January 19, when meridional flow over the Western Hemisphere was most intense. The 700-mb. mean for the last five days of the week (Jan. 17–21) represents a zonal index of 7.9 m. p. s., the beginning of the second phase of the index cycle. The rise in index can be accounted for principally as a result of the collapse of the Atlantic block.

WEEK ENDING JANUARY 28

The return of higher index is substantiated by the strong zonal flow from the central United States to the United Kingdom (fig. 9). The mean 700-mb. zonal index for the 5-day period ending on January 28 was about 10 percent higher than normal and marked the completion of the index cycle which began in mid-December (fig. 5). Strong meridional flow persisted in the eastern Pacific Ocean, but that flow was insufficient to balance the fast westerlies in the rest of the Western Hemisphere.

The beginning of a new blocking impulse in the Spitzbergen area is evidenced by the closed 700-mb. contour and positive height anomaly in figure 9. In this area there occurred a change in height anomaly in one week from −800 ft. to +500 ft. This new blocking first appeared as a small positive DN over Spitzbergen on the 5-day mean map ending January 26 (not shown), as the Icelandic Low intensified. At its maximum intensity sea level pressure of the daily Icelandic Low was below 940 mb., the 5-day mean sea level pressure was 965 mb., the 700-mb. 5-day mean height was less than 8000 feet, and the 5-day 700-mb. height DN was −980 ft.

A general cooling took place from Hudson Bay to southern California, with warming from Texas to New York. The north-south realignment of the large positive DN in the Gulf of Alaska favored the redevelopment of the California trough, as cold air once again flooded the western two-thirds of the United States (fig. 9), excepting parts of the Southwest, where above normal temperatures prevailed. Record-breaking low temperatures were reported in parts of Montana, Washington, and Oregon (table 1).

With warming in the East came moderate to heavy precipitation from eastern Texas to New England. Some local flooding occurred in Palm Beach and Martin counties of southern Florida, as amounts from 3 to 15 inches were reported. Increasing rainfall in the southern Appalachian area initiated severe flooding which followed heavy rains from January 27–30. Displacement of the warm air by colder air was responsible for several tornadoes reported in Oklahoma, Tennessee, and Louisiana.

TABLE 1.—*New temperature, precipitation, and windspeed records established during January 1957*

Date	Station	Value	Remarks
	TEMPERATURE		
		(° F.)	
15	Booneville, N. Y.	−55	All time low for New York State.
15	Burlington, Vt.	−29.6	All time low.
15	Rochester, N. Y.	−16	New January low.
15	Syracuse, N. Y.	−24	New January low.
15	Worcester, Mass.	−19	All time low.
18	Baltimore, Md.	−4	All time low at Friendship Airport.
18	Hartford, Conn.	−17	New January low at Bradley Field.
26	Missoula, Mont.	−33	All time low.
26	Olympia, Wash.	0	New January low.
27	Burns, Oreg.	−25	All time low.
27	Pendleton, Oreg.	−22	All time low.
31	Houston, Tex.	83	New January high.
	PRECIPITATION		
		(inches)	
8, 9	Detroit, Mich.	8.9	Greatest 24-hour snowfall at City Airport.
23	Pendleton, Oreg.	17	Greatest all time depth of snow on ground.
Jan.	Apalachicola, Fla.	.04	Lowest January rainfall.
Jan.	Grand Junction, Colo.	33.7	Greatest snowfall any month.
Jan.	Great Falls, Mont.	1.8	Greatest January precipitation.
Jan.	Miami, Fla. (CO)	.08	Lowest January rainfall since 1911.
Jan.	Tallahassee, Fla.	.21	Lowest January rainfall.
	WIND		
		(m.p.h.)	
8	Prescott, Ariz.	47	Highest for January at Municipal Airport.
19	Lincoln, Nebr.	58	Highest for any winter month.

3. COMPARISON WITH OTHER JANUARYS

Chart I–B indicates that monthly mean temperatures in the United States during January 1957 averaged above normal in the Southeast and Southwest, but below normal in the remainder of the nation, with maximum departures (−12° F.) in Montana. Precipitation (Charts II and III) was greater than normal in the Southwest and in the Tennessee Valley region. Subnormal amounts were observed in the Northeast, Northwest, Great Plains, and along the coast of the Gulf of Mexico. The relation between these weather anomalies and the pattern of the general circulation has previously been discussed. Of greatest importance was the strong northerly flow over Canada and the northern United States between the blocking ridge in the Gulf of Alaska and the deep Icelandic Low. Also noteworthy were the deeper than normal troughs off the southwestern coast and in the western Atlantic and the strong zone of confluence in the central part of the United States.

The monthly mean 700-mb. chart for January 1957 (fig. 1) was compared with corresponding maps for each January since 1933. There were only three instances in which large positive DN centers were observed in or near the Gulf of Alaska. The weather and circulation of these three Januarys, namely: 1937, 1949, and 1950, have been discussed in detail by Klein [5, 6] and Namias, [7, 9].

January 1937 was cold west of the Mississippi River and warm to the eastward. The precipitation pattern was similar to that of 1957, except that amounts in excess of 20 inches were reported in the Ohio Valley, where serious floods occurred. A strong DN flow from the south in the eastern United States and a ridge off the east coast were the major circulation differences from 1957.

January 1949 was very much like January 1937. It was also cold in the West and warm in the East. Heavy precipitation covered most of the United States. There was a ridge over the east coast and a strong DN flow from the western Gulf of Mexico.

In January 1950 the major positive DN field lay over the eastern Aleutians. Cold air was confined to the Far West and the northern Plains States, with the balance of the United States above normal in temperature. Precipitation was heavy in the East and the Northwest. Principal circulation differences from January 1957 included a more intense west coast trough, a moderate ridge along the east coast, and a strong positive DN center over the Middle Atlantic States.

All the three months briefly noted above were predominantly cold in the western part of the United States and warm in the East. If one can single out the one feature which was common to those three months and conspicuously absent in January 1957, it is the ridge in the East. In January 1957 the pool of cold Canadian air (shown in fig. 4), made repeated invasions into the United States. This may have been partly responsible for the absence of a 30-day mean ridge along the east coast.

When the Gulf of Alaska DN center is used as an anchor point, Martin's anomaly charts [12] indicate below normal 700-mb. heights over Alberta about 80 percent of the time, with an associated area of above normal heights over New England about 60 to 70 percent of the time. This was the predominant pattern of 700-mb. anomaly during the three Januarys, 1937, 1949, and 1950. In January 1957, however, these areas did not react in the expected way to the key area in the Gulf of Alaska, as shown by above normal heights in Alberta and below normal heights in New England in figure 1.

Grossly, then, it appears that each January of the three years discussed above was near average regarding its downstream arrangement of height departures from normal. January 1957, on the other hand, was somewhat anomalous in a DN sense downstream from the anchor point. Hence, the temperature, and to some extent, the precipitation anomalies in the United States deviated from the "average" observed in January 1937, 1949, and 1950. This "average" pattern was achieved, however, during the fourth week of January 1957 (fig. 9), when both the weather and circulation over the United States were quite similar to that observed during the three analogous Januarys.

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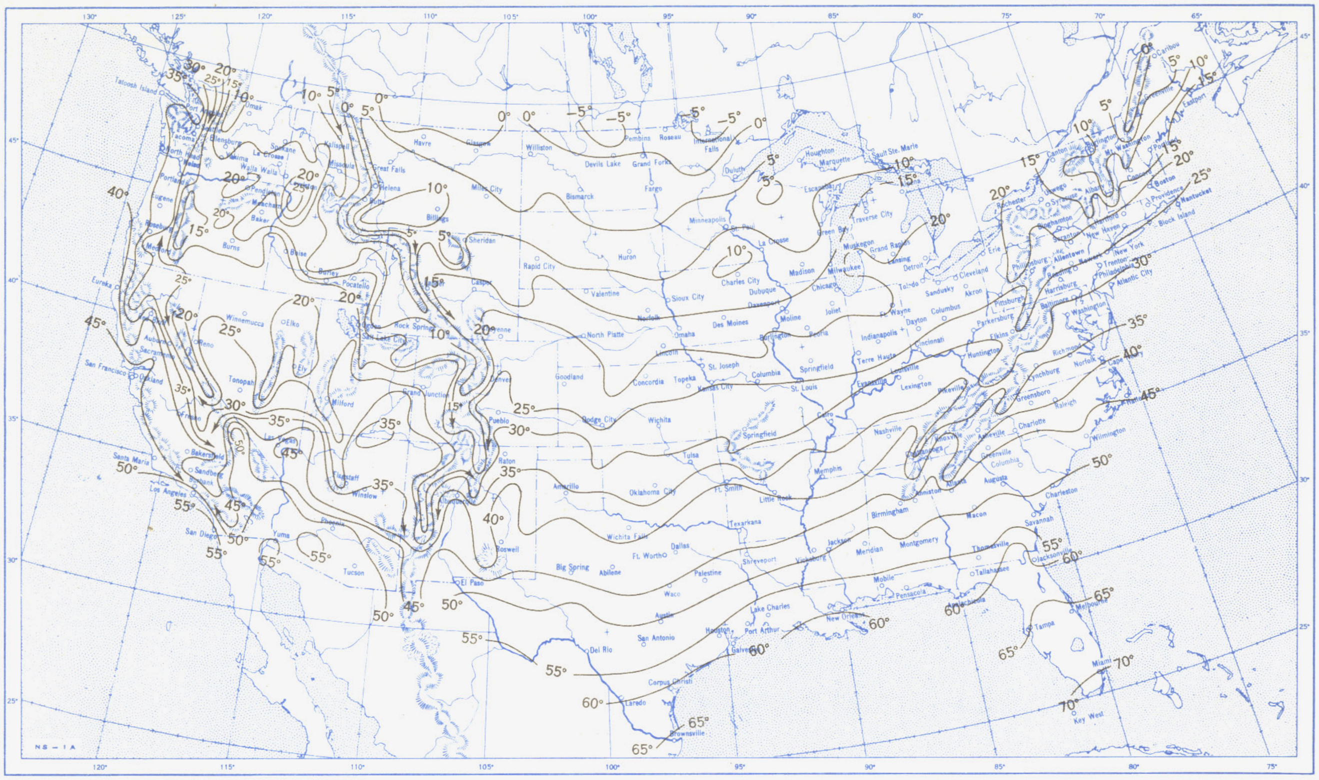
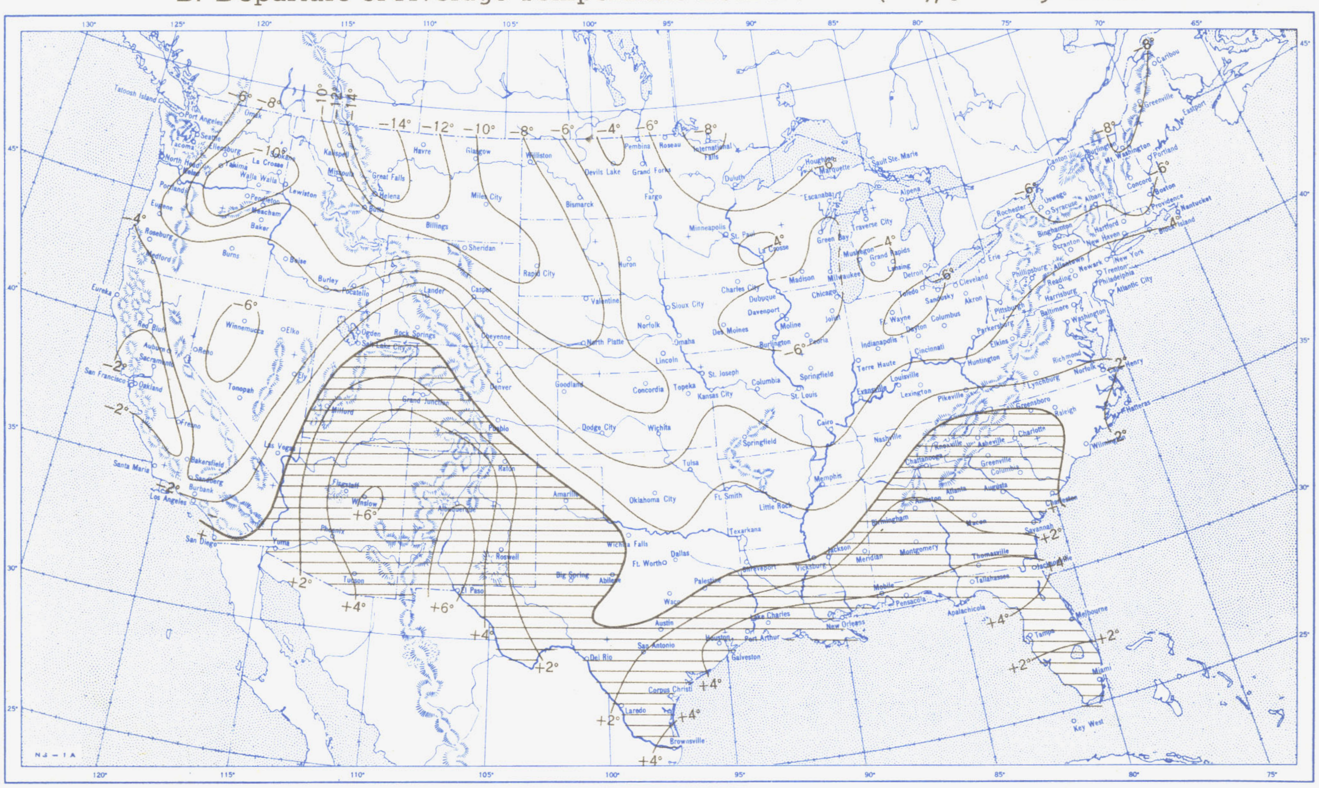
Chart I. A. Average Temperature (°F.) at Surface, January 1957.



