NOAA Technical Memorandum NWS WR-96

MAP TYPE PRECIPITATION PROBABILITIES FOR THE WESTERN REGION

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NATIONAL WEATHER SERVICE

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ABSTRACT

A method of obtaining probabilities of precipitation (PoPs) using 500-mb flow typing similar to that done by Augulis is presented. The typing method differs in that it results in fewer but more distinct flow types. An independent test is presented which shows that for flow significantly different than climatological the PoP forecasts represent a substantial improvement over climatology. PoPs for the Western Region and flow type maps are presented for the four seasons.

I. INTRODUCTION

This Technical Memorandum presents 500-mb map types for each of four seasons for 182-point grid including the western portion of North America plus a small portion of the eastern Pacific. A precipitation climatology is also presented for each map type in the form of frequency of occurrence of precipitation for the 12-hour period following map time. Suggestions for use of the maps are included as Appendix A. These suggestions are based on limited evidence and forecasters may want to add to and/or delete from this list as experience is gained. The types and precipitation climatologies for each season are included as Appendices B - E. Appendix F presents a listing of the dates which correlate highest with each of the map types.

The precipitation frequencies or probabilities of precipitation (PoPs), in conjunction with 500-mb prognoses, may be useful as supplements to the Primitive Equation and Trajectory Model Output Statistics (PEATMOS) PoPs currently being generated at NMC and transmitted nationwide over teletype and facsimile networks [1]. Verification statistics show that PEATMOS PoPs are substantially less skillful in Western Region than in the nation as a whole [2], [3], [4]. It is hoped that the results of this Technical Memorandum will help Western Region forecasters improve their local PoP forecasts.

II. BACKGROUND

In 1969, 500-mb map types were derived by Augulis [5], [6], [7], [8] for four seasons resulting in 25 winter types, 30 spring types, 29 summer types, and 25 fall types. The types were derived from 52 data grid points covering the western United States and eastern Pacific for a period of record November 1961 - October 1968. For each type, 12-hour precipitation climatologies were generated for a large network of Western Region stations. The occurrence or nonoccurrence of measurable precipitation for the 12-hour period subsequent to map time was tabulated and a summary of percent occurrence or PoP for each 500-mb map type was portrayed in map form. Five-hundred mb height data and prognostic output from the NMC operational primitive equation (PE) forecast model are currently correlated with each map type for the appropriate season every 12 hours. The numbers of the three map types which correlate best with

the 500-mb analysis and prognostic fields are transmitted to Western Region forecasters on teletype to provide a first approximation of 12-hour PoP.

The 500-mb map types derived by Augulis are patterned after work done by Lund [9] but differed from Lund's work in one subtle, but important, detail. The purpose of this study was threefold: (1) to reclassify 500-mb maps exactly according to the Lund technique using a larger grid area; (2) to derive a 12-hour precipitation climatology for each new map type just as Augulis did for his map types; (3) to verify a limited number of precipitation forecasts for several stations, using an independent sample of 500-mb and precipitation data. The implications of using a slightly different typing technique and different grid area are discussed in Section III. The 500-mb types were derived from the same seven-year data sample used by Augulis.

The map types as presented in this report were derived by John Cornett of Air Resources Laboratory in Las Vegas, Nevada, using computer programs borrowed from Scientific Services Division, Western Region Headquarters.

III. GENERATION OF MAP TYPES

The method of typing used was the same as that used by Lund for typing sea-level pressure patterns and goes as follows:

Step 1. Correlate the 500-mb heights on each map of the total sample with the corresponding heights on all of the other maps in the sample. The grid used was a 182-point portion of the NMC PE grid shown in Figure 1. The maps were correlated using the formula for the simple linear correlation coefficient for 182 pairs of values:

$$r_{xy} = \frac{\sum_{i=1}^{182} \left[(x_i - \bar{x})\,(y_i - \bar{y}) \right]}{\left[\sum_{i=1}^{182} (x_i - \bar{x})^2 \sum_{i=1}^{182} (y_i - \bar{y})^2 \right]^{1/2}}$$

Step 2. Select the map which has the most correlation coefficients of 0.8 or higher and designate it as Type 1.

Step 3. Remove all of the Type 1 cases (maps correlated at $\geq$0.8 with Type 1 map) from the sample. From the remaining maps, after recounting the number of correlation coefficients greater than or equal to 0.8,

select the one with the most correlation coefficients of 0.8 or higher and designate it Type 2.

Step 4. Remove all of the Type 1 and Type 2 cases and select Type 3 as explained above.

Step 5. Repeat the above process until either no cases with correlations of 0.8 or higher remain or a maximum of 10 types have been selected.

Augulis selected his map Type 1 exactly as stated above, but he selected the remaining types in a slightly different way. After removing all Type 1 maps from the data sample, the number of high correlations ($\geq$0.8) for each map in the remaining sample were not recounted using only those maps left in the sample. In other words, if a map not removed from the original sample had 200 high correlations initially, it still was counted as having 200 high correlations when selecting Type 2, even though some of the 200 maps correlating highly with this map had been removed from the sample. The same method was used in selecting Type 3, 4, etc.

In this procedure the high correlations were recounted before selecting map Type 2 and then recounted again before selecting each subsequent map type. A map having 200 high correlations initially may have only 100 high correlations when the Type 2 selection is made.

Although the typing procedure used varies only slightly from the Augulis method, the typing results are considerably different. Fewer but more distinct types are produced. The Augulis method produced 25 - 30 types for each season, whereas this method produced 8 - 10 types per season. This low number of types is not merely the result of the arbitrary cutoff value of 10 types since only 33 cases were left from the initial sample of 4897 cases after completion of the typing process. In other words, the uncorrelated cases constitute less than one percent of the total sample. The low number of types also is not believed to be merely the result of using a different grid. Several of the Augulis map types are fairly similar, i.e., they are fairly highly correlated with one another (although they are correlated with one another by less than 0.8). On the other hand, the typing method used in this study insures that no map type will be highly correlated with any of the other types.

After the typing is completed, each map is assigned to a particular type for the purpose of compiling the precipitation climatology. Each map is assigned to the type with which it correlates the highest. A listing of all the dates falling within each type is included as Appendix F. Forecasters might like to use this listing of dates as a source for subjectively selecting analogs.

The 182-point grid used differs from the 52 point Augulis grid in three respects. First of all it covers about twice as much area. Secondly every NMC PE grid point within the area of Figure 1 was used in the typing procedure, whereas, Augulis used only half the grid points in his chosen area. Finally the 182-point grid is more nearly centered on the Western Region.

Since the 182-point grid covers a larger area, the procedure described above will do a better job of typing large-scale features at 500-mbs but may not do very well on small-scale features. Therefore, the forecaster may often want to modify the PoPs to take into account locations of short-wave troughs and ridges.

The Lund typing method classifies a larger percentage (roughly 50%) of the data sample as Type 1. Consequently, some of the higher numbered types have very small data samples, and precipitation climatologies derived from such small samples may not be statistically stable. Also these small samples make it difficult to further stratify the sample based on other predictors such as vertical velocity, relative humidity, and vorticity advection. The Augulis method also has a tendency to type a large percentage of the data sample as Type 1 but not to the same extent. For example in winter the Lund method classifies 662 of 1319 cases as Type 1, while the Augulis method types 356 of 1195 cases as Type 1 using basically the same data sample. Statistics for other seasons are similar. This slight difference in results is believed to be due mainly to the difference in typing technique and not to the difference in grids.

IV. GENERATION OF POPs

The map-type probabilities were generated in the following manner. First a magnetic tape with precipitation records for the seven years of the map typing dependent sample was generated. This tape contains the precipitation records of 111 Western Region stations (see Figure 6) for the years 1961 to 1968.

The computer was used to check each map-type date for measurable precipitation at each station. The result is a tabulation (for each season) containing: (1) the number of forecast periods in each map type for which precipitation records were available (N); (2) the number of these periods during which measurable precipitation occurred (P); and (3) the frequency of precipitation (f) at each station for each map type. The PoP is obtained by multiplying the frequency by 100:

$$f = P/N$$

$$PoP = 100 \times (P/N).$$

The resulting PoPs are those published in appendices B - E.

Some of the map types had a small number of occurrences in the dependent sample. For example, winter map Type 8 was a severe and unusual storm which was centered over Arizona in mid-December of 1967. This storm, comprising four periods, represents the only cases selected for this type in the winter sample. Thus, the PoP at all stations over the region is either 0, 25, 50, 75, or 100 depending on how many of the four periods each particular station received precipitation.

The number of forecast periods in the dependent sample for each map type is given in Figure 2. Clearly PoPs derived based on smaller samples are statistically less stable, and caution must be taken not to infer too much from very small samples. The number distribution of types is further discussed in Section V.

V. TEST OF POPs

An independent sample of 500-mb height fields and precipitation data for the winters of 1968 - 69 and 1969 - 70 was used to evaluate the usefulness of the type precipitation climatologies in PoP forecasting. The precipitation data were not for all 111 stations but encompassed 42 of the more important stations. The test is not intended to be a complete evaluation of the type climatologies as a forecast system. Rather the test results are intended to serve as guidance on the strengths, weaknesses, and general applicability of the system.

The method of verification is exactly the same as that described by MacDonald [10]. For completeness a brief description is given here.

A. Method of Verification

The half Brier score was used to compare PoP forecasts obtained from winter types to climatological PoPs. For each of the 42 stations, a percentage improvement of type Brier scores over climatology was computed. In addition to total scores, the results were stratified by:

(1) Map Type - This was done since there was a large variation in the sample sizes of the various map types.

(2) Correlation Coefficients - To determine if maps with high correlations to the type maps result in better forecasts.

(3) Precipitation Probabilities - For each of the 13 possible forecasts of probability of precipitation (e.g., the allowed categories are 0%, 2%, 5%, 10%, 20%, etc.), the system was scored for the aggregate of forecasts of that probability. In addition to the Brier scoring described above, the frequency of precipitation for each probability was tabulated.

Before presenting the results, a brief discussion of the distribution of the total sample by map types is given. Figure 2 shows the number of maps classified as belonging to each of the ten map types for both the independent and dependent samples. Notice that more than 1/3 of both the independent and dependent samples fall into map type 1. Examination of map Type 1 (Appendix B, page 19) reveals that it is very similar to the climatological average map. The fact that the computed PoPs for map Type 1 are close to climatology reinforces this impression. The importance of this fact is made clear in the results below.

B. Results

Table I is a summary of the total verification results stratified by station. The column labeled Brier is the half Brier score for the map type PoPs; the CLIM column is the Brier score of climatology. The third column, IMP(PC), gives the percentage improvement over climatology, and the fourth column (NUM) tells how many forecasts were involved in the independent verification. The bottom row is the average result, and it can be seen that the typing system improves over climatology by 4.6% with 14,532 "forecasts" scored.

(1) Map-Type Stratification.

Figure 3 shows the percentage improvement over climatology as a function of map type. Most of the results discussed will pertain only to the so-called "pure" forecast system, the open bars in each figure. A short explanation of the "engineered" system (the solid bars) is given in part (6) of this section.

Note that in Figure 3 map Types 5, 8, and 10 were not included since they were based on very small dependent samples. In fact, as can be noted in Figure 2, map Types 5 and 8 were not even selected in the independent sample.

Referring to the open bars in Figure 3, it is very evident that for the map types other than the "climatological" map Type 1 (and map Type 2 which will be discussed below), the type PoPs are better than climatology by a very substantial margin. This is reasonable because one would not expect the "climatology" map Type 1 to better than climatology since it is essentially the same thing based on a much smaller dependent smaple. Therefore, the real strength of the forecast system is clear: when the highest correlating map type is other than map Type 1, the PoPs given are substantially better than climatology. The forecast test confirmed what one would have expected a priori, that the precipitation patterns associated with anomalous long-wave patterns (i.e., any long-wave pattern which differs significantly from climatology) are forecast well by the map typing system. Thus, it is reasonable to infer that even though this test was just for the winter season, we may extend this major result to all seasons.

(2) Importance of Map-Type Results.

A central problem of forecasting, one which occurs many times every season, is the following: The long-wave pattern, which has been essentially climatological, is shown by the numerical prognoses (24-, 48-, and 72-hour progs) to be undergoing a major shift to a different pattern. If the pattern shift is correct in the forecaster's subjective assessment, he must try to infer what weather will be associated with the new configuration.

This is where the map-typing system is of greatest utility. It gives the forecaster a precise idea of the precipitation patterns to be expected with the new long-wave pattern. It fills what has previously been a weak link in the forecasting of major circulation changes--what weather will be associated with the new pattern.

Since correctly forecasting the "big change" is of critical economic importance, it is thought that proper use of the map type PoPs will provide an objective input in an area which has previously been mostly subjective.

(3) Case Study.

For two reasons it is appropriate to discuss map Type 2, which as shown in Figure 3, indicates less skill than climatology. First, it serves as a case study of how the system works, and second it reveals a weakness in the system for which adjustment can be made.

During February 1970 a persistent trough developed off the West Coast farther south than usual, bringing rain to southern California and Arizona. Referring to Figure 5, it can be seen that map Type 2 shows a trough off the northwest coast with a strong onshore flow in northern California and Oregon. The resemblance between the type map and the map for February 10 is obvious with both maps showing a strong ridge in British Columbia, a large trough on the eastern fringe of the grid, and a low off the West Coast. However, it is also clear why the map type PoPs would be badly in error since the West Coast low on the February 10 map is located much farther south than on the Type 2 map. In this case a subjective adjustment of the precipitation pattern from the northern west coast to the southern west coast would result in a better forecast.

It is possible that a different independent sample might have scored map Type 2 well above climatology, with perhaps another map type showing less skill than climatology. With a very large independent sample, the nonclimatological map types (other than map Type 1) would probably, on the average, improve over climatology by 15 to 20%.

(4) Stratification by Correlation.

Figure 4 shows the improvement over climatology stratified by map-type correlation. Examination of the open bars shows that in general the higher the correlation coefficient the more reliable the forecast. This is as it should be, with the only anomaly being the fact that the maps with correlations less than 0.80 did fairly well.

The fact that the higher correlating maps scored better is an additional plus for the system, because it allows a judgment

on the validity of the forecast. For example, the map Type 2s of February 1970 generally correlated at 0.86 or less, a good indicator that the maps should be examined carefully before using the map-type PoPs.

(5) Reliability.

Figure 7 shows a reliability diagram and a graph of improvement over climatology along the same abscissa. The percentages shown in the reliability diagram are the percentage of cases falling in each forecast category. It is seen that the map-type PoPs are fairly reliable except for forecasts of more than 70%. In these cases the forecasts could be improved by forecasting 70% whenever the PoPs are at 70% or above. The poor reliability for forecasts above 70% is due in part to the small number of independent cases falling in the forecast categories above 70%.

The low reliability of the higher PoPs is undoubtedly the reason why the 80% and 90% PoPs did so poorly in comparison to climatology.

(6) Engineered System.

An attempt was made to improve the PoPs by using the two map types with highest correlations. If the two correlations differed by .200 or more, the higher correlation determined the PoP. If the correlations differed by less than .200, the adjusted PoP was the weighted average of the two PoPs, weighted by the correlation coefficients.

The results of this test can be determined by examination of the solid bars in Figures 3 and 4. (In Figure 3, the engineered PoP was assigned to the map type with higher correlation, and in Figure 4 the engineered PoP was assigned to the higher correlation.) Note in Figure 3 that while it improved map Type I PoPs, the improvement for the other types was mixed. The score for the entire system was improved slightly (from 4.6% to 5.1%).

The conclusion which can be drawn from this experiment is that when map Type I is forecast and another map type correlates almost as well, the PoP can be improved by averaging between the two. For other map types, the best PoP is given and should not be averaged with the second-best correlator.

VI. CONCLUSION

This map-typing system was designed as a replacement for the typing system developed by Augulis [5], [6], [7], [8]. It is felt that the new system is an improvement for several reasons.

This is where the map-typing system is of greatest utility. It gives the forecaster a precise idea of the precipitation patterns to be expected with the new long-wave pattern. It fills what has previously been a weak link in the forecasting of major circulation changes--what weather will be associated with the new pattern.

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VI. CONCLUSION

This map-typing system was designed as a replacement for the typing system developed by Augulis [5], [6], [7], [8]. It is felt that the new system is an improvement for several reasons.

First, as explained in Section III, the new map types are fewer in number and very distinct from one another. Almost half of the maps fall into Type I for each season, and for these it is difficult to improve over climatology. However, when a different type correlates most highly, the forecaster can be assured that the flow and precipitation regimes will be substantially different from the climatological mean. In contrast, the Augulis system had a number of map types that were similar to the climatological average.

A second advantage of the new system is the independent test which identifies the strengths and weaknesses of the system. This allows for more intelligent use of the PoPs. For example, it shows that PoPs for map types other than Type I are much better than climatology, and confidence in the PoPs should be higher for higher correlation coefficients.

The third difference between the two systems lies in the typing grid used. The Augulis typing grid is smaller, and includes fewer points (52 vs. 182). Therefore, the current system can be considered a typing of the larger scale features. It is well known that the longer range prognoses (48, 72 hour) are most useful as predictors of the large-scale flow pattern. The new system is consequently more appropriate for use with these longer range prognoses.

VII. ACKNOWLEDGMENTS

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3. Sadowski, A. F. and Cobb, G. F., "National Weather Service May 1971 - April 1972 Public Forecast Verification Summary", NOAA Technical Memorandum NWS FCST 19, July 1973.

4. Sadowski, A. F. and Cobb, G. F., "National Weather Service April 1972 - March 1973 Public Forecast Verification Summary", NOAA Technical Memorandum NWS FCST 21, June 1974.

5. Augulis, R. P., "Precipitation Probabilities in the Western Region Associated with Winter 500-mb Map Types", ESSA Technical Memorandum WBTM WR 45-1, December 1969.

6. Augulis, R. P., "Precipitation Probabilities in the Western Region Associated with Spring 500-mb Map Types", ESSA Technical Memorandum WBTM WR 45-2, January 1970.

7. Augulis, R. P., "Precipitation Probabilities in the Western Region Associated with Summer 500-mb Map Types", ESSA Technical Memorandum WBTM WR 45-3, January 1970.

8. Augulis, R. P., "Precipitation Probabilities in the Western Region Associated with Fall 500-mb Map Types", ESSA Technical Memorandum WBTM WR 45-4, January 1970.

9. Lund, I. A., "Map-Pattern Classification by Statistical Methods", Journal of Applied Meteorology, Vol. 2, No. 1, February 1963.

10. MacDonald, A. E., "An Operational Evaluation of 500-mb Type Stratified Regression Equations", NOAA Technical Memorandum NWS WR 93, June 1974.

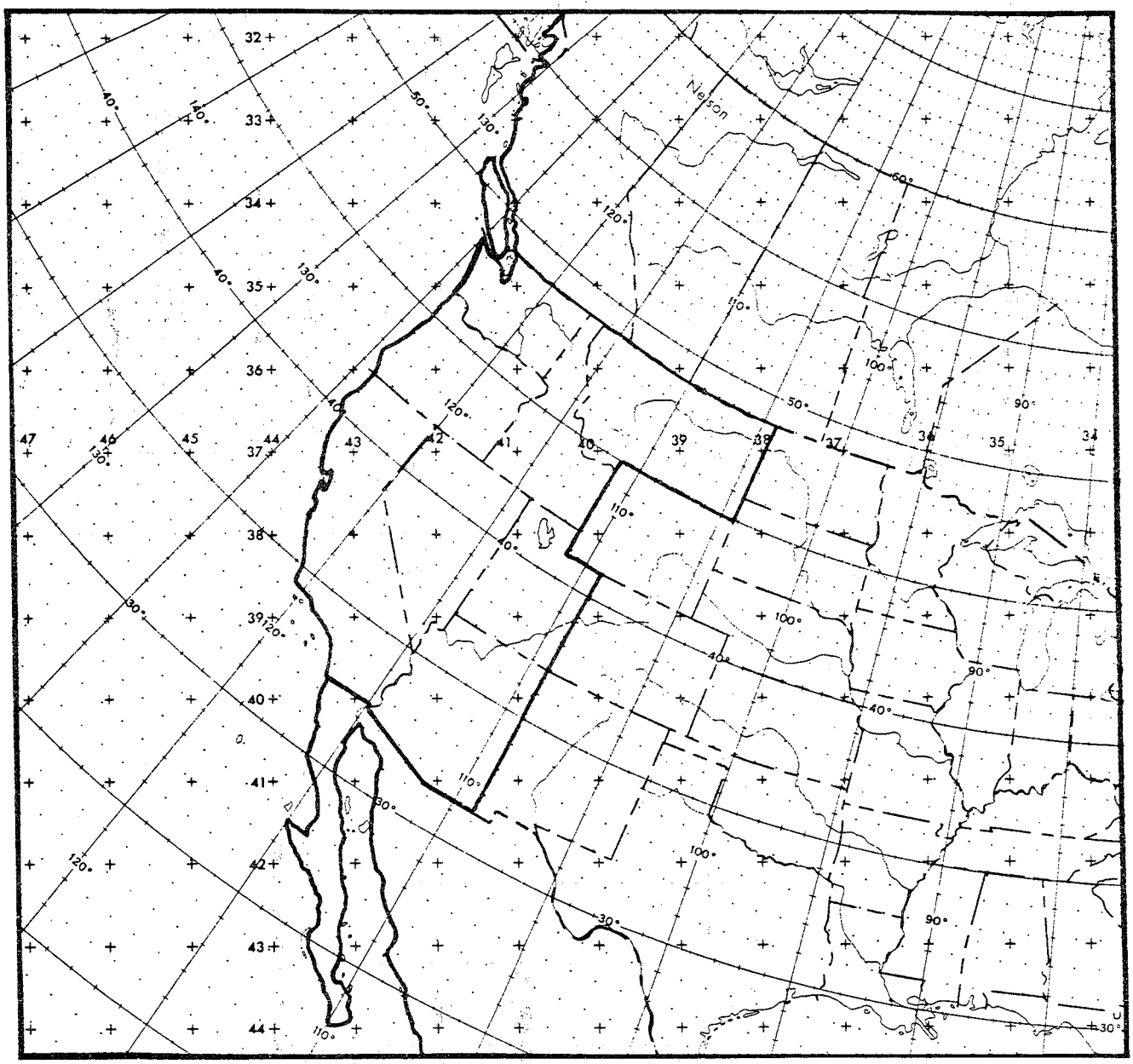


Figure 1. Portion of NMC PE Grid Used in Typing Program.

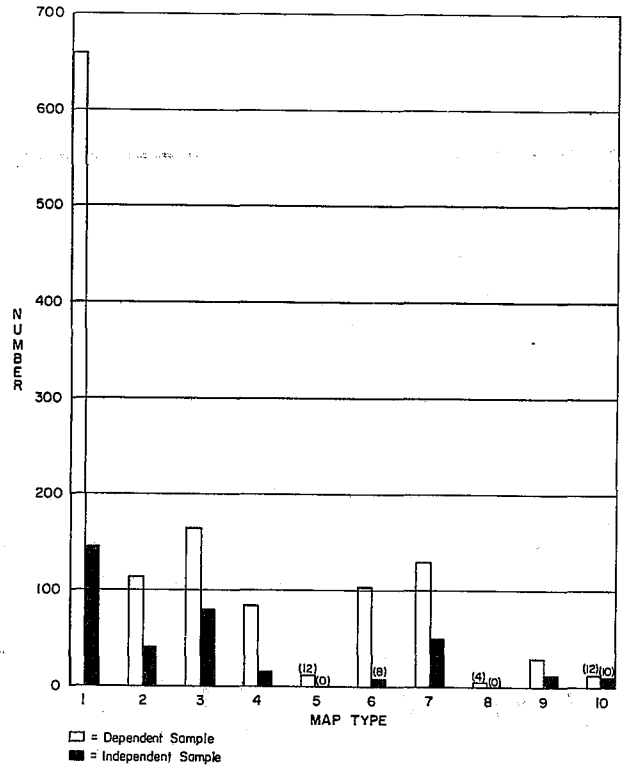


Figure 2. Number of Maps in Each Map Type.

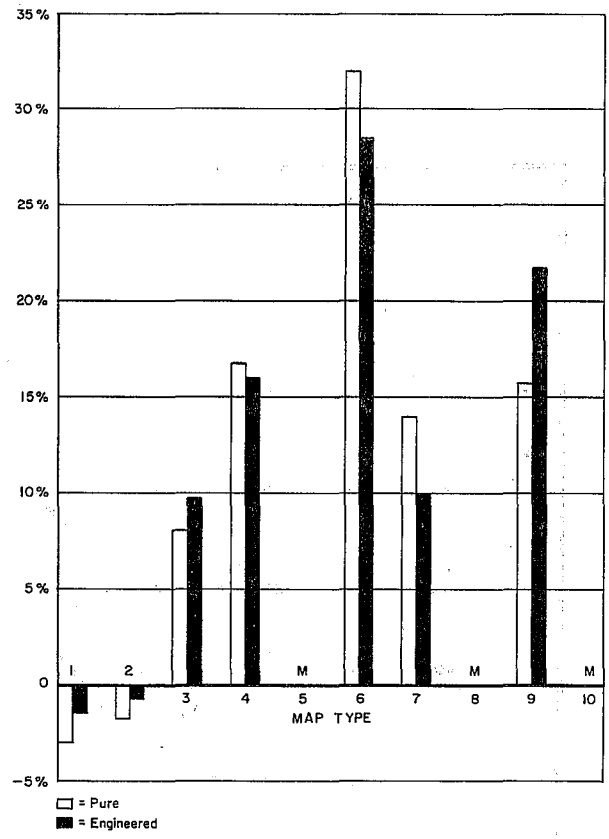


Figure 3. Improvement Over Climatology as a Function of Map Type.

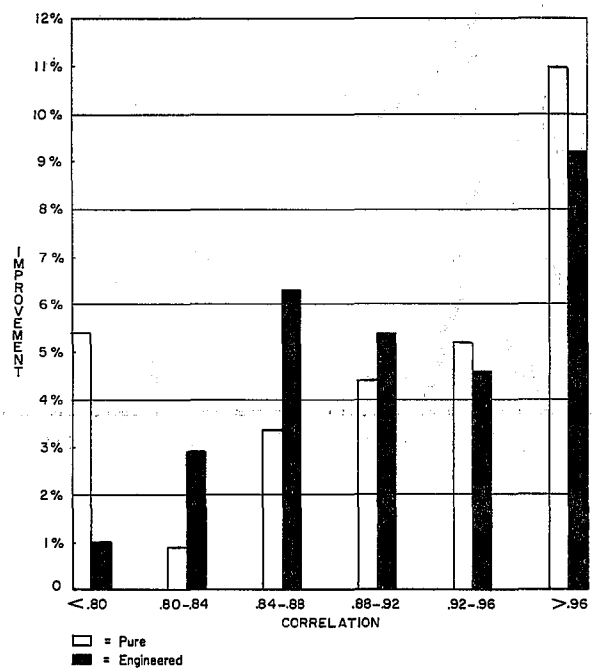


Figure 4. Improvement Over Climatology as a Function of Map Type Correlation.

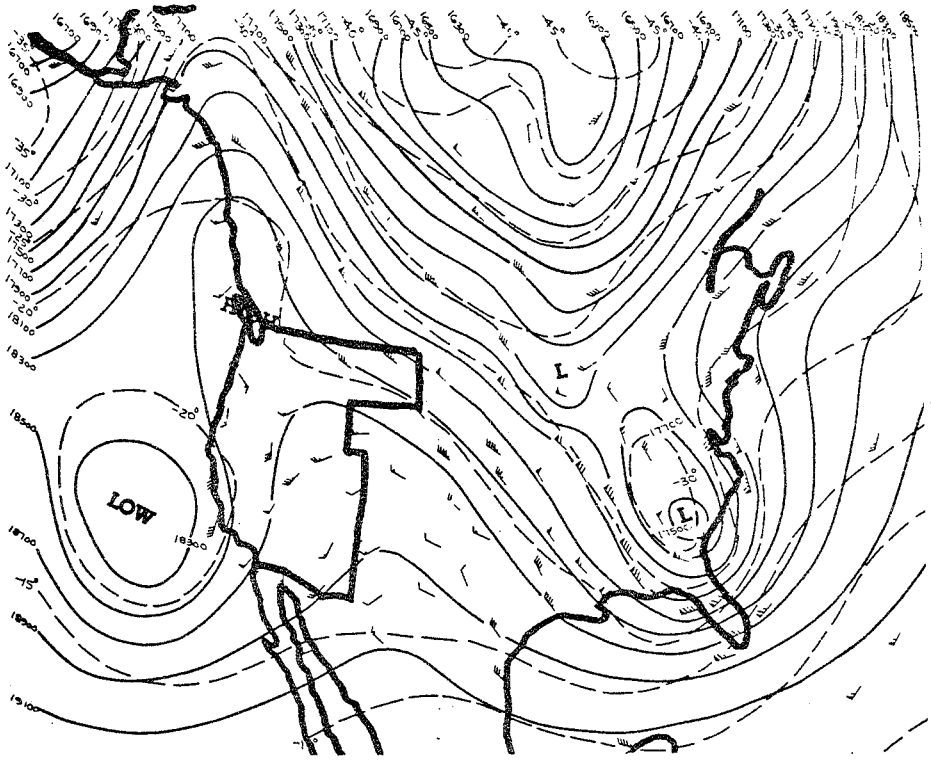


Figure 5a. February 10, 1970, Correlation Coefficient: .856.

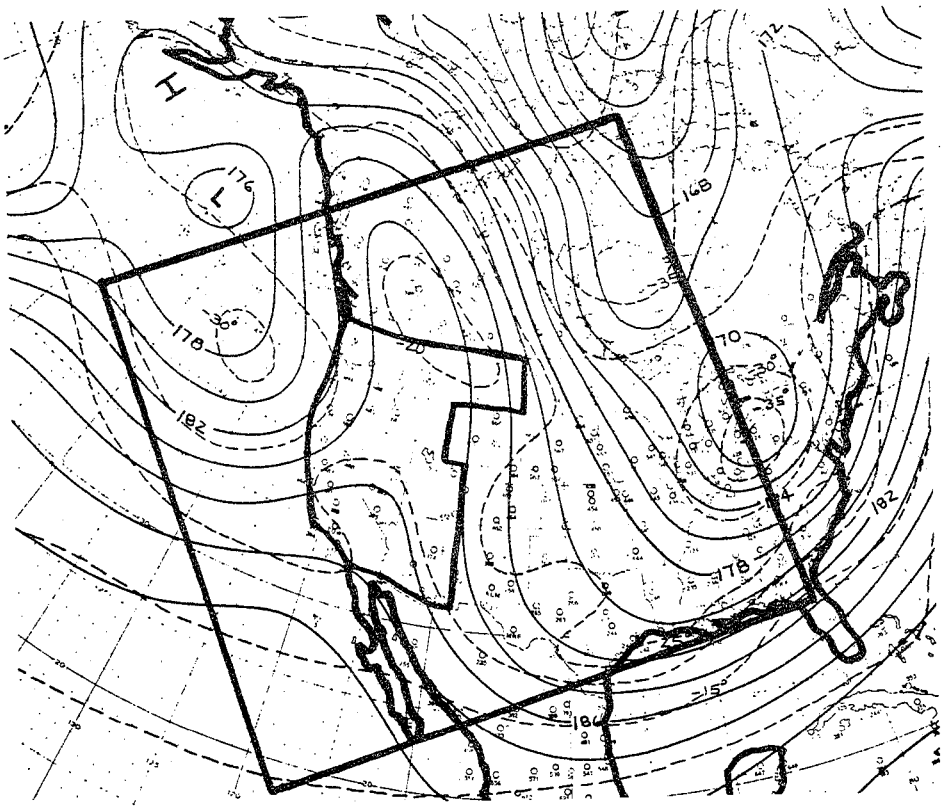


Figure 5b. Map Type 2.

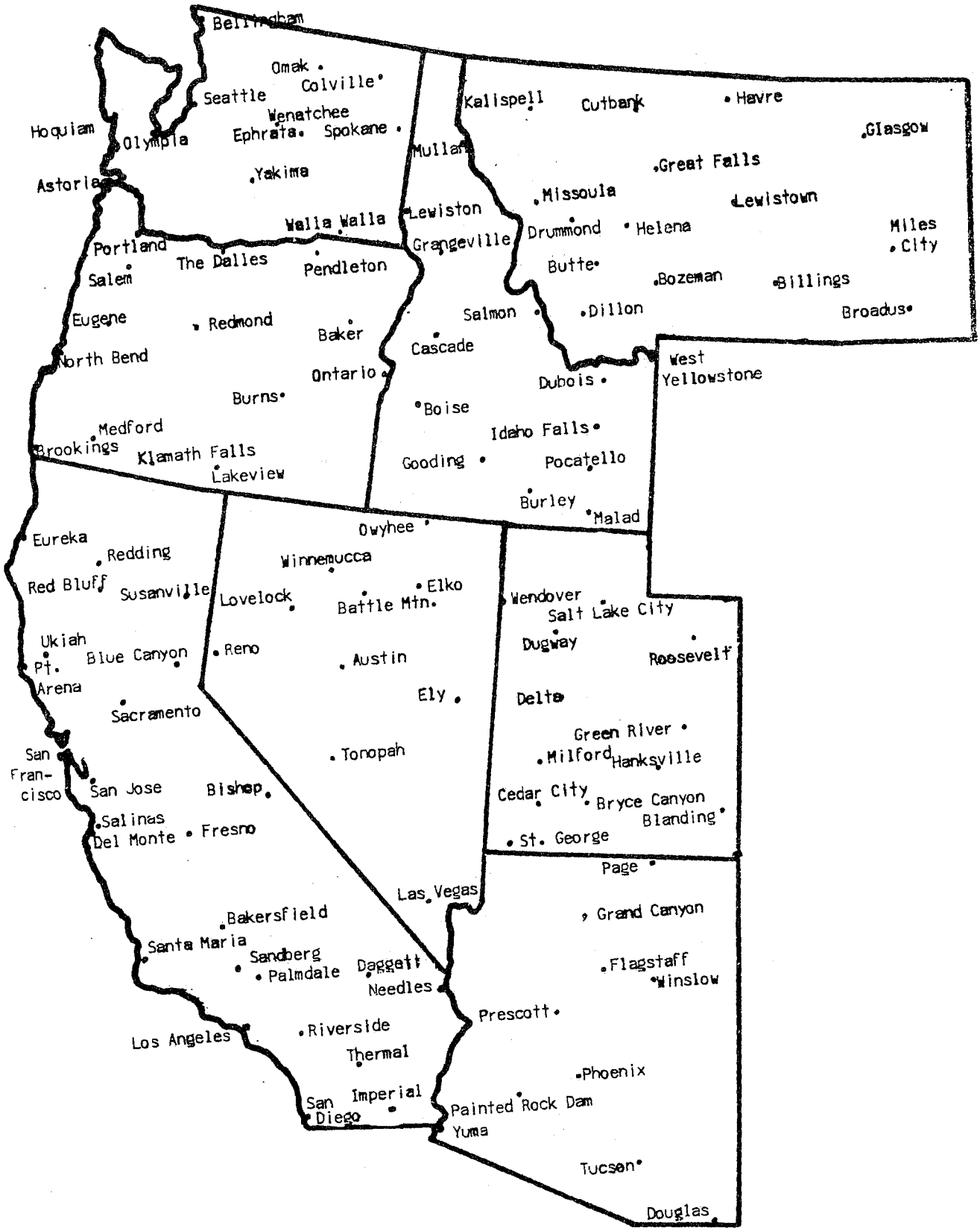


Figure 6. Distribution of Climatological Stations.

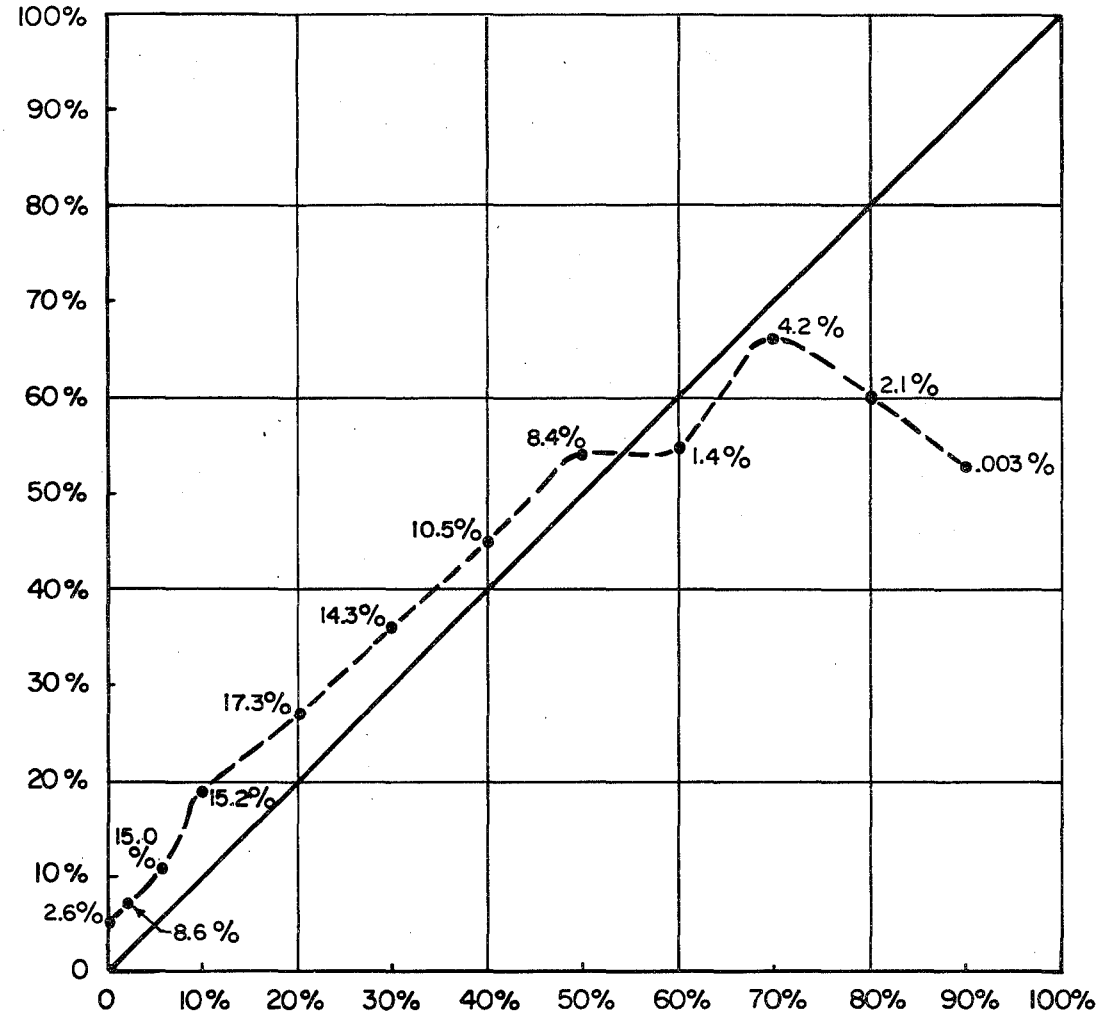


Figure 7a. Reliability Diagram.

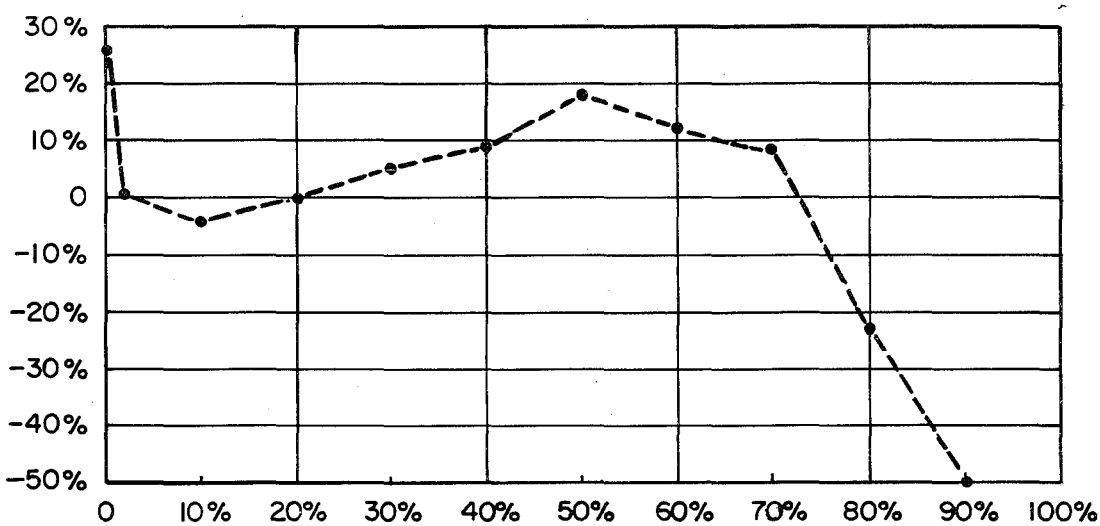


Figure 7b. Improvement Over Climatology as a Function of PoP.