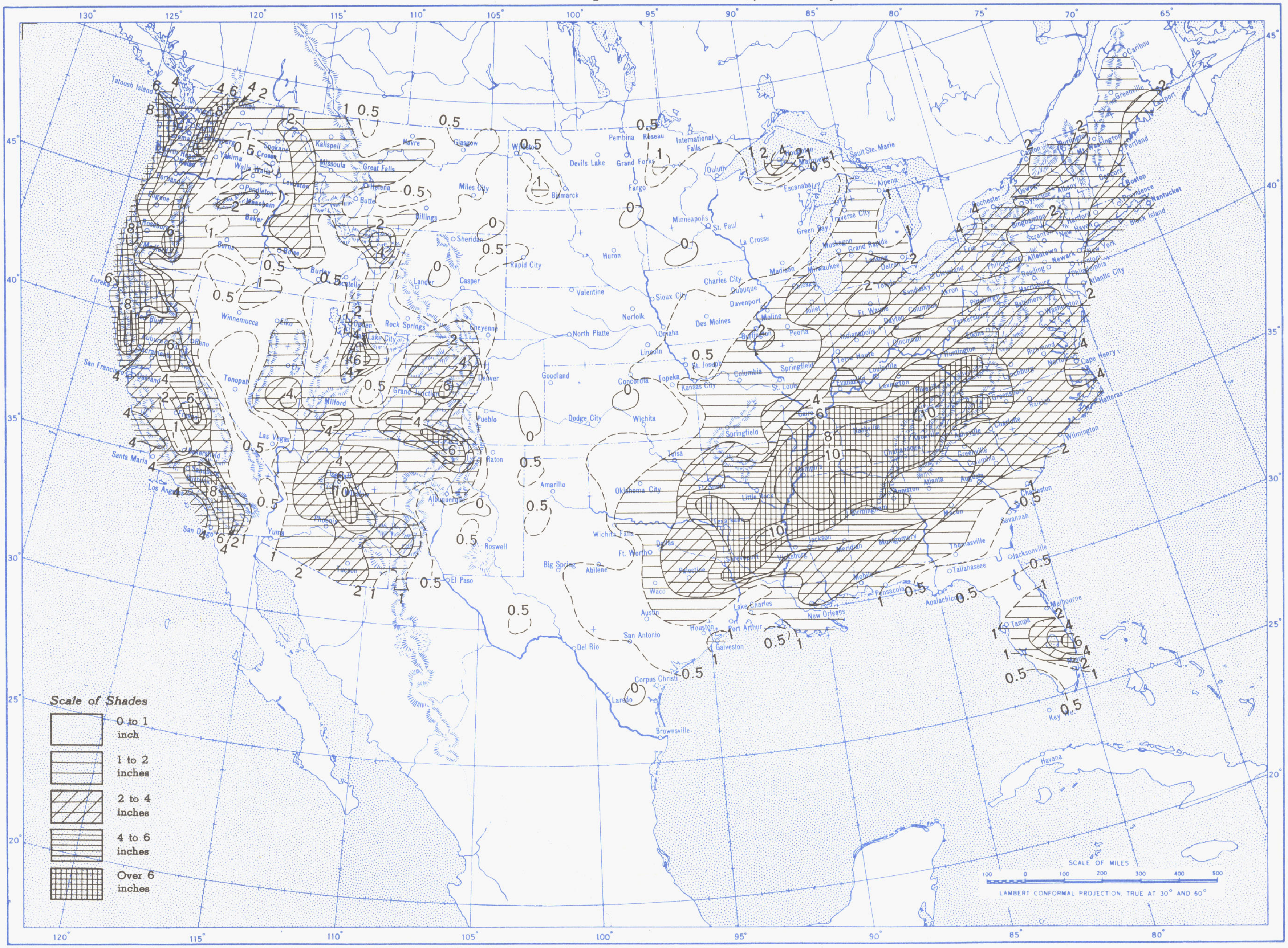
B. Departure of Average Temperature from Normal (°F.), January 1957.



A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.

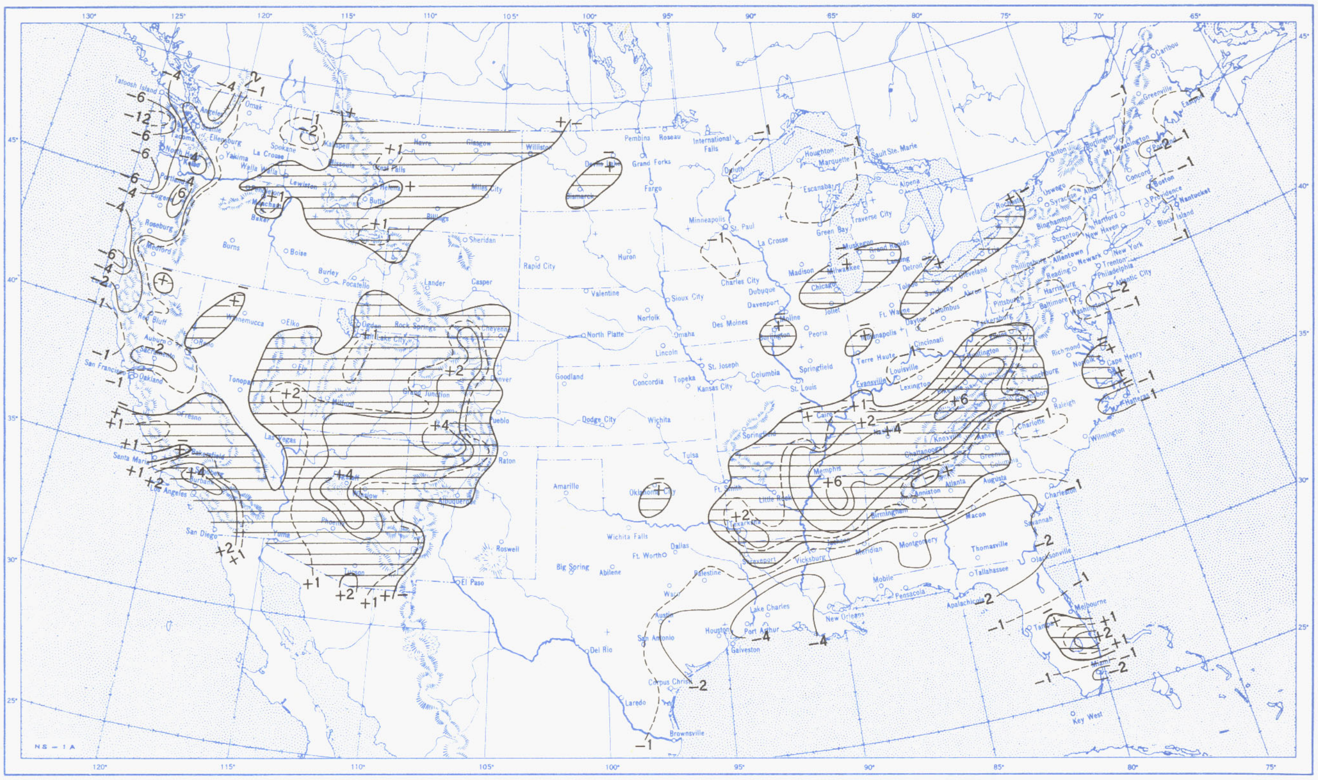
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), January 1957.