	BRIER	CLIM	IMP(PC)	NUM
ELY	.114	.126	8.9	346
BFL	.142	.155	7.8	346
TUS	.070	.074	6.2	346
LAS	.078	.083	6.0	346
PHX	.075	.084	10.8	346
YUM	.051	.053	3.1	346
SAC	.232	.254	8.7	346
SMX	.172	.203	15.5	346
BIL	.151	.151	.1	346
SLC	.172	.174	.7	346
BOI	.232	.233	.5	346
BNO	.226	.242	6.8	346
GTF	.182	.192	5.1	346
MSO	.218	.222	2.0	346
PDT	.232	.241	3.5	346
EKA	.220	.253	12.9	346
MFR	.238	.243	2.1	346
SEA	.232	.248	6.5	346
FAT	.186	.192	3.3	346
LAX	.127	.150	15.1	346
MLF	.130	.145	10.5	346
RNO	.151	.156	3.1	346
SAN	.136	.153	11.3	346
INW	.080	.079	-.6	346
SFO	.232	.258	10.0	346
PIH	.194	.198	1.8	346
GEG	.225	.240	6.5	346
RBL	.246	.253	3.0	346
PDX	.245	.251	2.5	346
OLM	.226	.246	8.3	346
ALW	.270	.262	-3.2	346
AST	.221	.227	2.6	346
SLE	.257	.256	-.6	346
EUG	.250	.252	.9	346
FCA	.221	.219	-1.1	346
HVR	.163	.161	-1.1	346
HLN	.170	.181	6.0	346
GGW	.152	.158	3.9	346
LWS	.217	.221	1.6	346
EKO	.201	.198	-1.2	346
WMC	.186	.176	-5.6	346
FLG	.141	.168	16.4	346
TOT	.182	.191	4.6	14532

Table 1. A Comparison Between the Type PoPs and Climatology. IMP(PC) is percentage improvement over climatology.

APPENDIX A

Suggestions for Use of PoPs.

1. Map Type I - for each season is essentially climatology and therefore will generally not improve upon climatology. PEATMOS PoPs and other predictors should be given strong consideration when Type I is the best correlating map.

2. PoPs for map types other than I can be expected to do much better than climatology.

3. Because of the large grid area used, the typing is basically a typing of large-scale features. Consequently, adjustment of the PoPs often will be necessary to make them consistent with small-scale or short-wave features. PEATMOS PoPs should be helpful in making such adjustments. However, this type of adjustment is discouraged when the PoPs are used with the 72-hour prog due to the PE model's inability to forecast small-scale features with accuracy in the extended time frame.

4. The PoPs are a reliable and objective method for determining precipitation distribution associated with flow regimes which are significantly different from climatology. They should be very helpful when the numerical (24, 48, and 72 hour) progs suggest a change from climatology to an anomalous (other than map Type I) flow pattern in determining what the associated precipitation pattern will be.

5. The correlation coefficient is an index of reliability: maps with correlations less than .875 should be examined carefully for significant differences from the map-type maps.

6. When map Type I correlates most highly, but another map type also has a high correlation the PoPs can be improved by averaging between the two PoPs. Averaging of PoPs should not be used in other cases.

7. High PoPs (80%, 90%, 100%) are less reliable than lower PoPs.

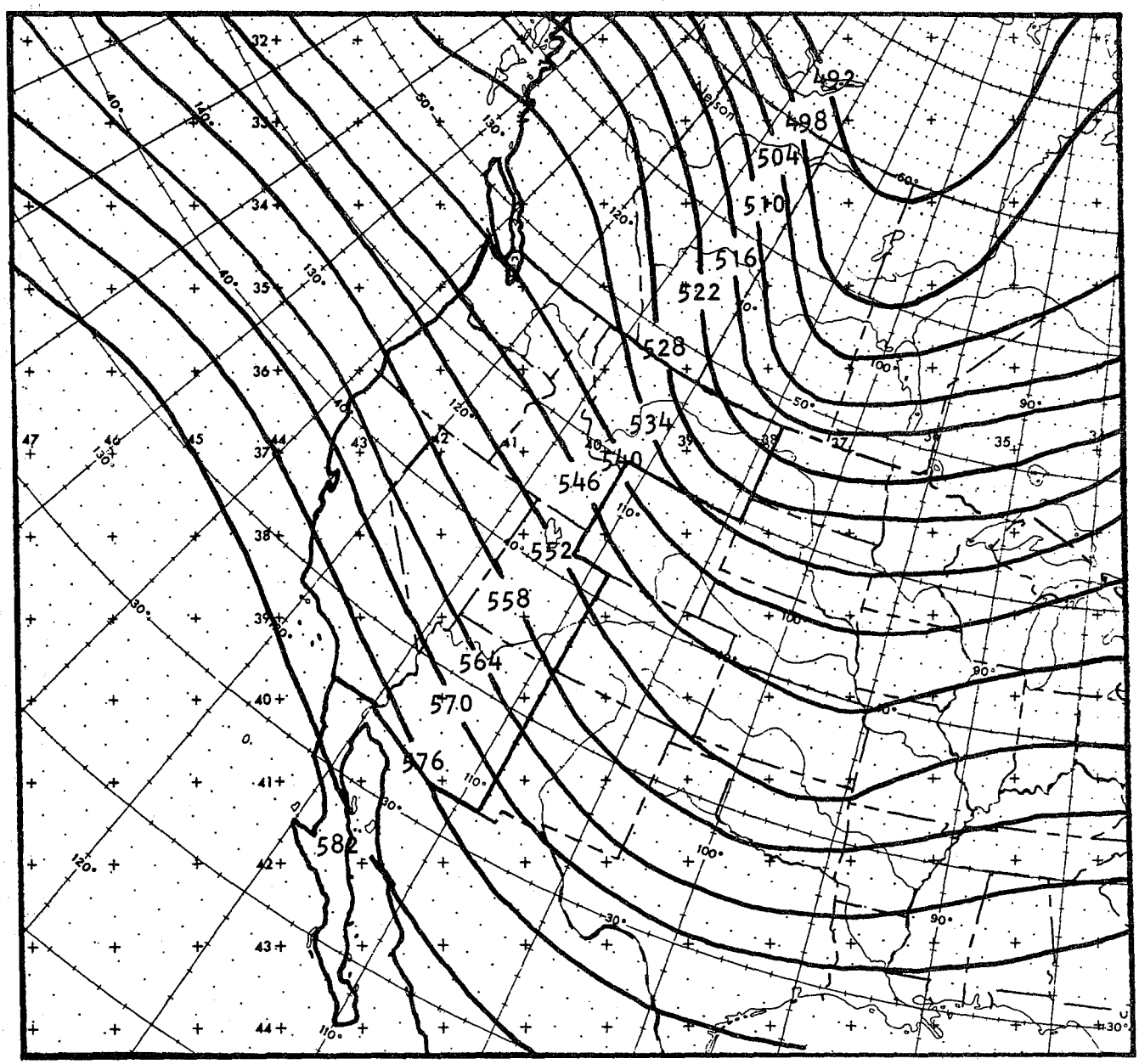
APPENDIX B

WINTER TYPES AND ASSOCIATED PRECIPITATION CLIMATOLOGIES

SAMPLE SIZE: 1319 CASES

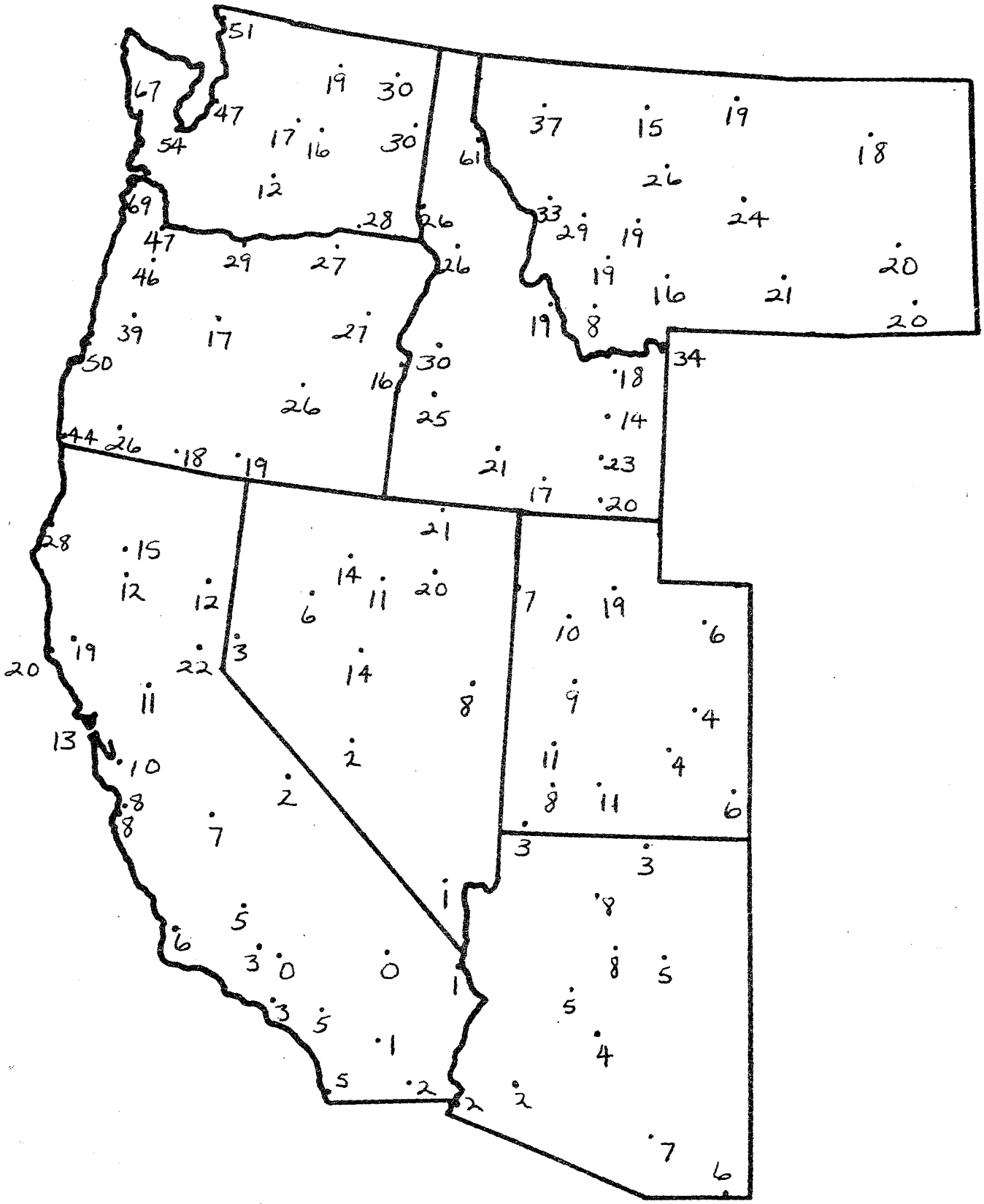
WINTER TYPE I

12Z December 25, 1964
662 Cases



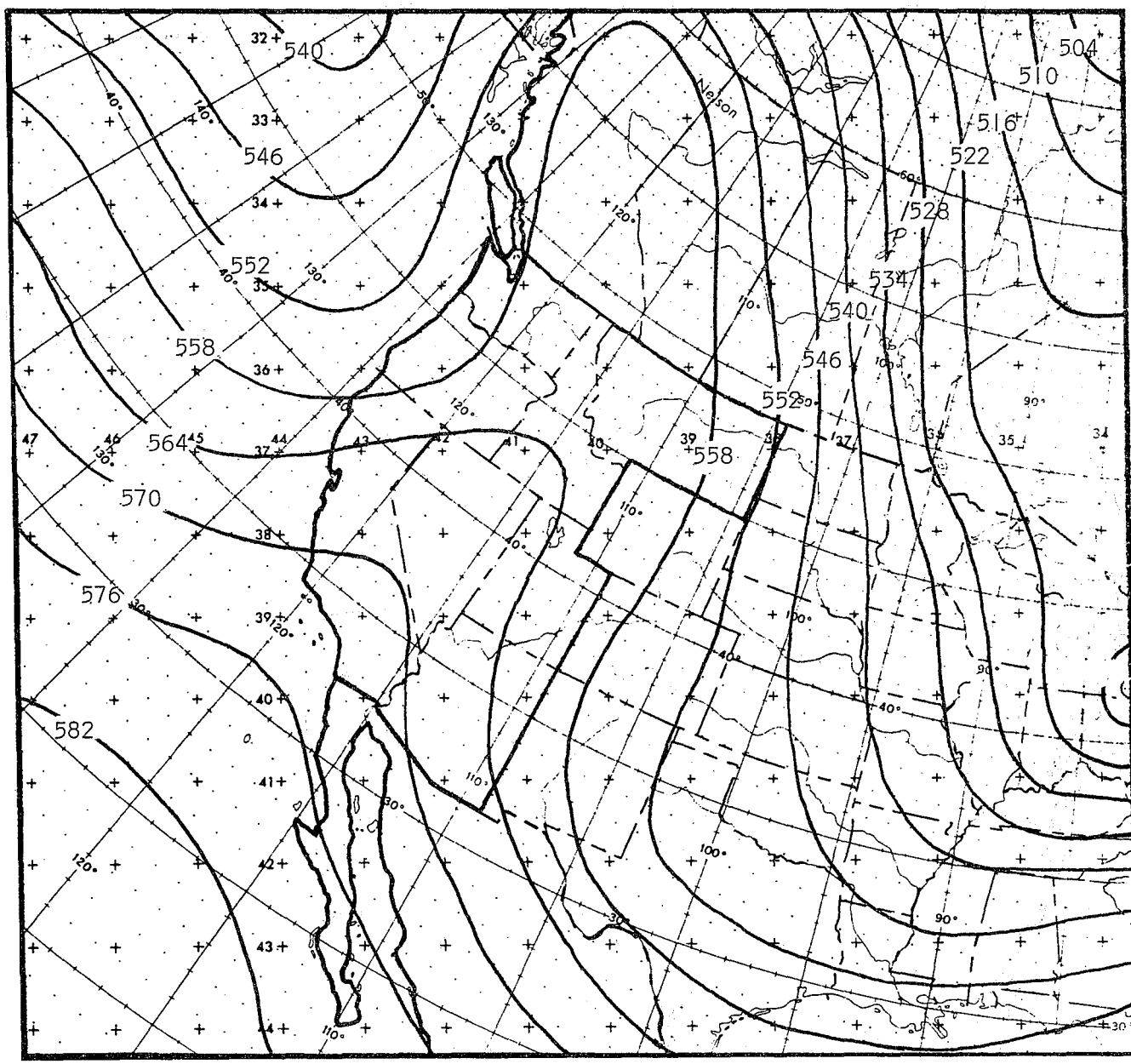
WINTER TYPE I

Percent Frequency of Precipitation Occurrence



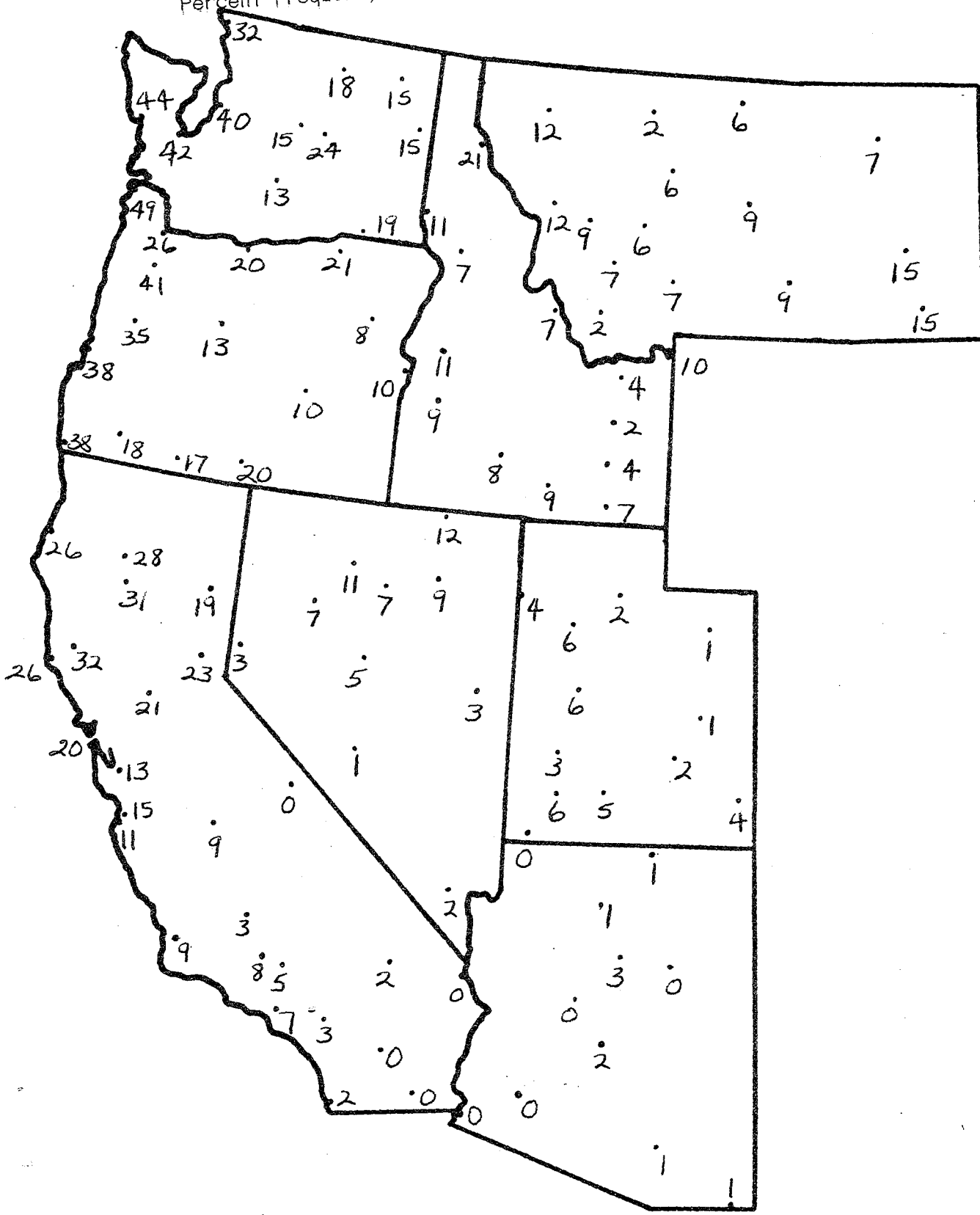
WINTER TYPE 2

12Z February 13, 1963
113 Cases



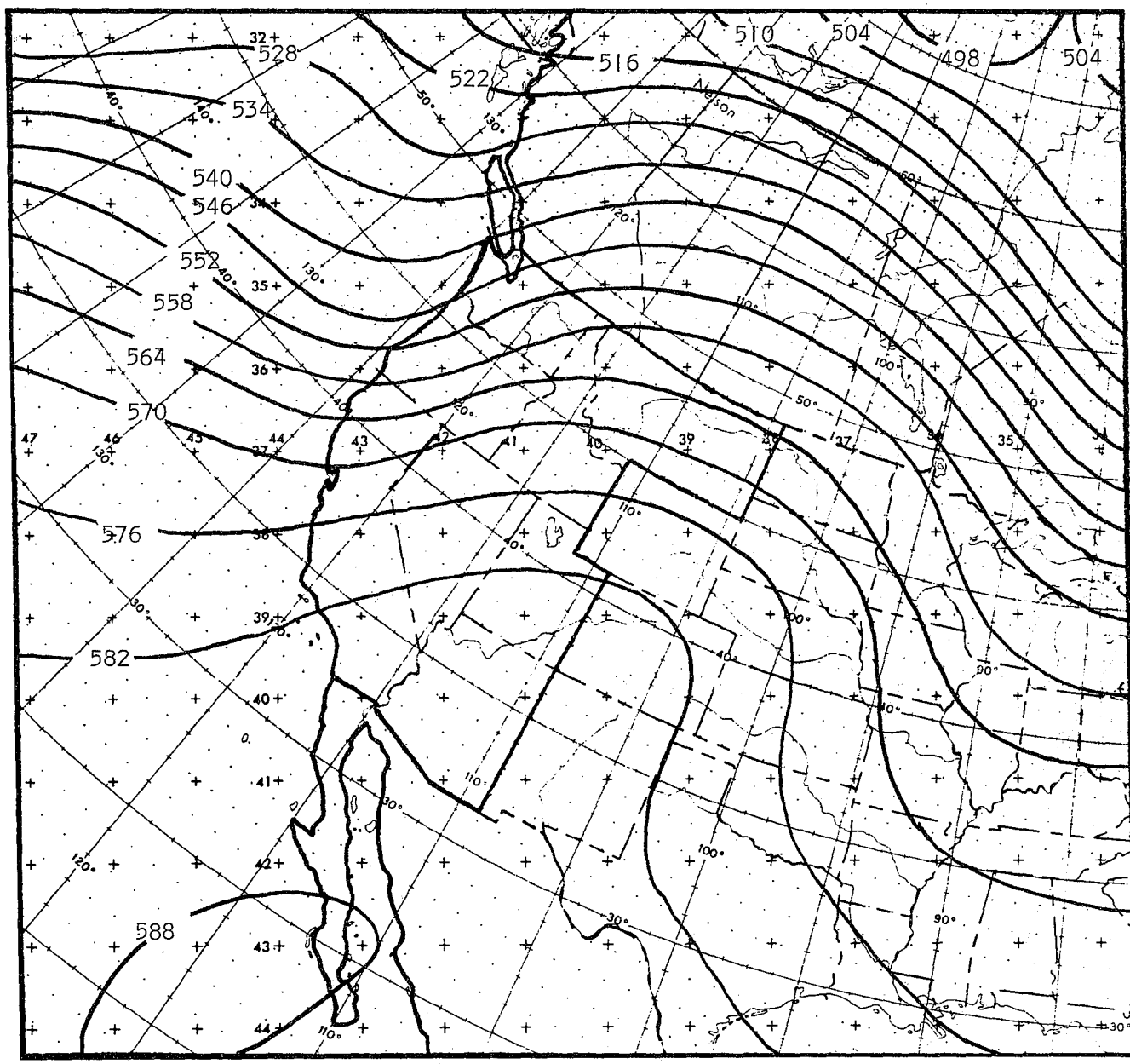
WINTER TYPE 2

Percent Frequency of Precipitation Occurrence

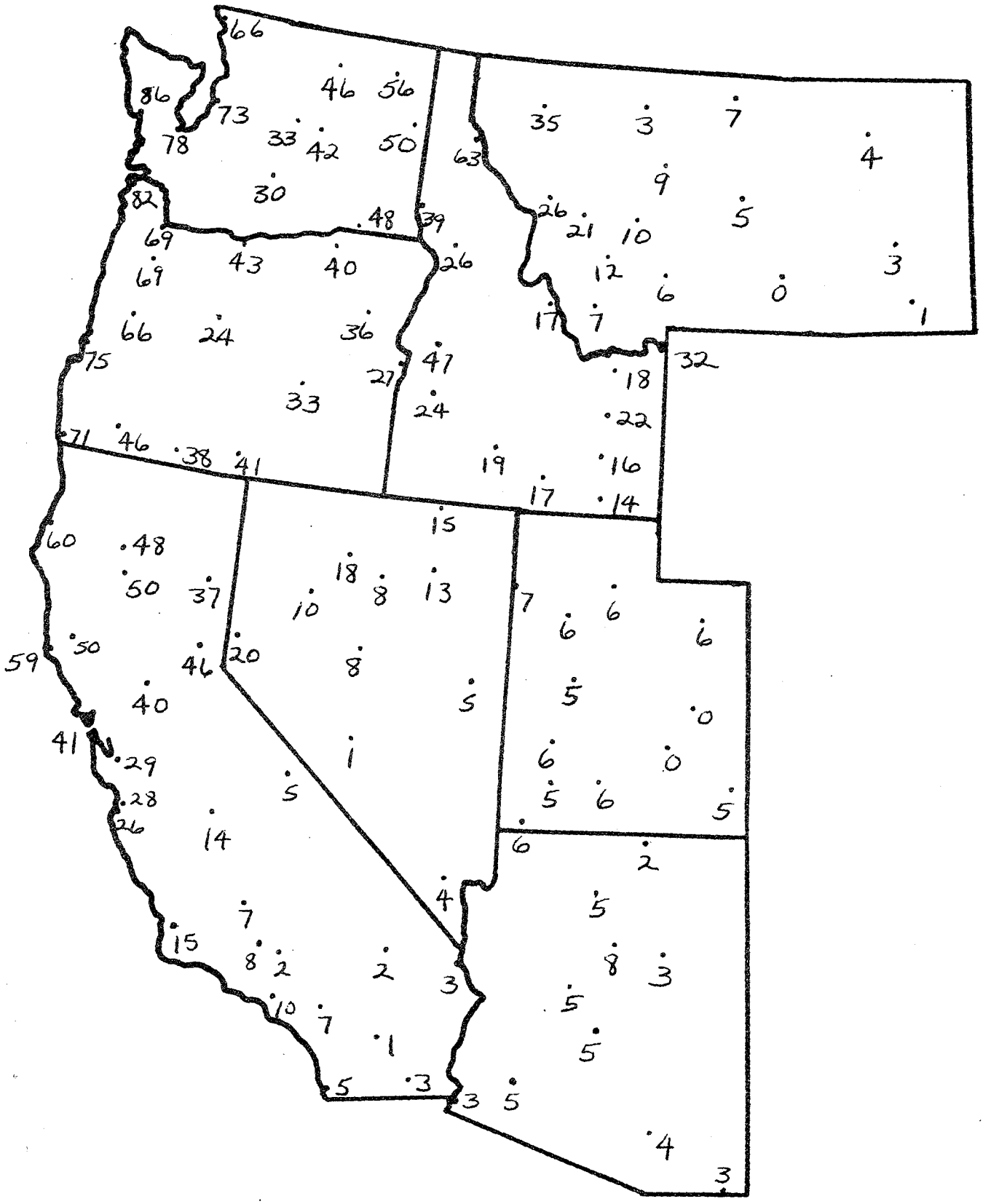


WINTER TYPE 3

00Z February 5, 1963
165 Cases

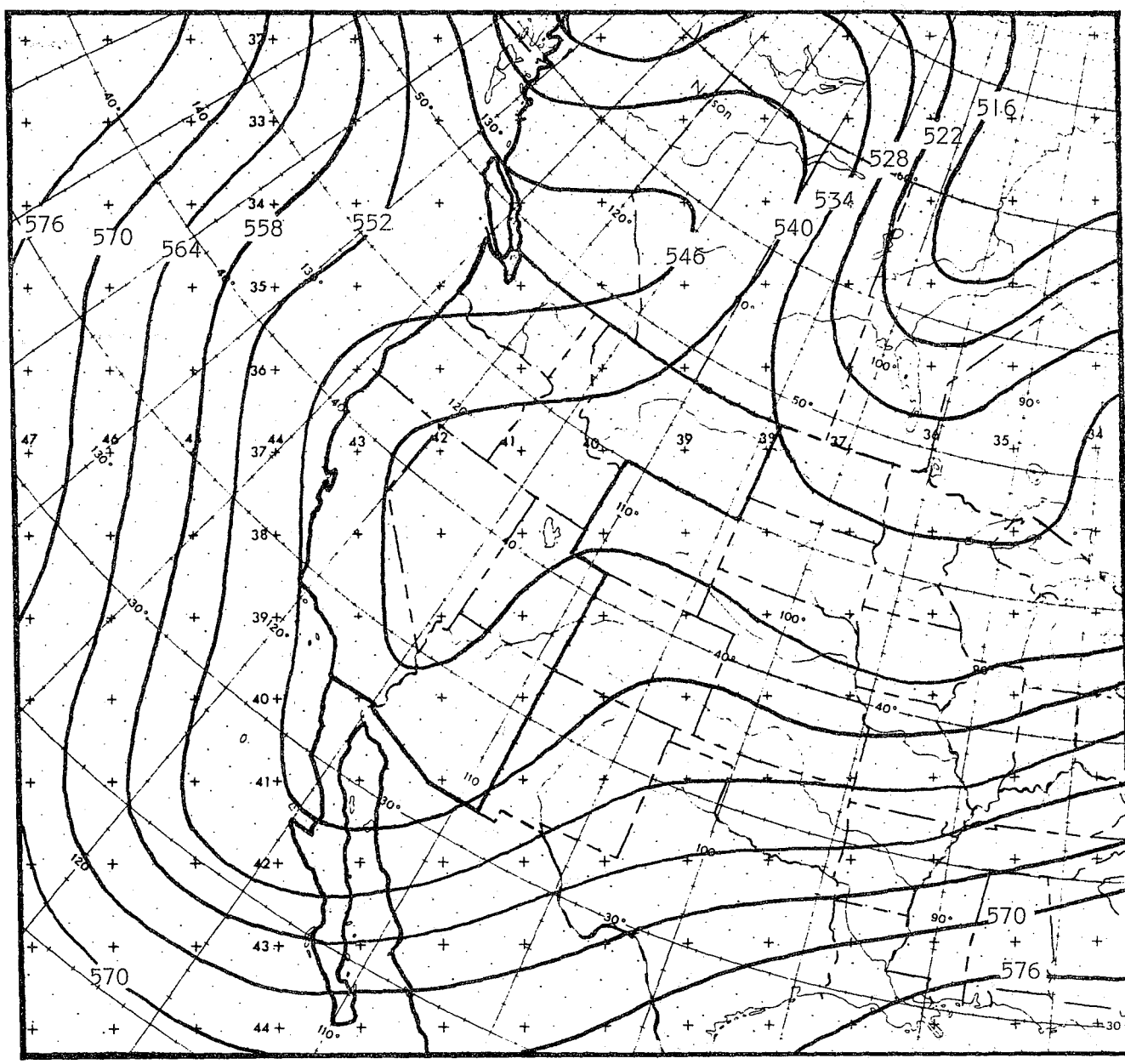


WINTER TYPE 3
Percent Frequency of Precipitation Occurrence



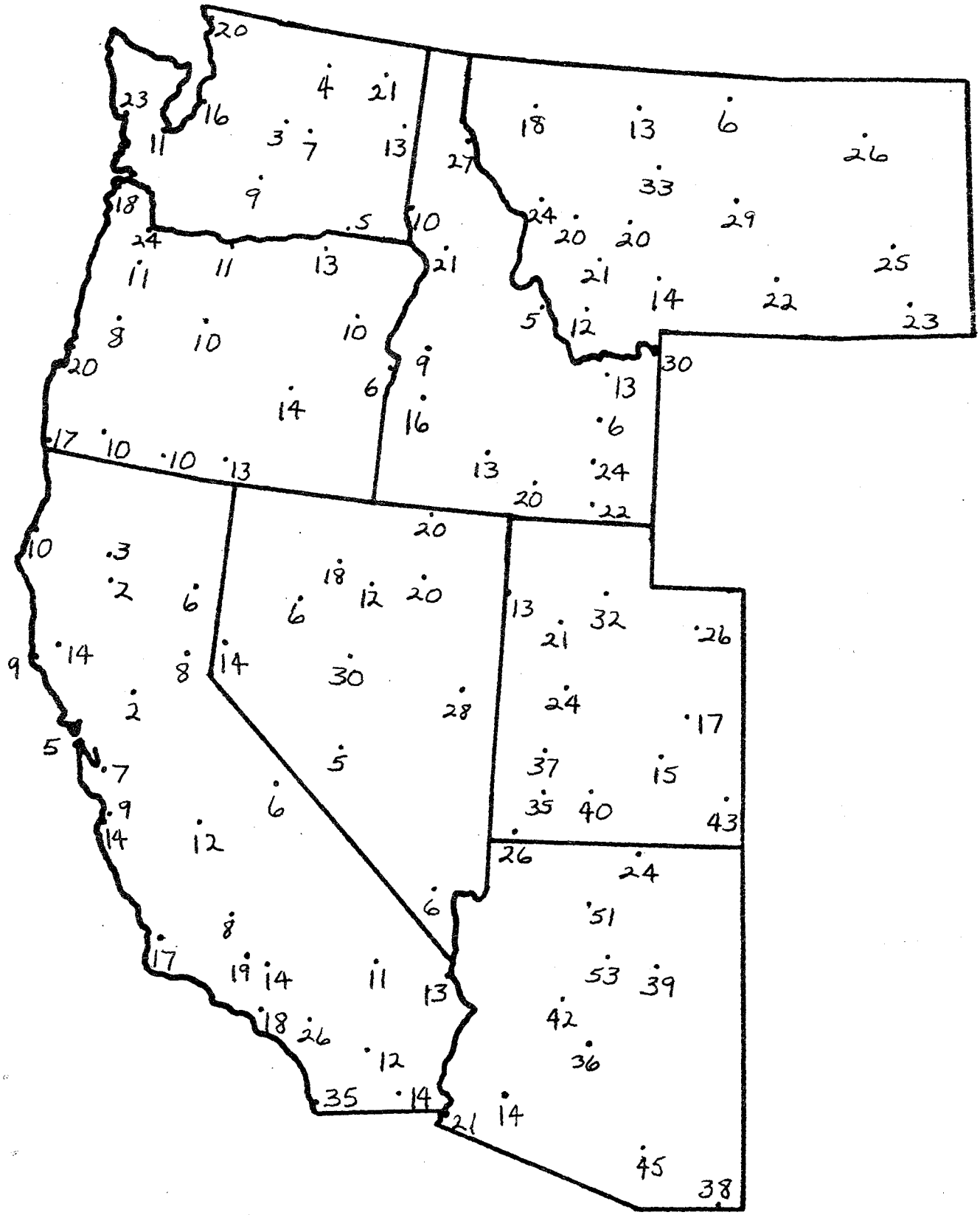
WINTER TYPE 4

12Z December 15, 1963
88 Cases



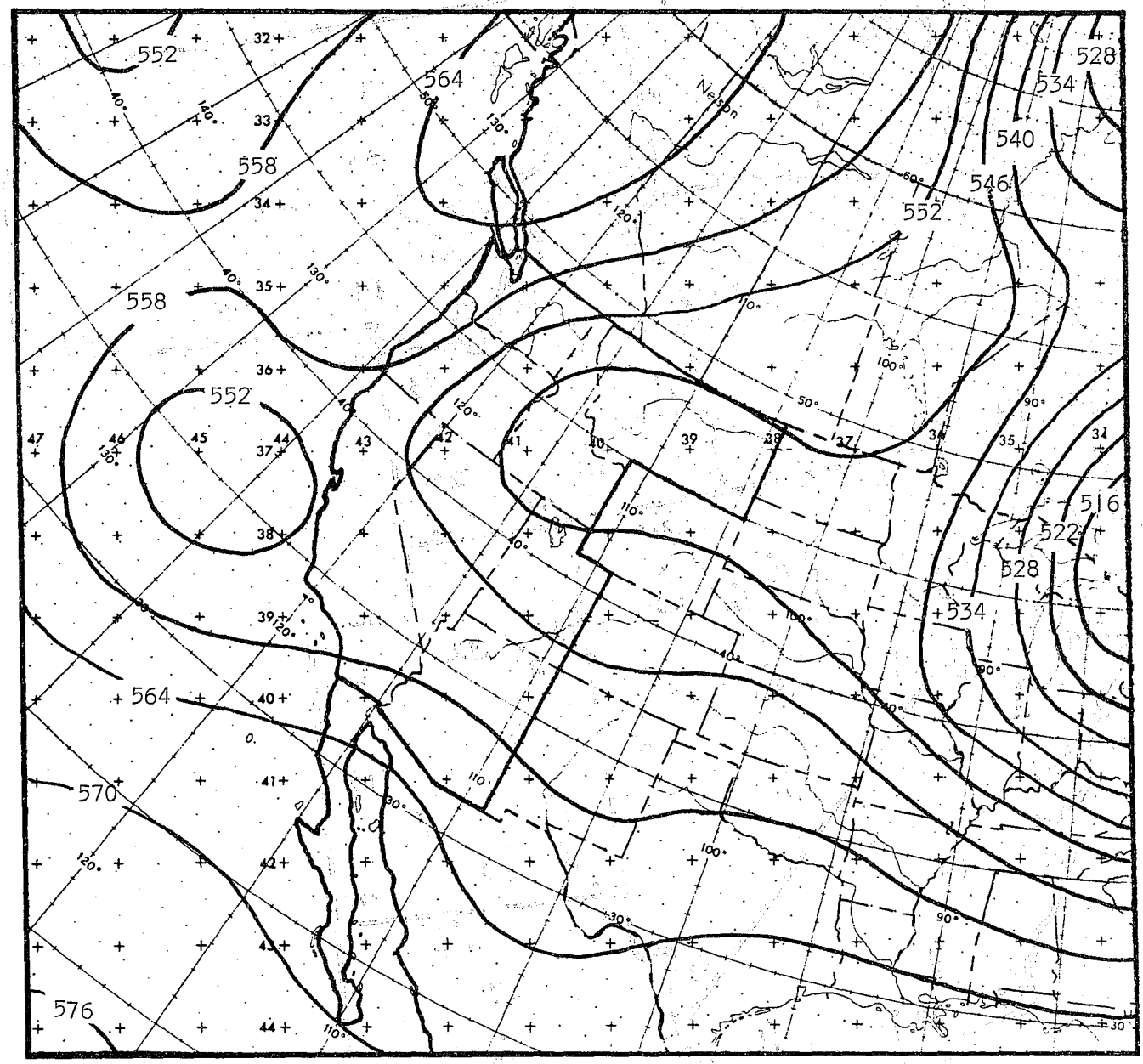
WINTER TYPE 4

Percent Frequency of Precipitation Occurrence



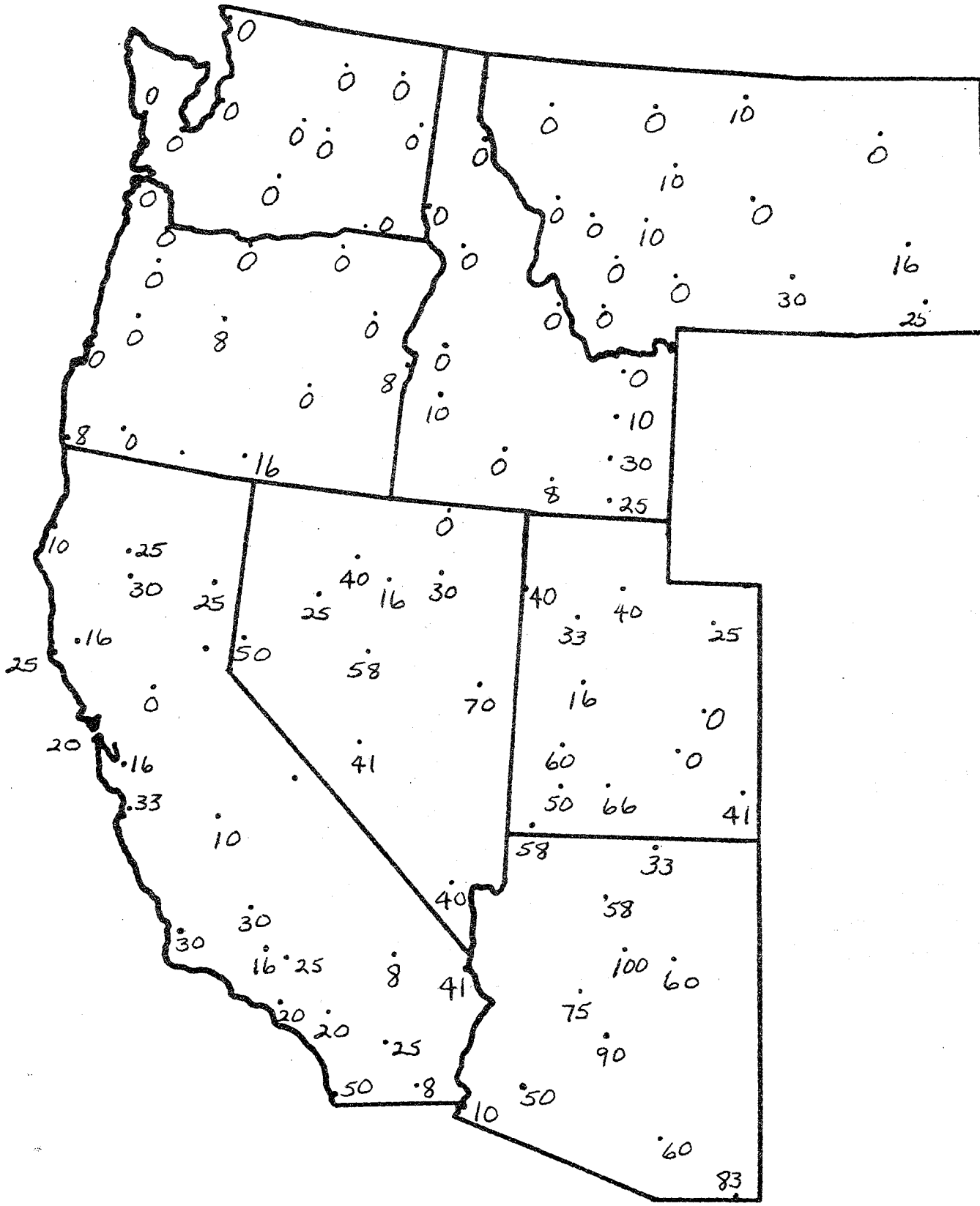
WINTER TYPE 5

00Z February 13, 1968
12 Cases



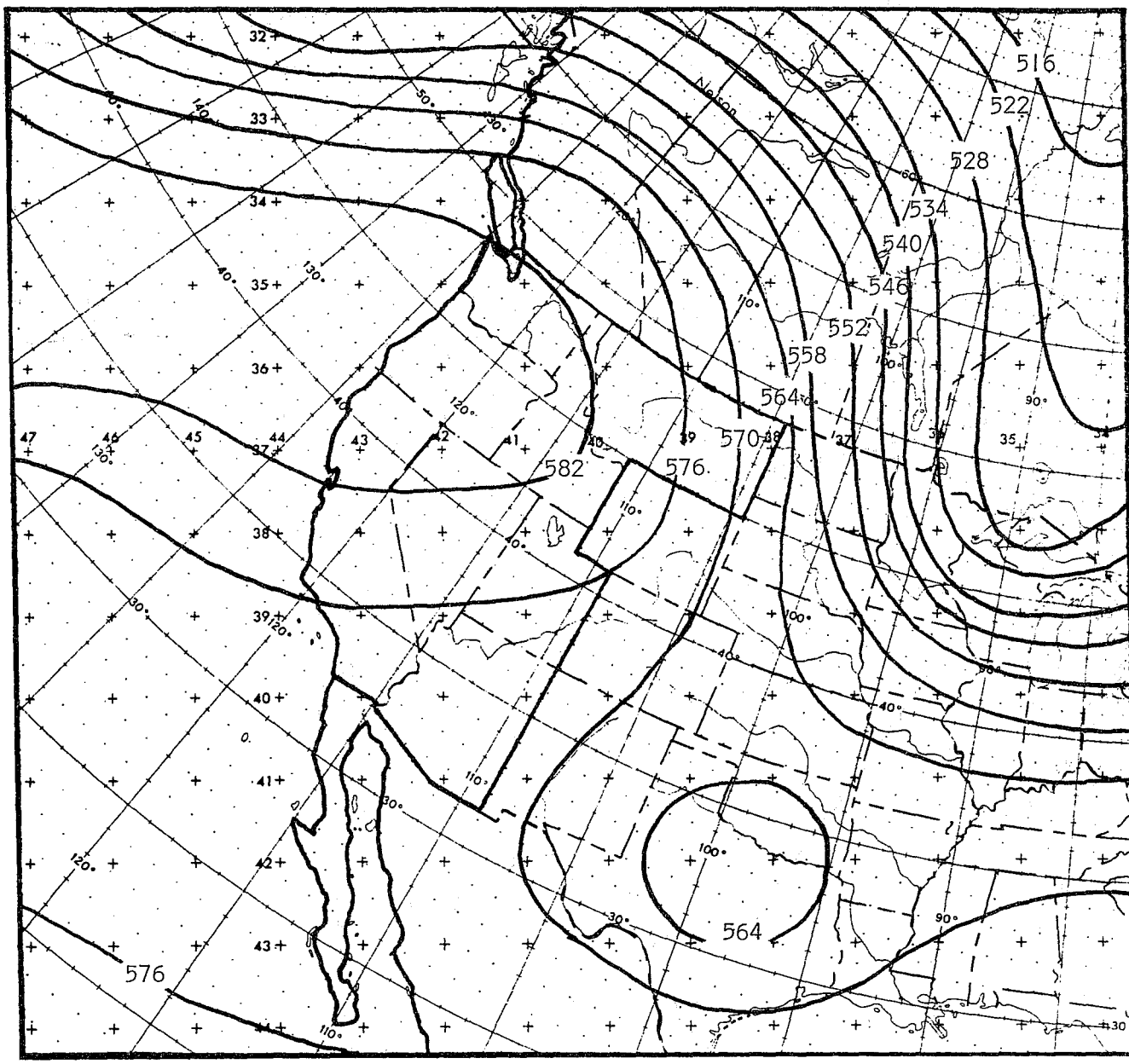
WINTER TYPE 5

Percent Frequency of Precipitation Occurrence



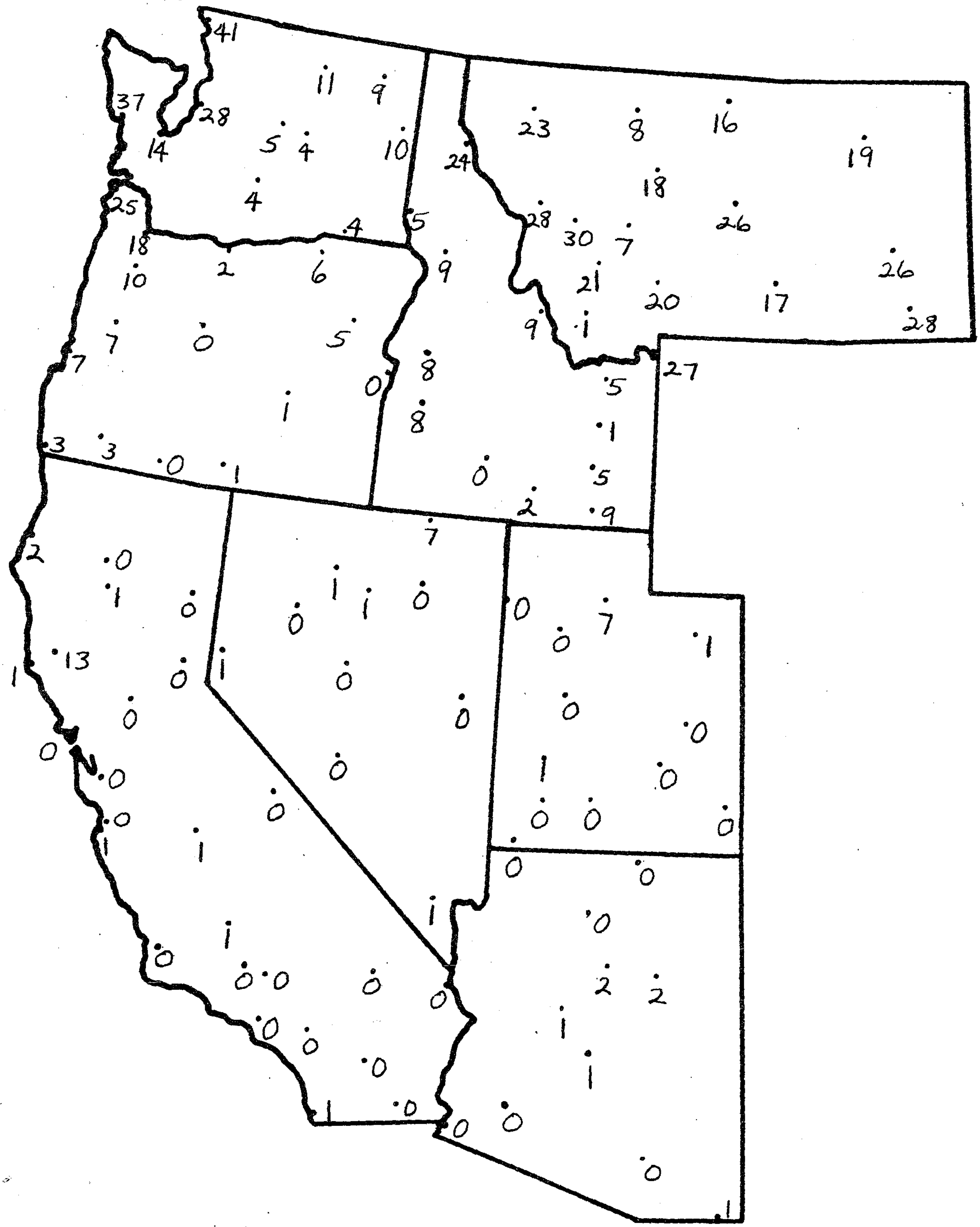
WINTER TYPE 6

00Z January 23, 1968
104 Cases