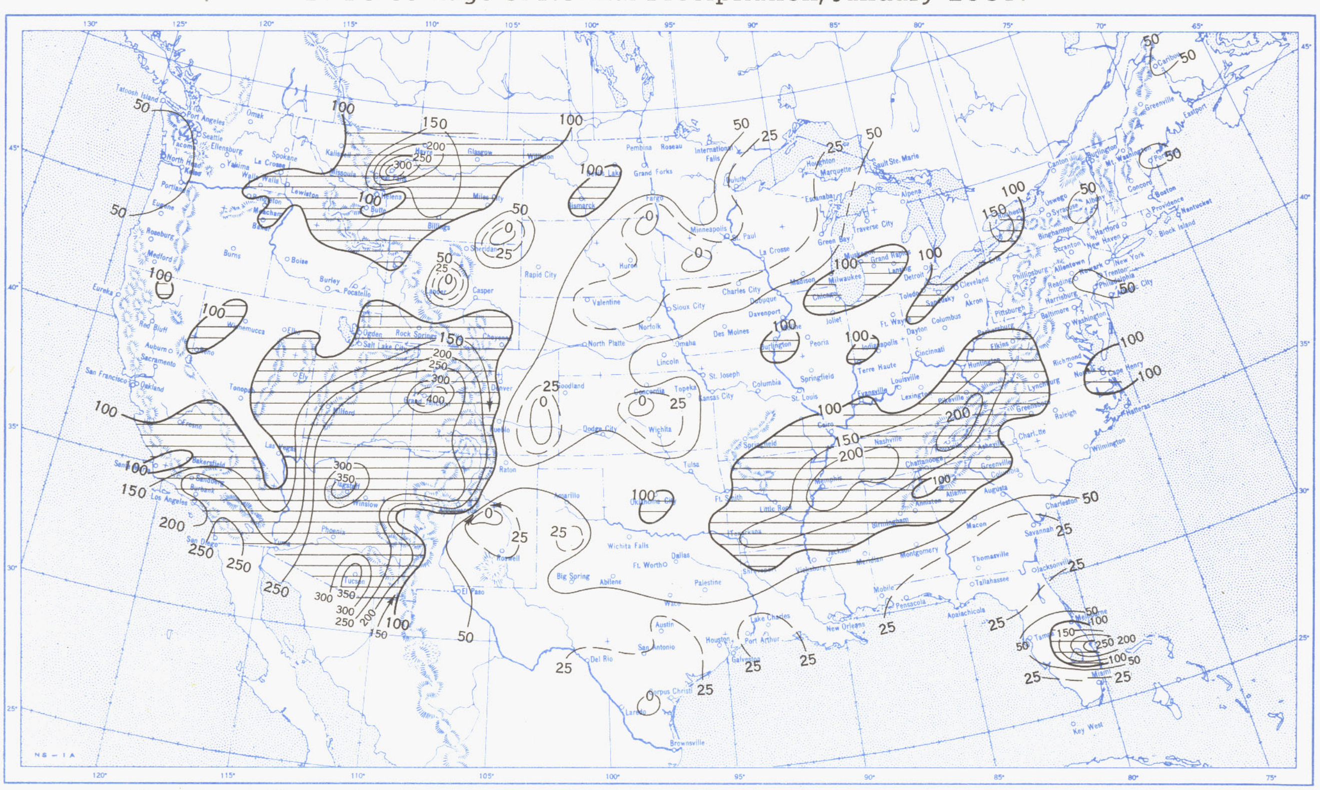


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), January 1957.

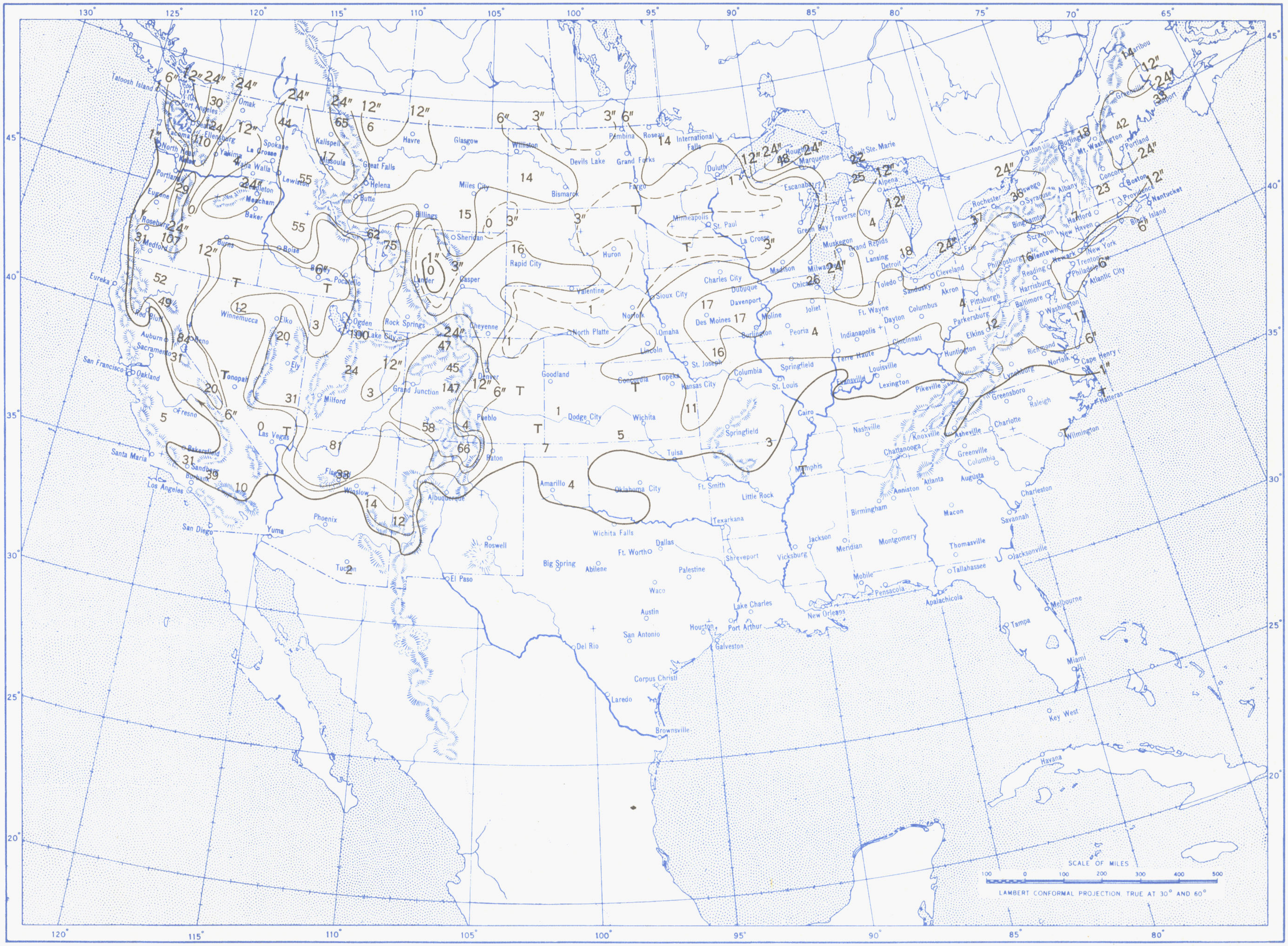


B. Percentage of Normal Precipitation, January 1957.



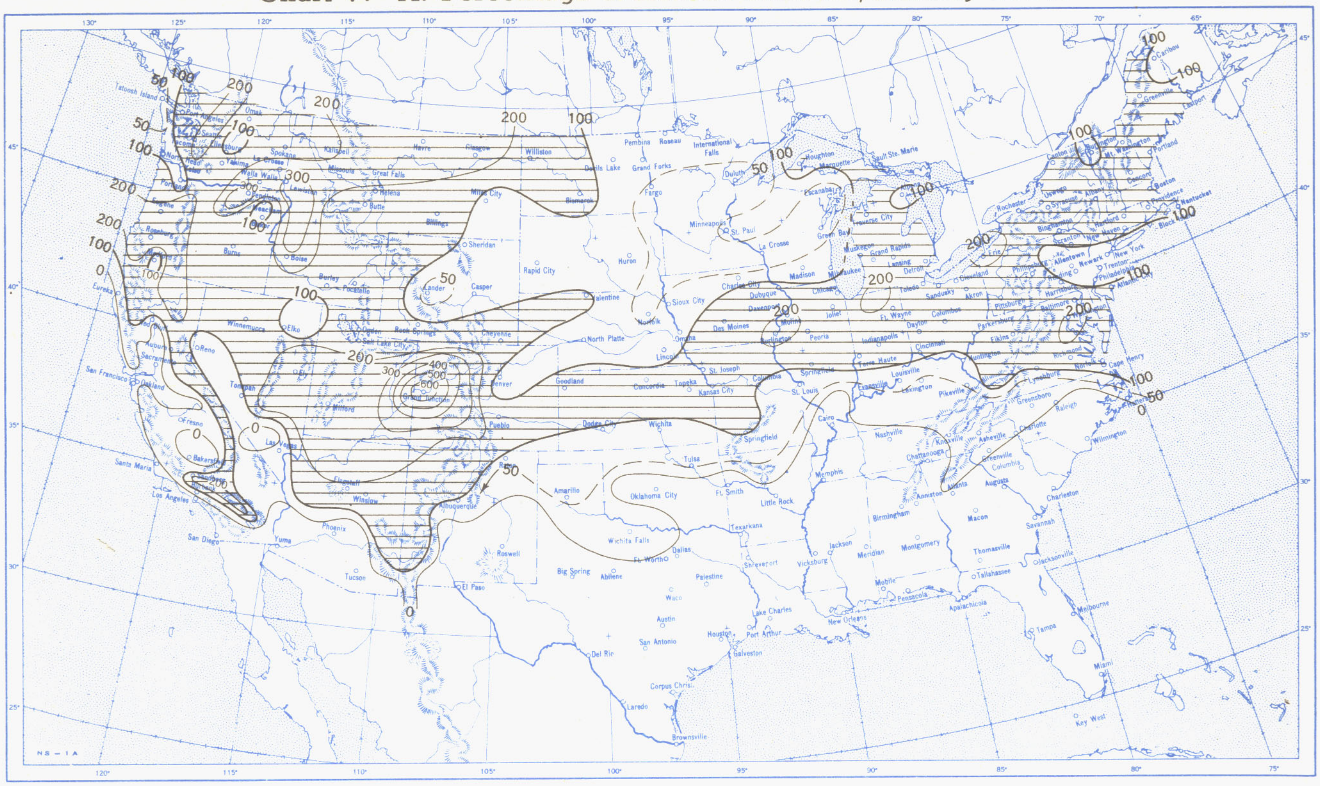
Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart IV. Total Snowfall (Inches), January 1957.