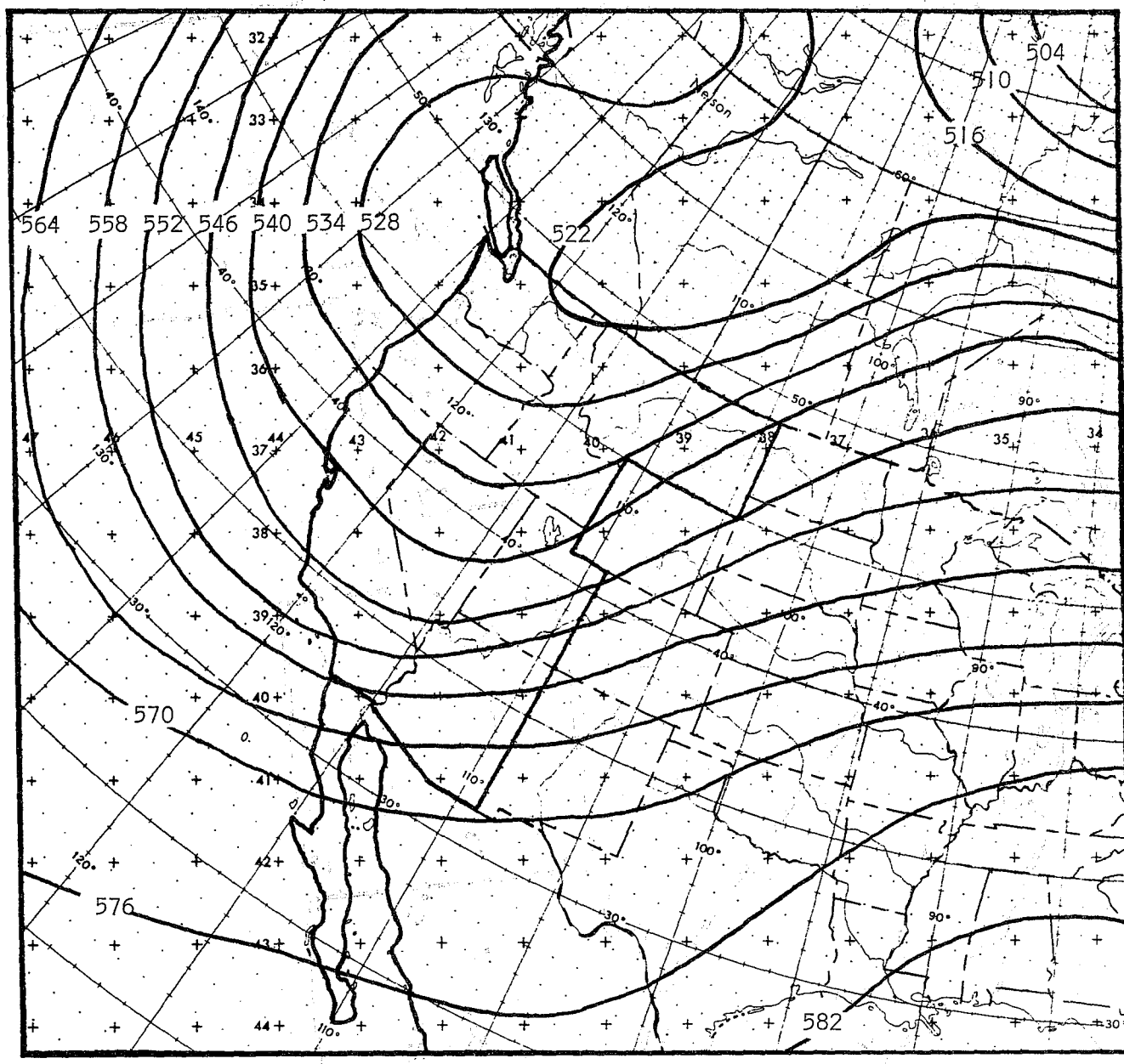
WINTER TYPE 6

Percent Frequency of Precipitation Occurrence



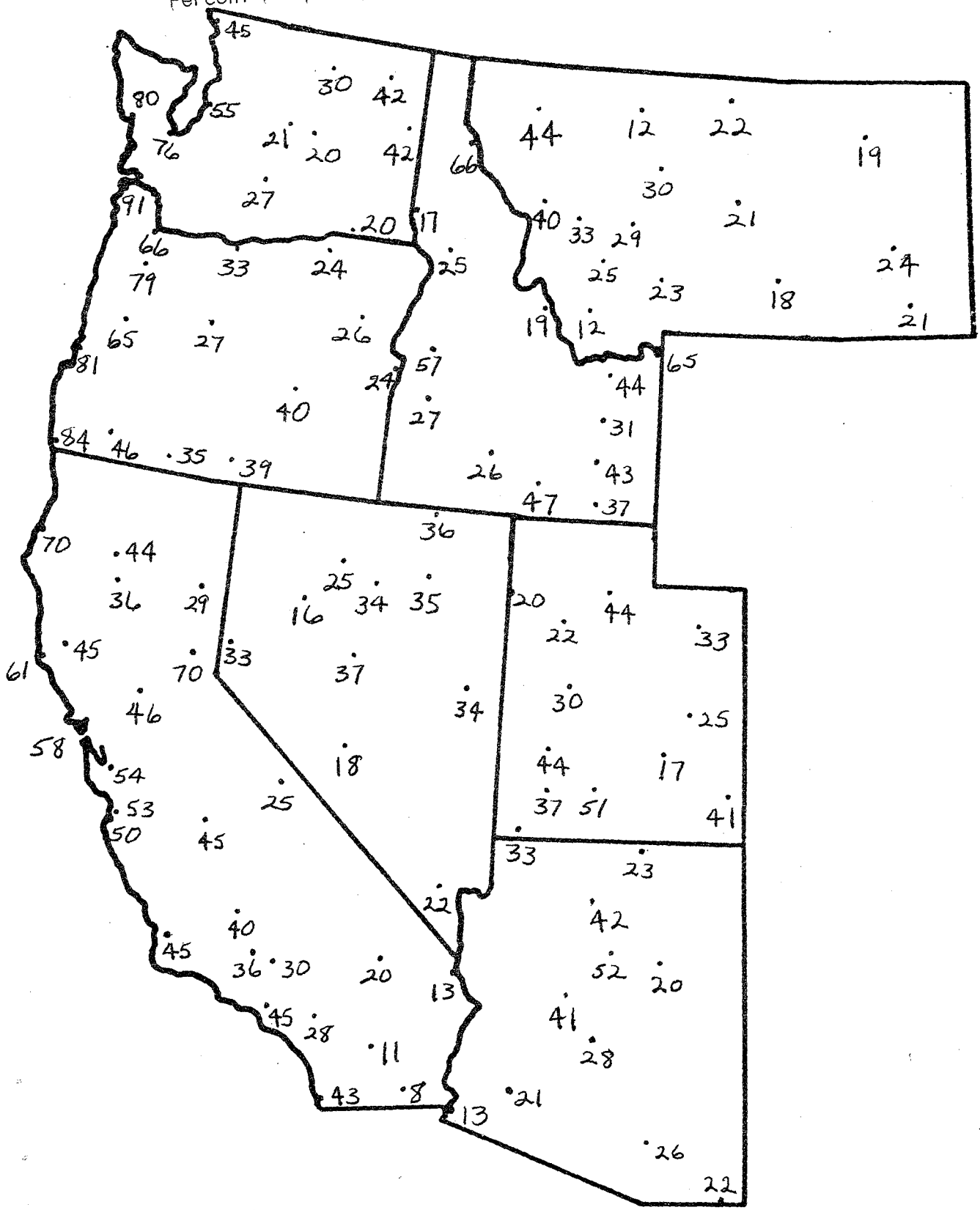
WINTER TYPE 7

12Z January 28, 1968
129 Cases



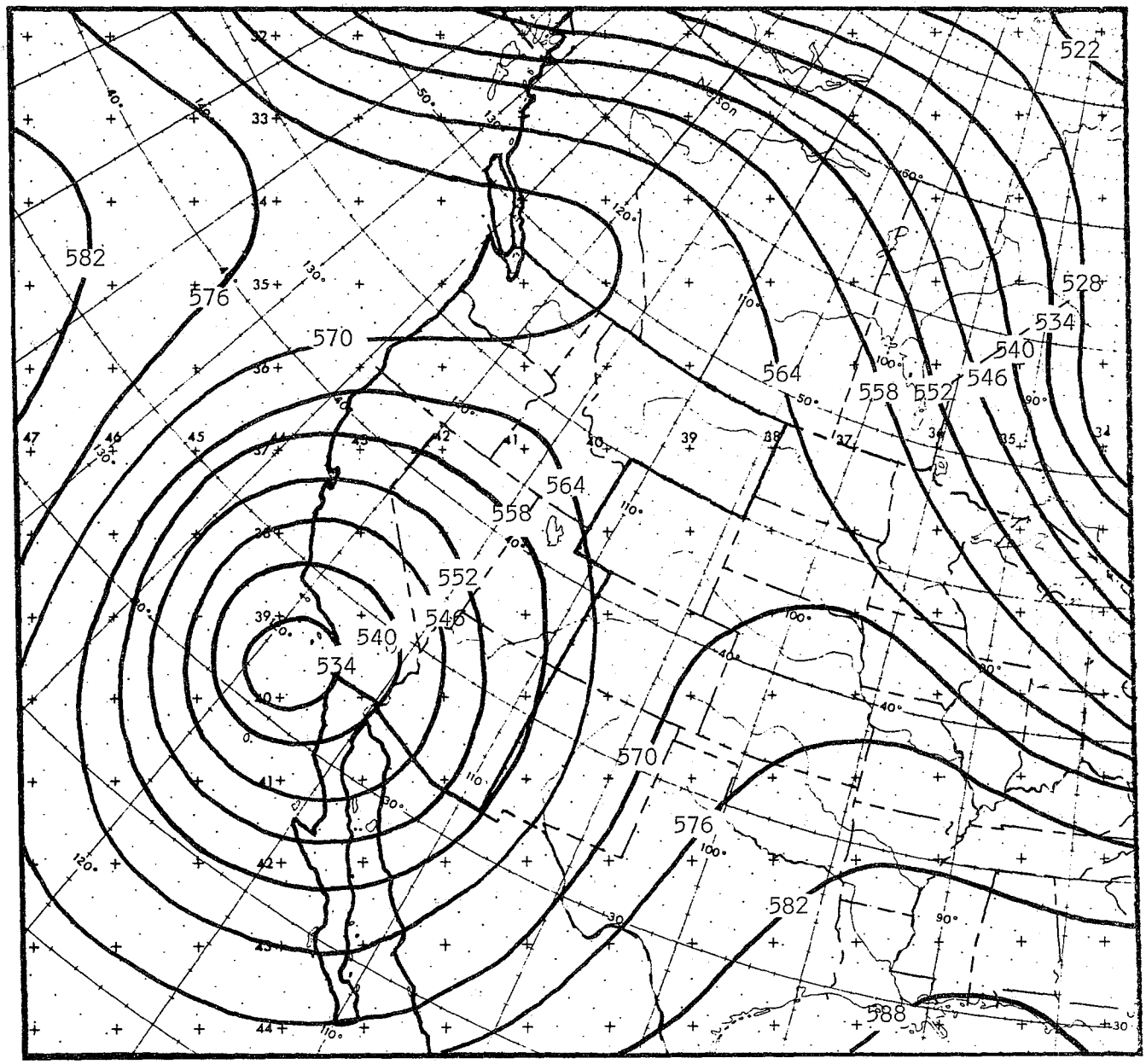
WINTER TYPE 7

Percent Frequency of Precipitation Occurrence



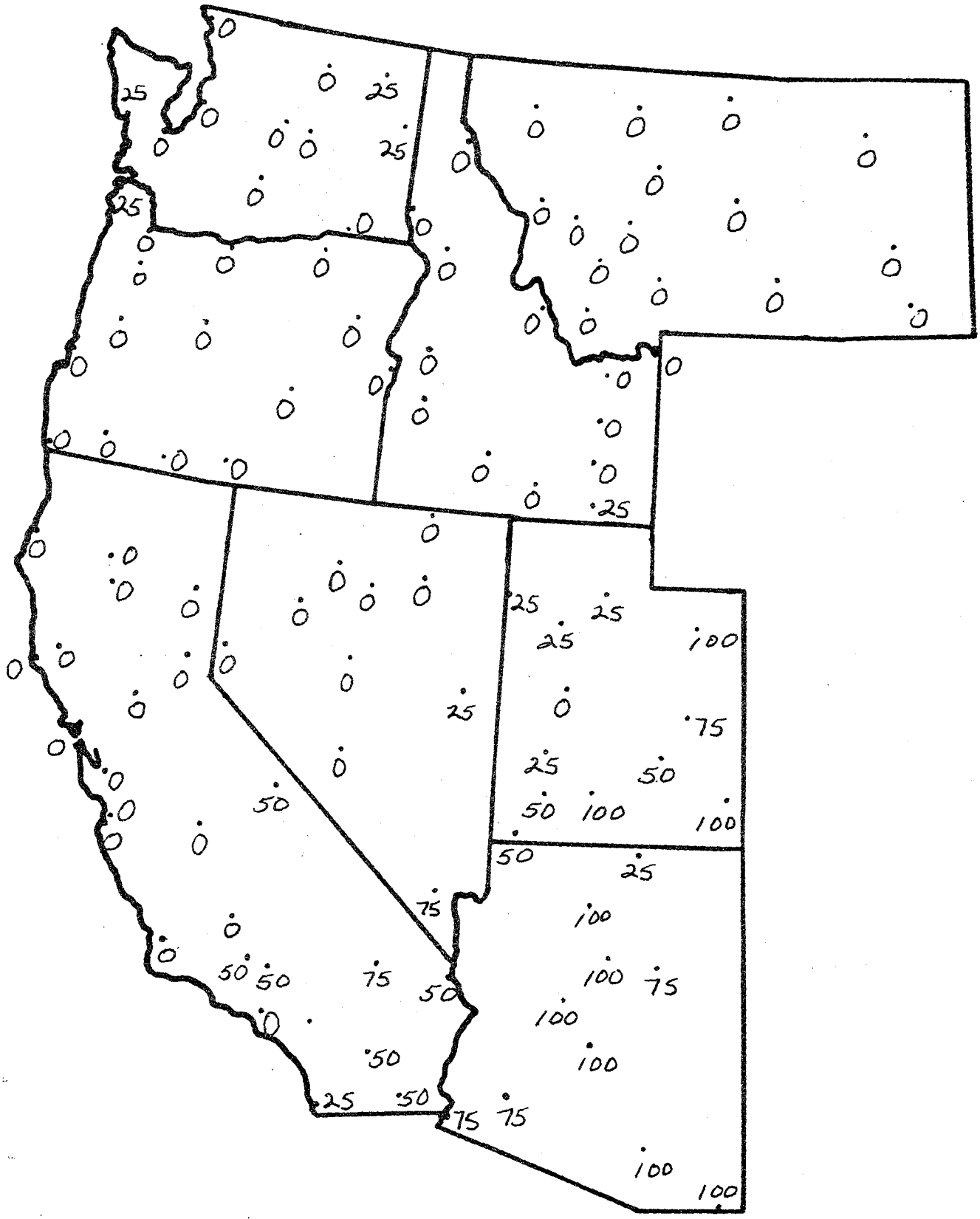
WINTER TYPE 8

12Z December 15, 1967
4 Cases



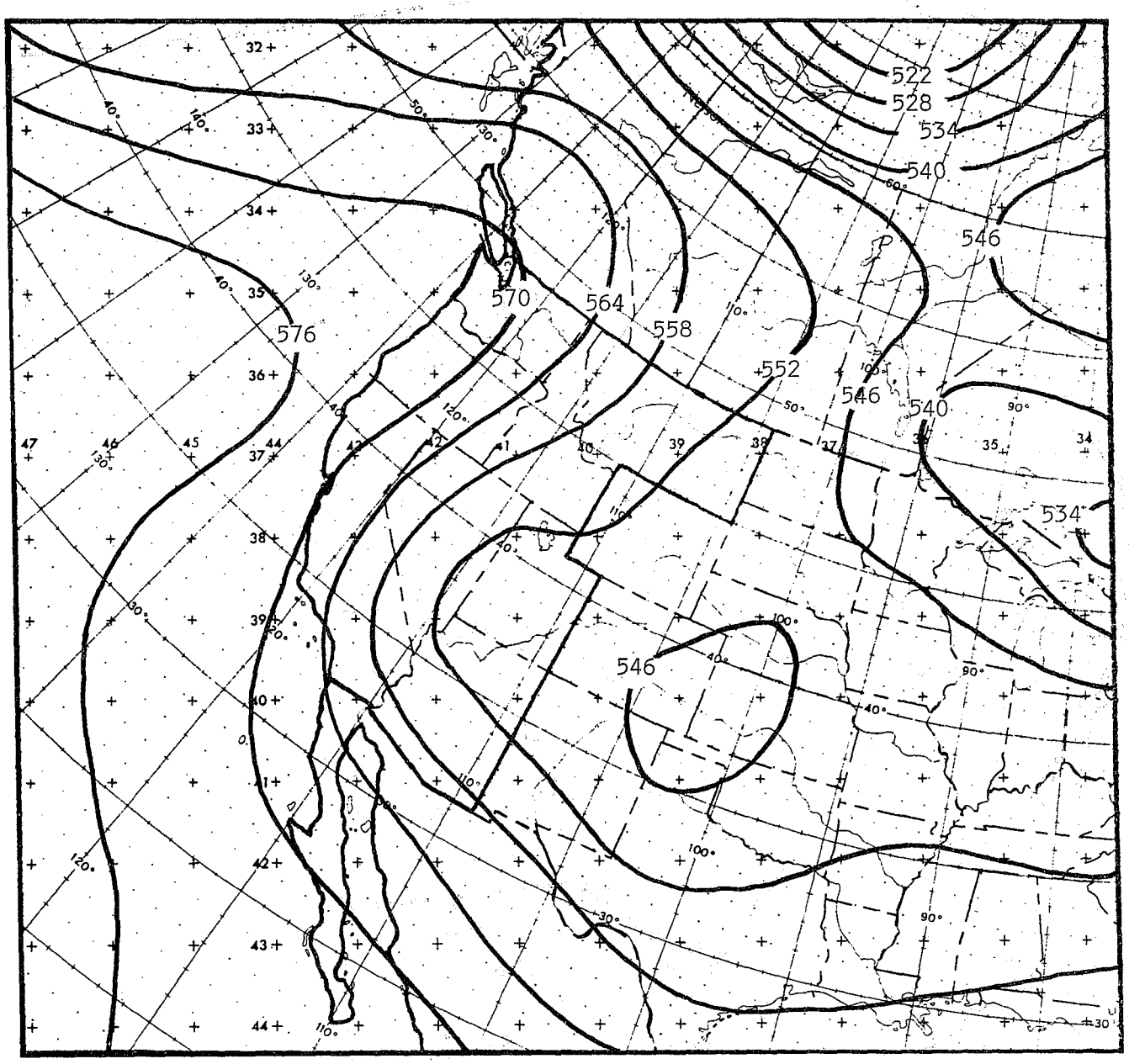
WINTER TYPE 8

Percent Frequency of Precipitation Occurrence



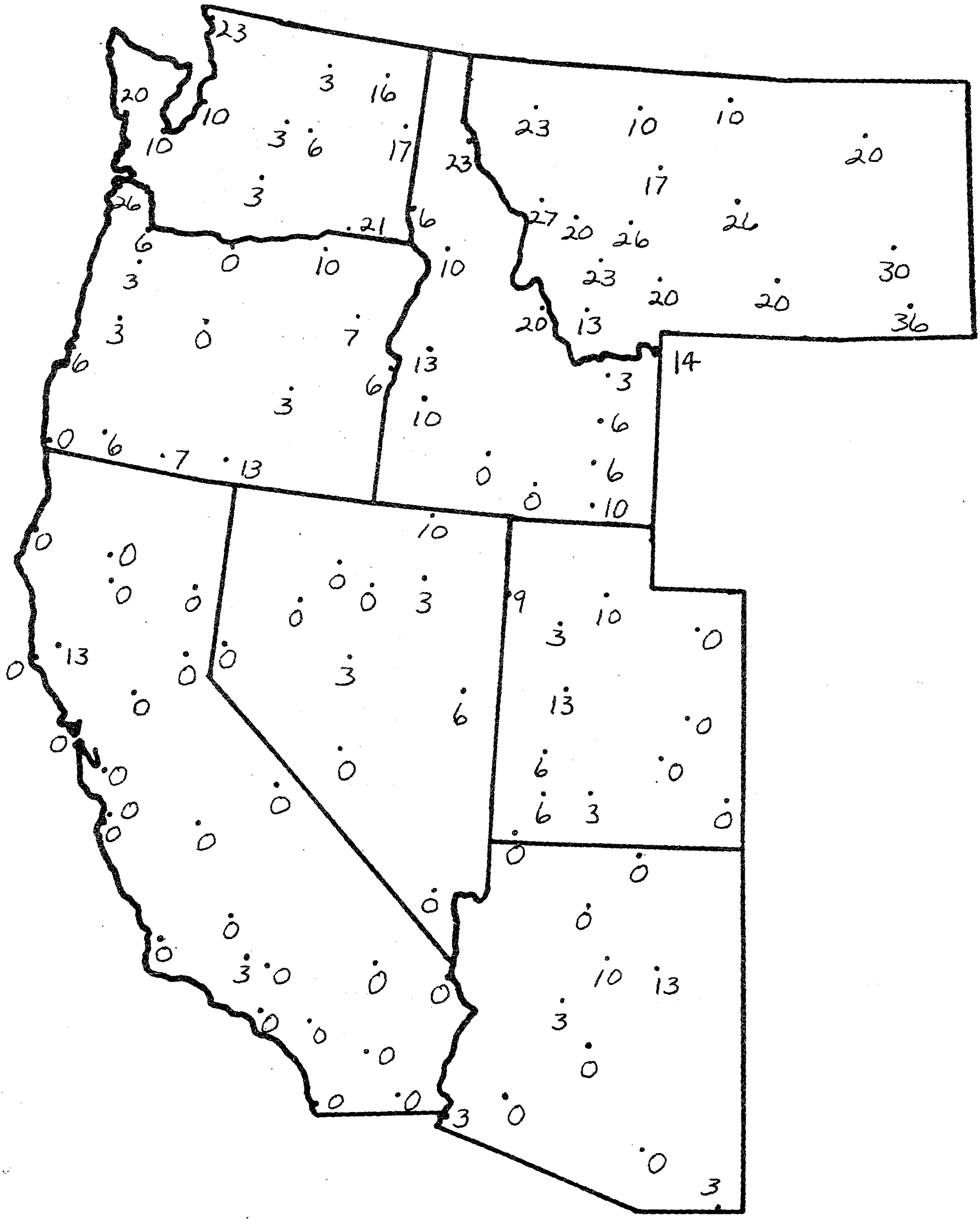
WINTER TYPE 9

00Z January 16, 1966
30 Cases



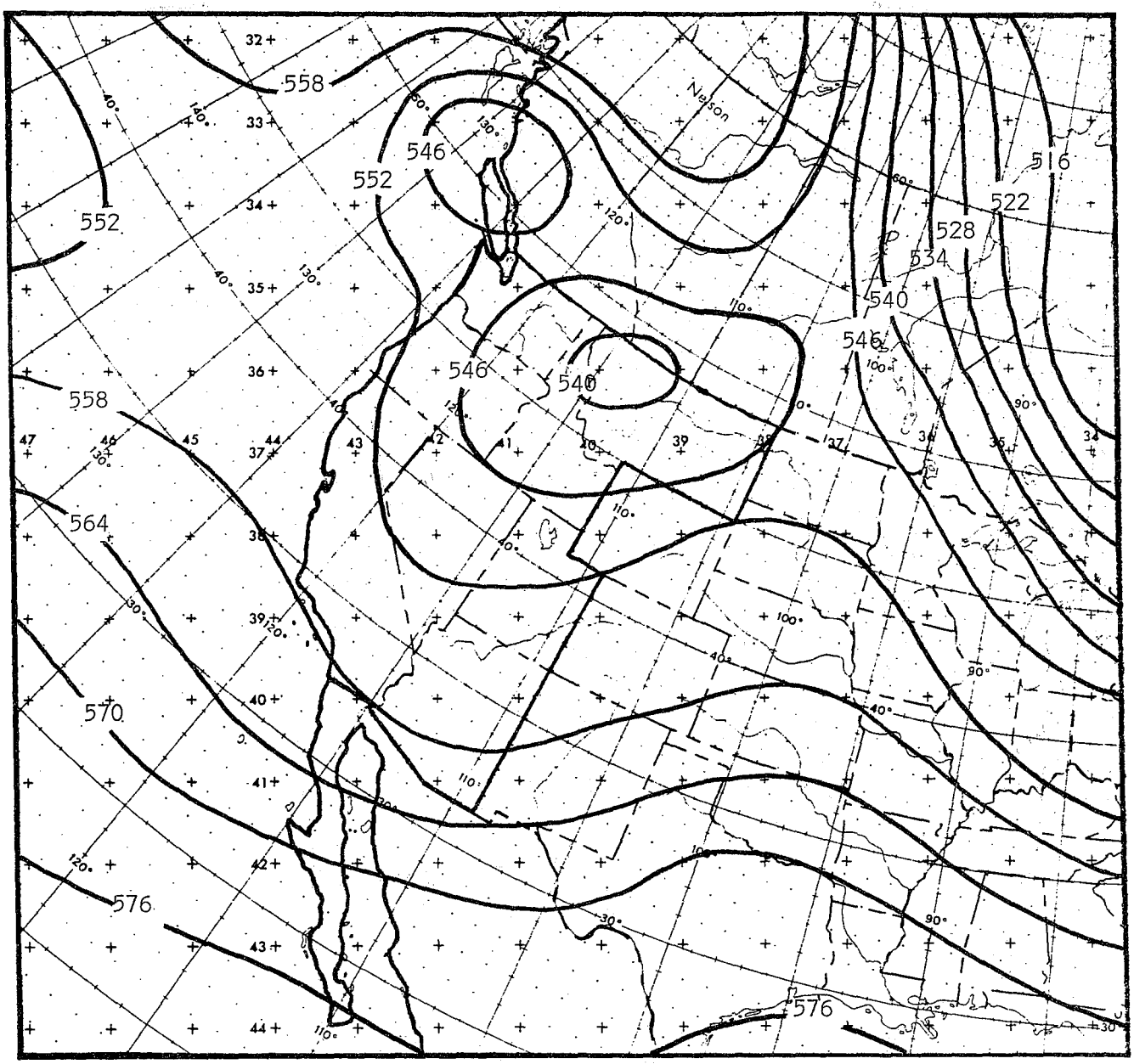
WINTER TYPE 9

Percent Frequency of Precipitation Occurrence

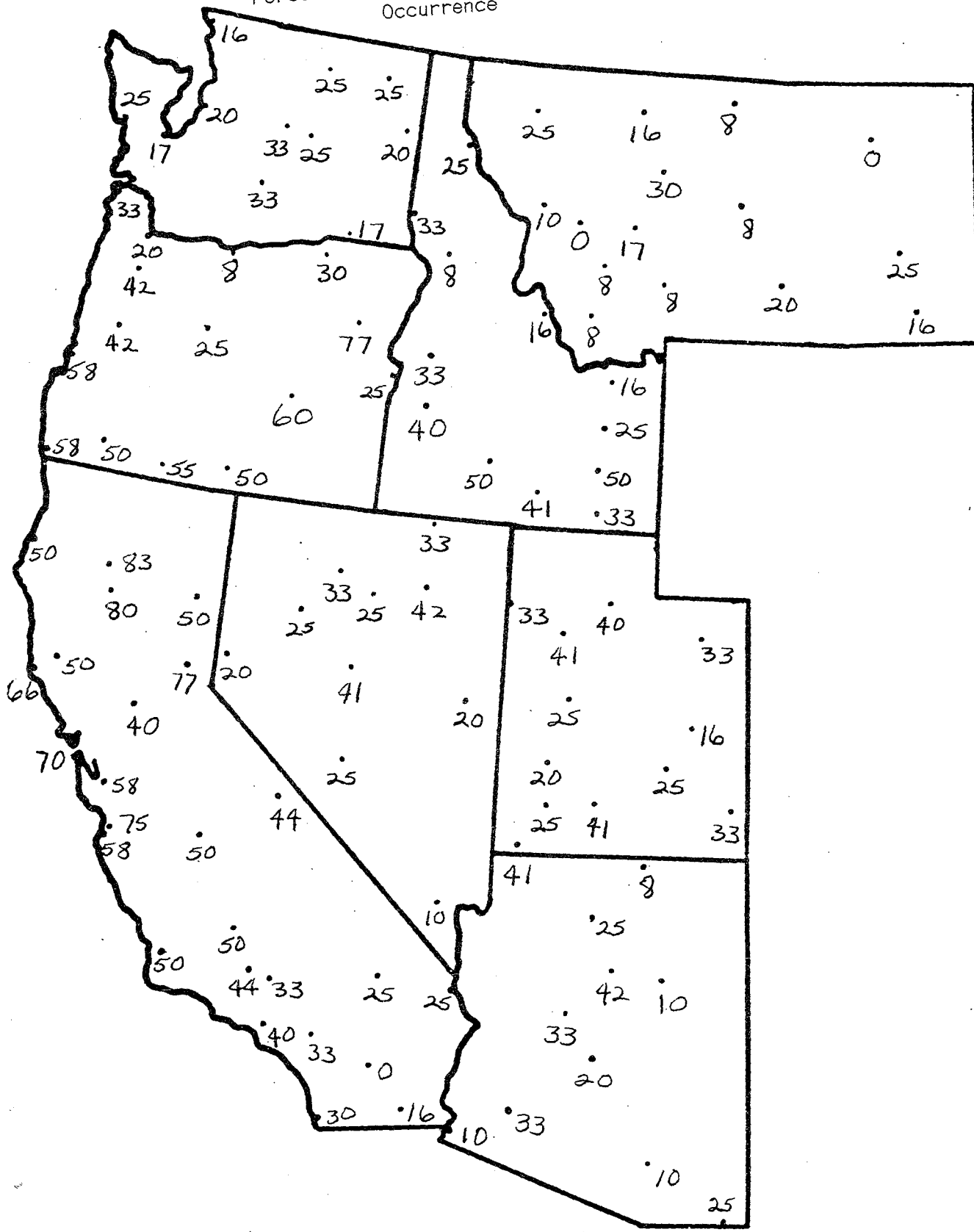


WINTER TYPE 10

12Z February 14, 1968
12 Cases



WINTER TYPE 10
Percent Frequency of Precipitation
Occurrence



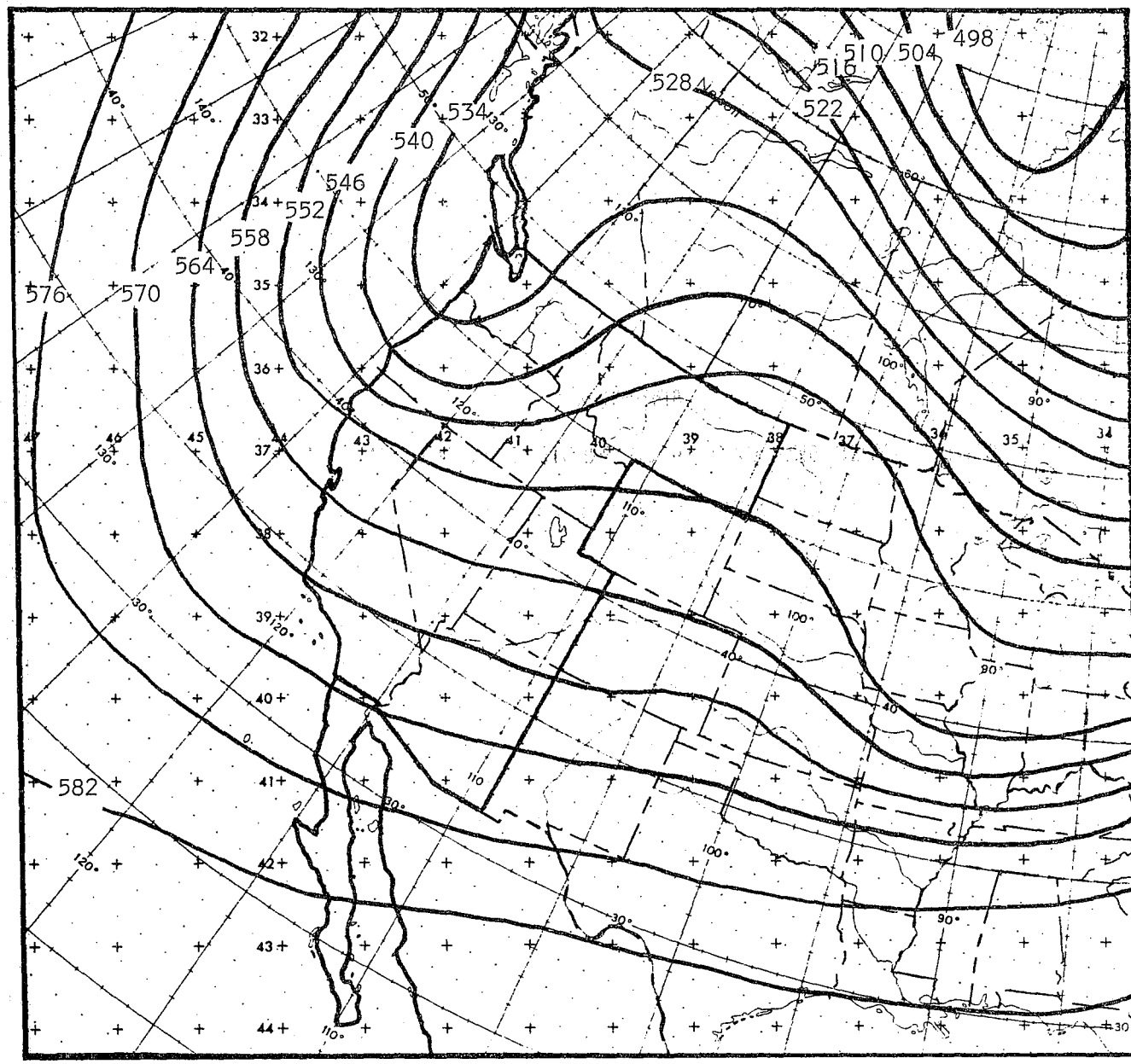
APPENDIX C

SPRING TYPES AND ASSOCIATED PRECIPITATION CLIMATOLOGIES

SAMPLE SIZE: 1123 CASES

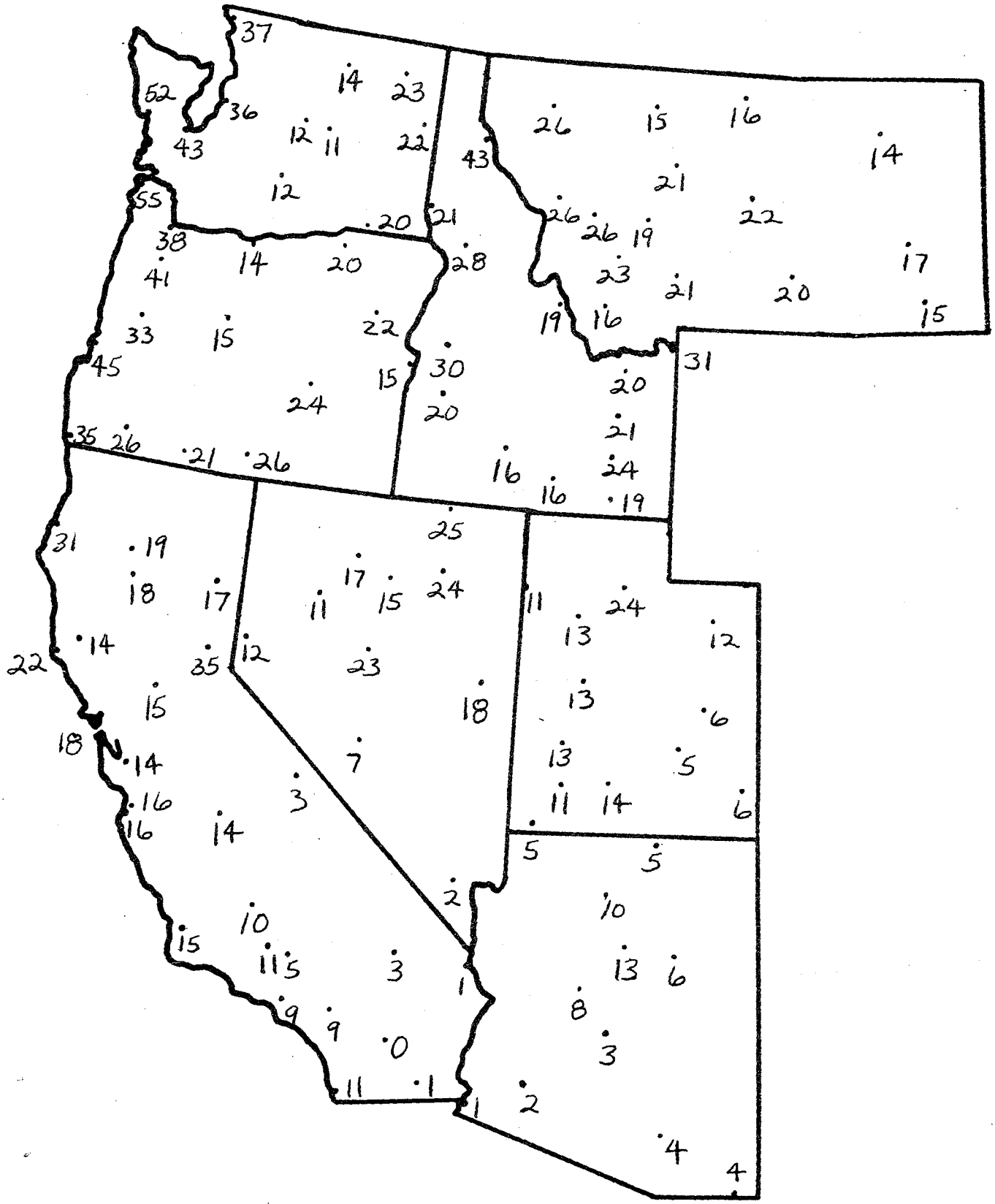
SPRING TYPE I

12Z March 14, 1963
588 Cases



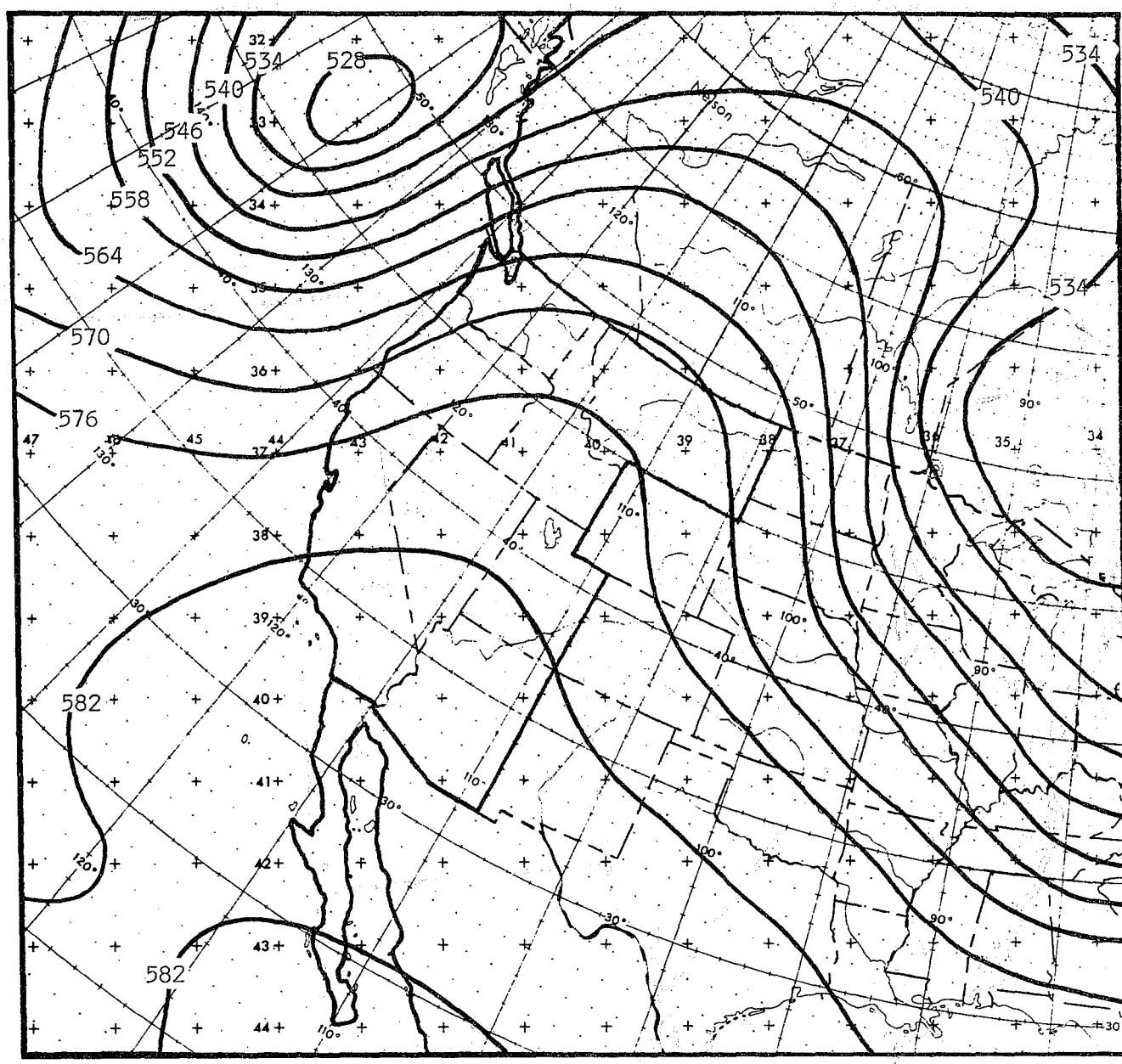
SPRING TYPE 1

Percent Frequency of Precipitation Occurrence



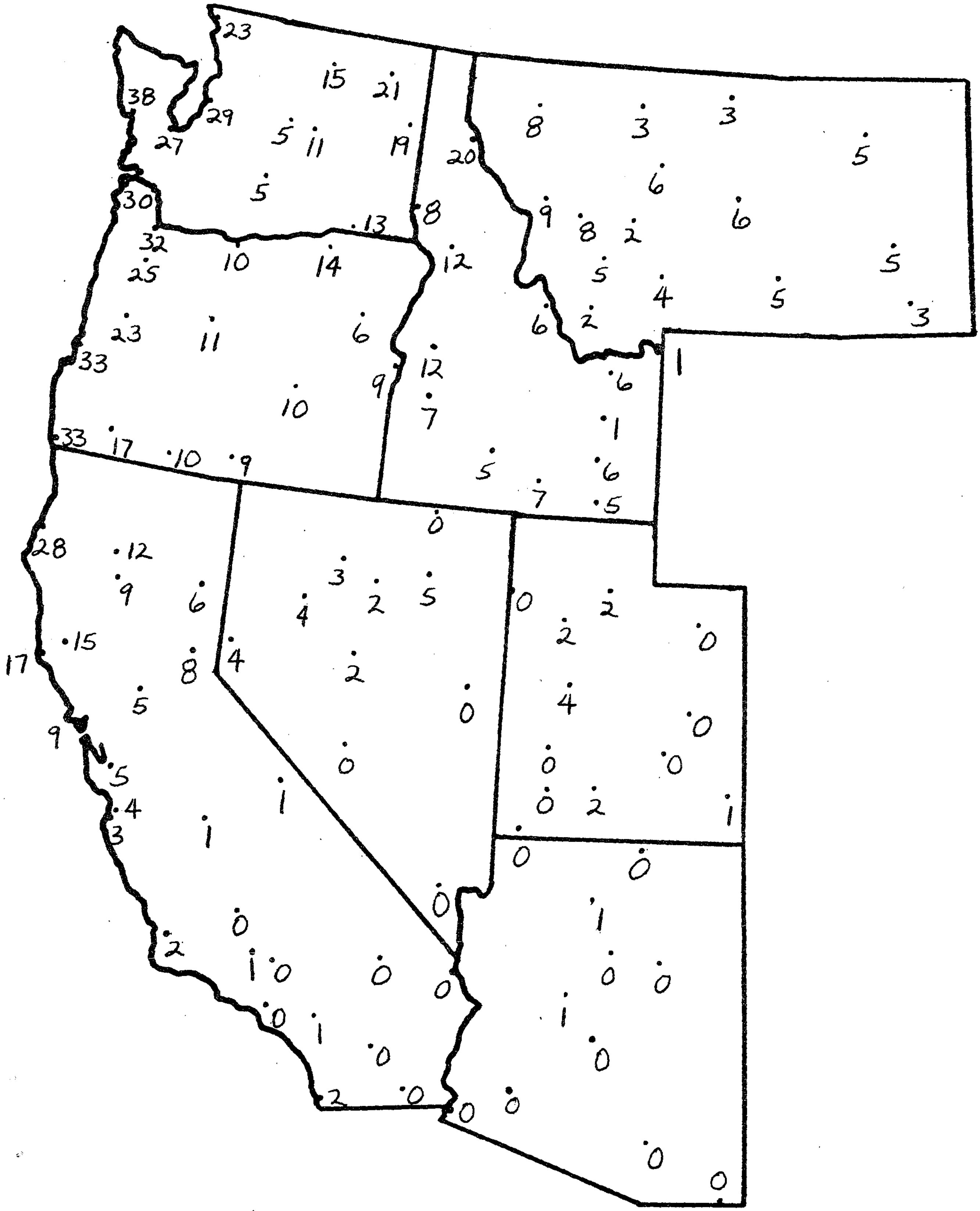
SPRING TYPE 2

12Z April 14, 1962
119 Cases