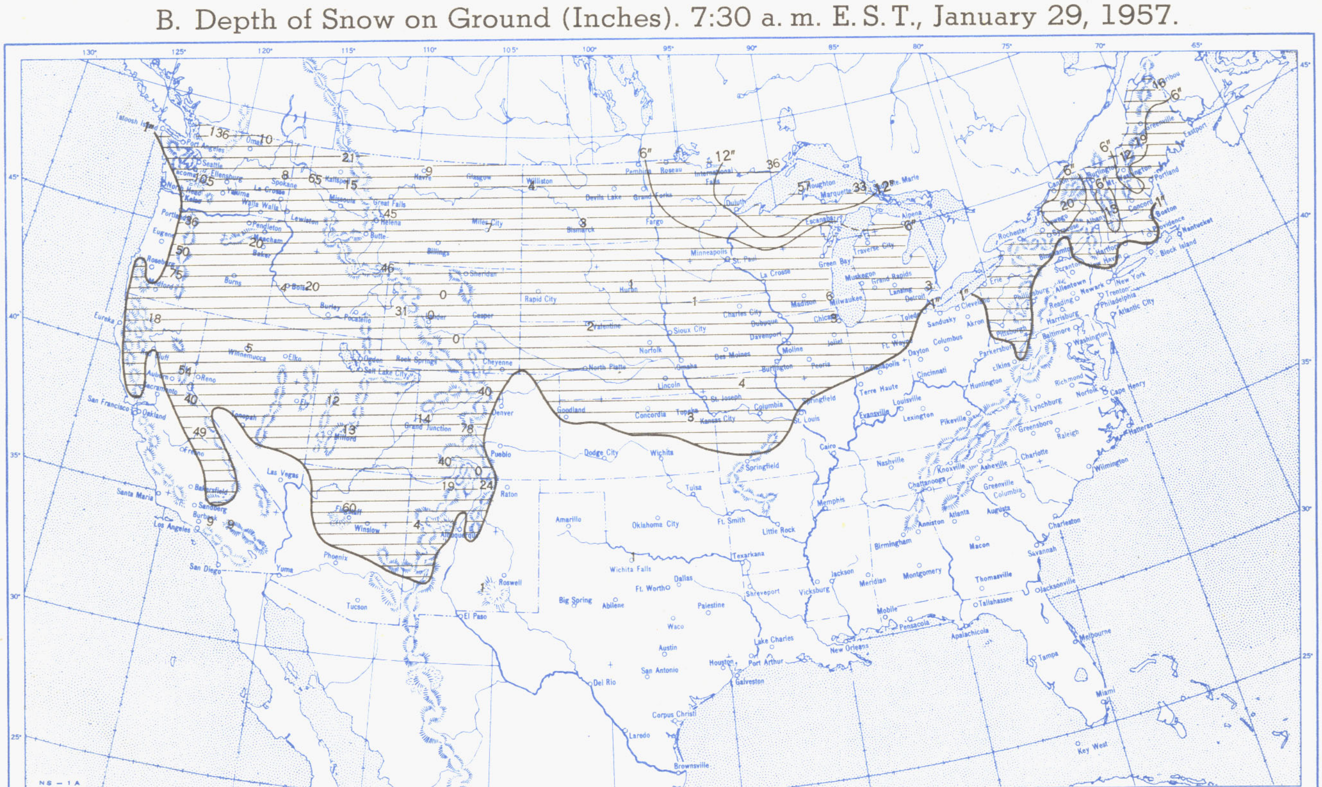


This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.

Chart V. A. Percentage of Normal Snowfall, January 1957.

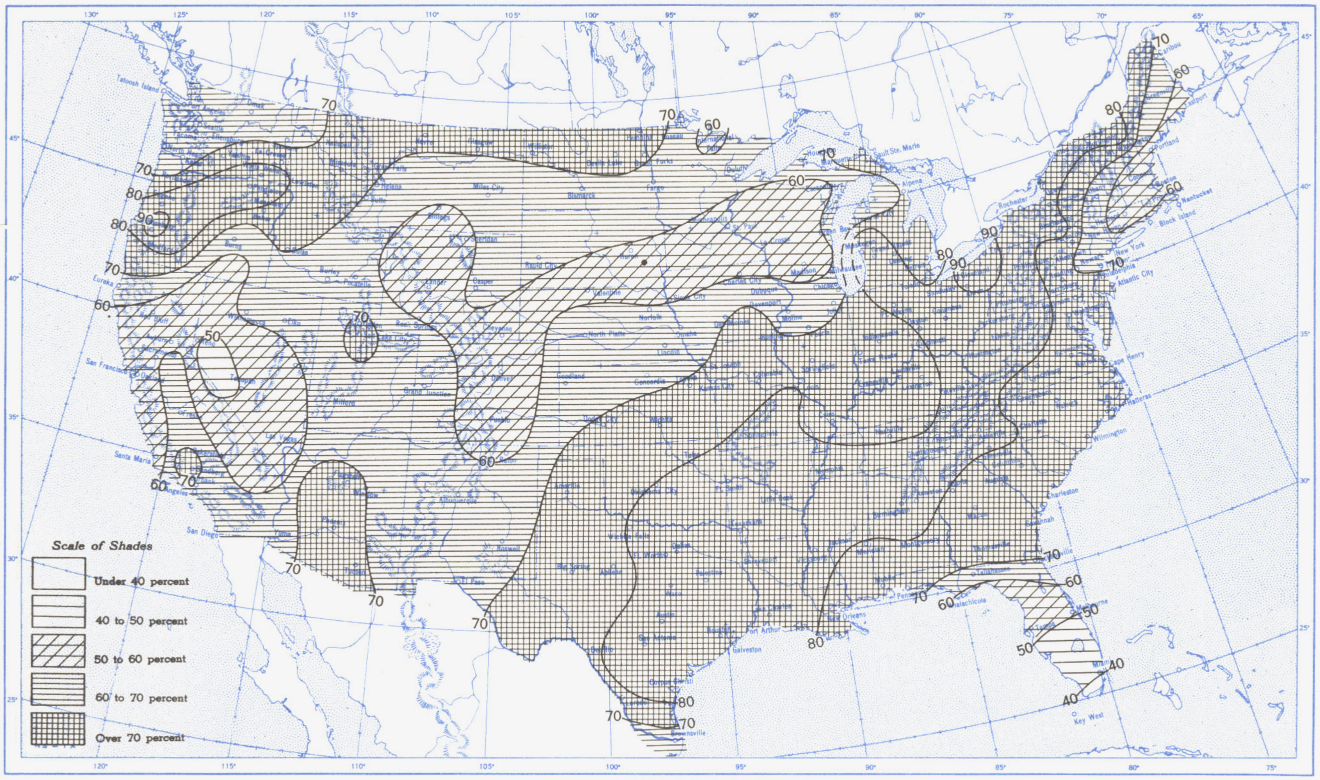


B. Depth of Snow on Ground (Inches). 7:30 a. m. E. S. T., January 29, 1957.

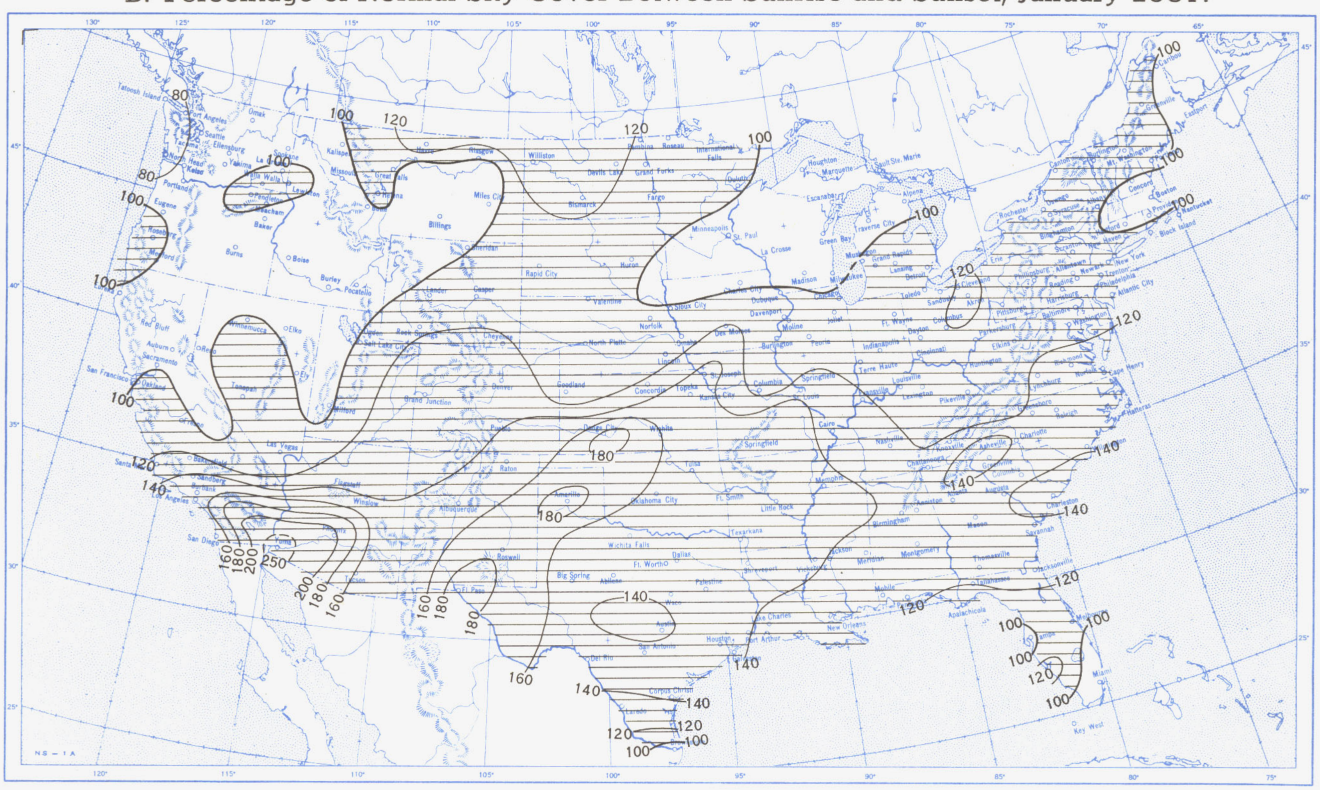


A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record.
B. Shows depth currently on ground at 7:30 a. m. E. S. T., of the Tuesday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, January 1957.

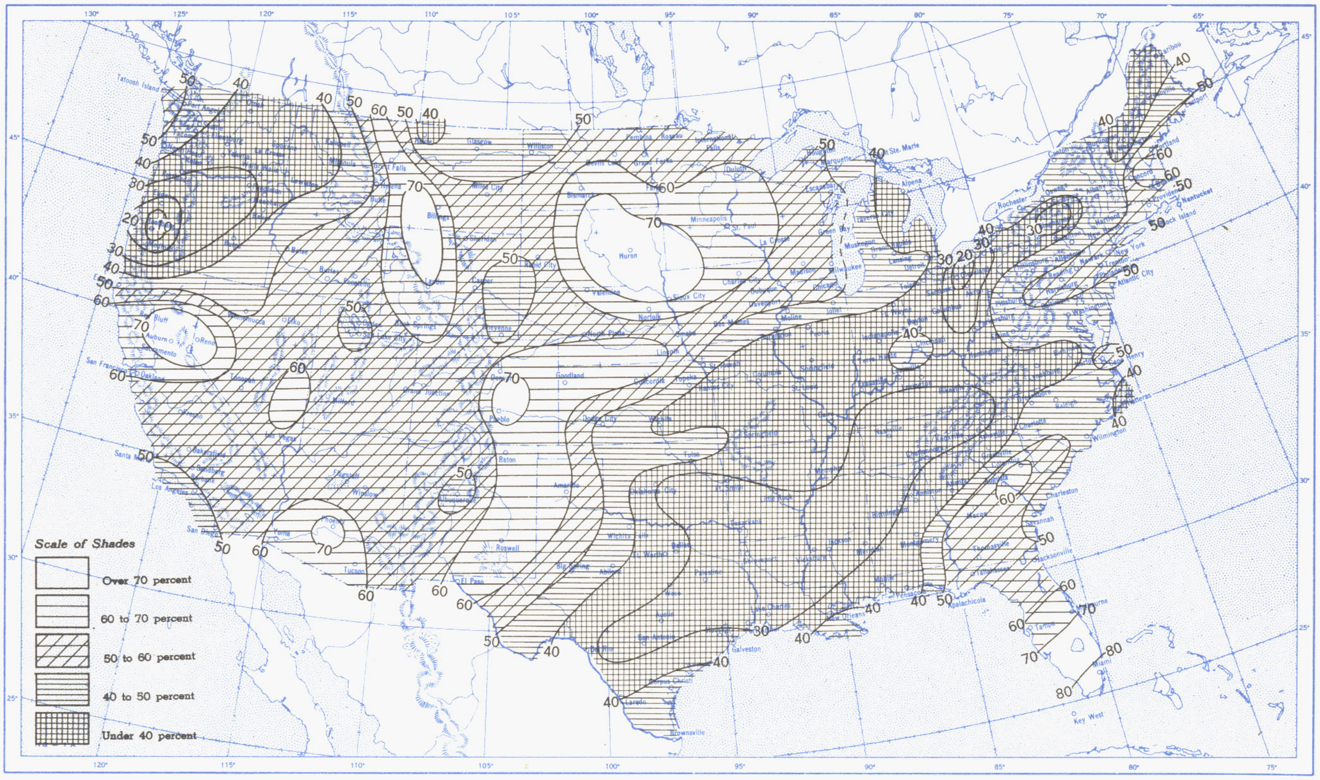


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, January 1957.