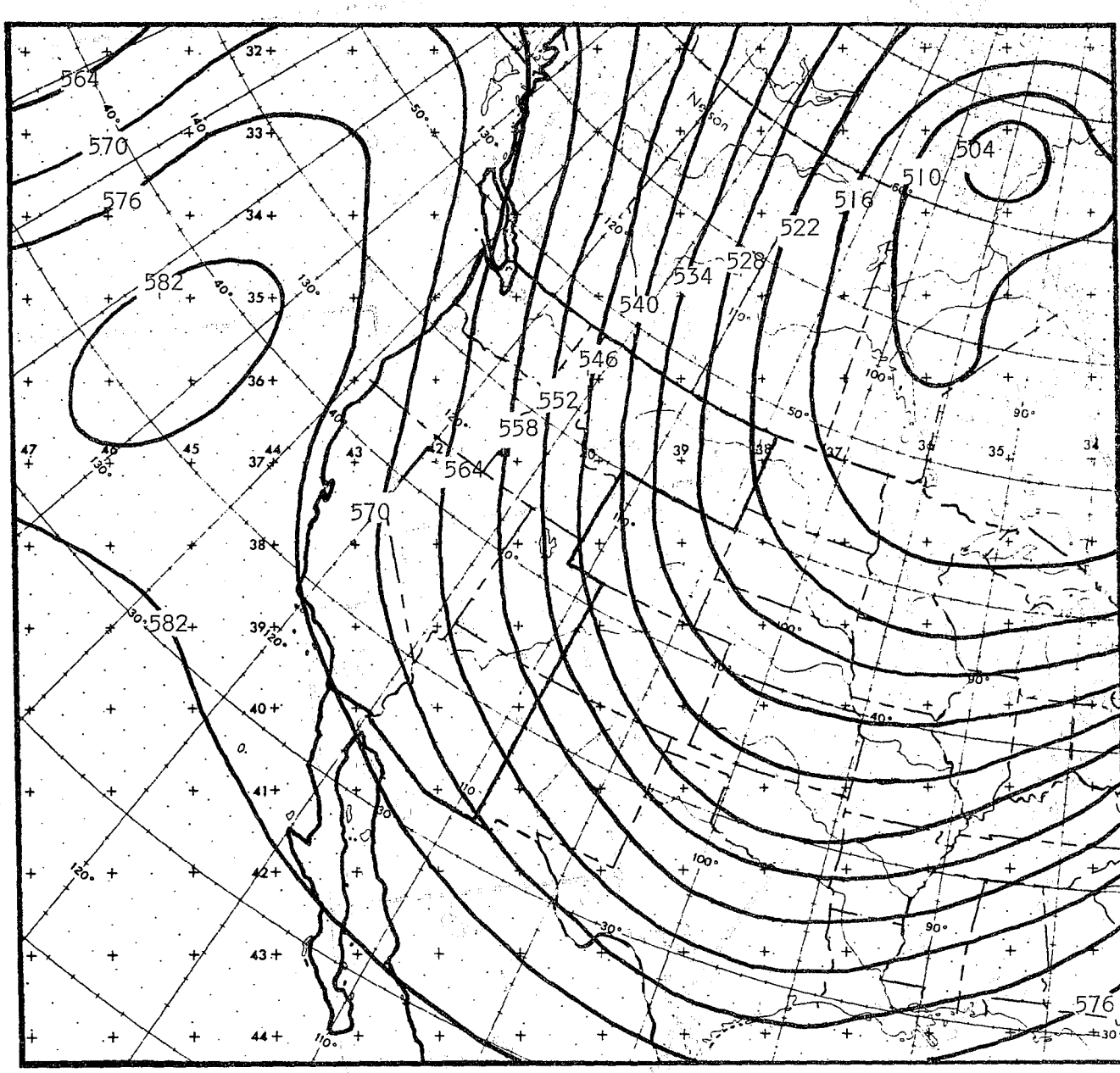
SPRING TYPE 2

Percent Frequency of Precipitation Occurrence



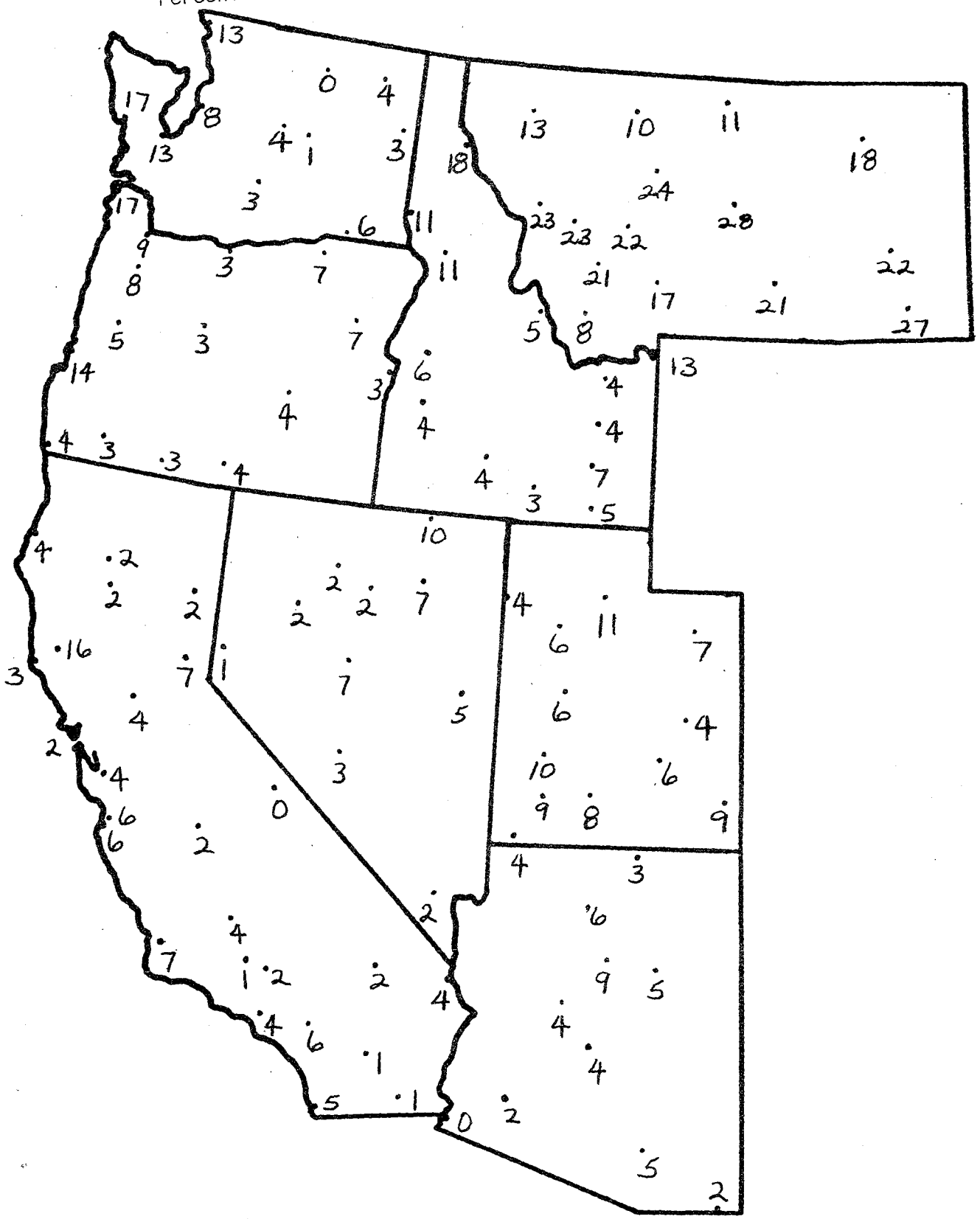
SPRING TYPE 3

00Z March 20, 1965
165 Cases



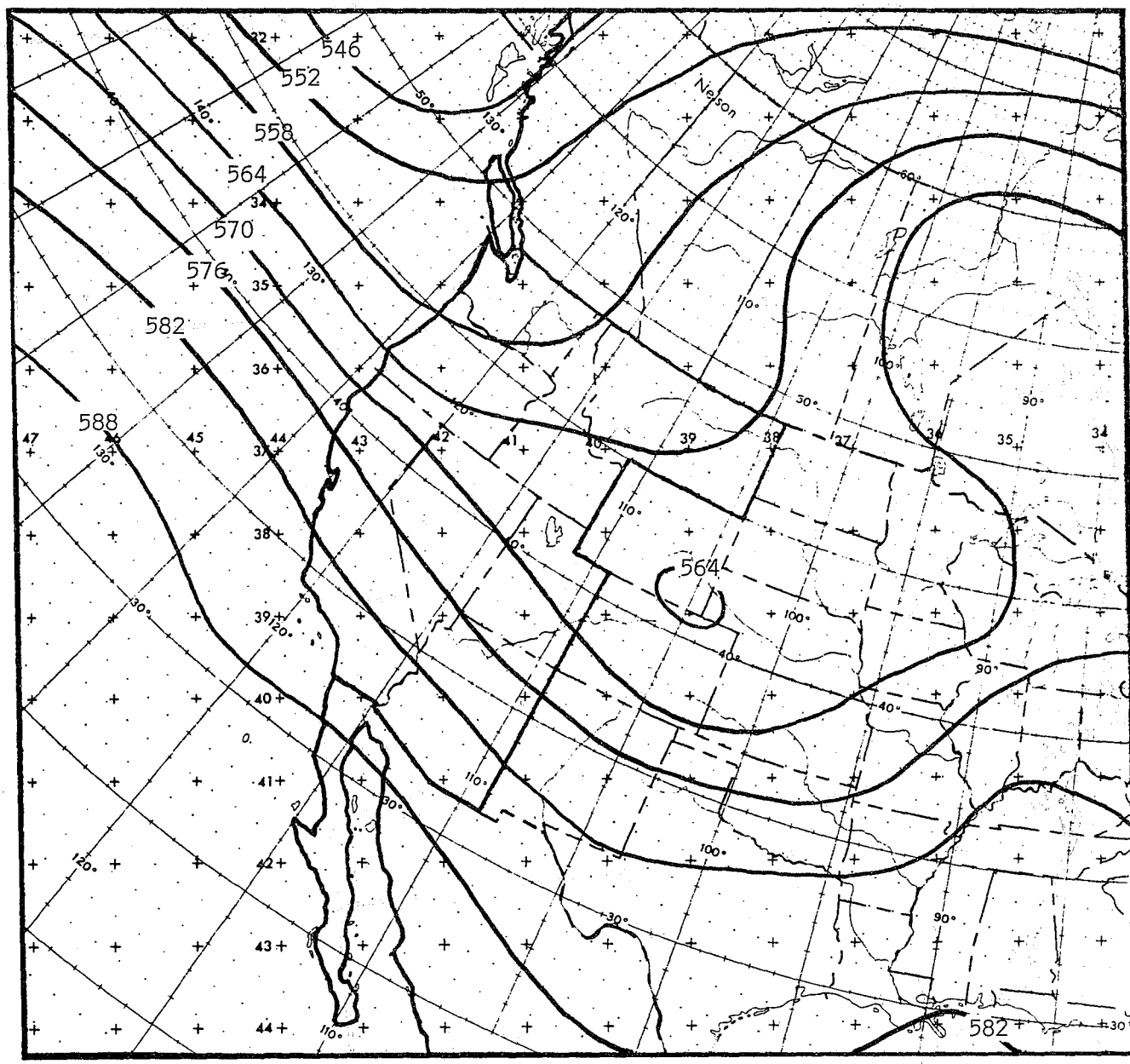
SPRING TYPE 3

Percent Frequency of Precipitation Occurrence



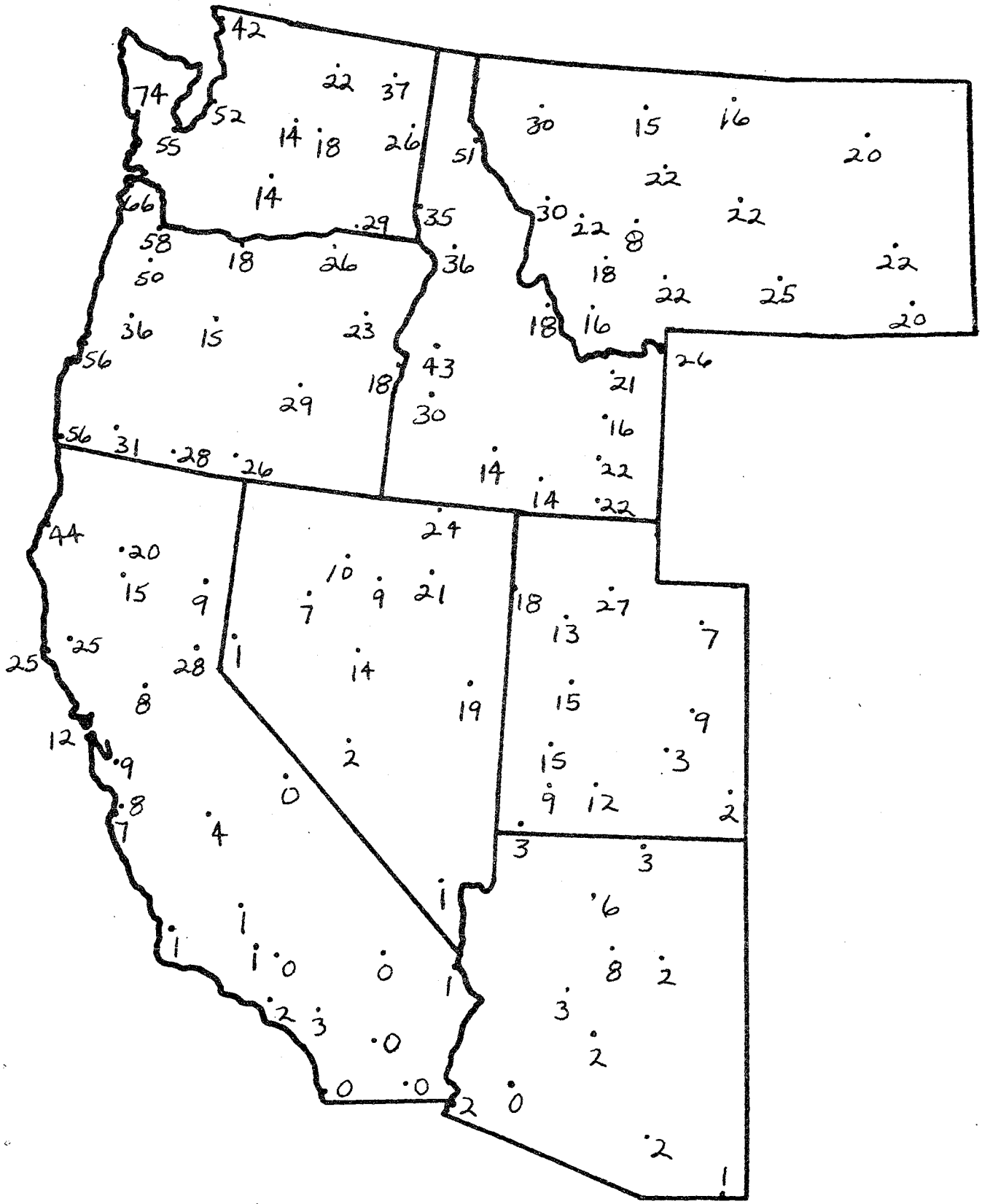
SPRING TYPE 4

12Z May 25, 1968
82 Cases



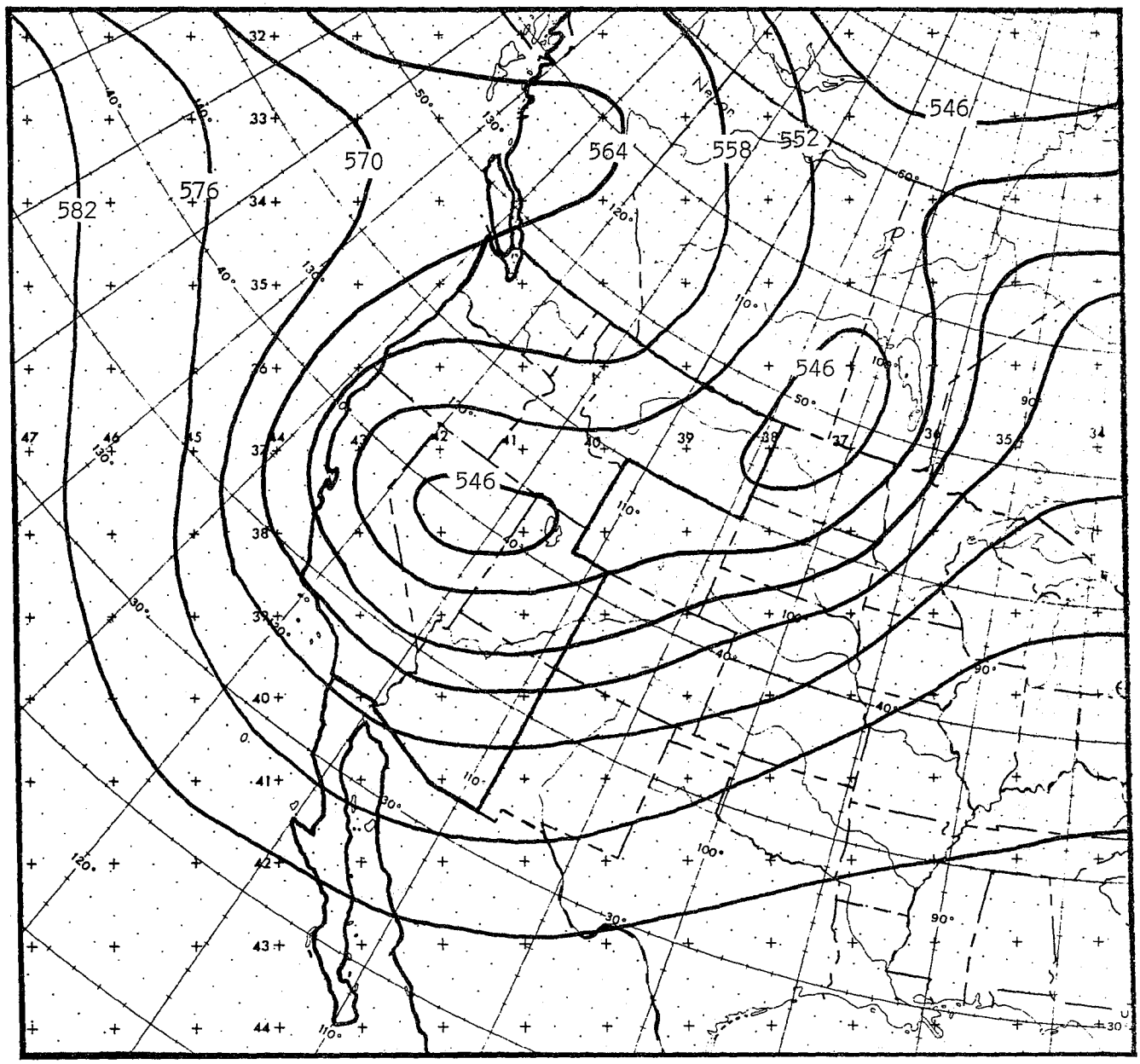
SPRING TYPE 4

Percent Frequency of Precipitation Occurrence



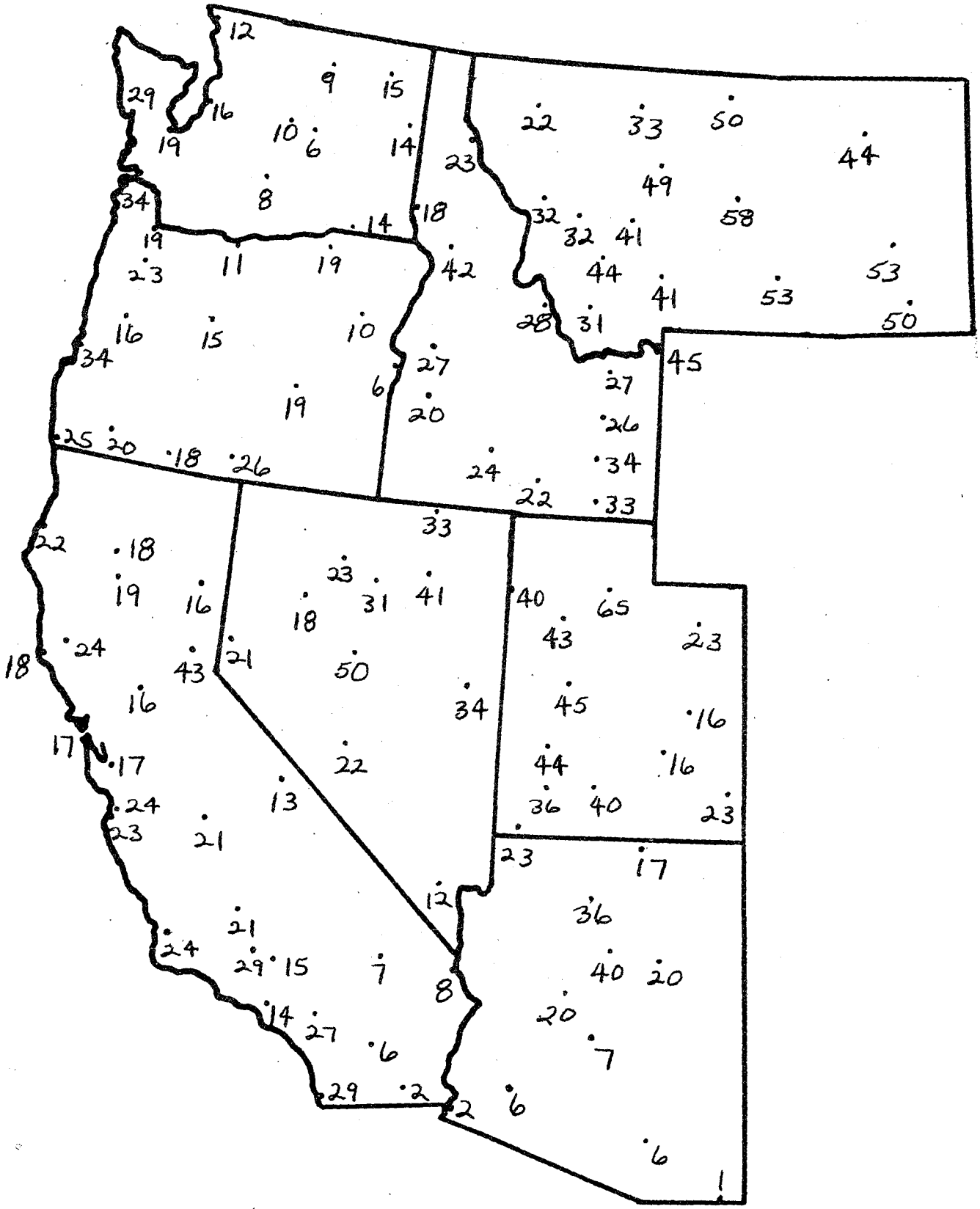
SPRING TYPE 5

00Z May 7, 1965
95 Cases



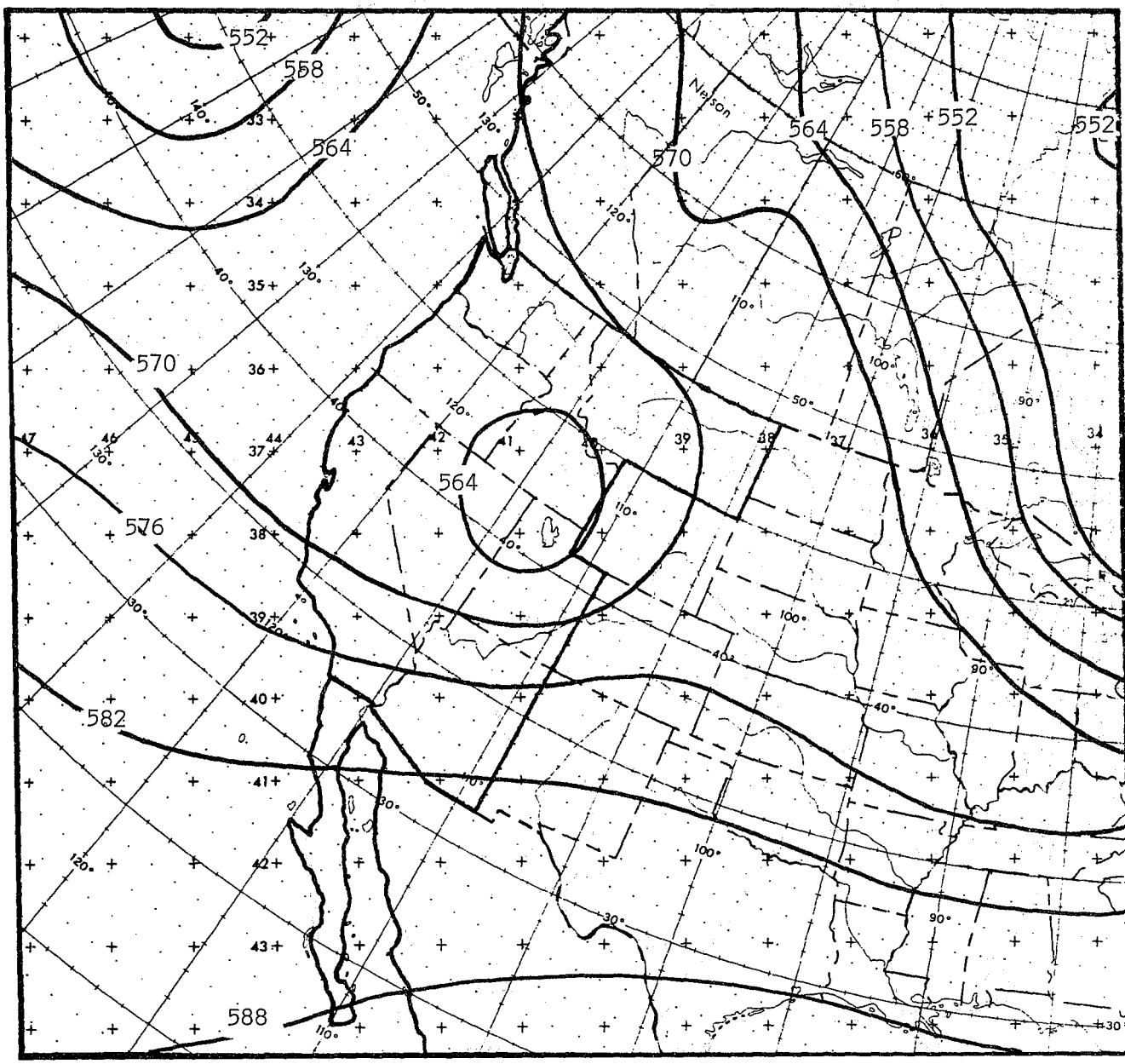
SPRING TYPE 5

Percent Frequency of Precipitation Occurrence



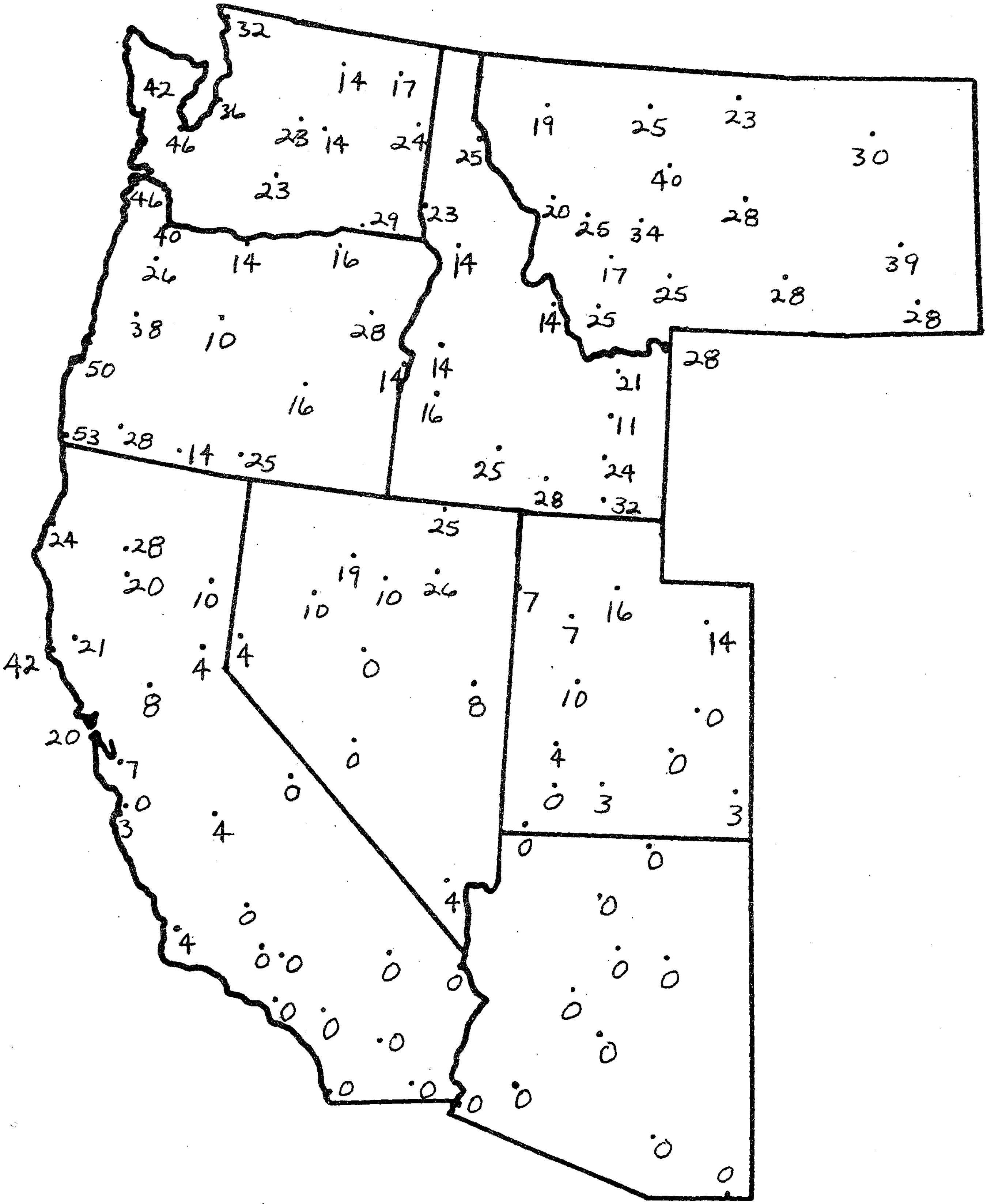
SPRING TYPE 6

12Z May 28, 1964
28 Cases



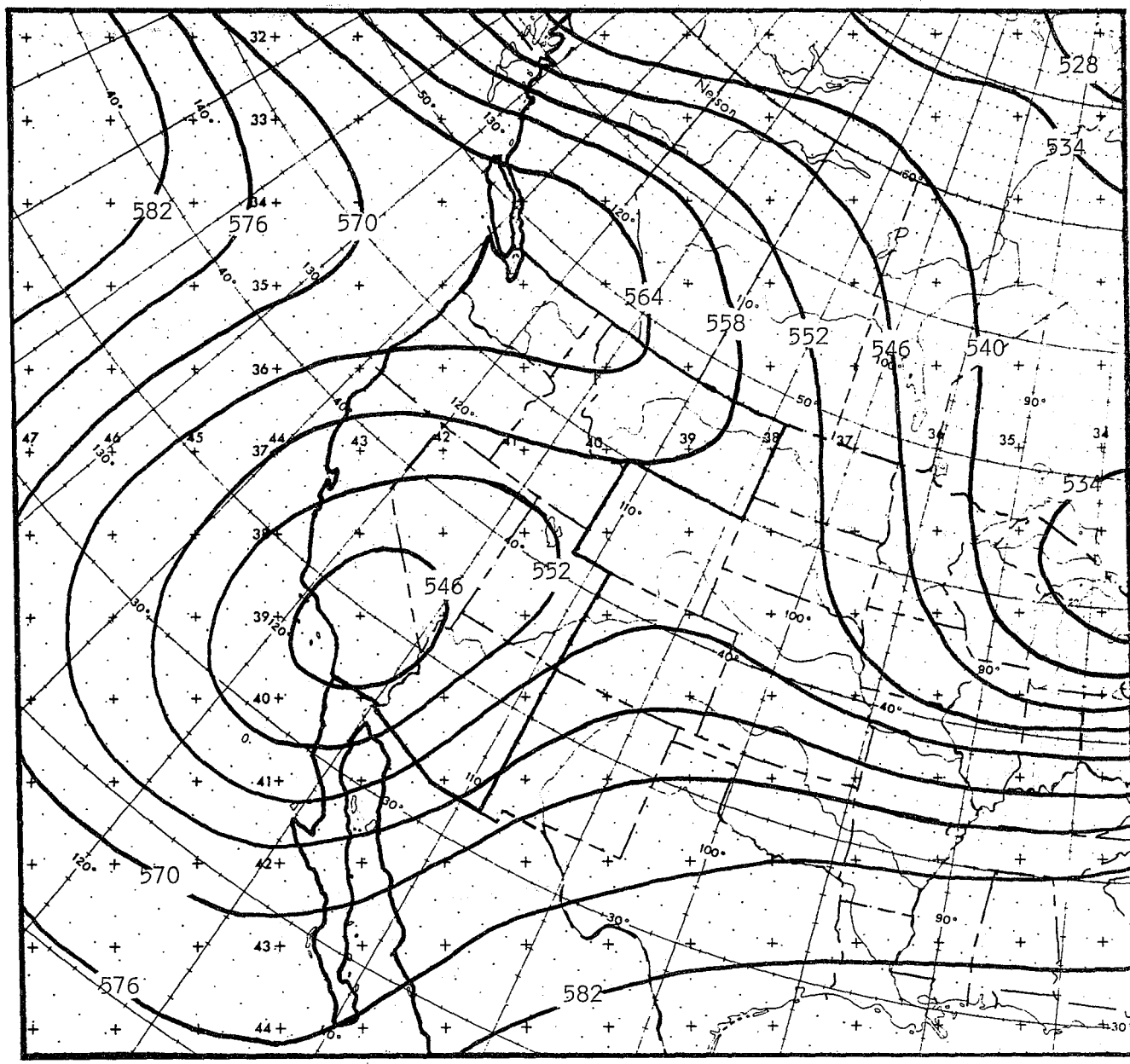
SPRING TYPE 6

Percent Frequency of Precipitation Occurrence



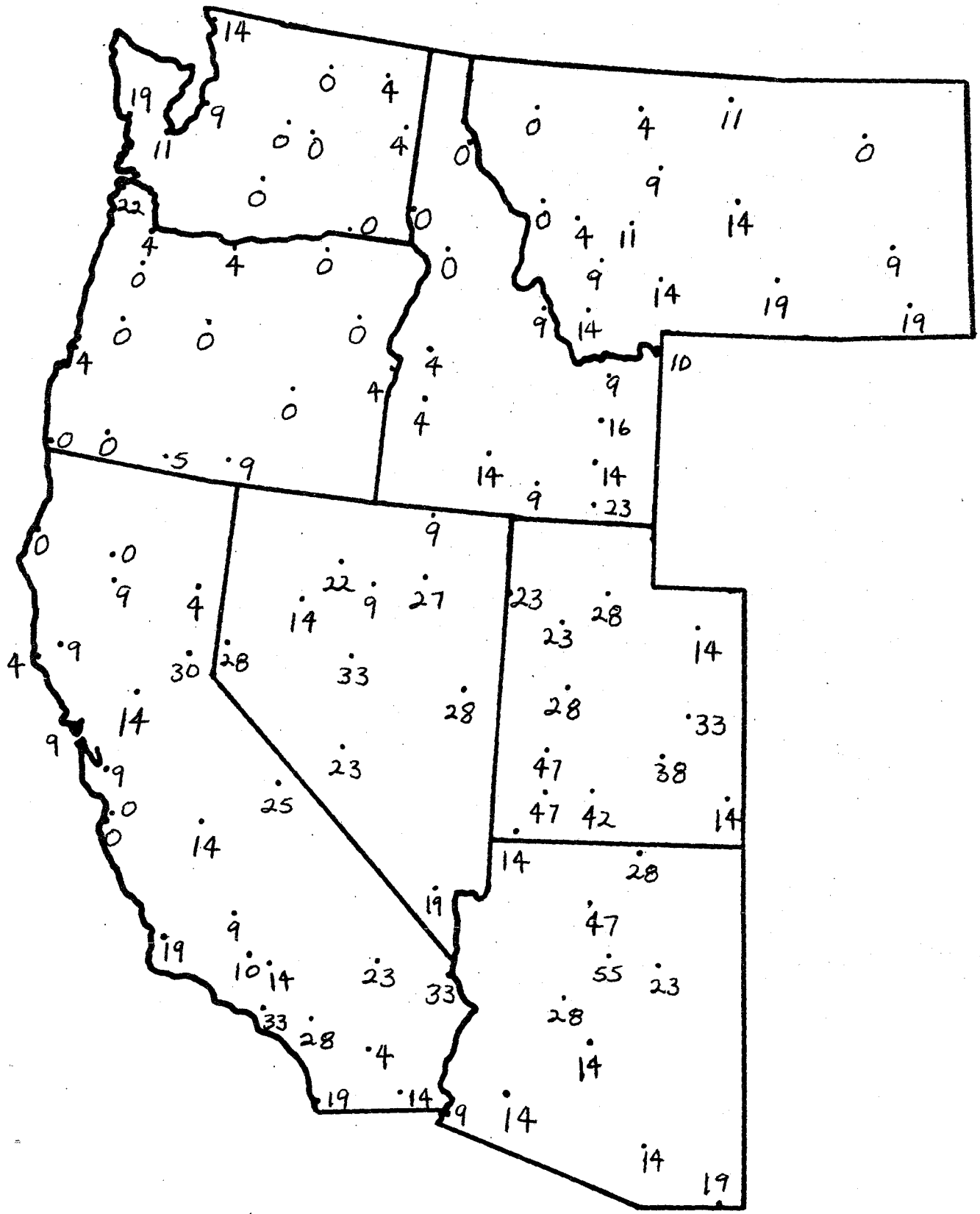
SPRING TYPE 7

12Z April 12, 1965
21 Cases



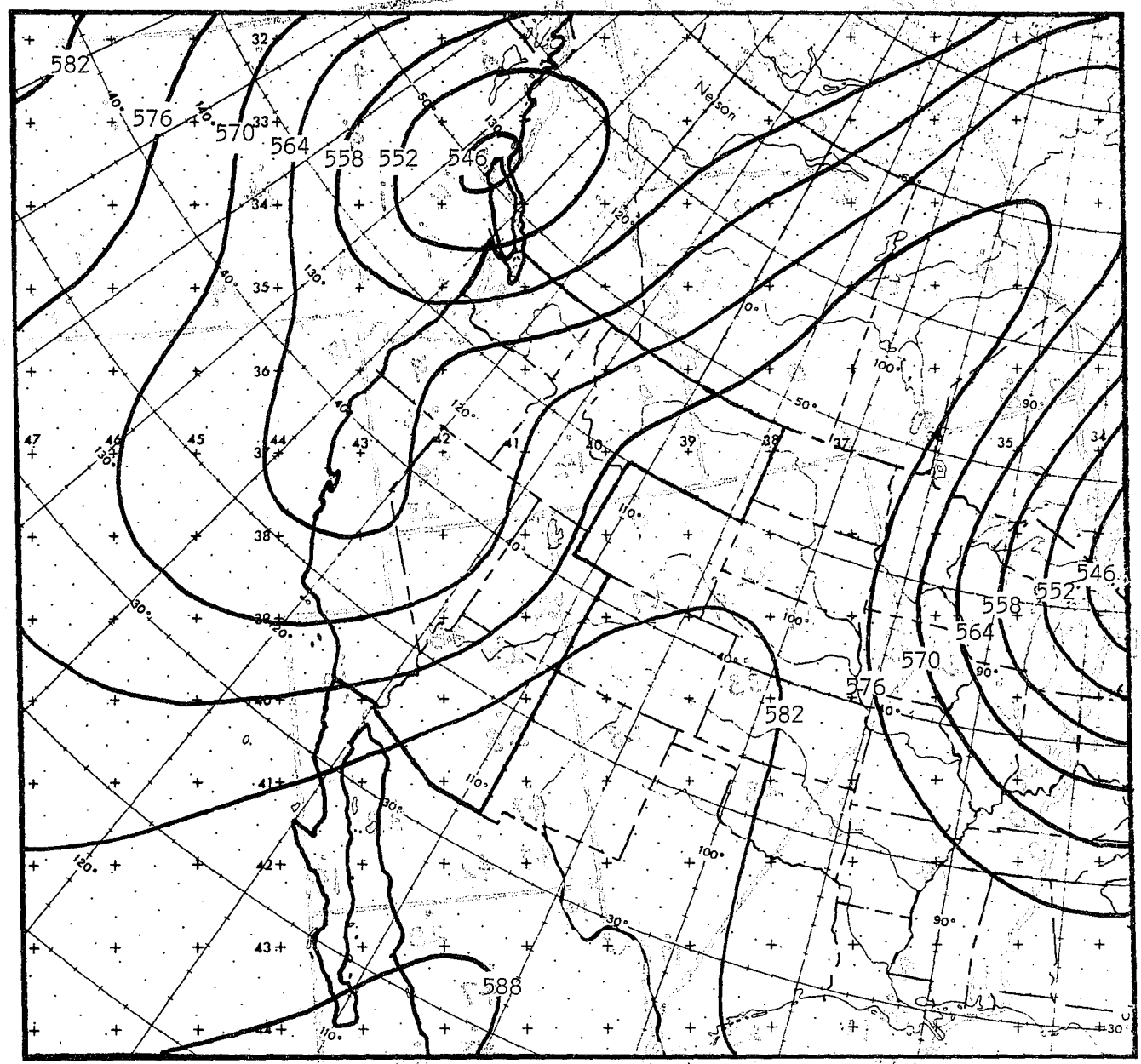
SPRING TYPE 7

Percent Frequency of Precipitation Occurrence



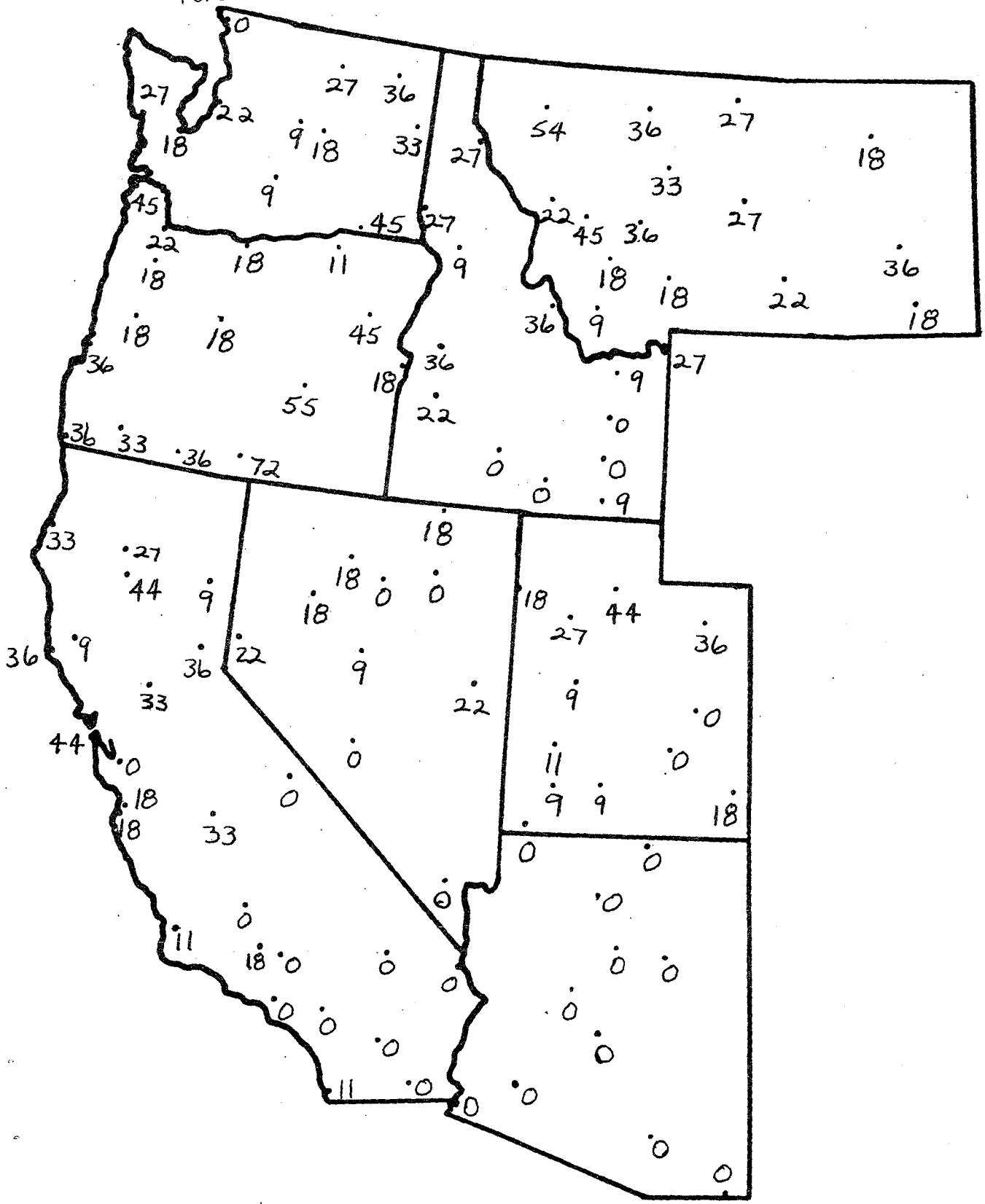
SPRING TYPE 8

12Z May 30, 1966
11 Cases



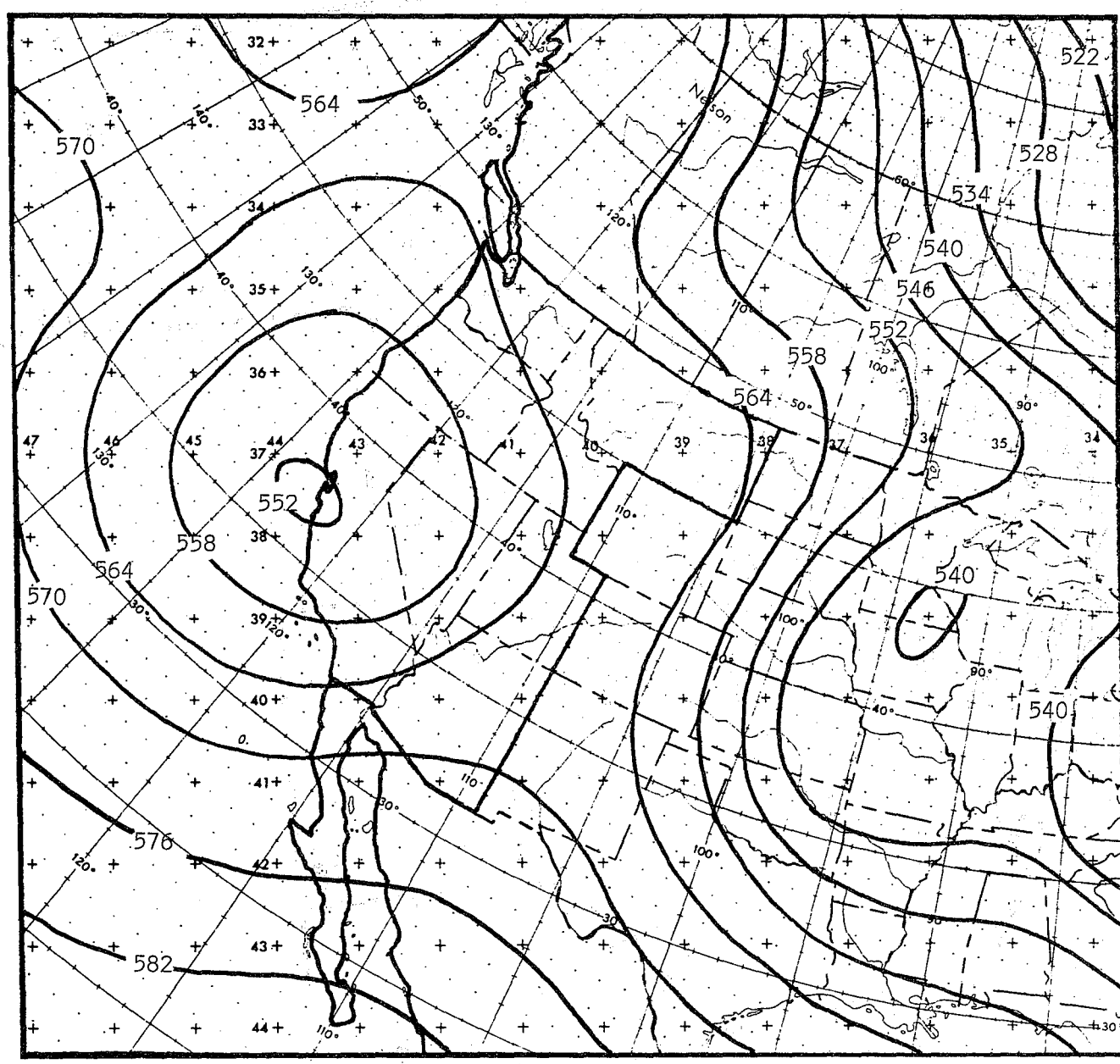
SPRING TYPE 8

Percent Frequency of Precipitation Occurrence



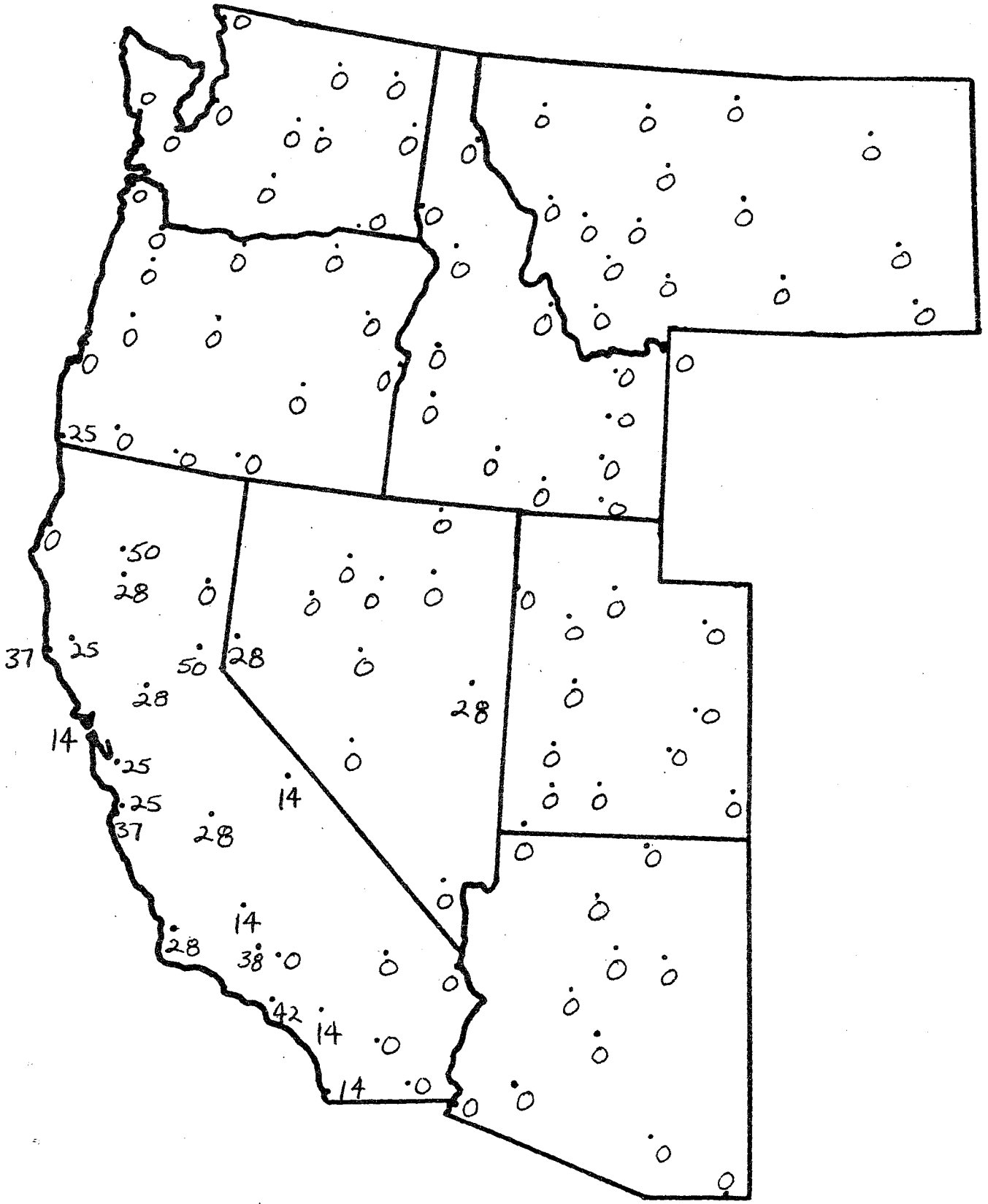
SPRING TYPE 9

00Z March 7, 1965
8 Cases



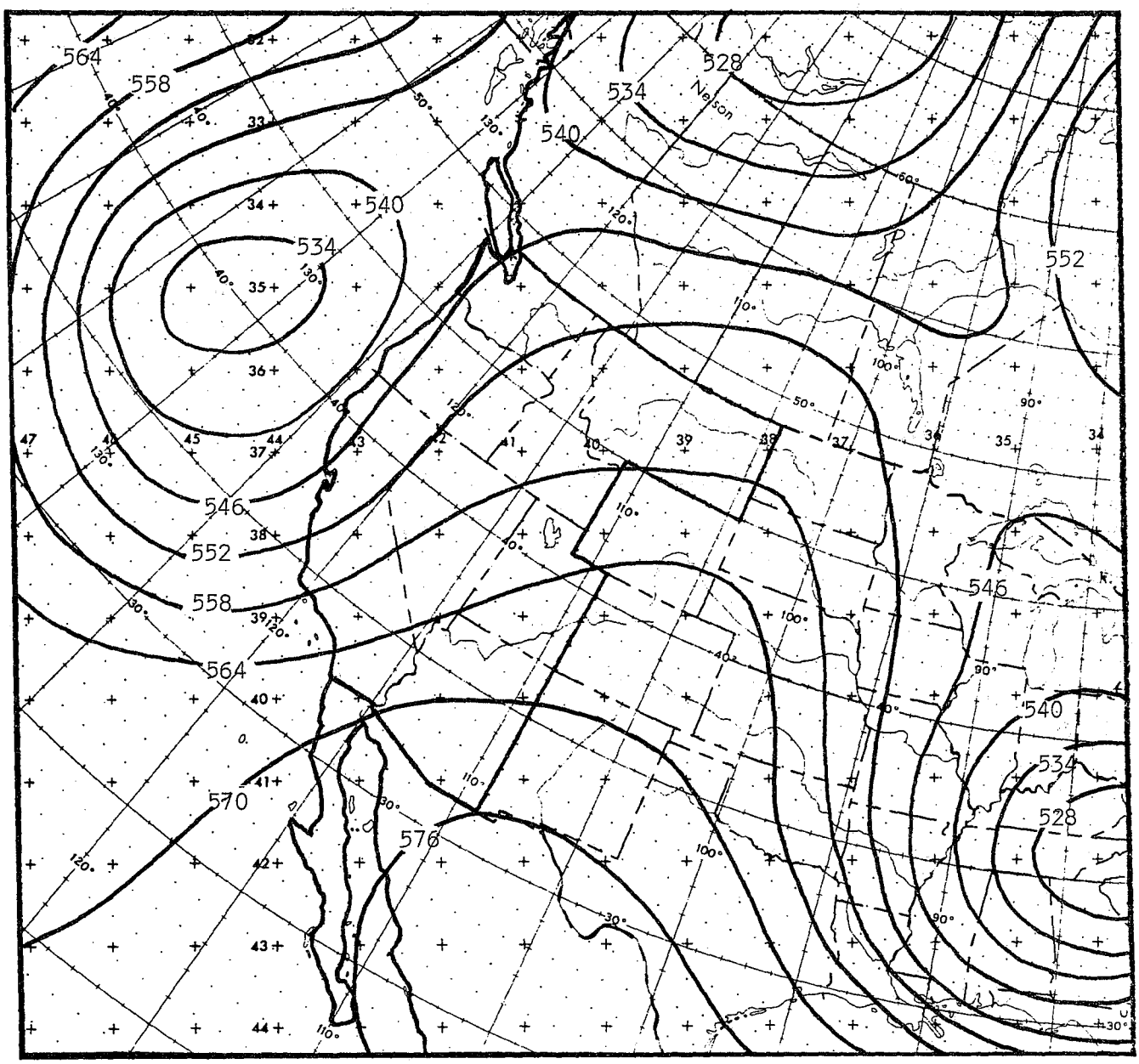
SPRING TYPE 9

Percent Frequency of Precipitation Occurrence



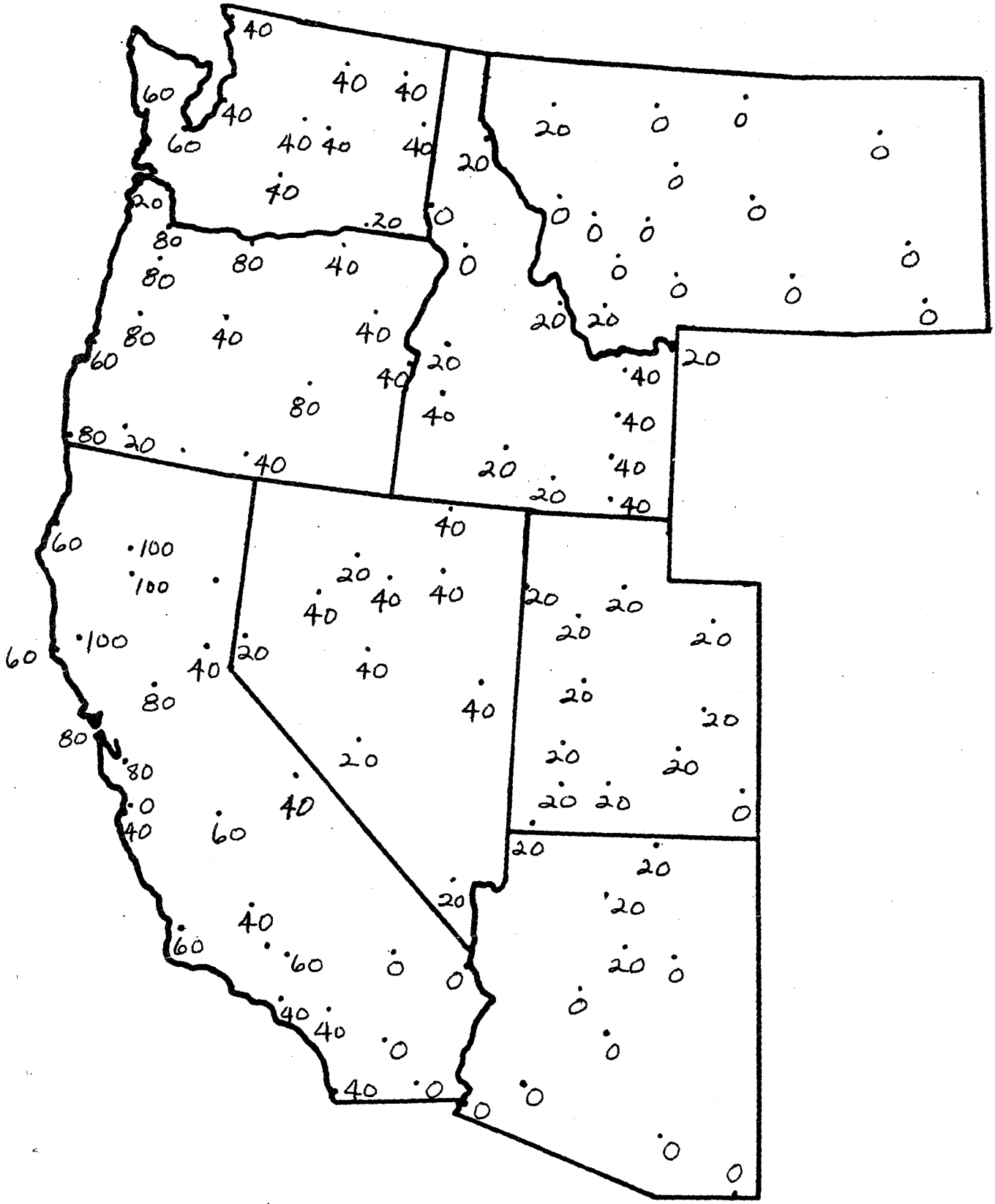
SPRING TYPE 10

00Z March 6, 1962
5 Cases



SPRING TYPE 10

Percent Frequency of Precipitation Occurrence



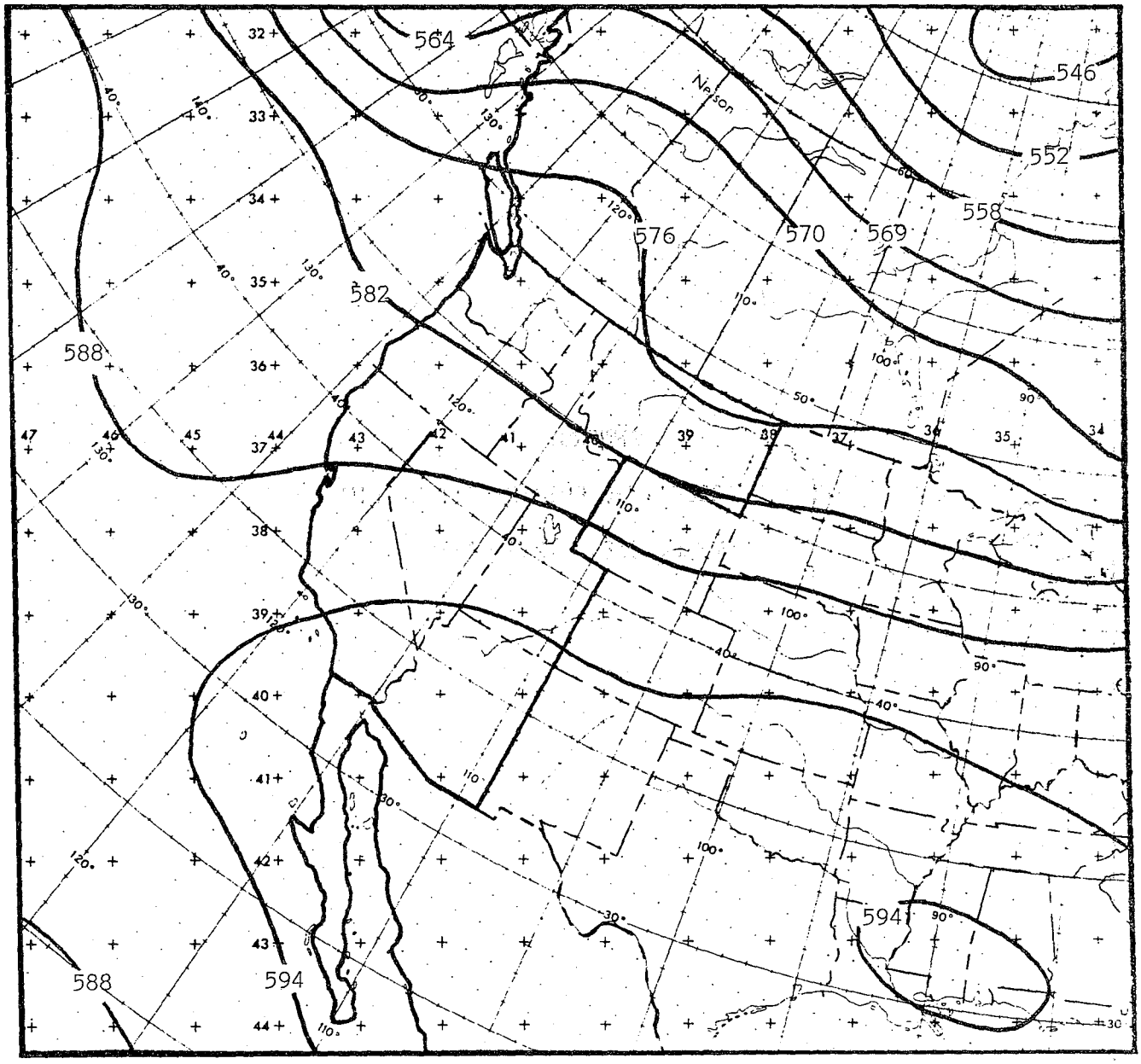
APPENDIX D

SUMMER TYPES AND ASSOCIATED PRECIPITATION CLIMATOLOGIES

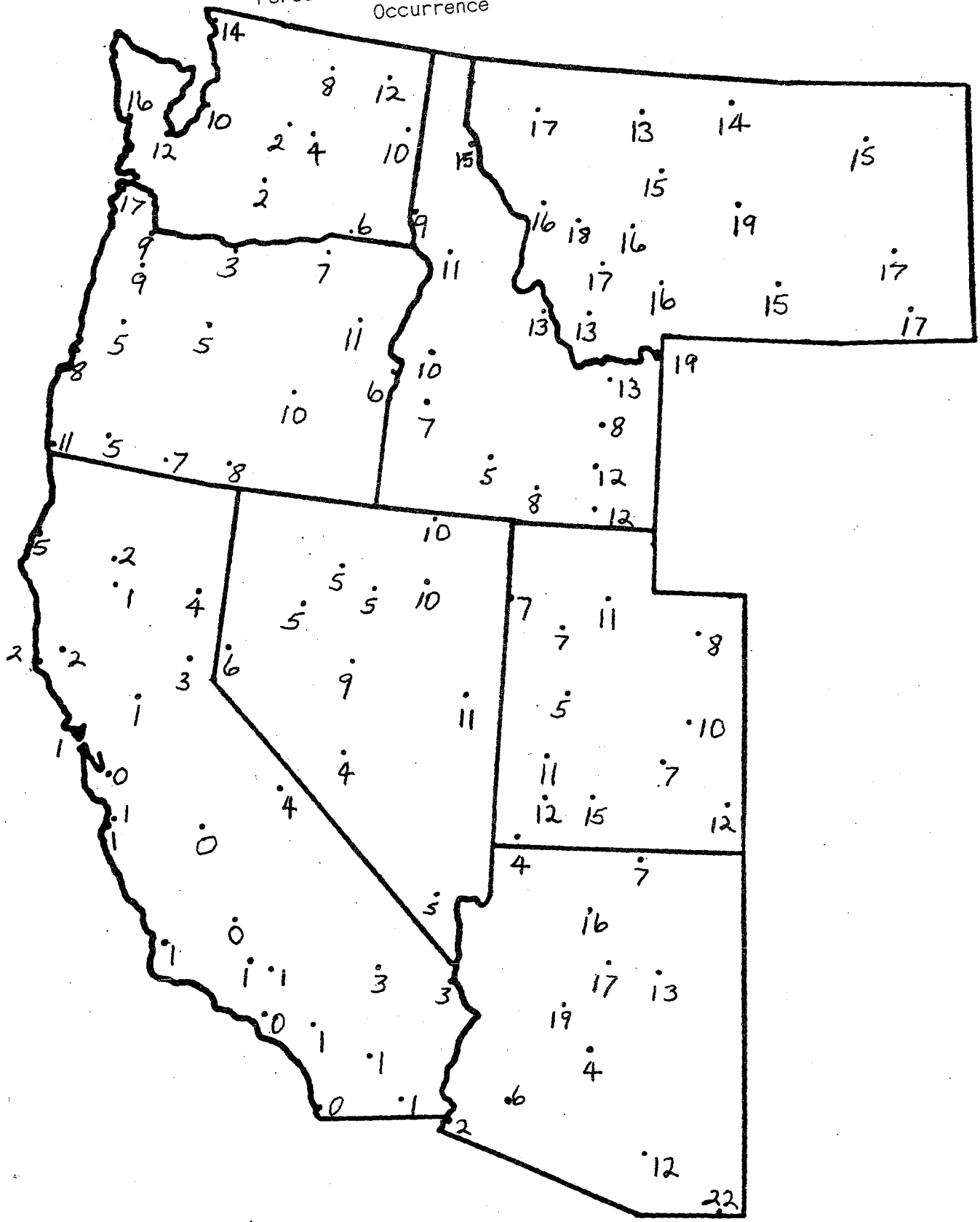
SAMPLE SIZE: 1223 CASES

SUMMER TYPE I

00Z July 19, 1963
663 Cases

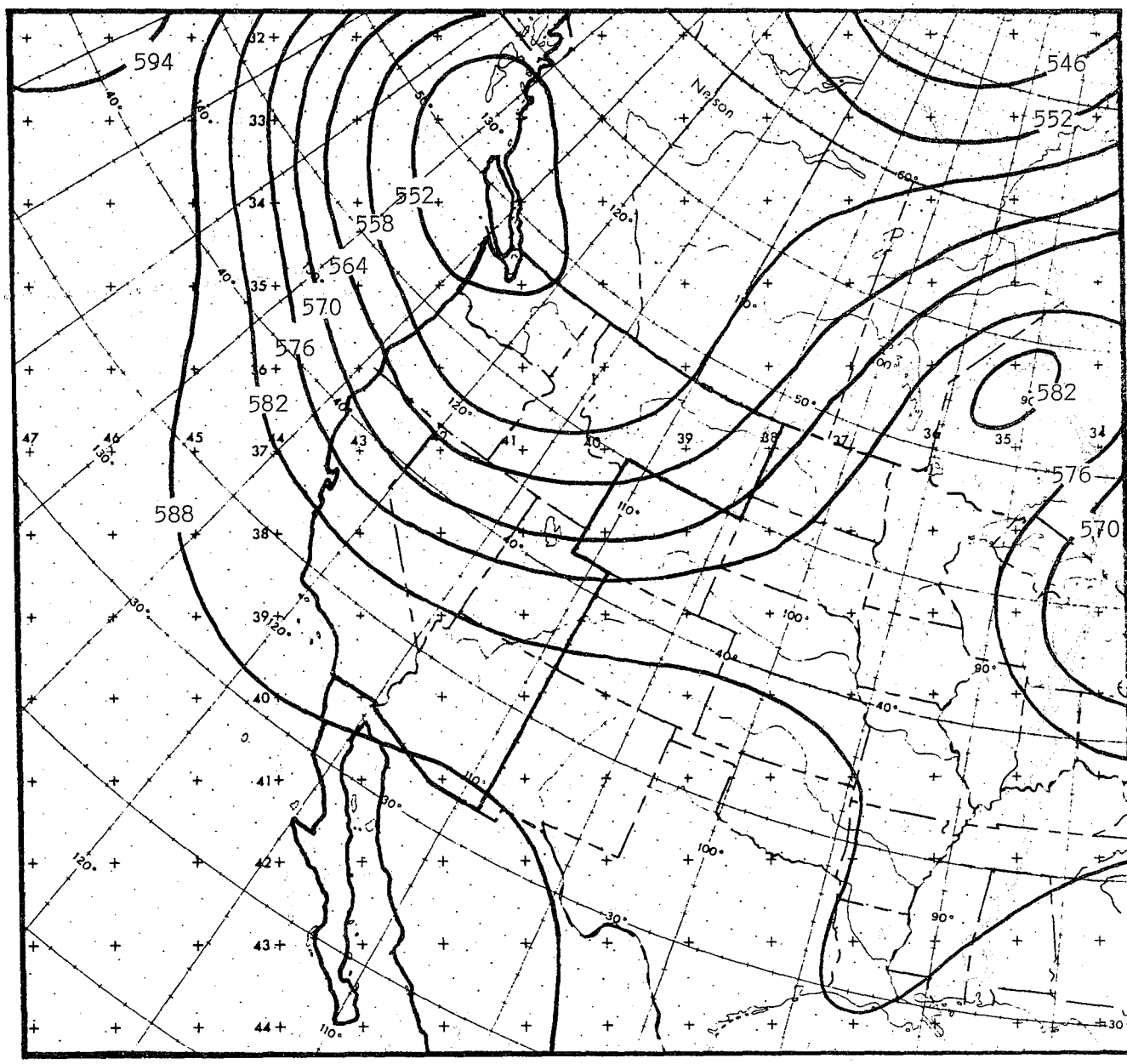


SUMMER TYPE I
Percent Frequency of Precipitation
Occurrence

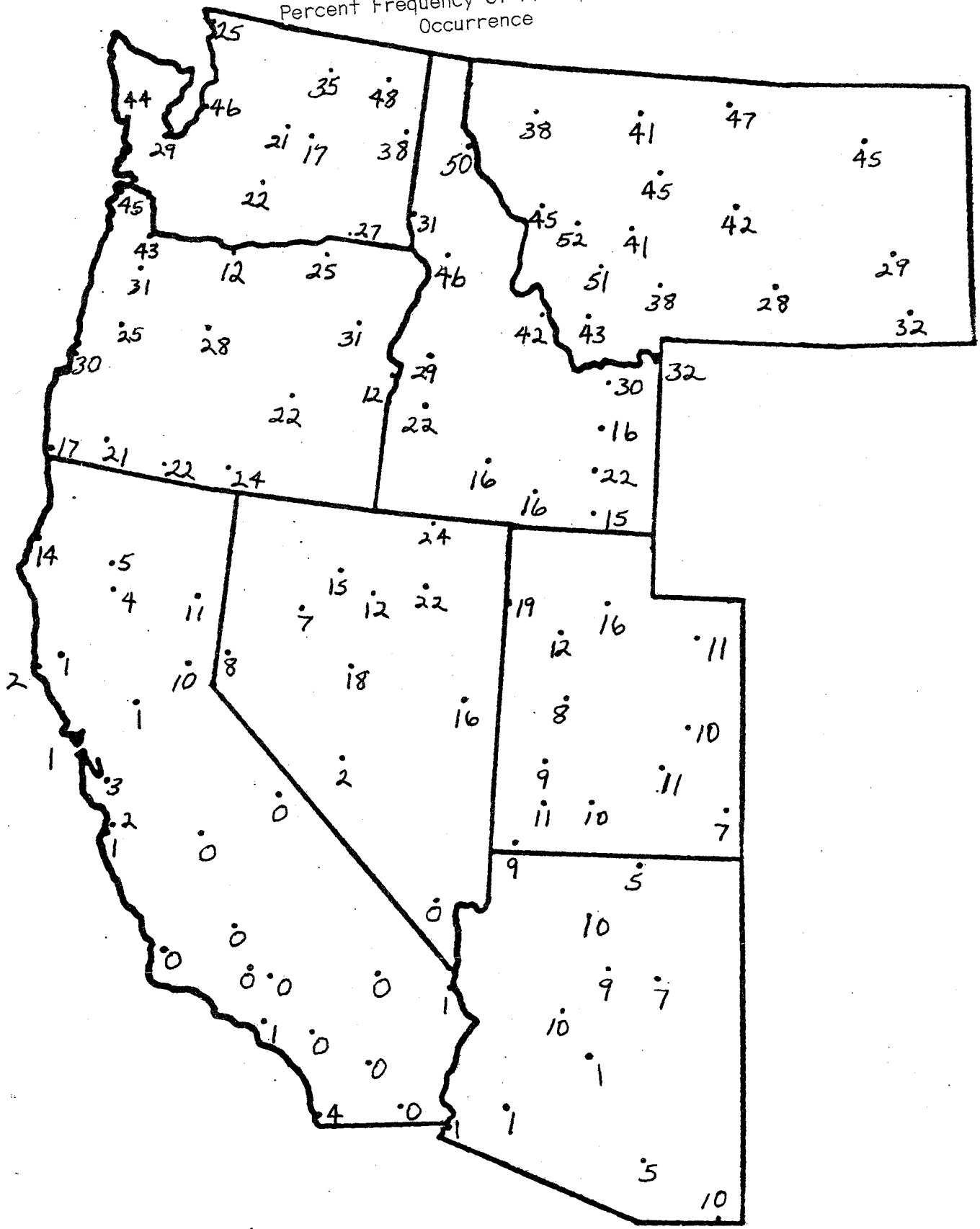


SUMMER TYPE 2

00Z June 22, 1963
78 Cases

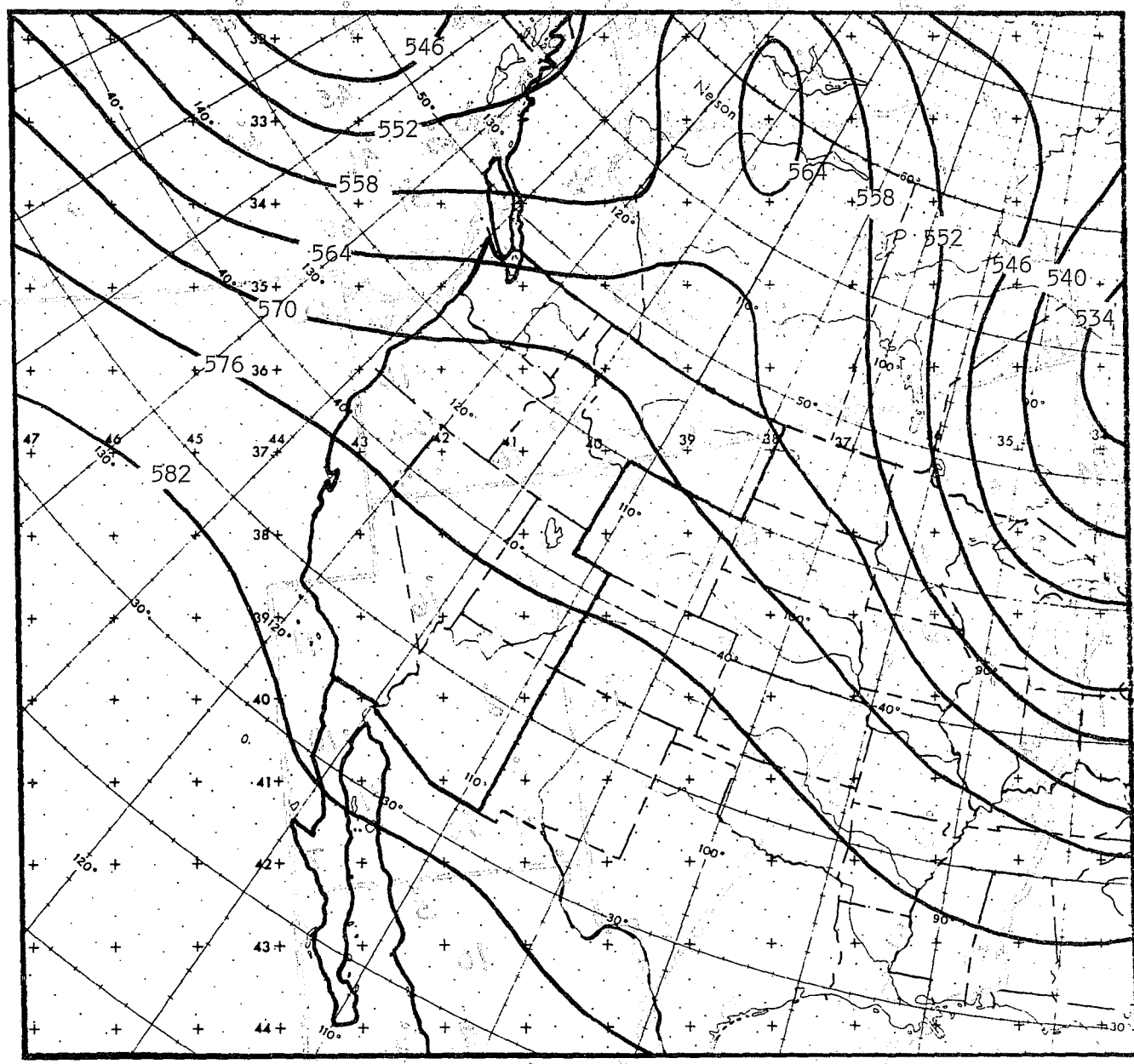


SUMMER TYPE 2
Percent Frequency of Precipitation
Occurrence

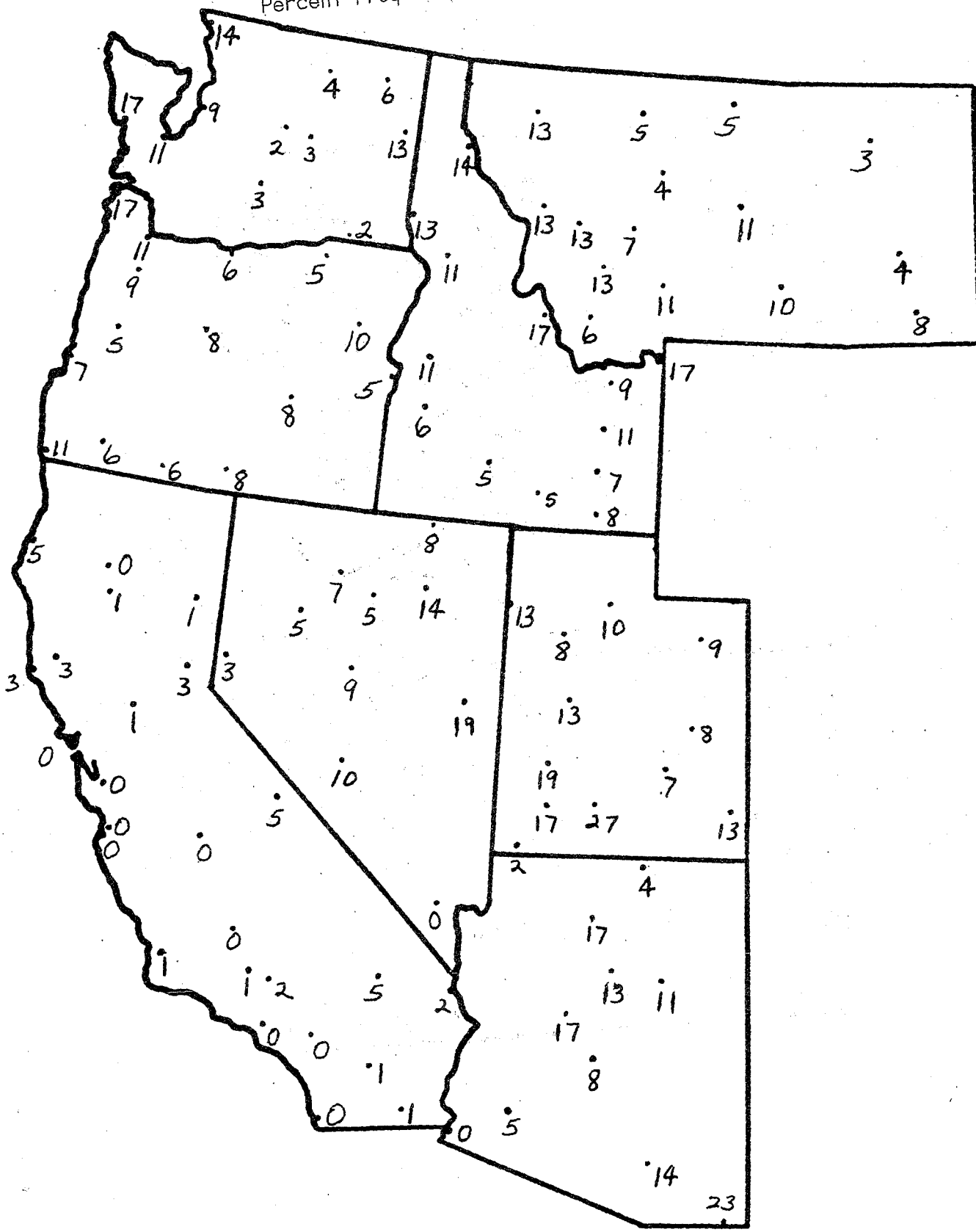


SUMMER TYPE 3

12Z June 3, 1964
135 Cases

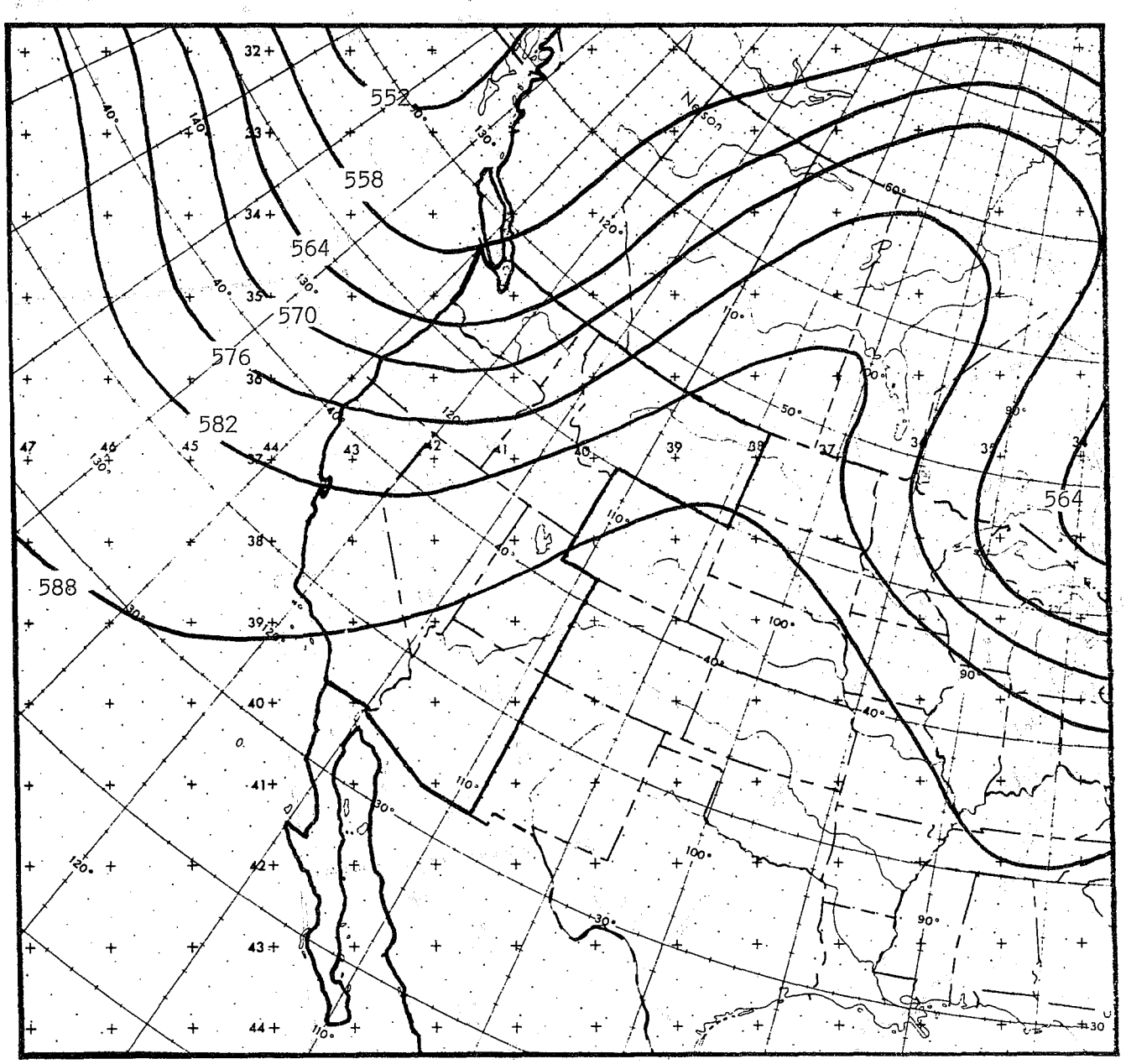


SUMMER TYPE 3
Percent Frequency of Precipitation Occurrence



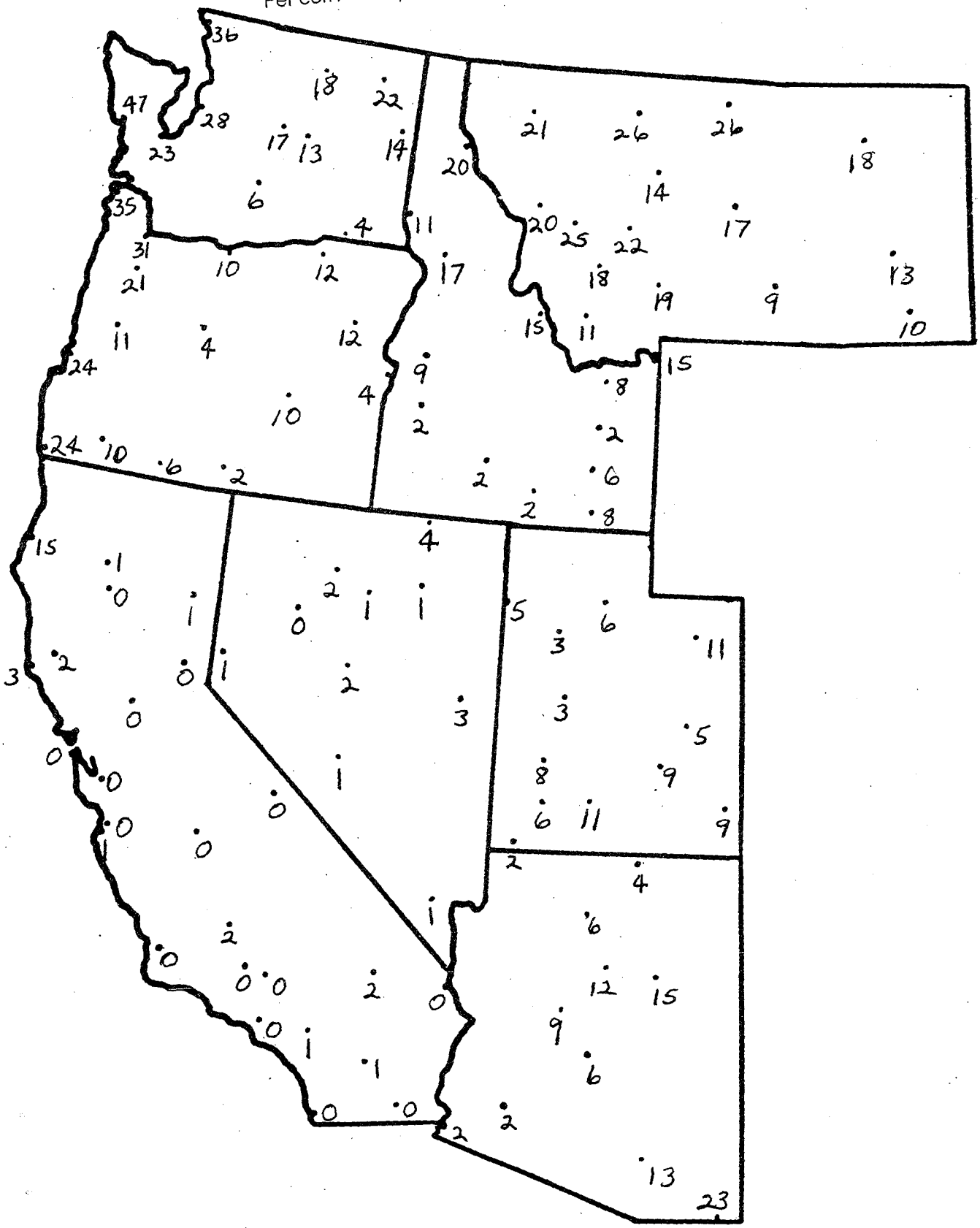
SUMMER TYPE 4

00Z August 26, 1968
86 Cases



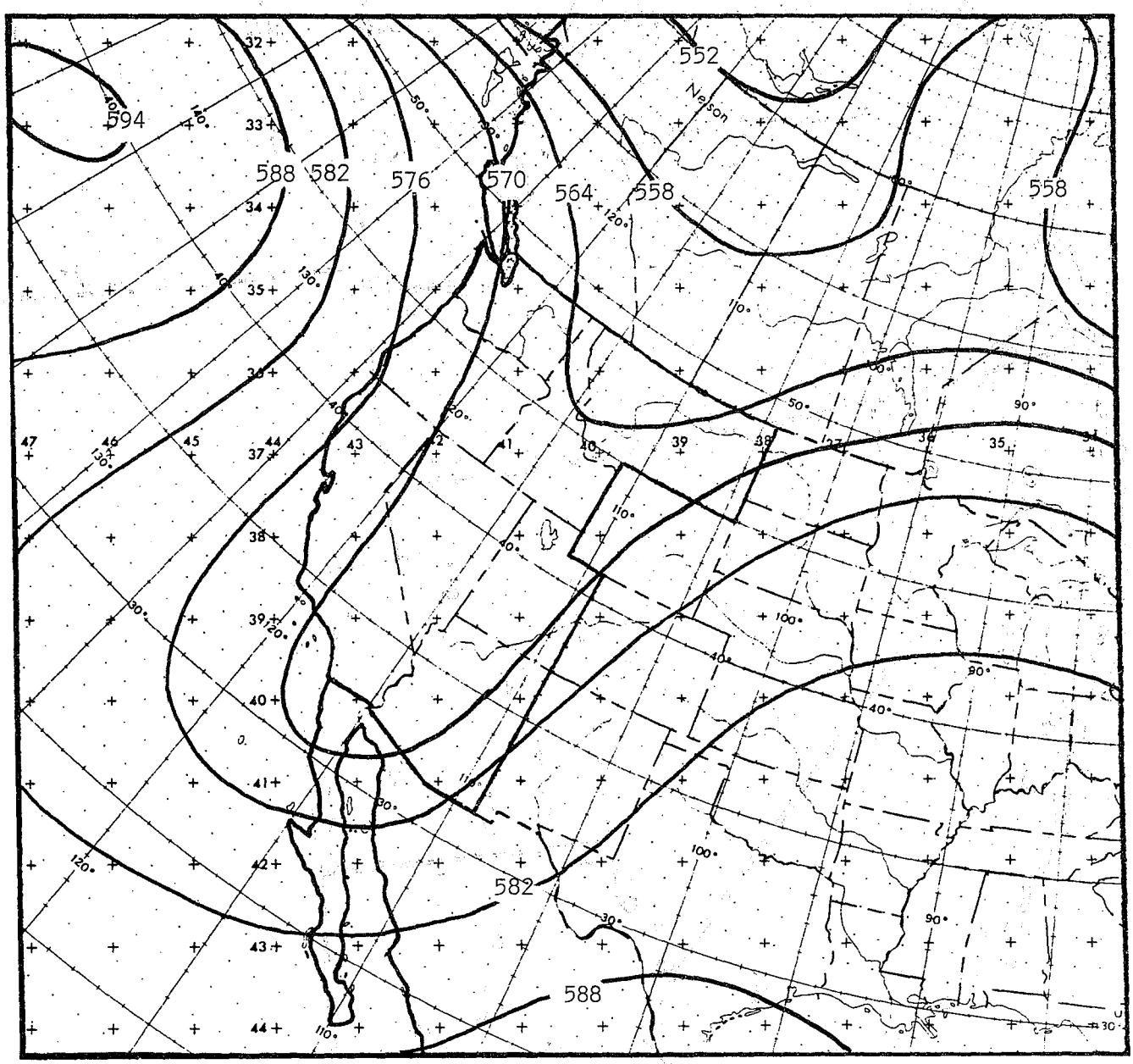
SUMMER TYPE 4

Percent Frequency of Precipitation Occurrence



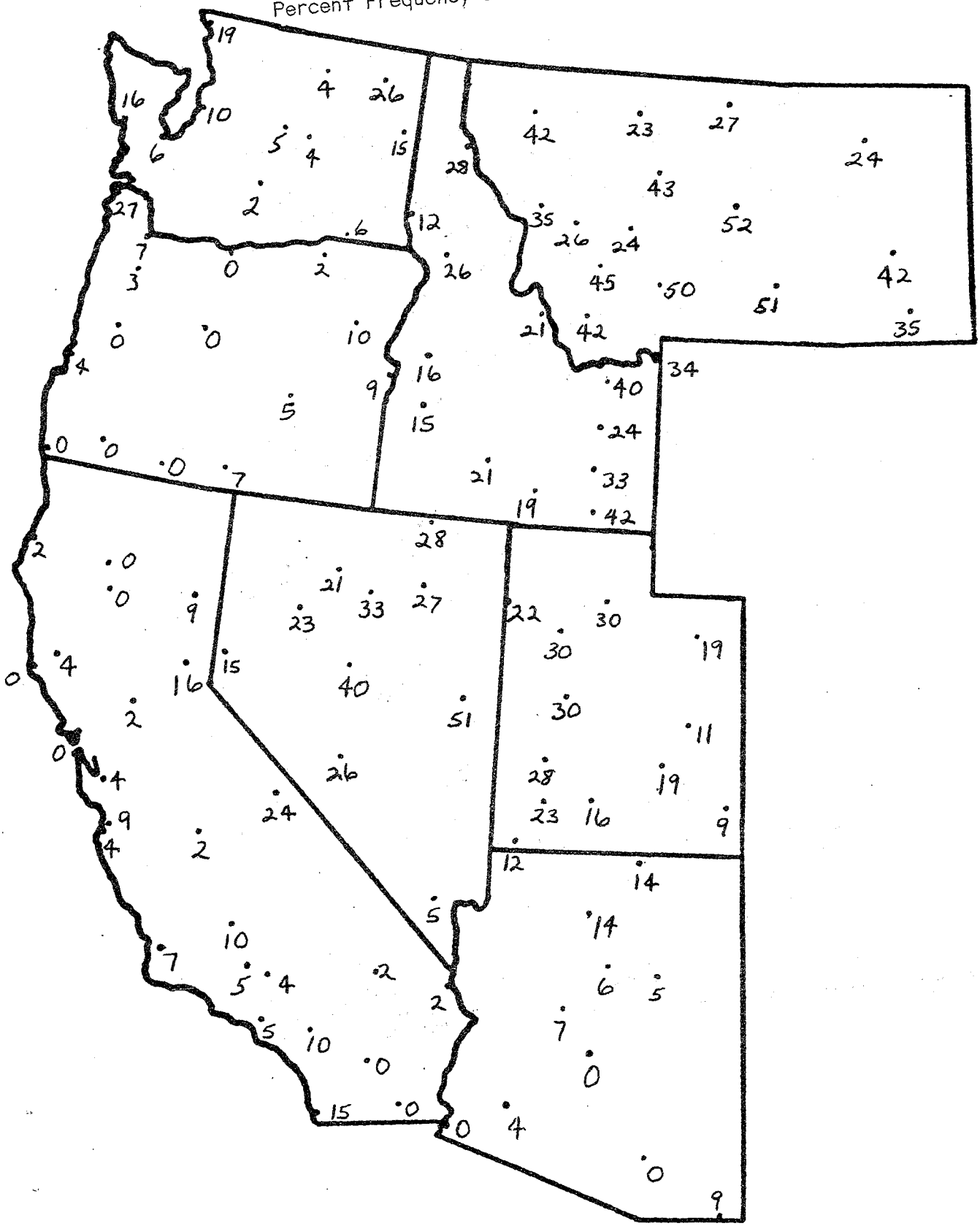