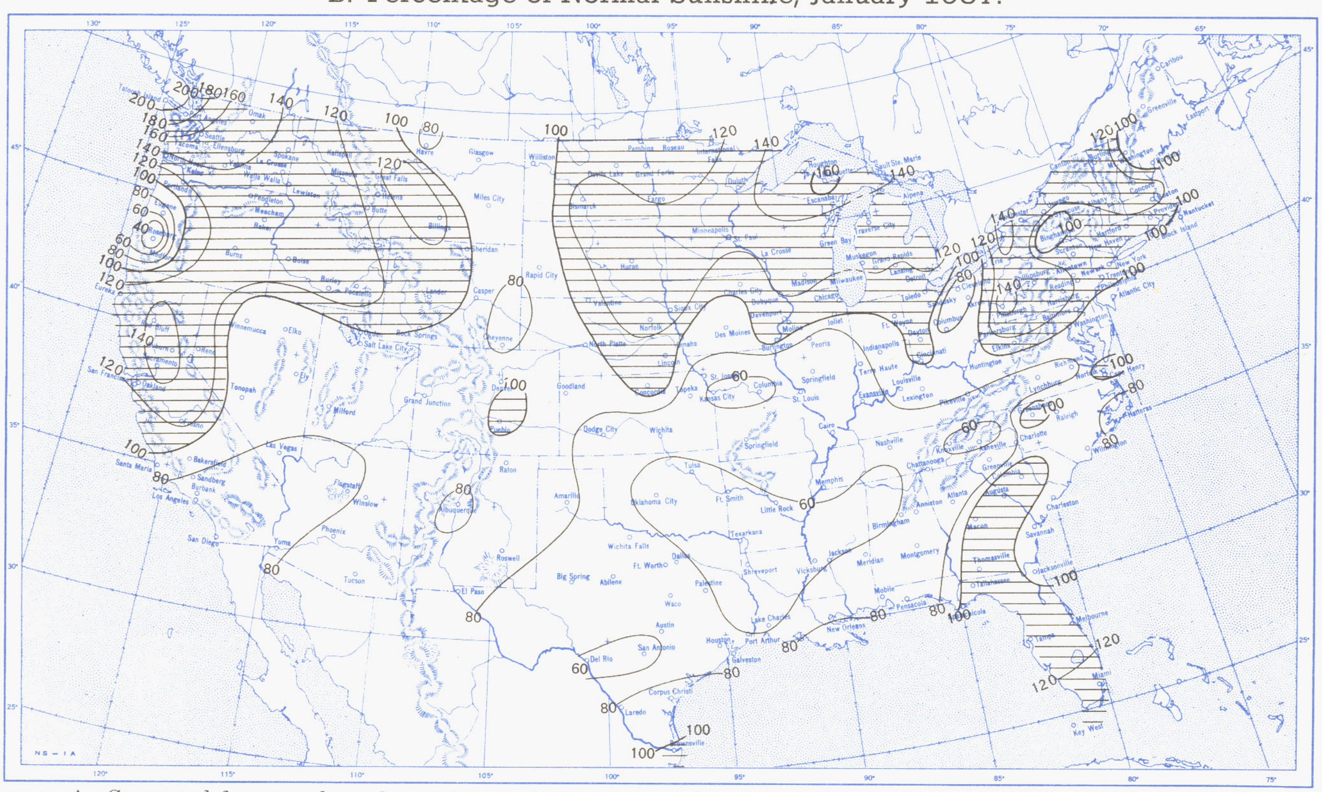


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, January 1957.



B. Percentage of Normal Sunshine, January 1957.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, January 1957. Inset: Percentage of Mean Daily Solar Radiation, January 1957. (Mean based on period 1951-55.)

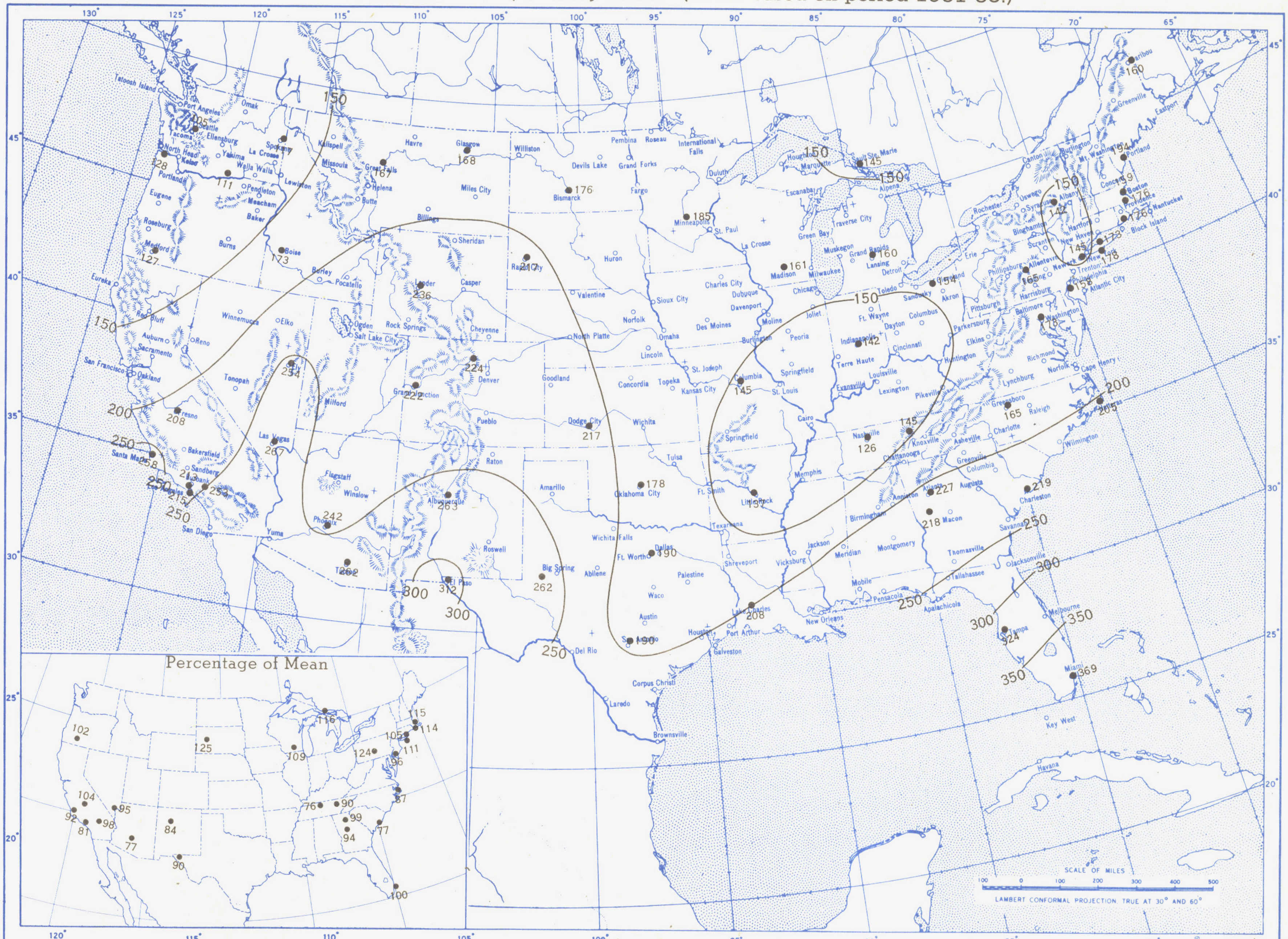
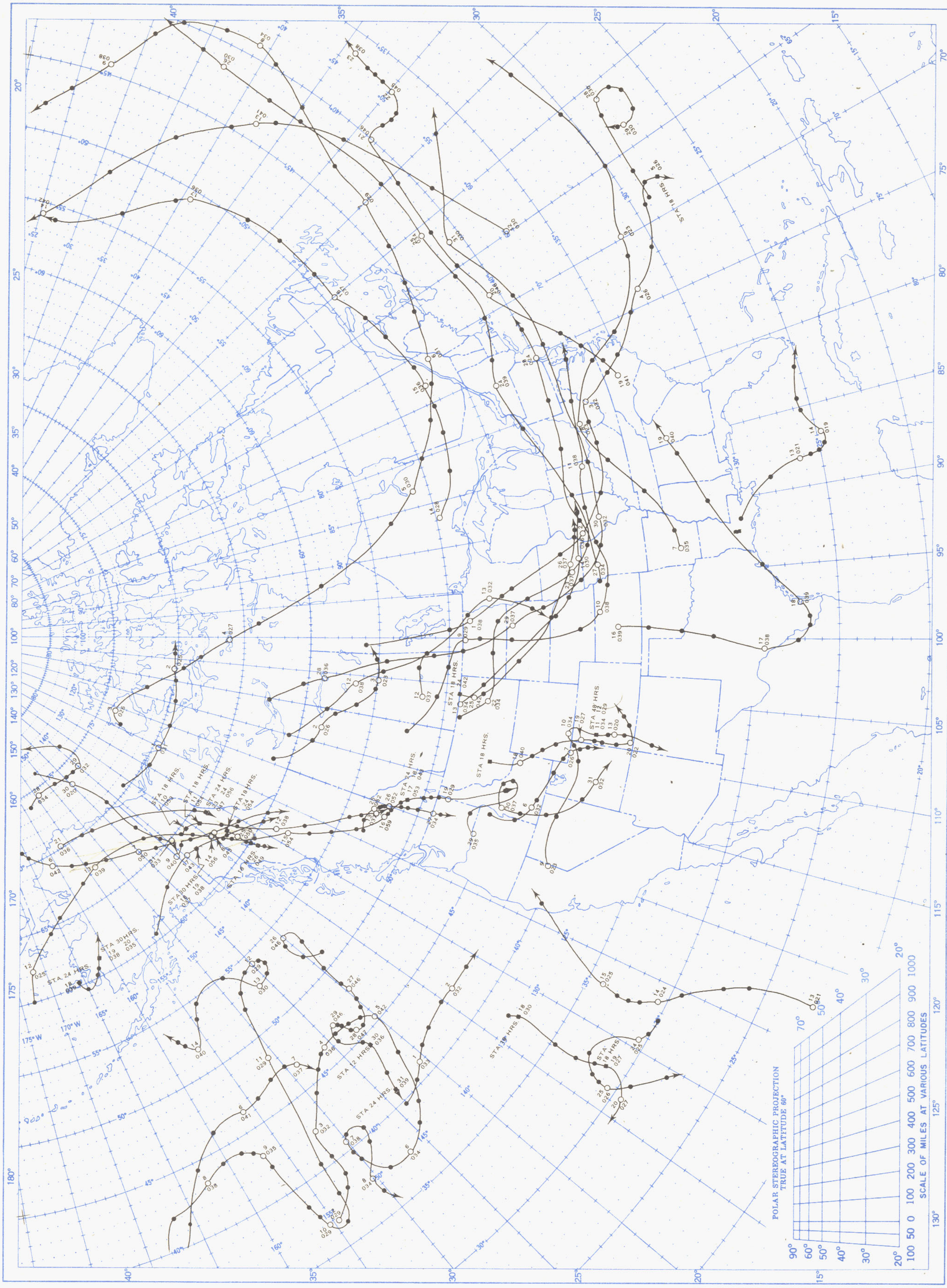


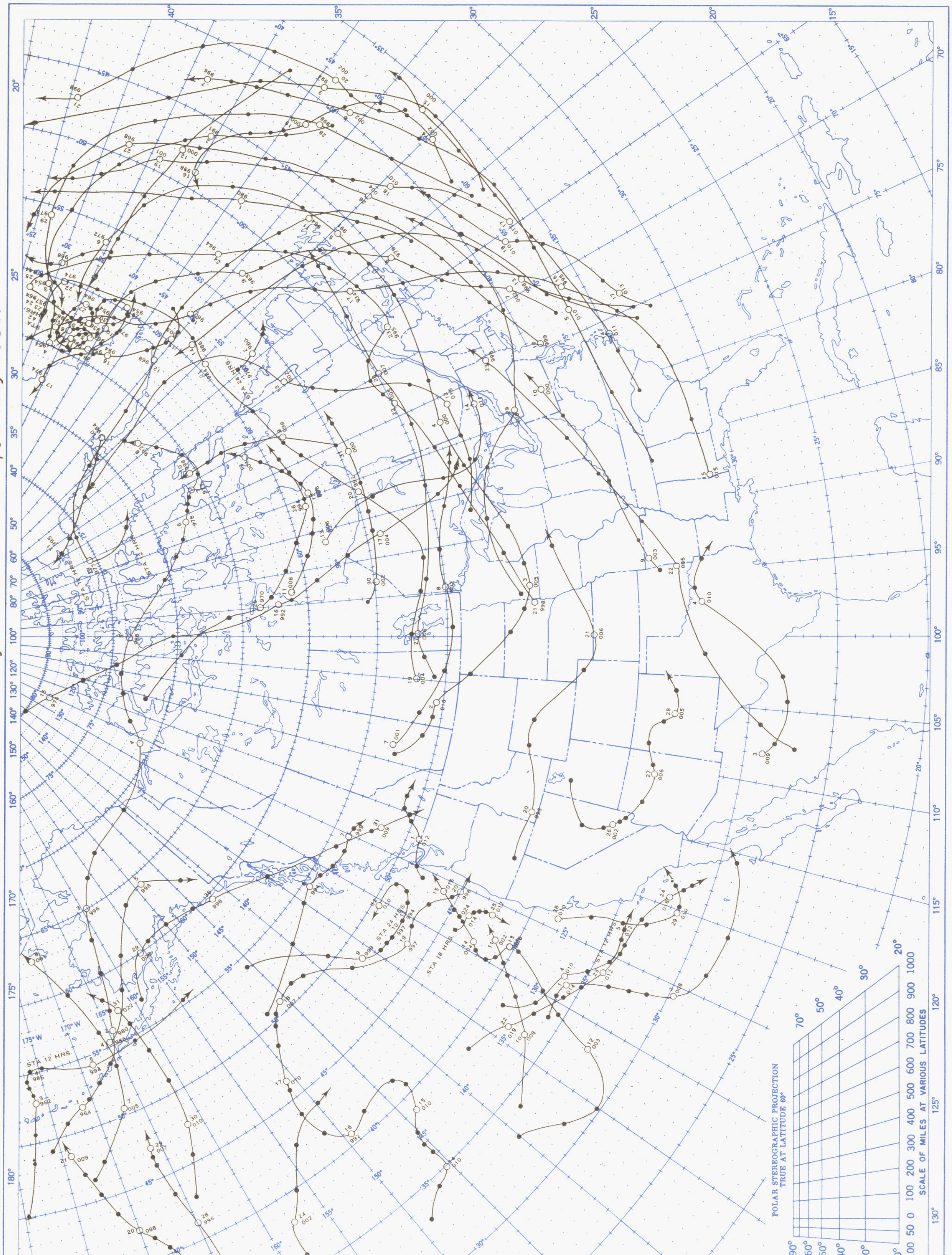
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm.$^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, January 1957.



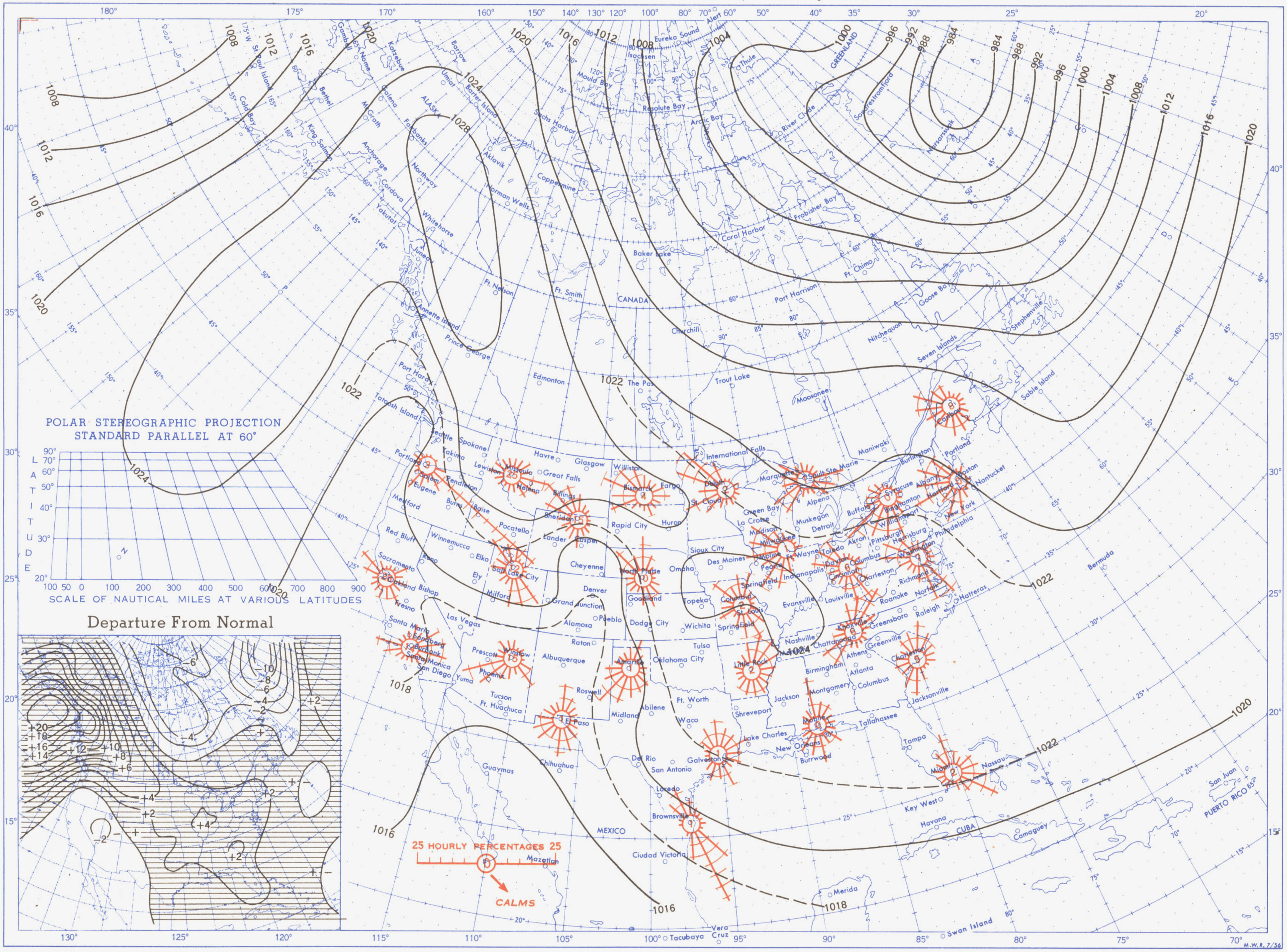
Circle indicates position of center at 7:30 a.m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, January 1957.



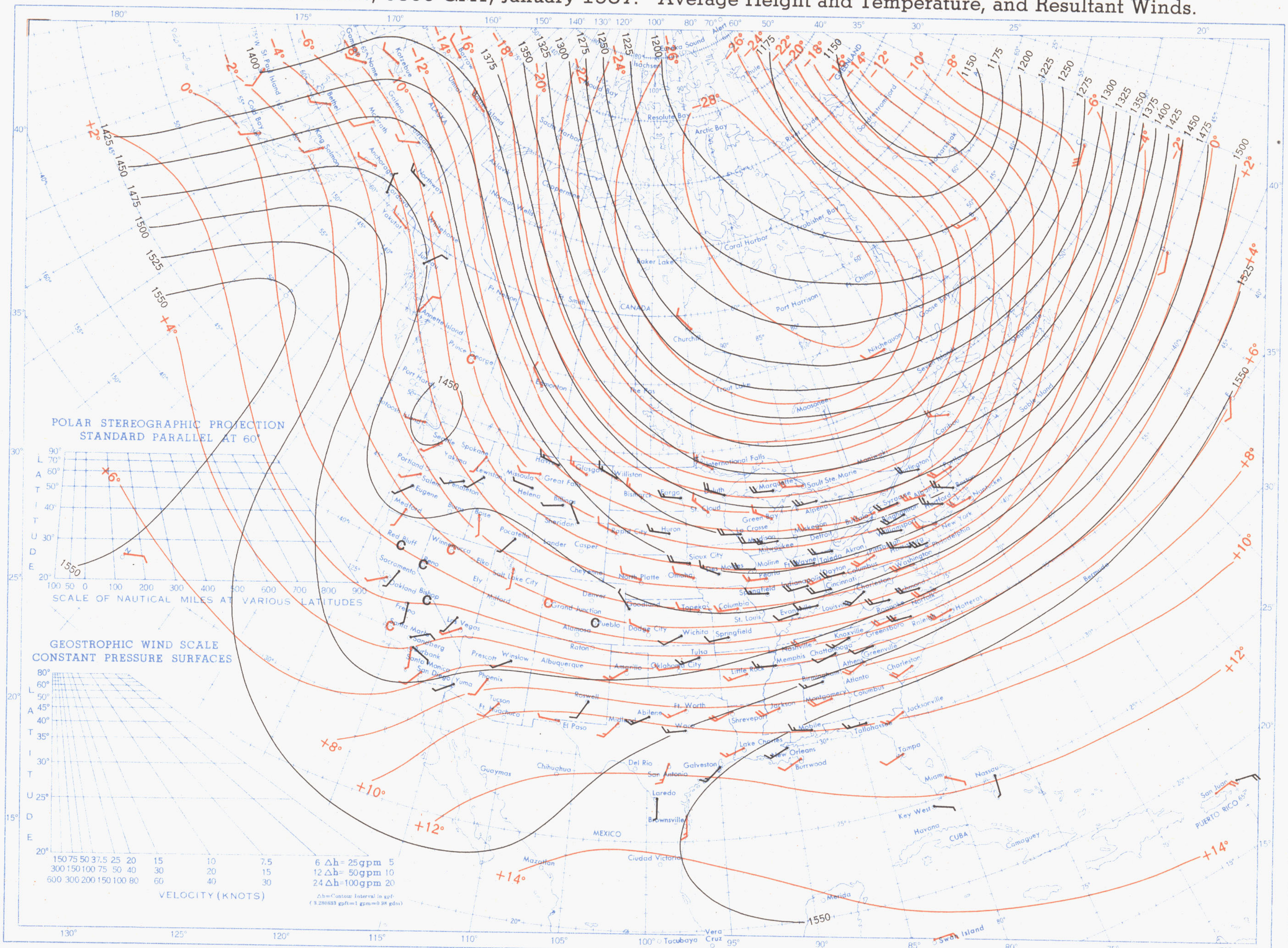
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, January 1957. Inset: Departure of Average Pressure (mb.) from Normal, January 1957.