SUMMER TYPE 5

12Z June 8, 1963
42 Cases



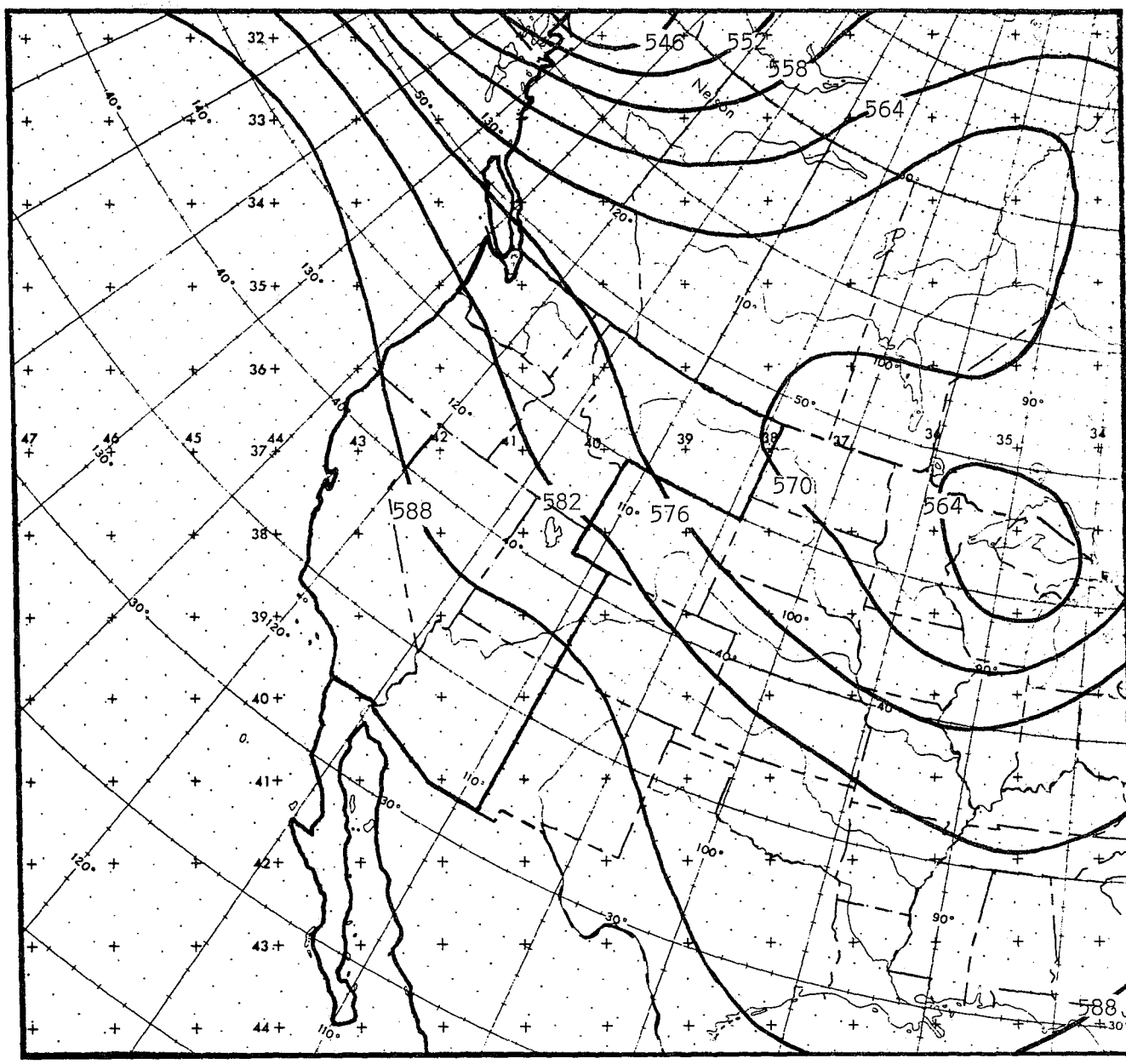
SUMMER TYPE 5

Percent Frequency of Precipitation Occurrence

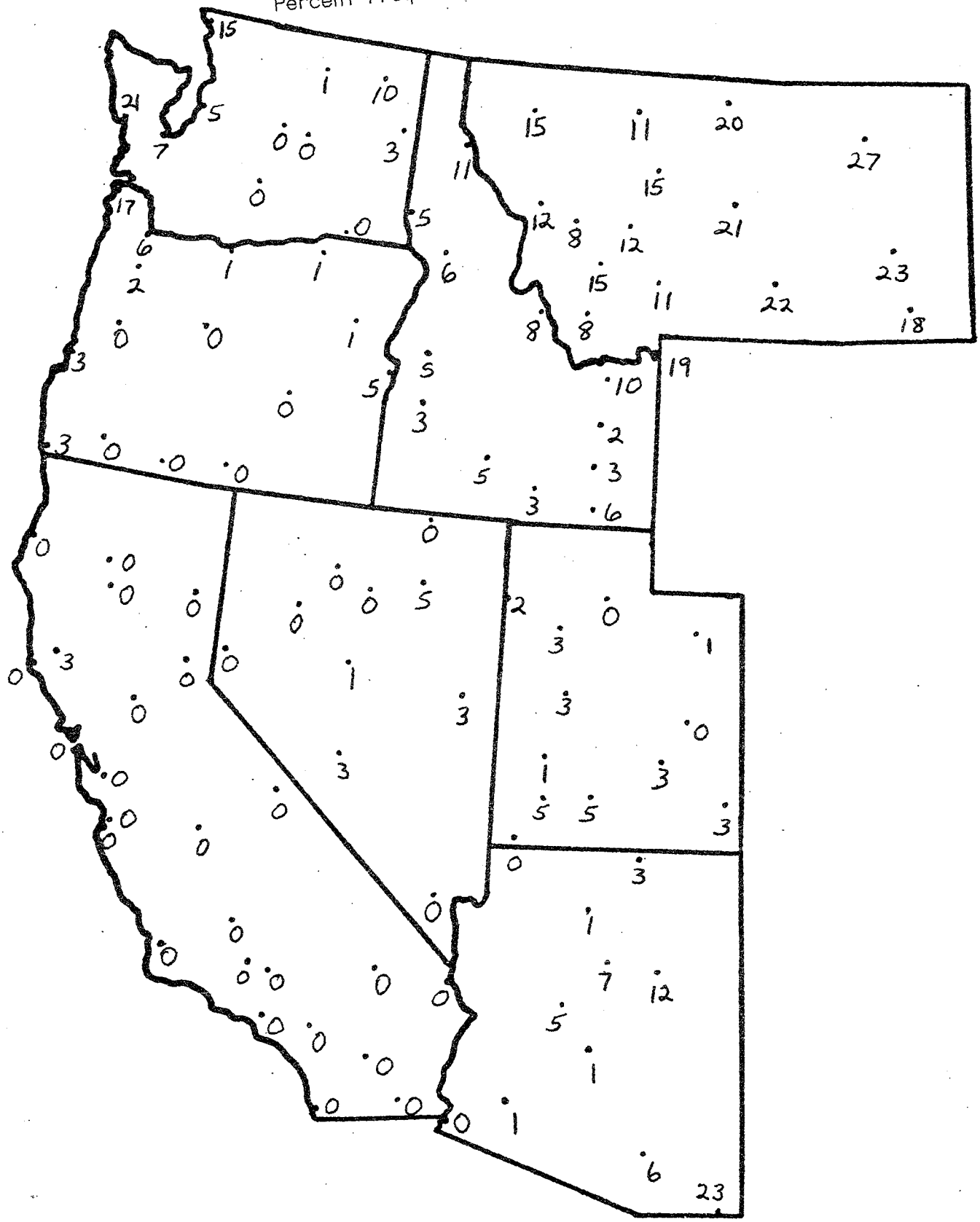


SUMMER TYPE 6

12Z August 9, 1966
60 Cases

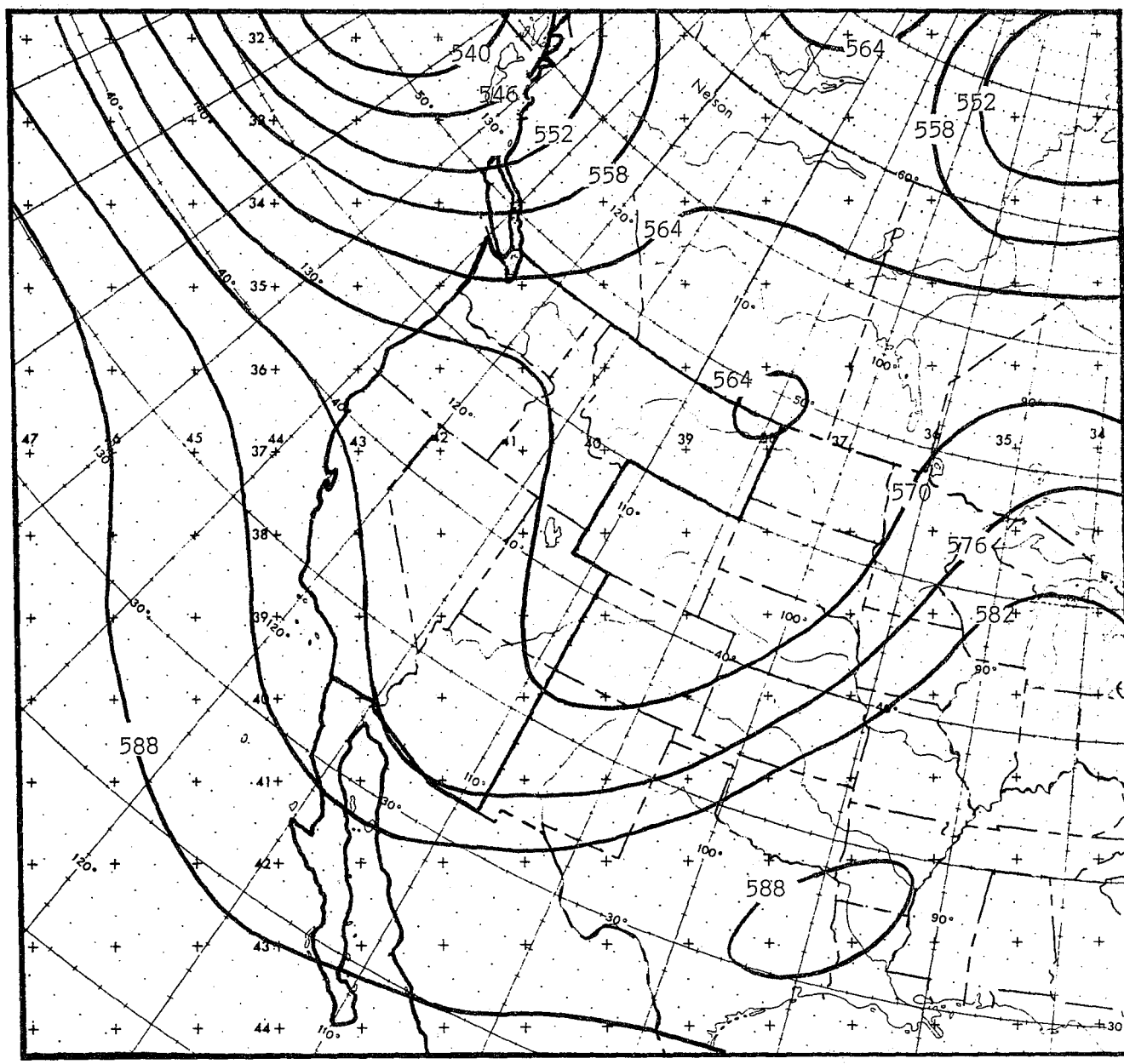


SUMMER TYPE 6
Percent Frequency of Precipitation Occurrence

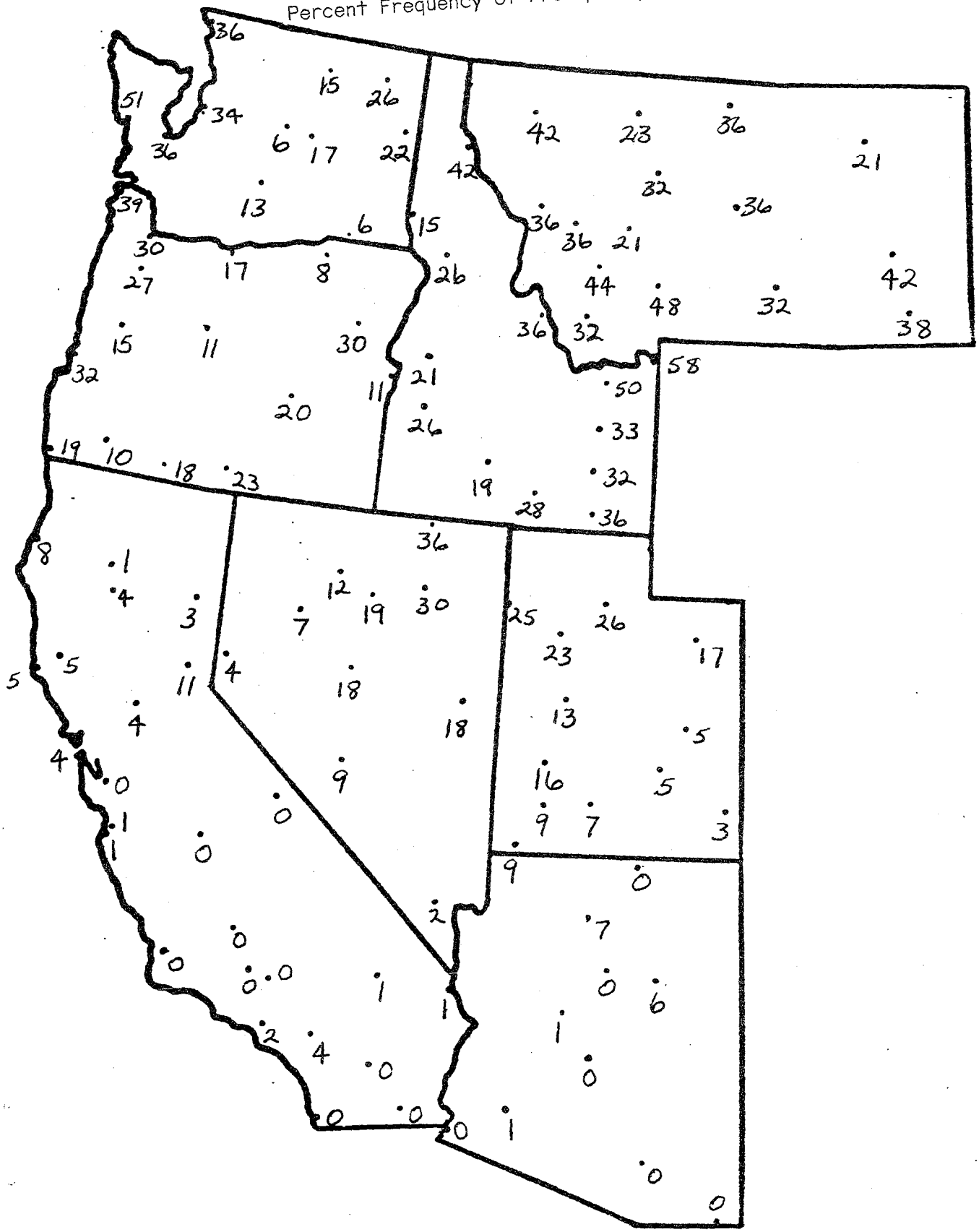


SUMMER TYPE 7

12Z June 10, 1968
52 Cases

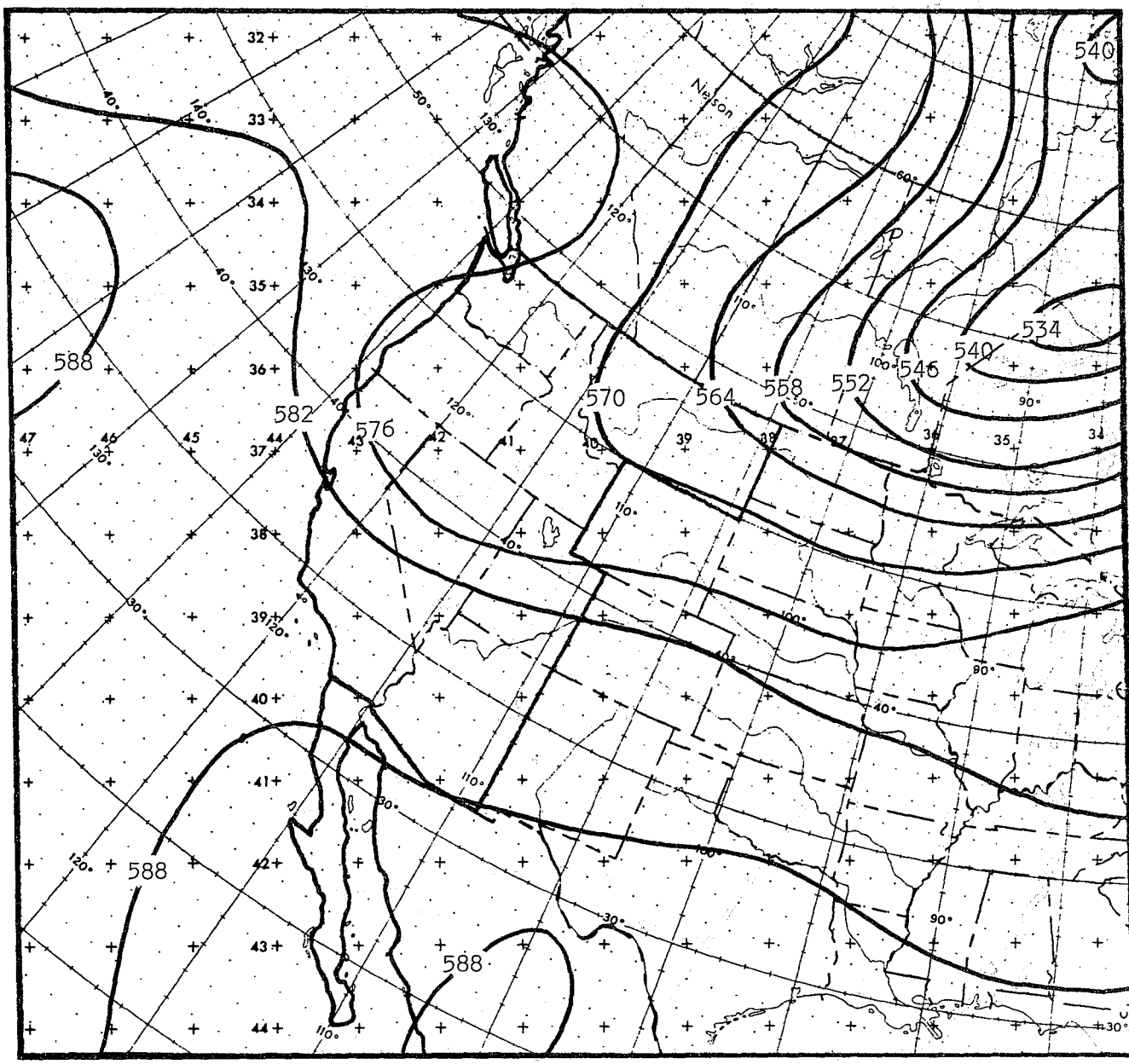


SUMMER TYPE 7
Percent Frequency of Precipitation Occurrence

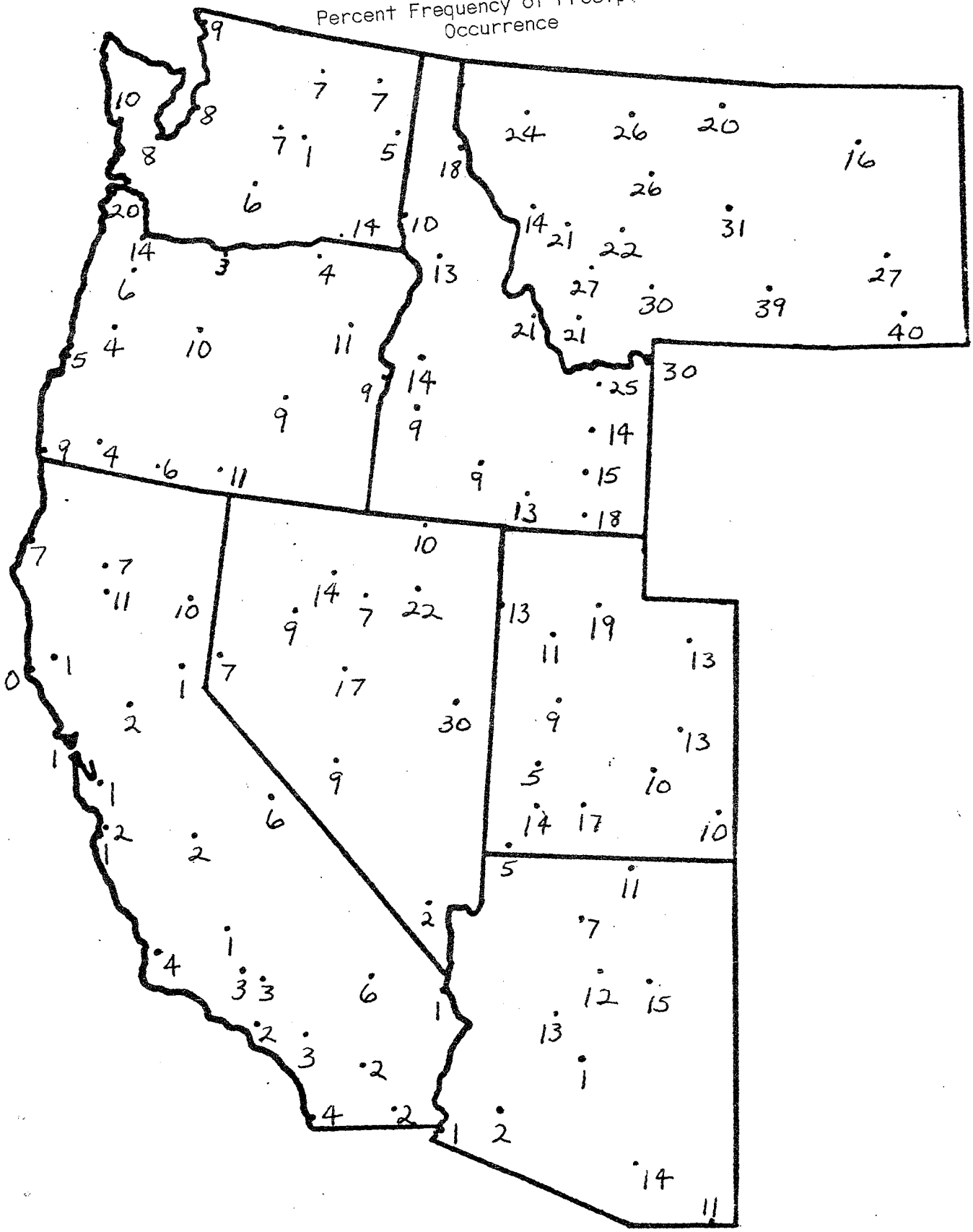


SUMMER TYPE 8

00Z June 23, 1967
76 Cases

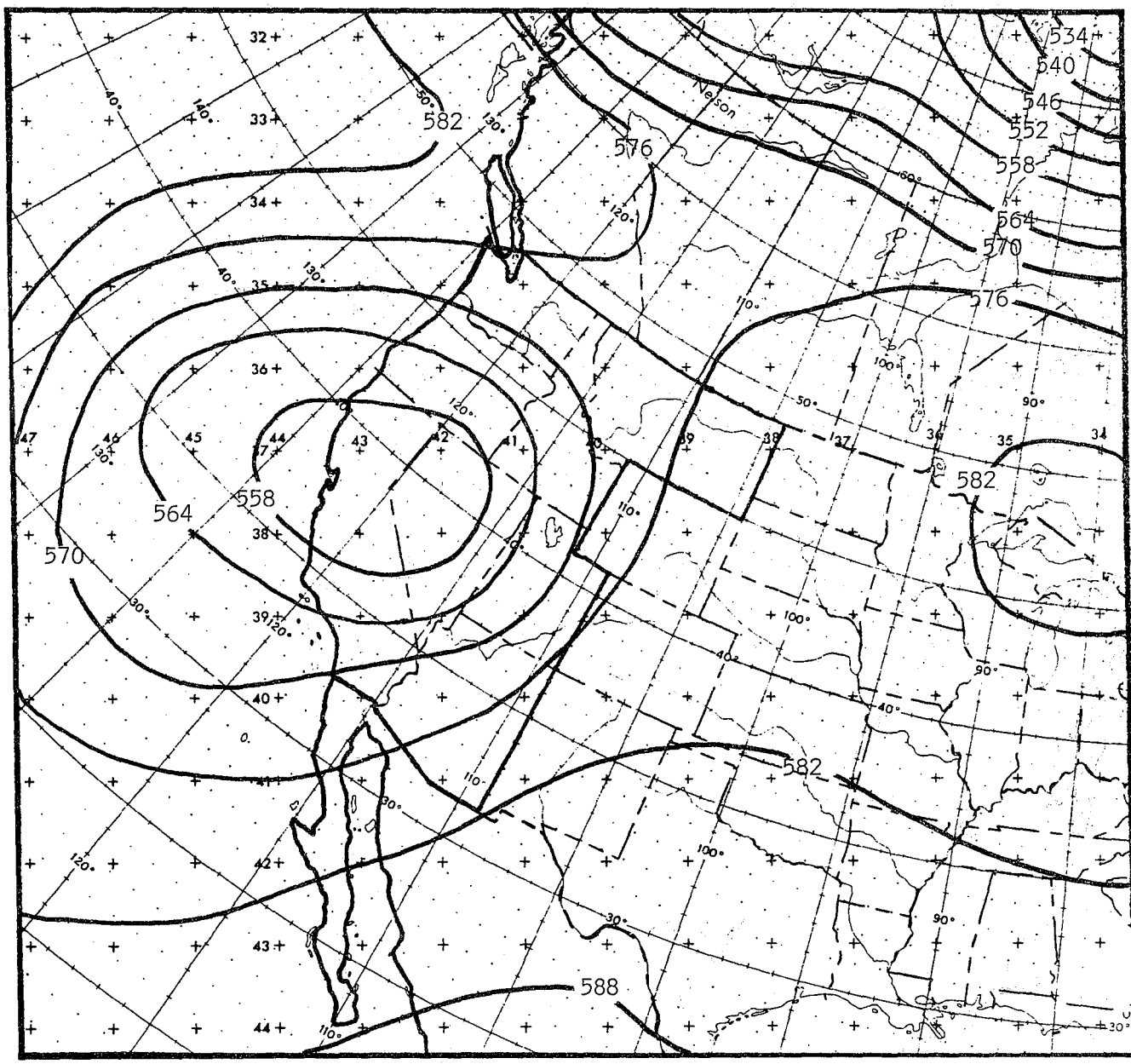


SUMMER TYPE 8
Percent Frequency of Precipitation
Occurrence



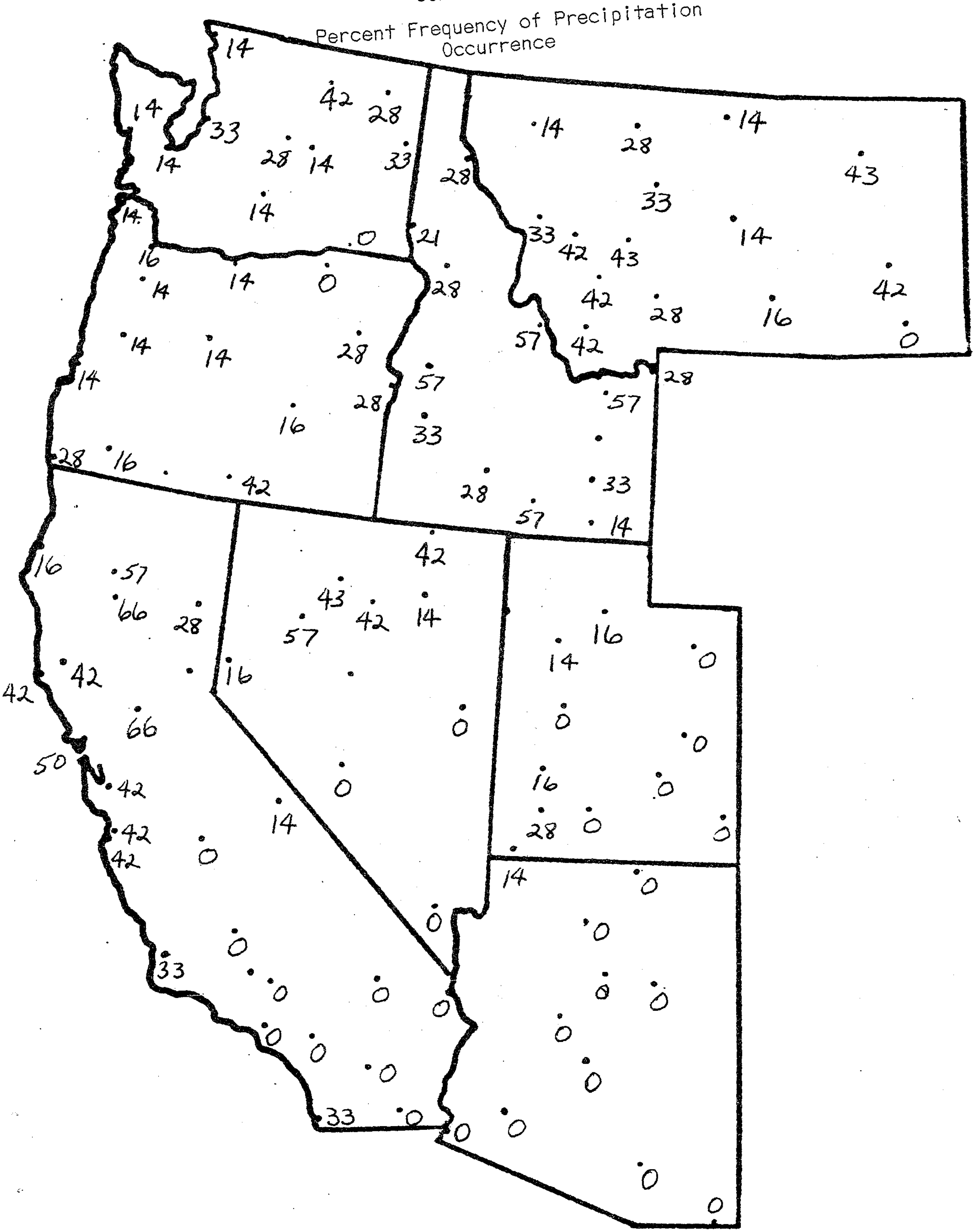
SUMMER TYPE 9

00Z June 2, 1967
7 Cases



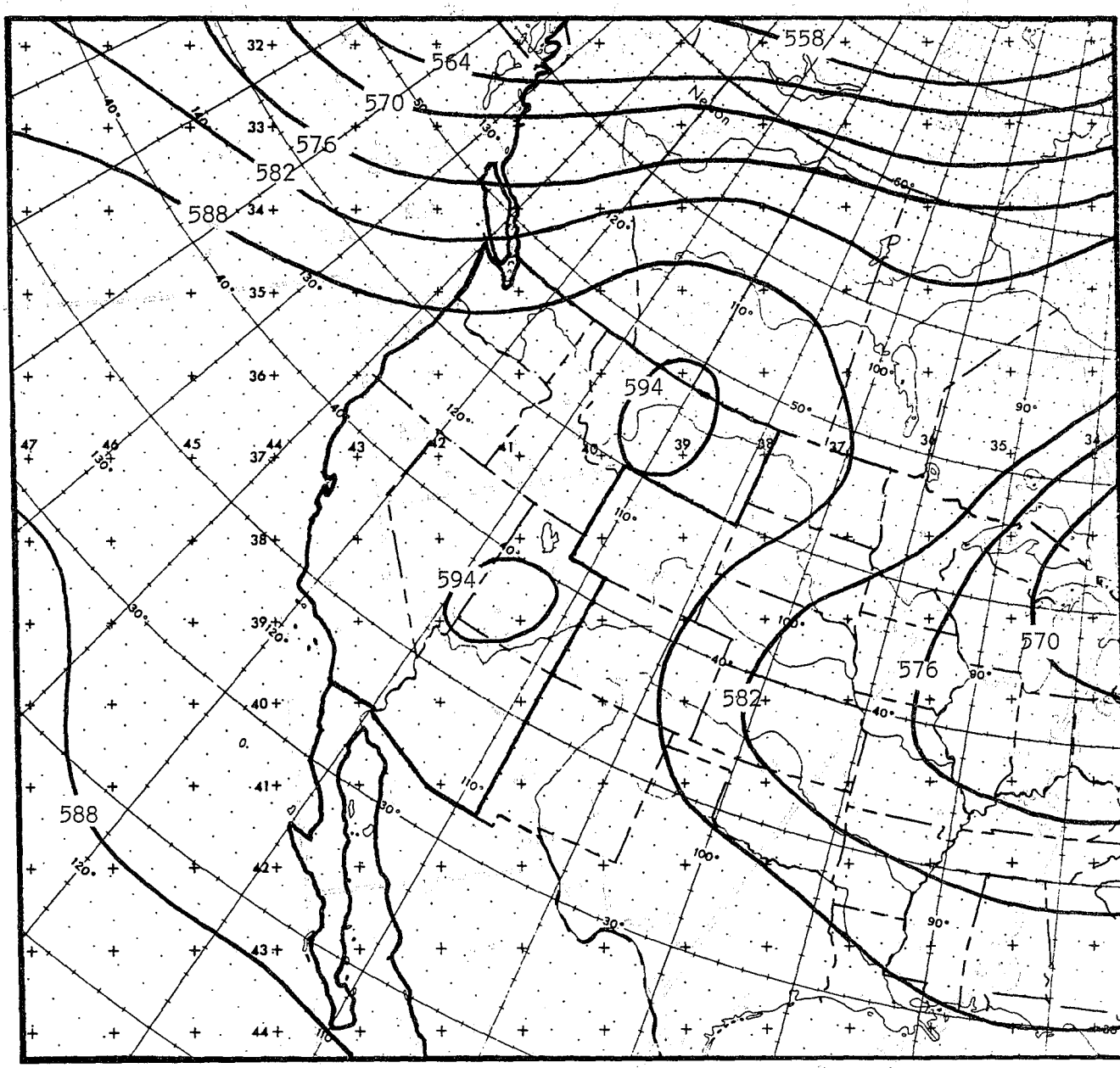
SUMMER TYPE 9

Percent Frequency of Precipitation Occurrence



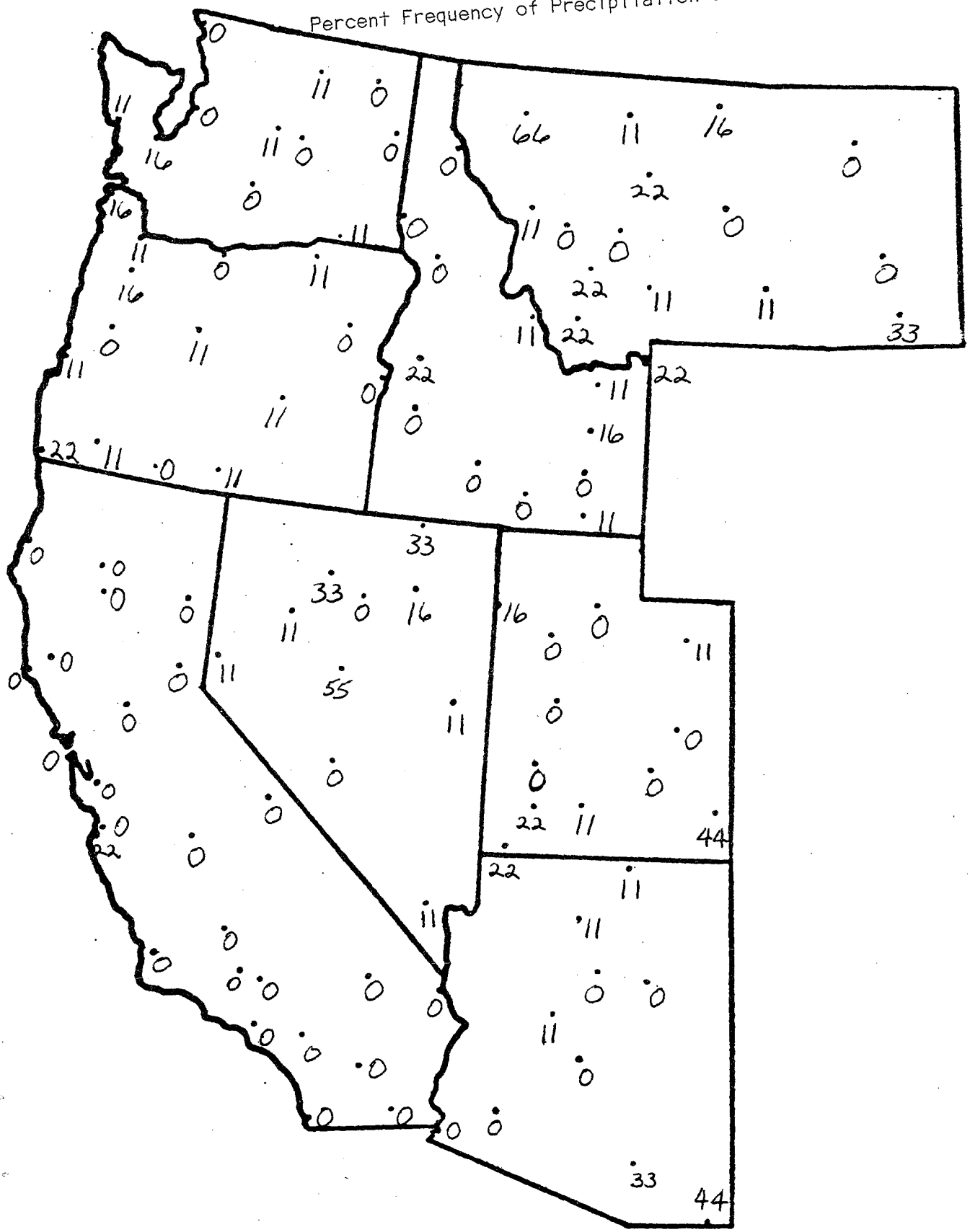
SUMMER TYPE 10

12Z July 12, 1964
9 Cases



SUMMER TYPE 10

Percent Frequency of Precipitation Occurrence



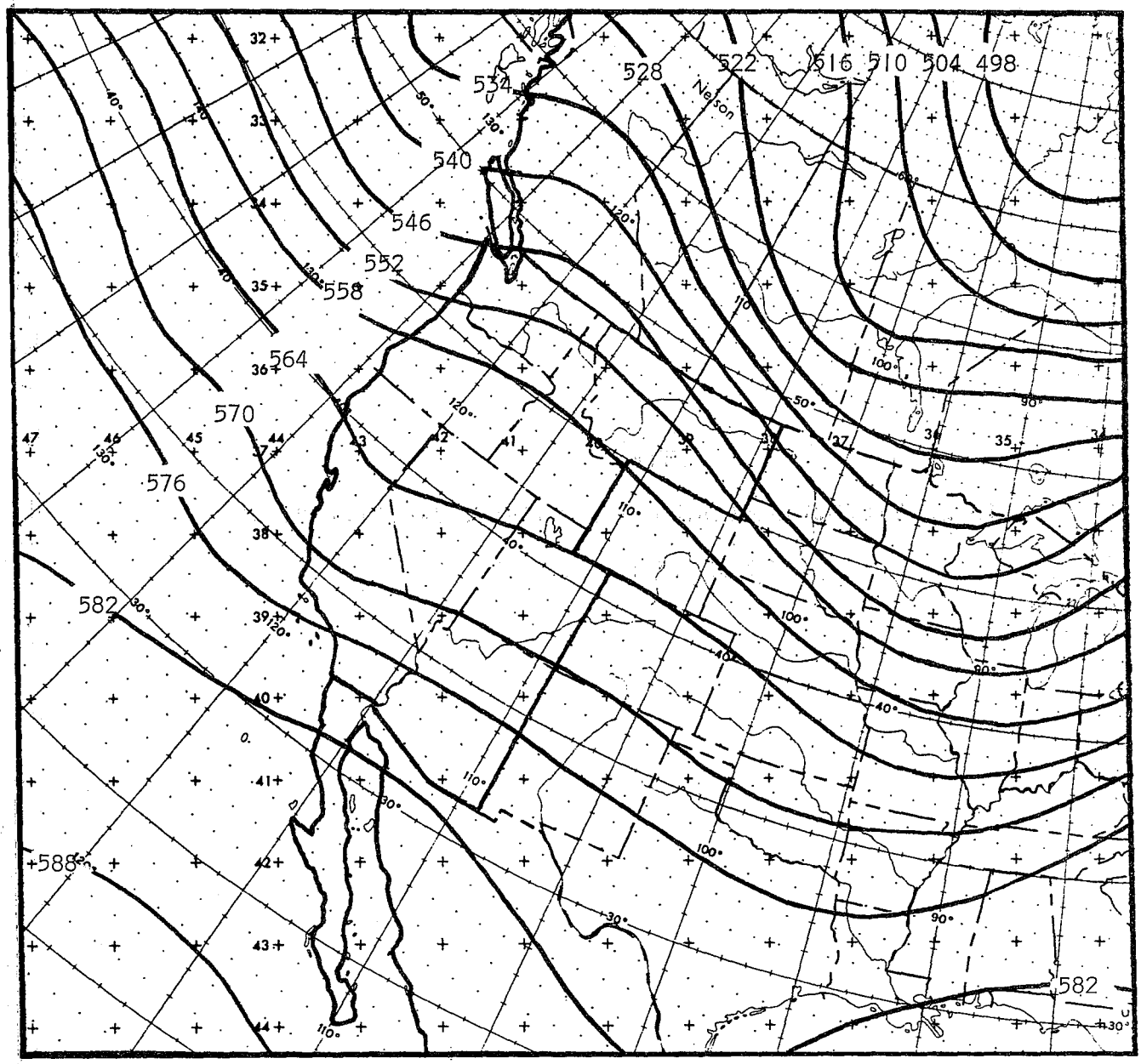
APPENDIX E

FALL TYPES AND ASSOCIATED PRECIPITATION AND CLIMATOLOGIES

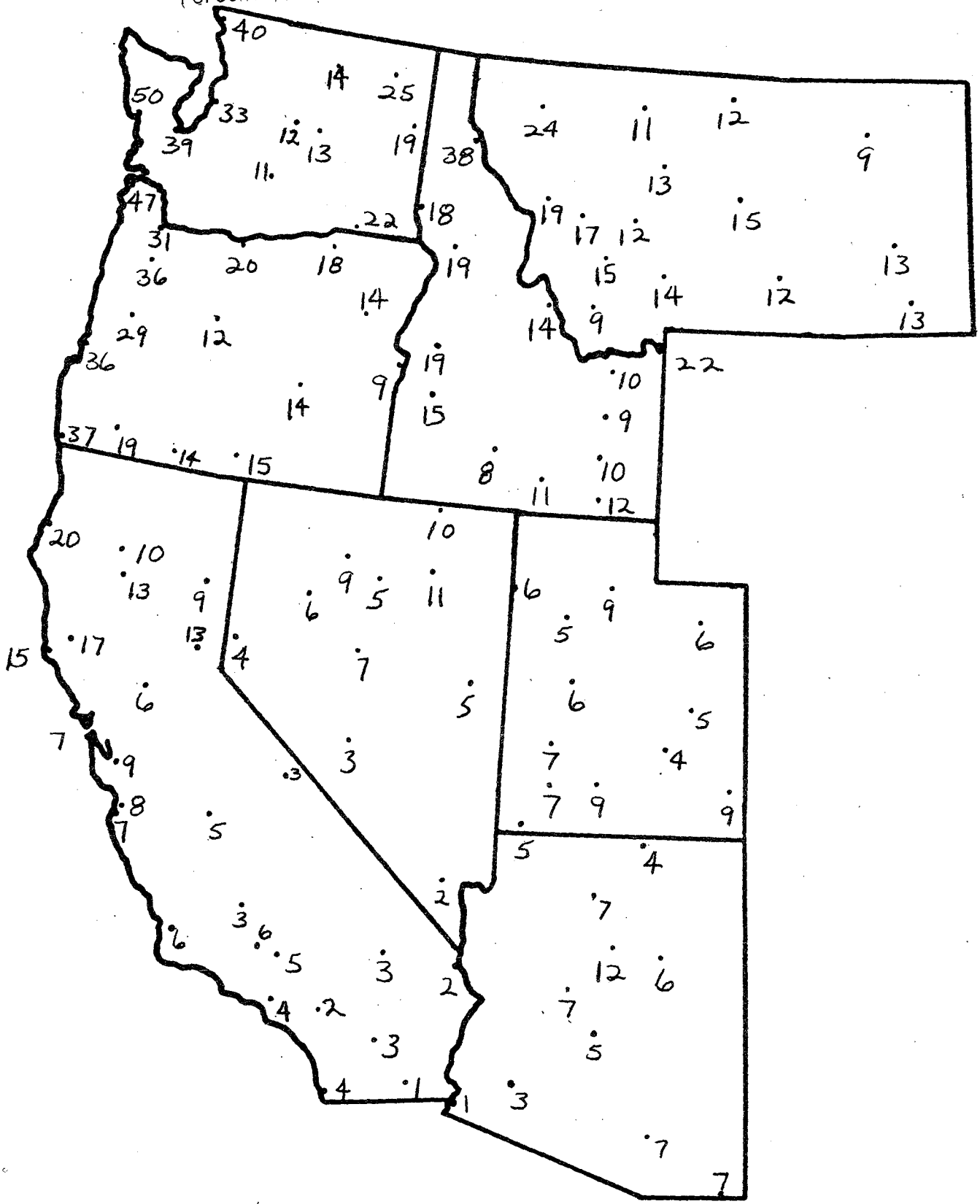
SAMPLE SIZE: 1231 CASES

FALL TYPE I