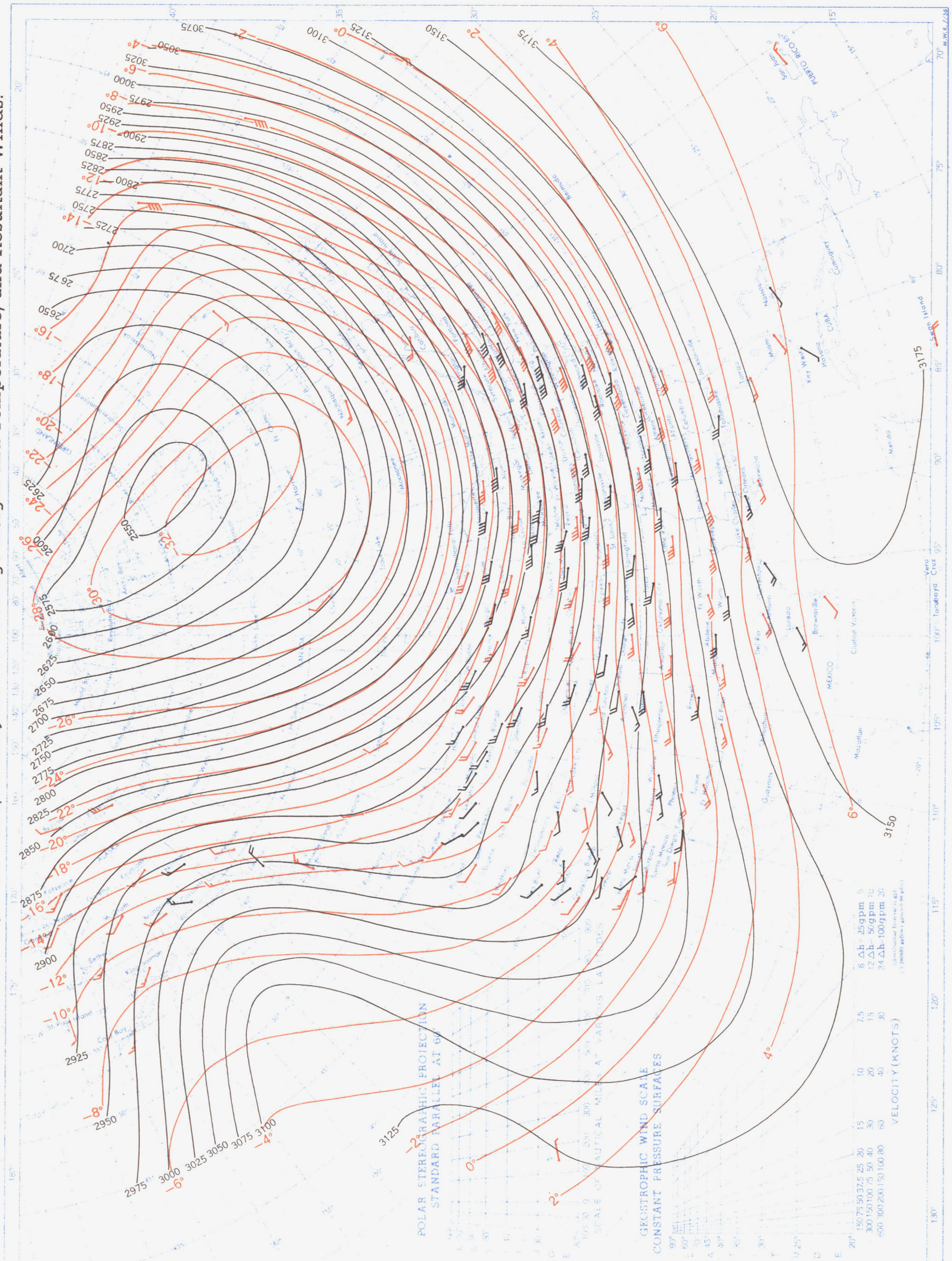
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. 850-mb. Surface, 0300 GMT, January 1957. Average Height and Temperature, and Resultant Winds.



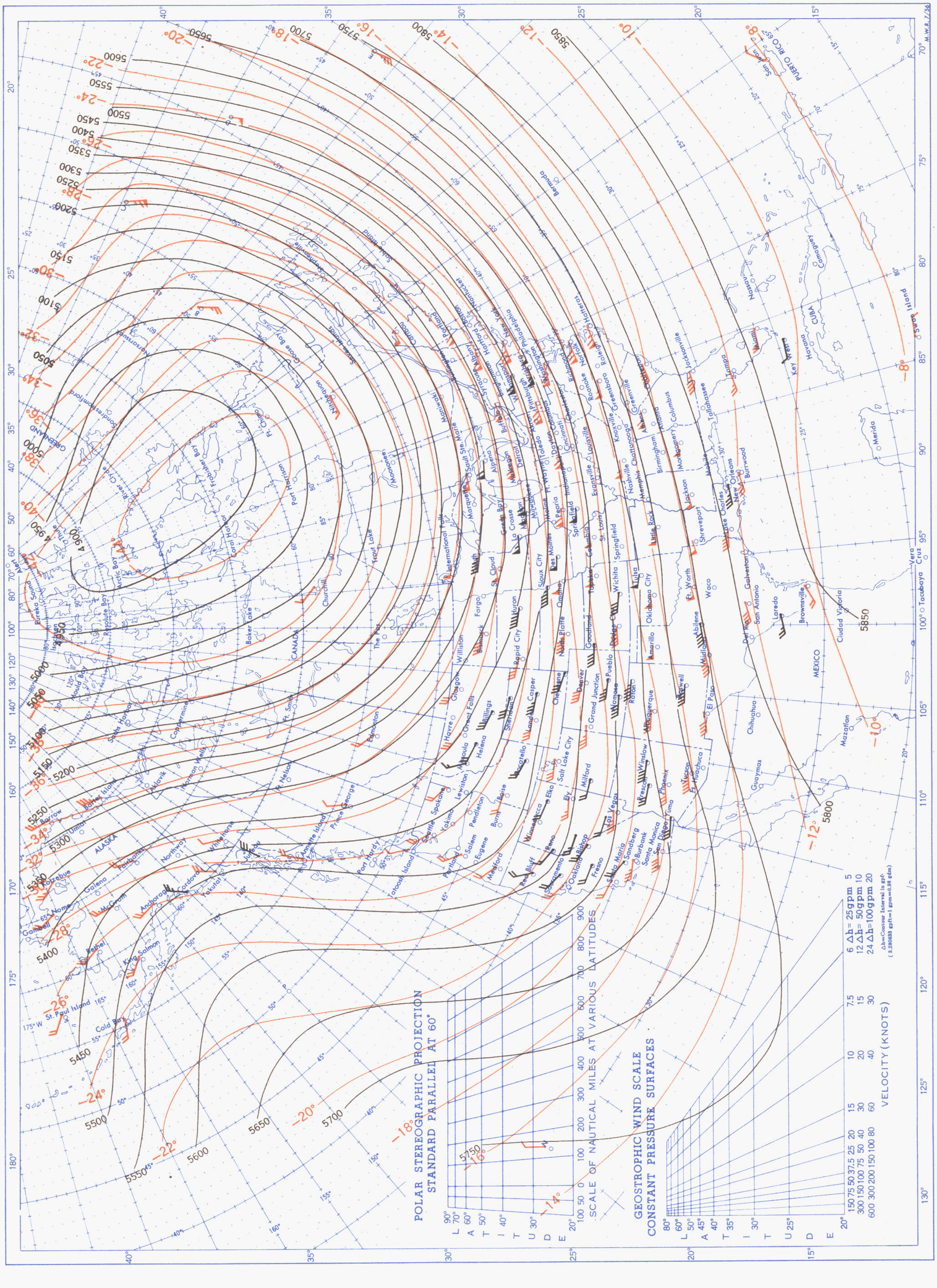
Height in geopotential meters (1 g.p.m. = 0.98 dynamic meters). Temperature in °C. Wind speed in knots; flag represents 50 knots, full feather 10 knots, and half feather 5 knots. Winds shown in red are based on rawins taken at the indicated pressure surface and time. Those in black are based on pibals taken at 2100 GMT and are for the nearest standard height level.

Chart XIII. 700-mb. Surface, 0300 GMT, January 1957. Average Height and Temperature, and Resultant Winds.



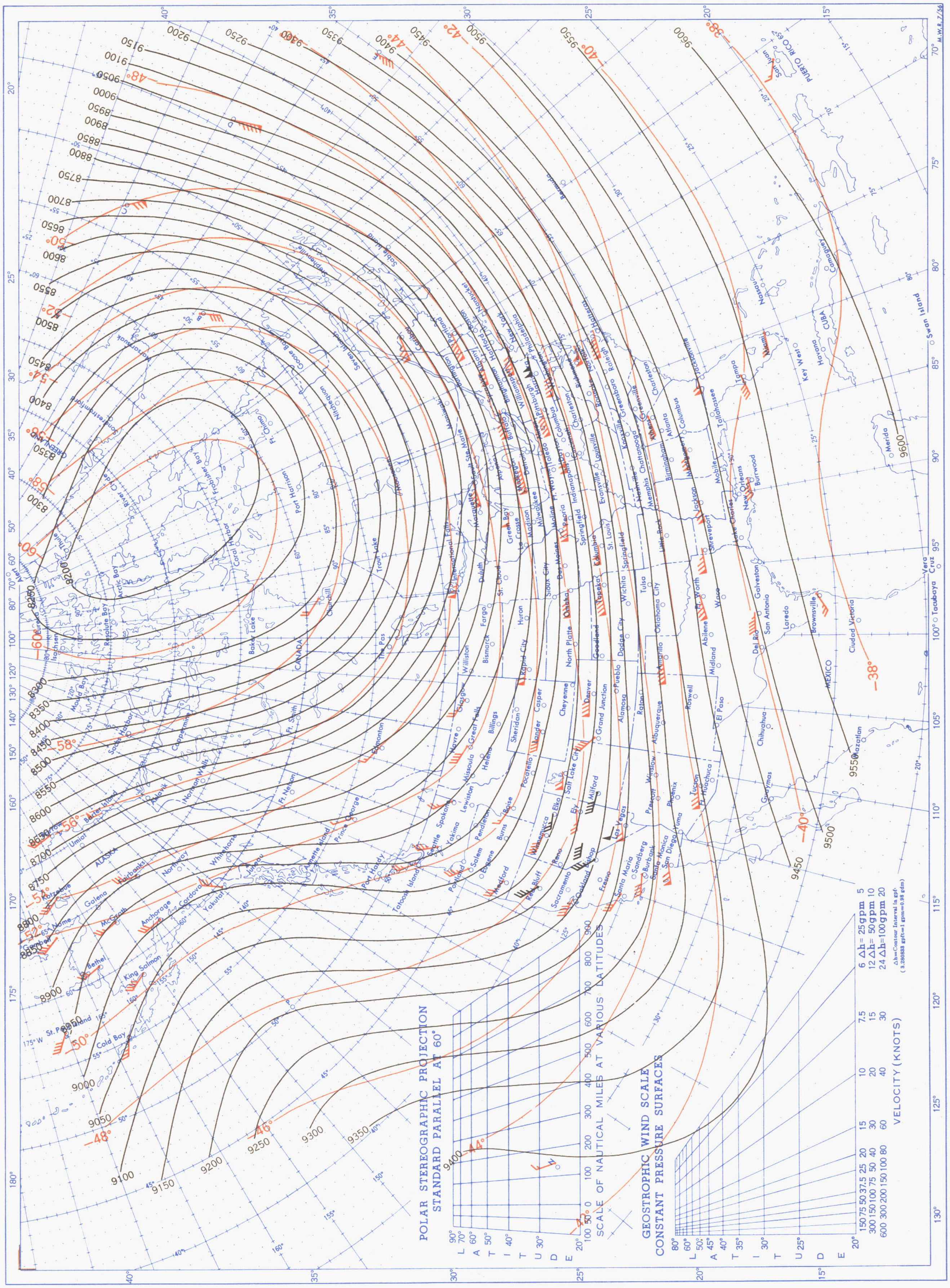
See Chart XII for explanation of map.

Chart XIV. 500-mb. Surface, 0300 GMT, January 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map.

Chart XV. 300-mb. Surface, 0300 GMT, January 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map.

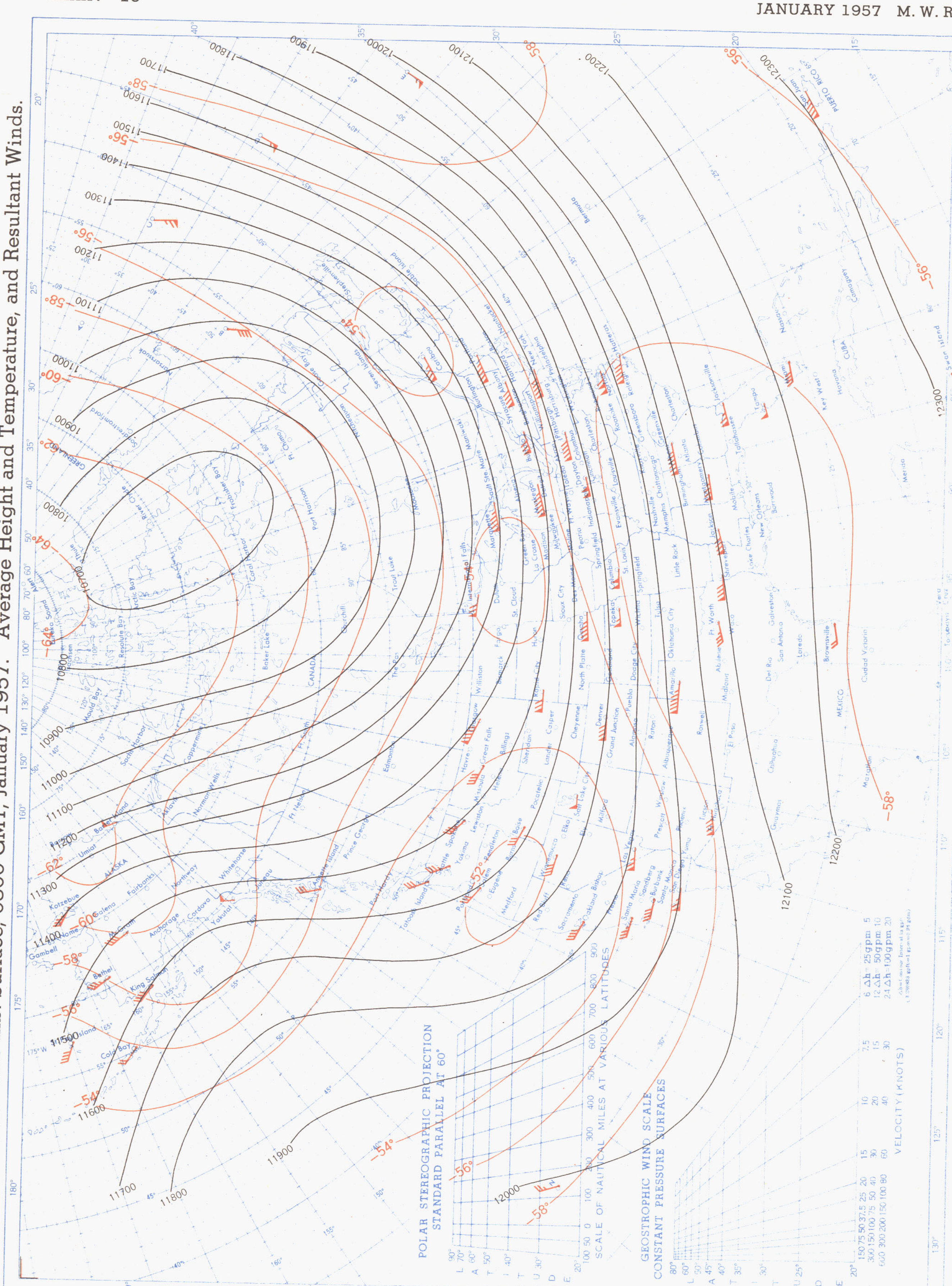
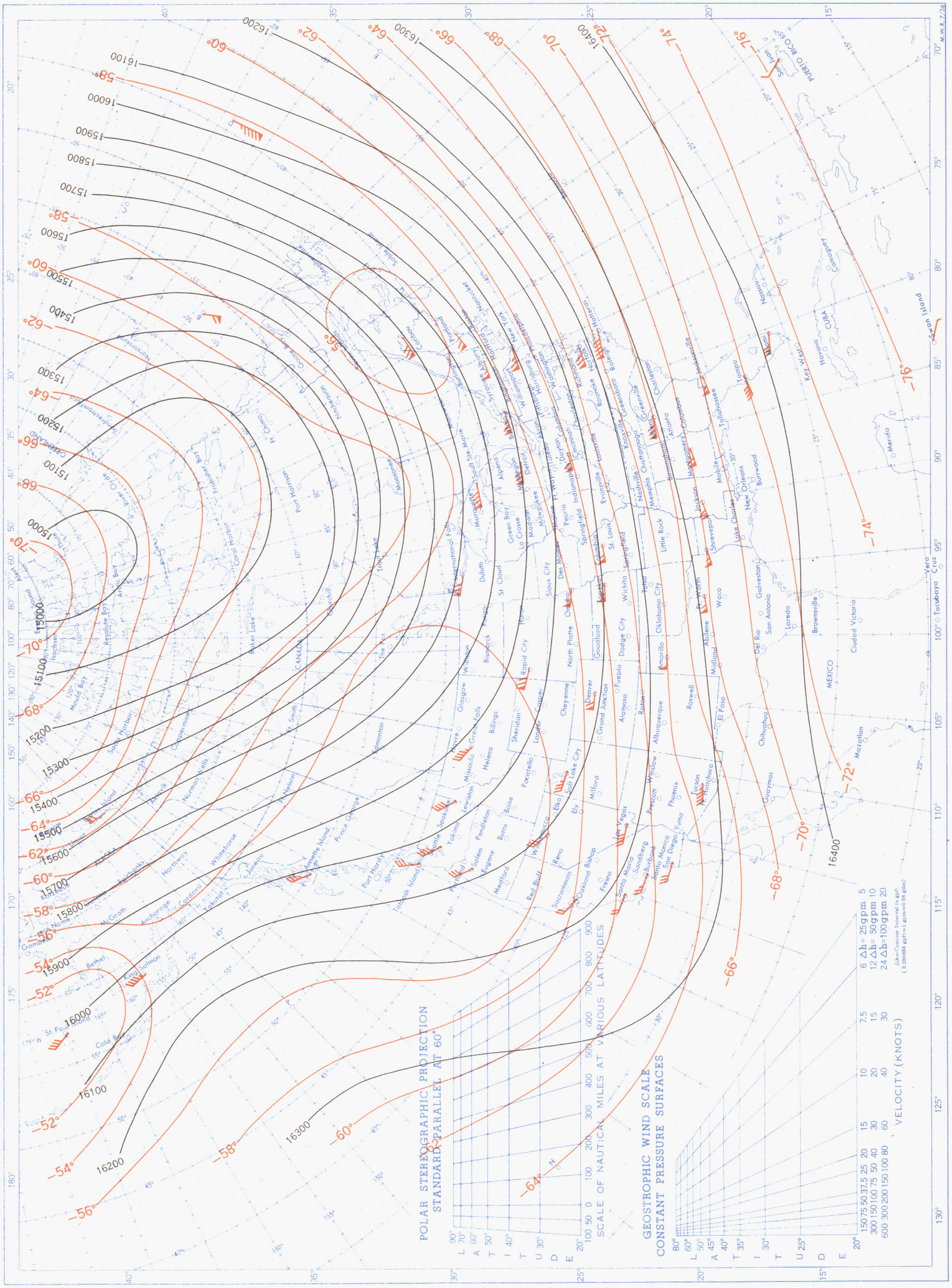


Chart XVI. 200-mb. Surface, 0300 GMT, January 1957. Average Height and Temperature, and Resultant Winds.

See Chart XII for explanation of map. All winds are from rawin reports.

Chart XVII. 100-mb. Surface, 0300 GMT, January 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map. All winds are from rawin reports.