00Z November 12, 1966
754 Cases

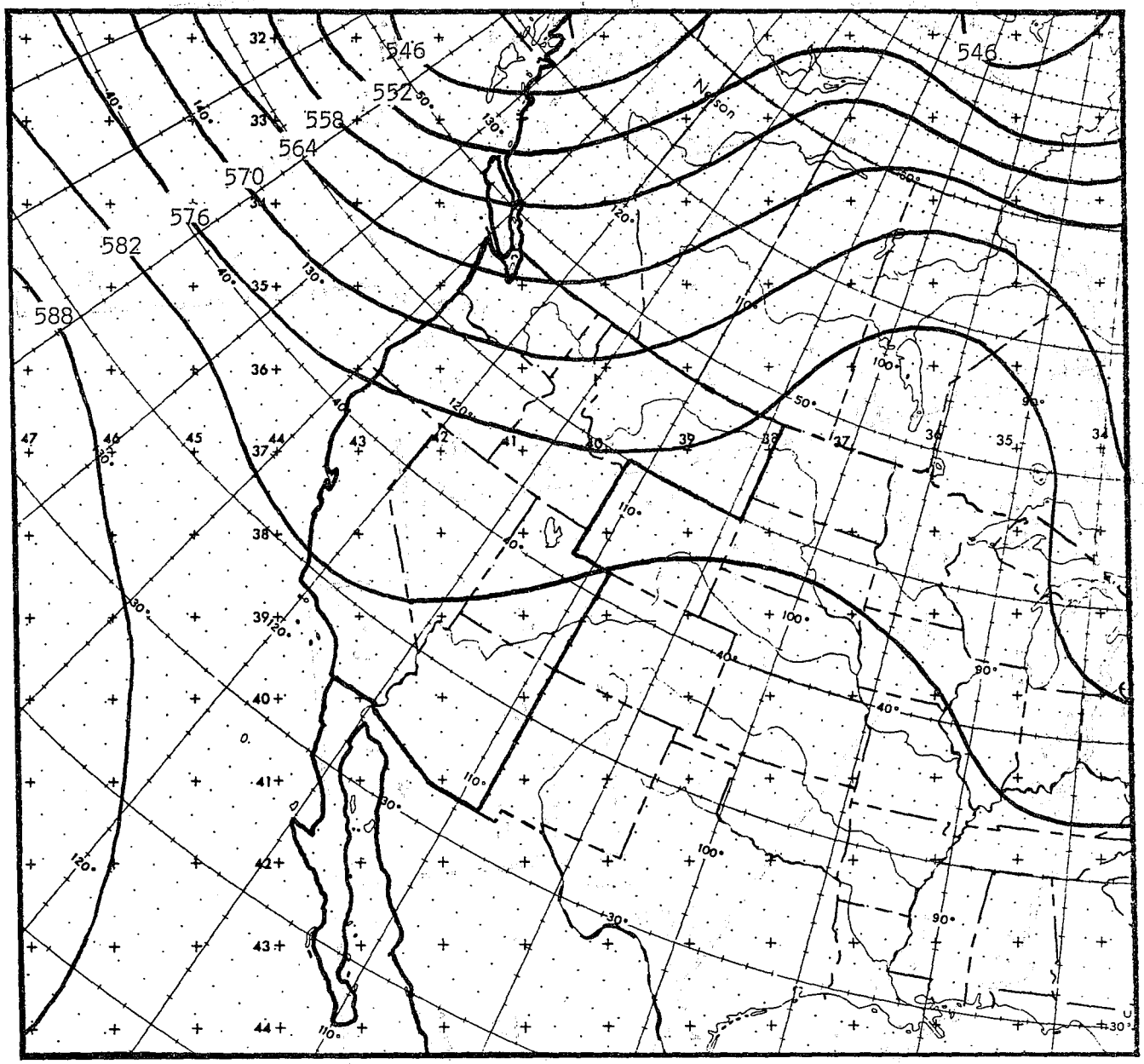


Percent Frequency of Precipitation Occurrence



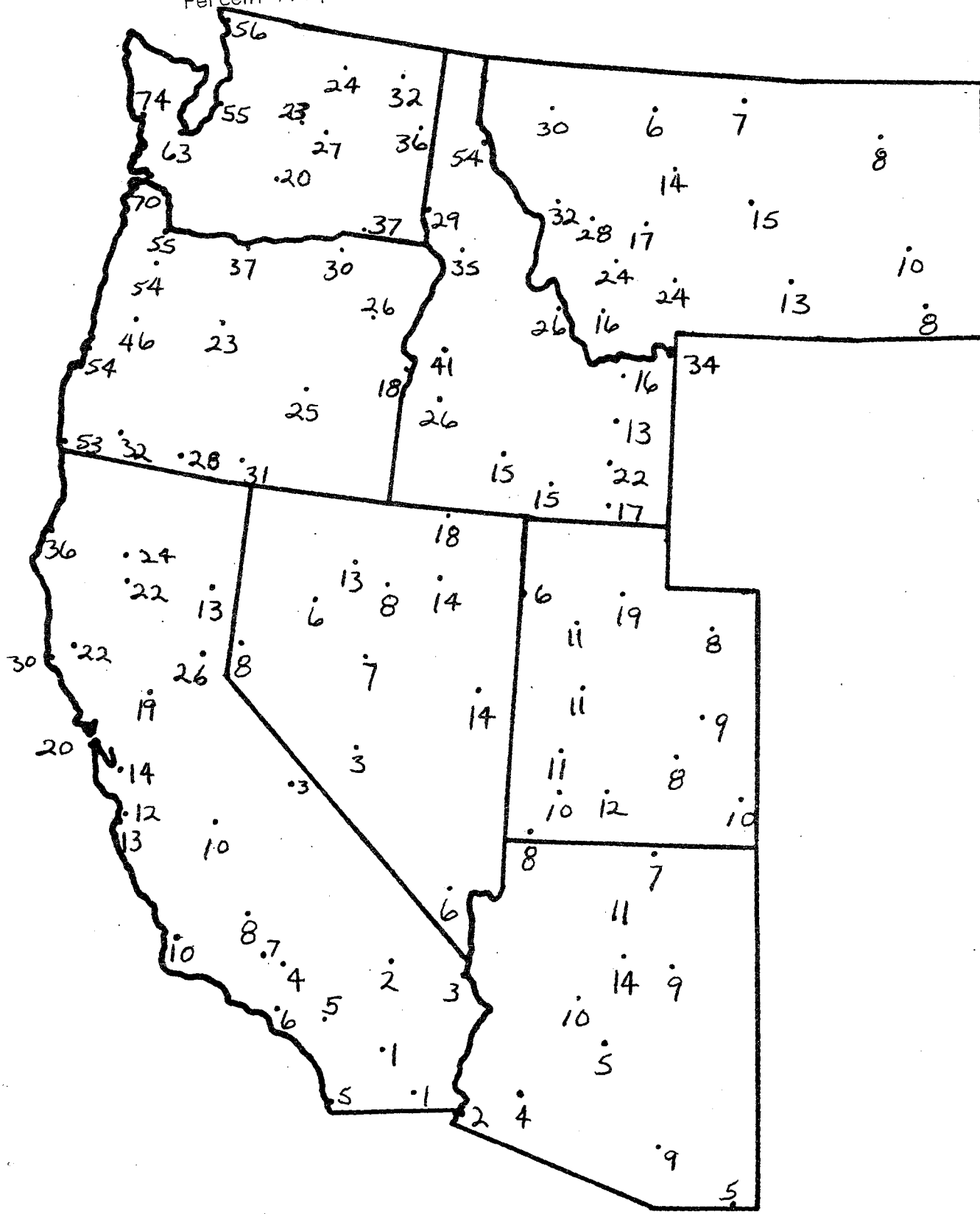
FALL TYPE 2

12Z September 12, 1968
190 Cases



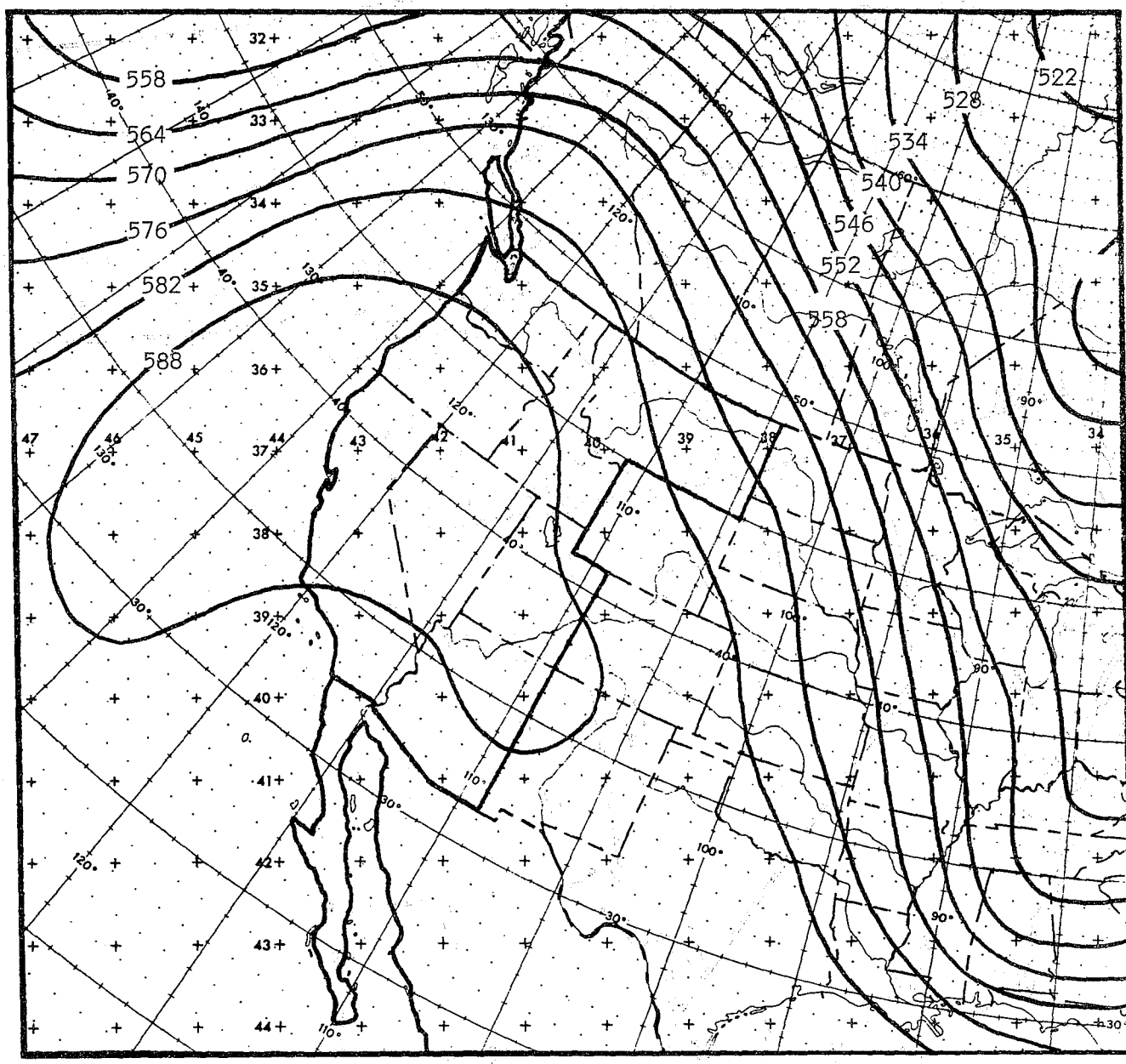
FALL TYPE 2

Percent Frequency of Precipitation Occurrence



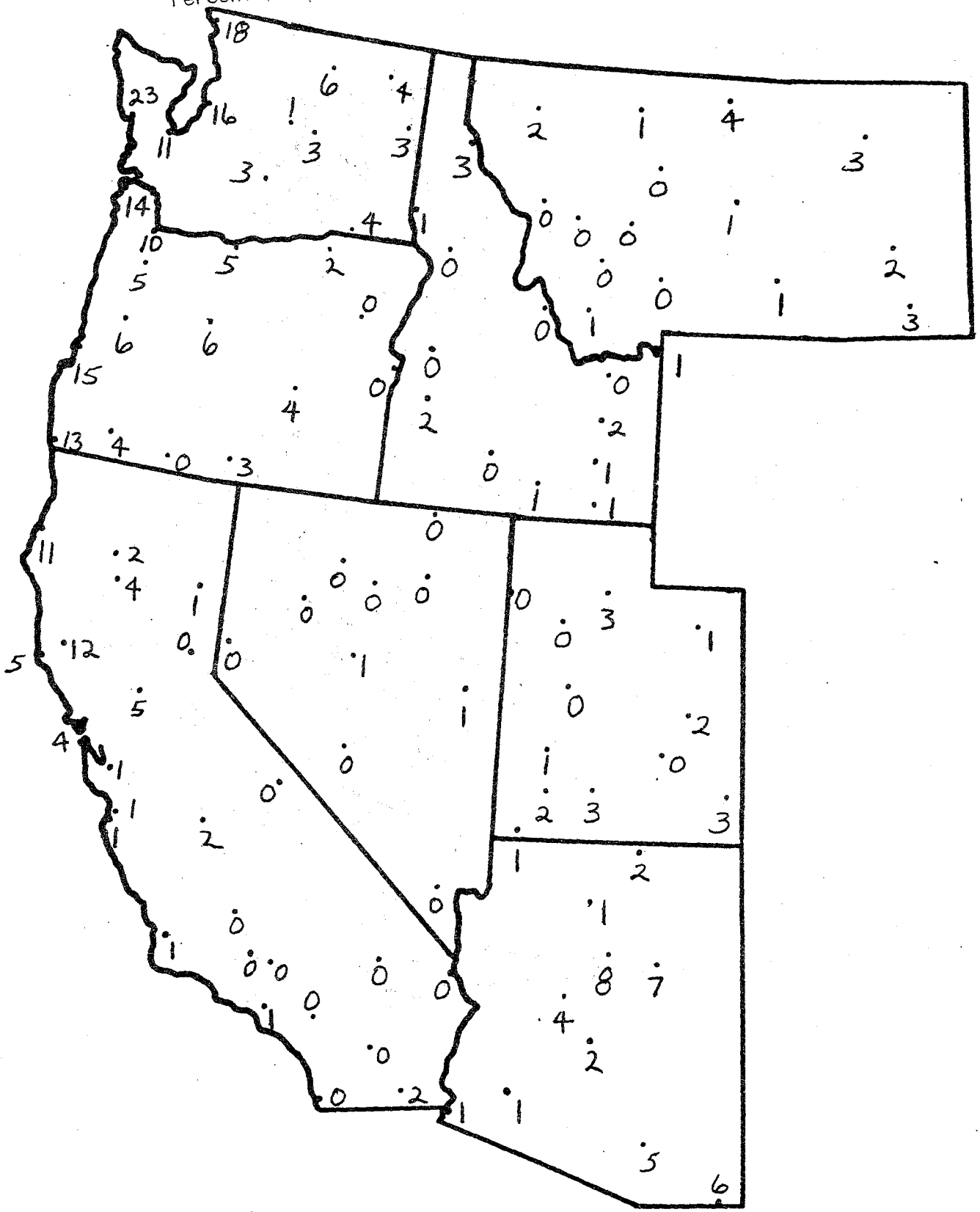
FALL TYPE 3

12Z October 20, 1964
116 Cases



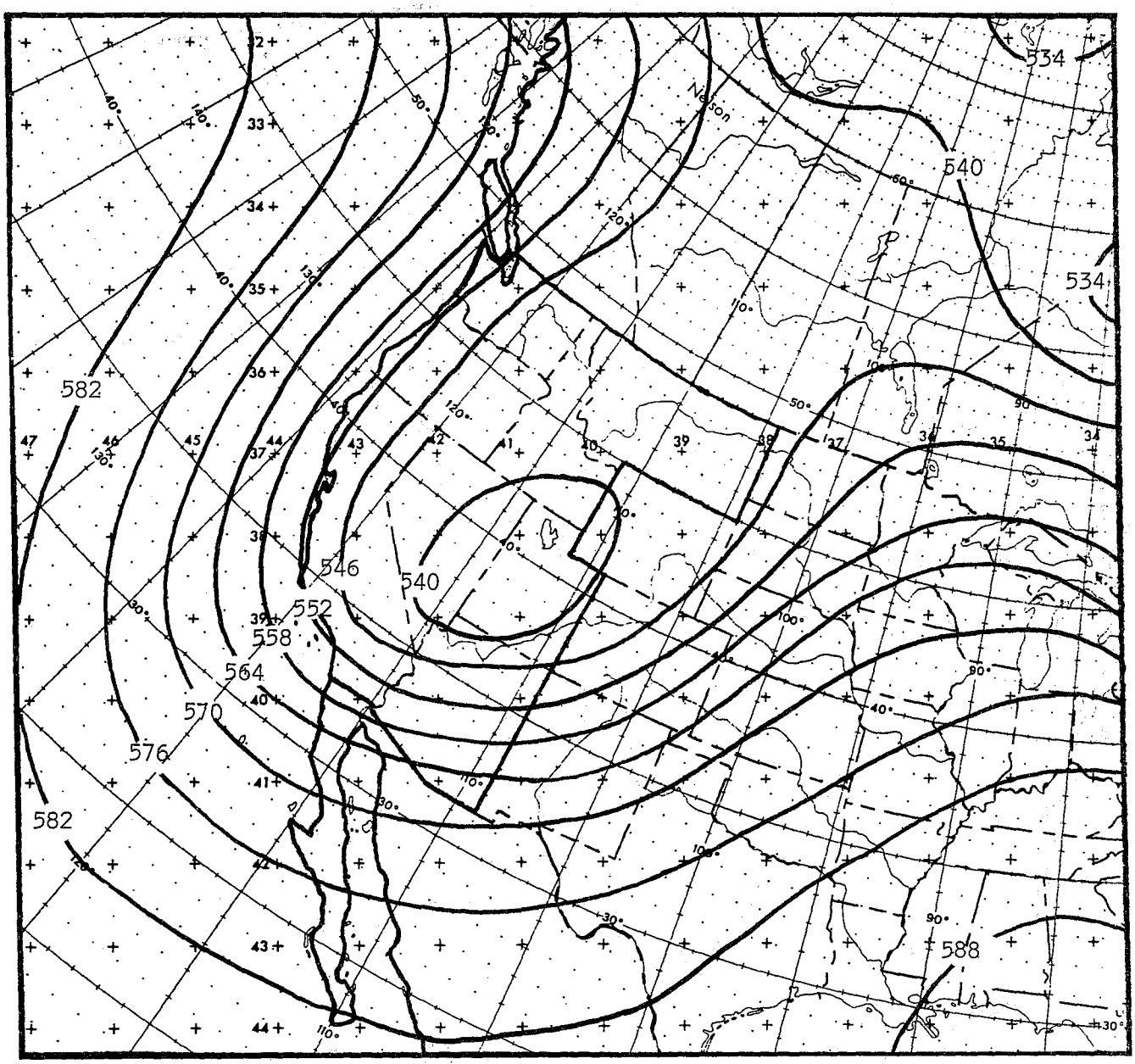
FALL TYPE 3

Percent Frequency of Precipitation Occurrence



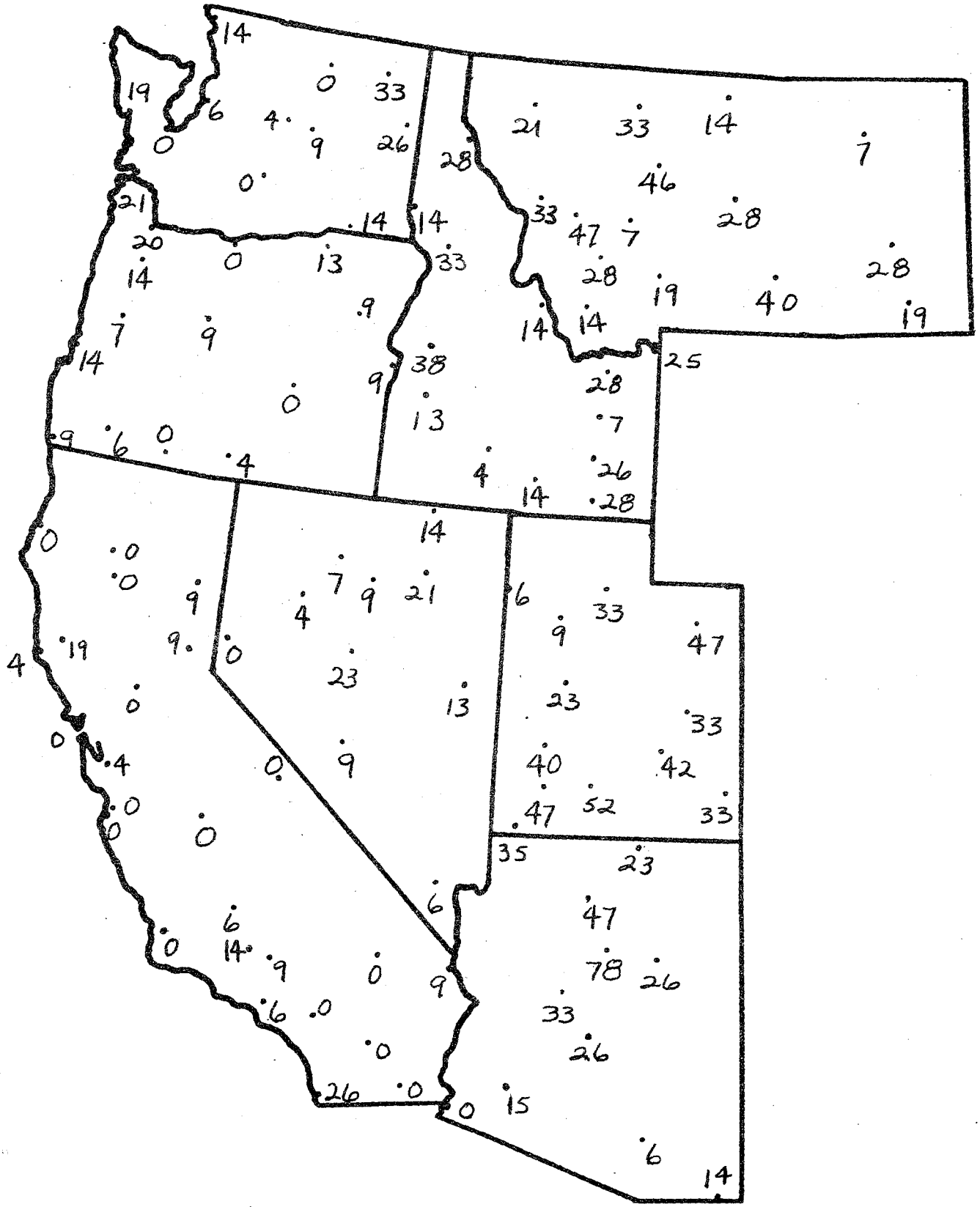
FALL TYPE 4

12Z November 14, 1964
21 Cases



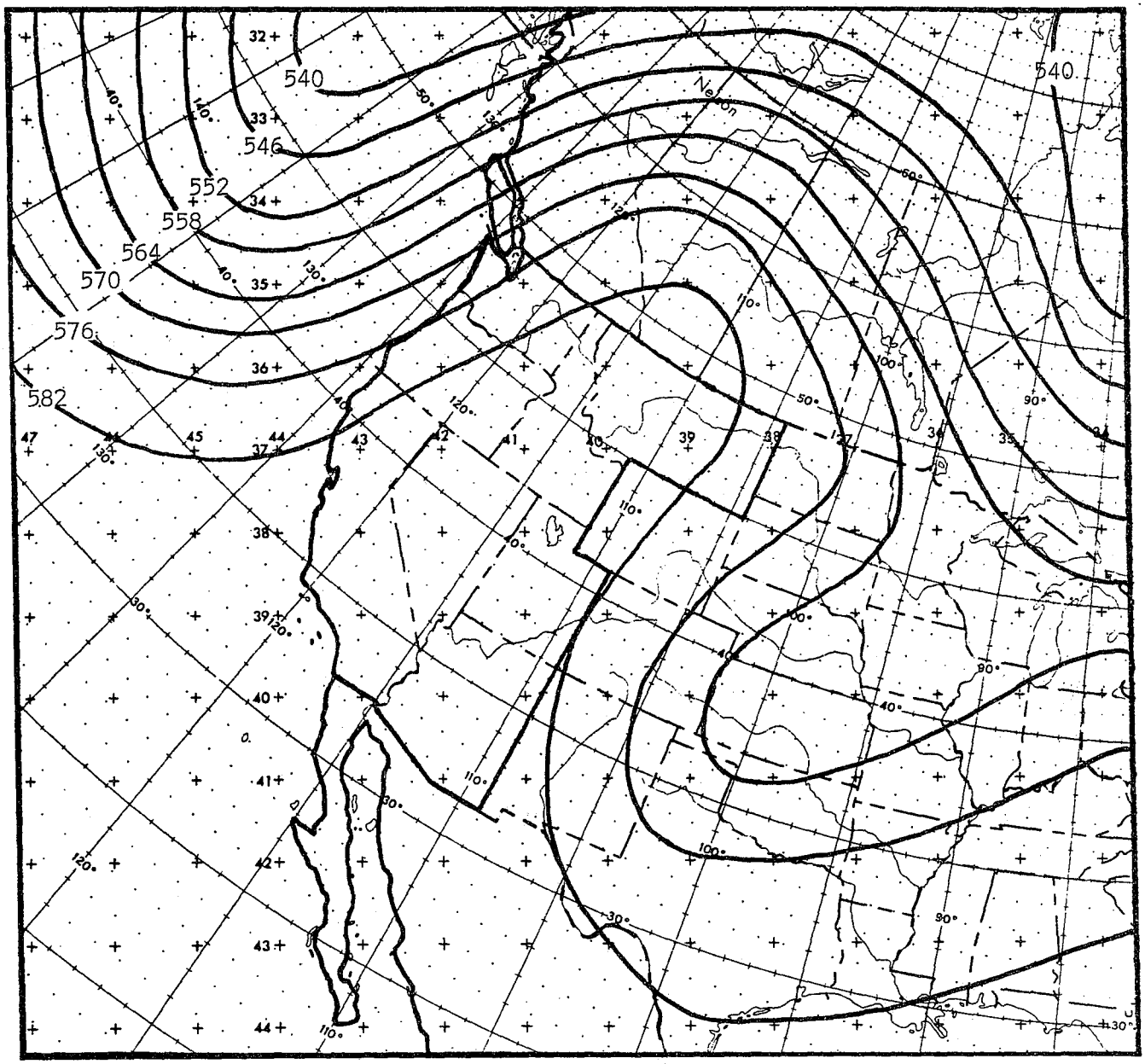
FALL TYPE 4

Percent Frequency of Precipitation Occurrence



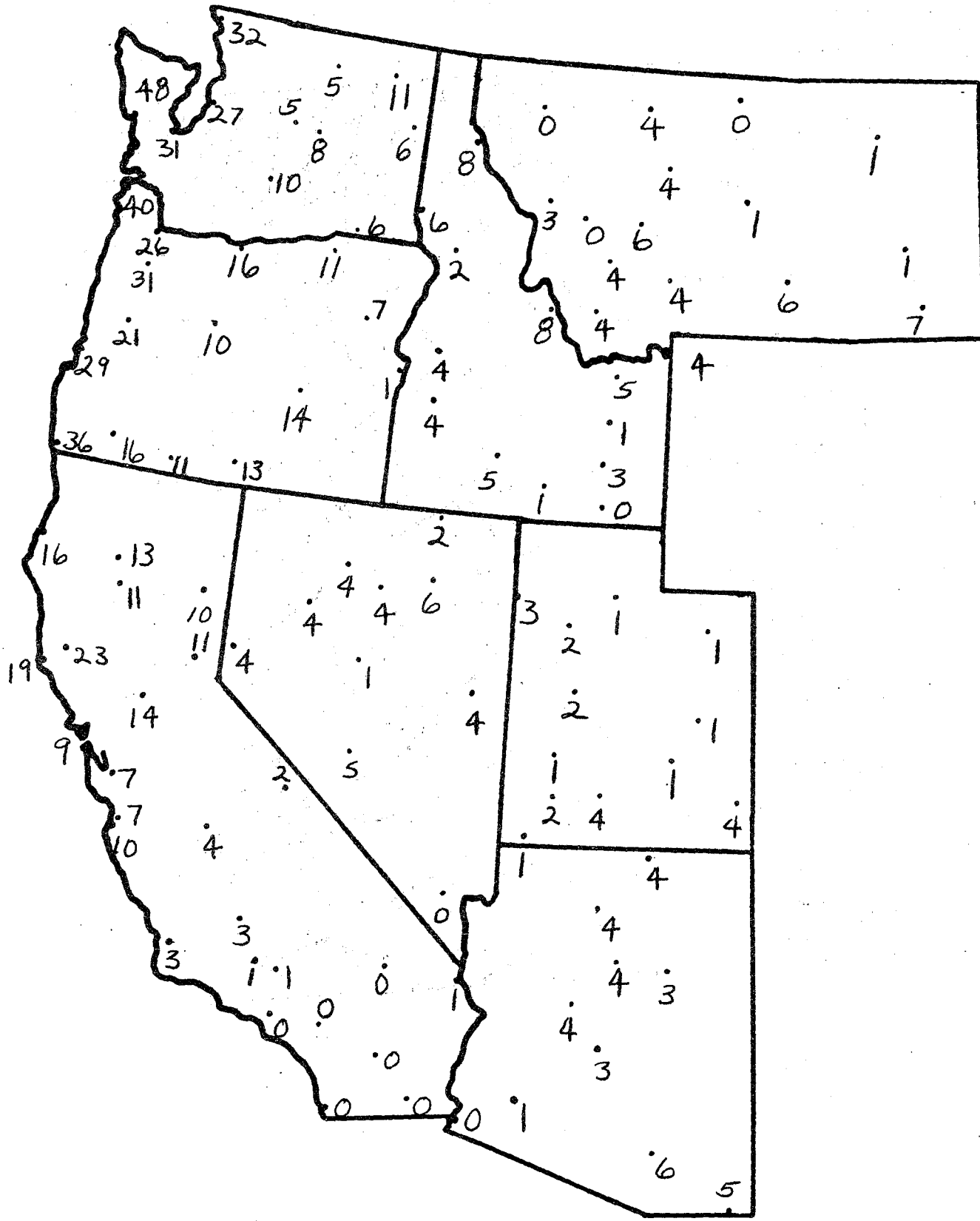
FALL TYPE 5

12Z October 12, 1964
68 Cases



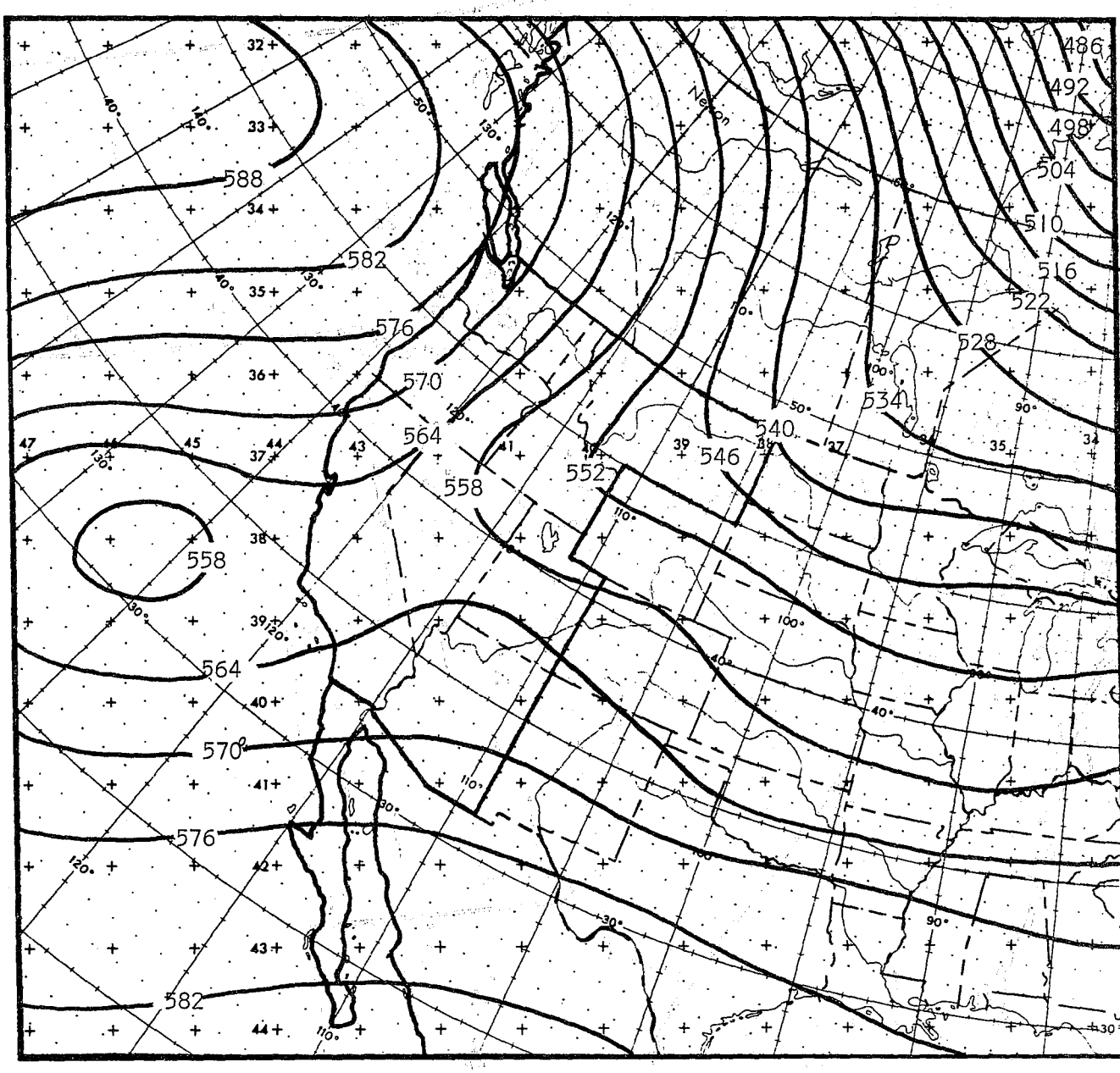
FALL TYPE 5

Percent Frequency of Precipitation Occurrence



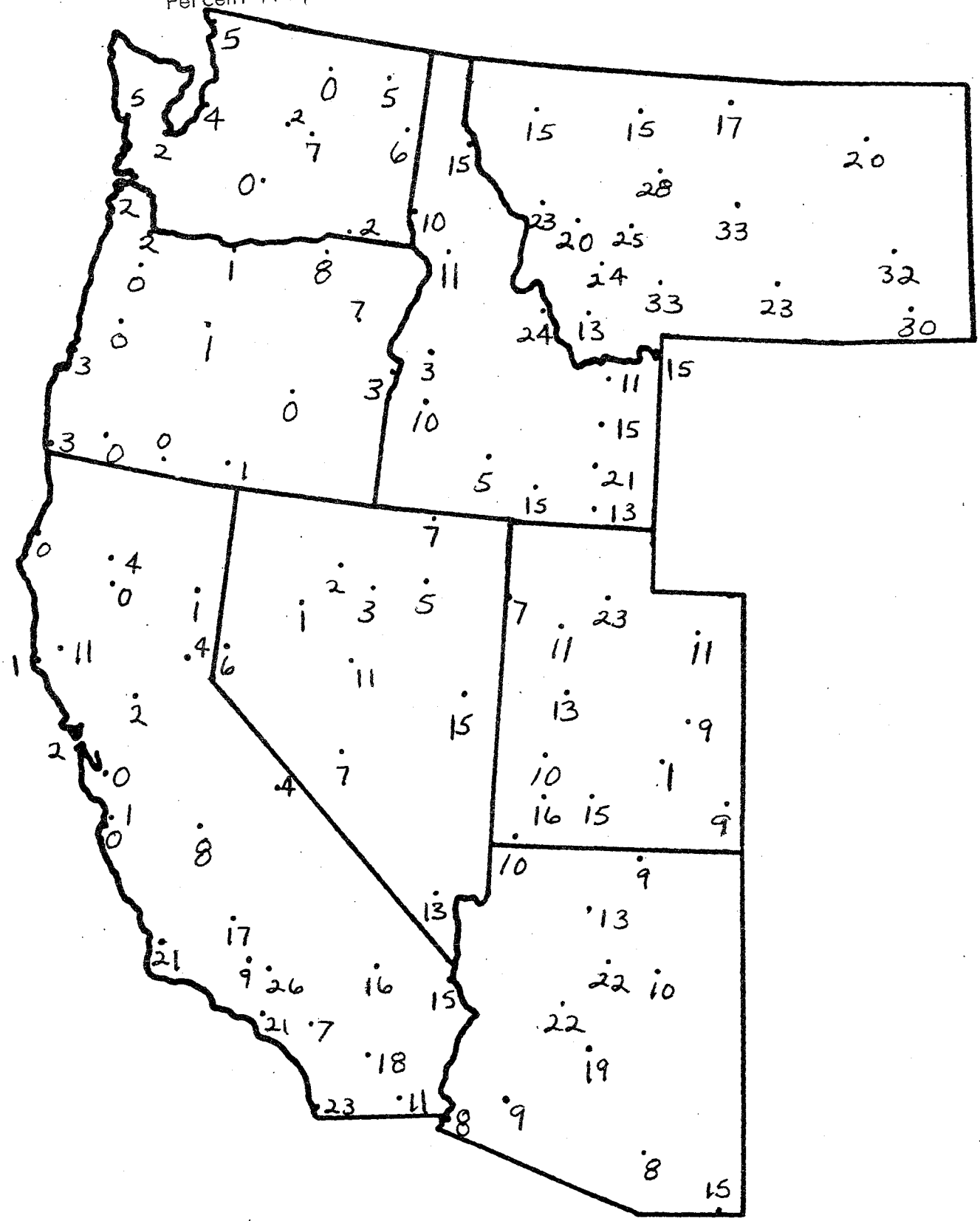
FALL TYPE 6

12Z November 21, 1967
53 Cases



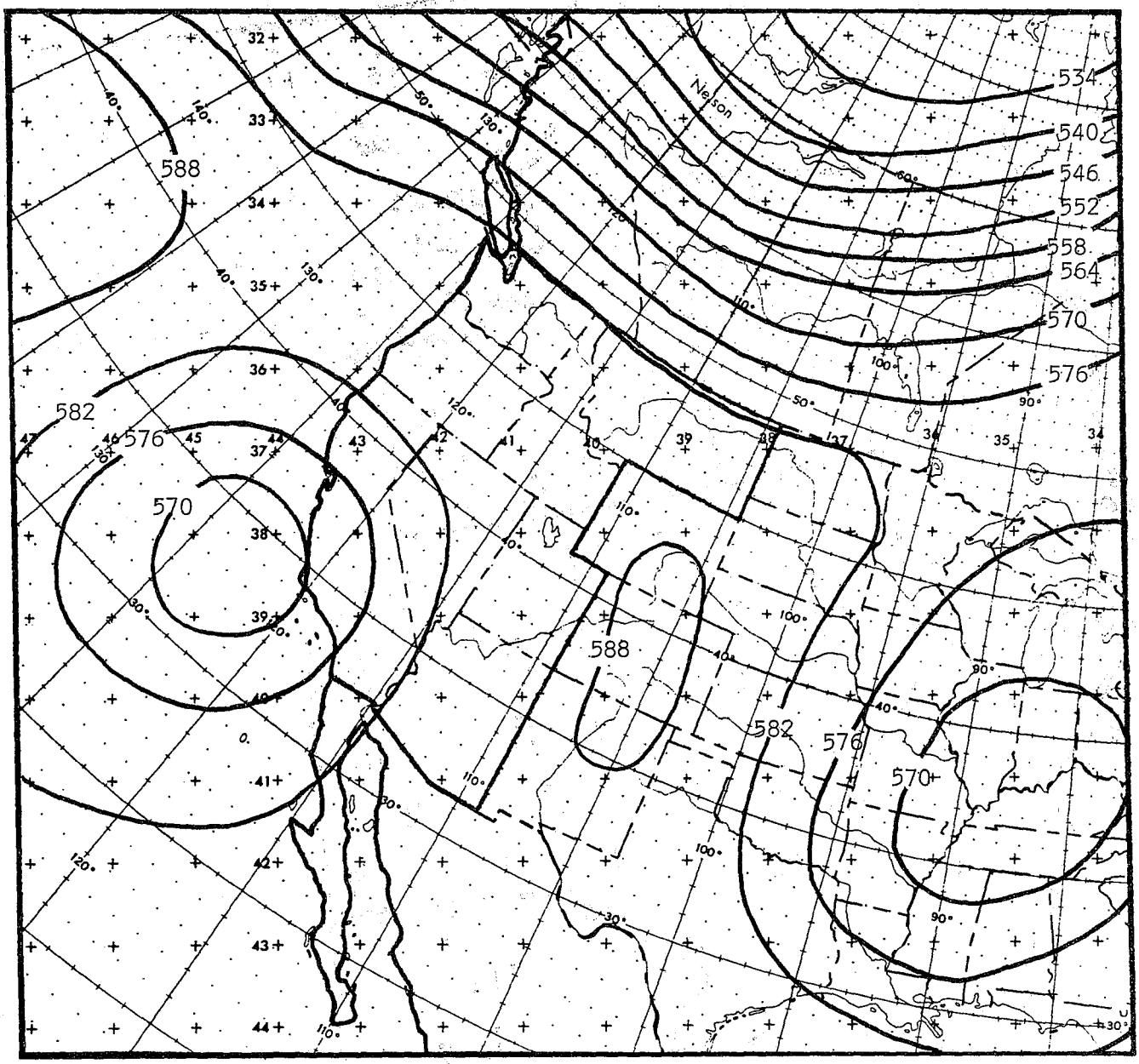
FALL TYPE 6

Percent Frequency of Precipitation Occurrence



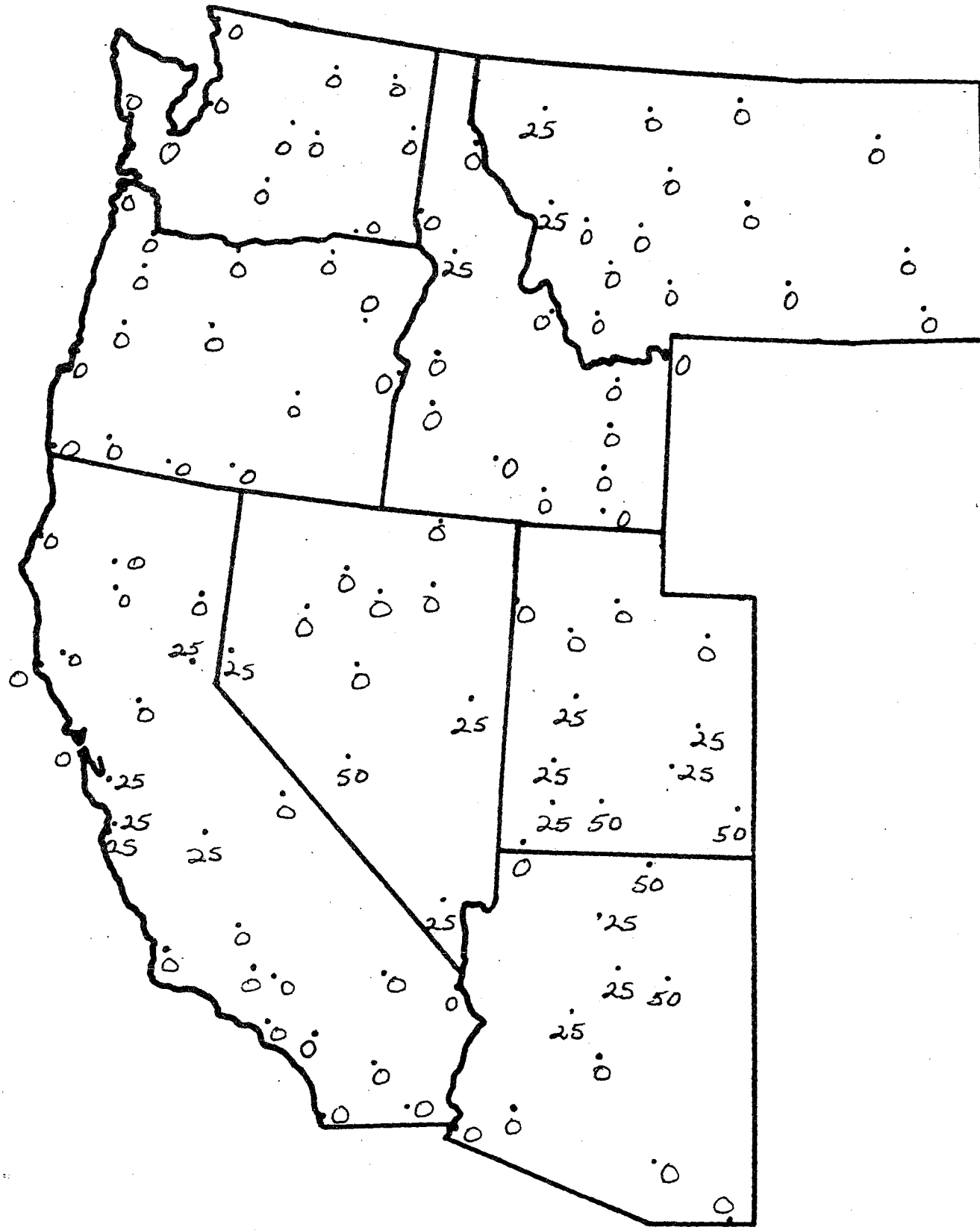
FALL TYPE 7

12Z September 20, 1966
4 Cases



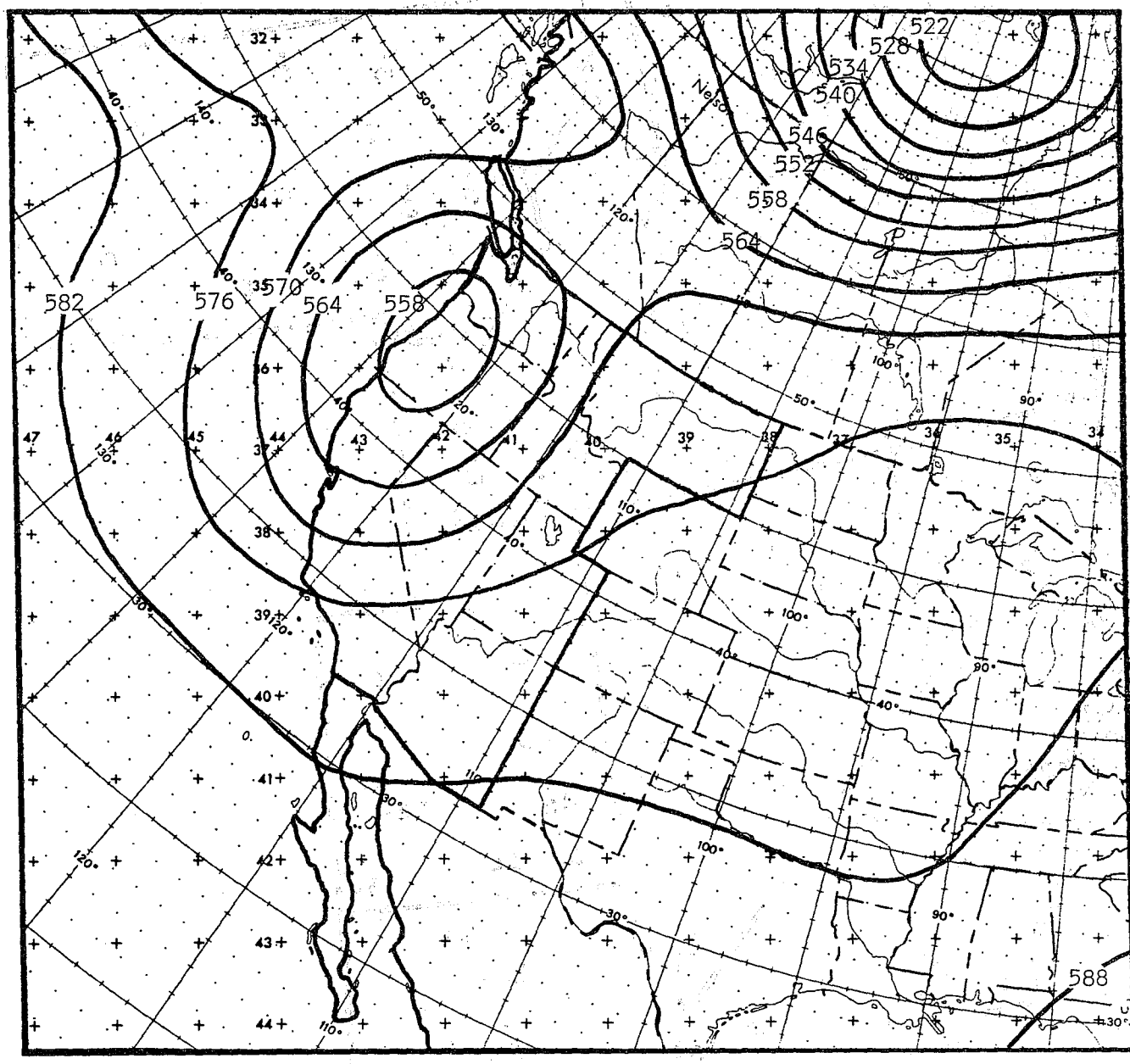
FALL TYPE 7

Percent Frequency of Precipitation Occurrence



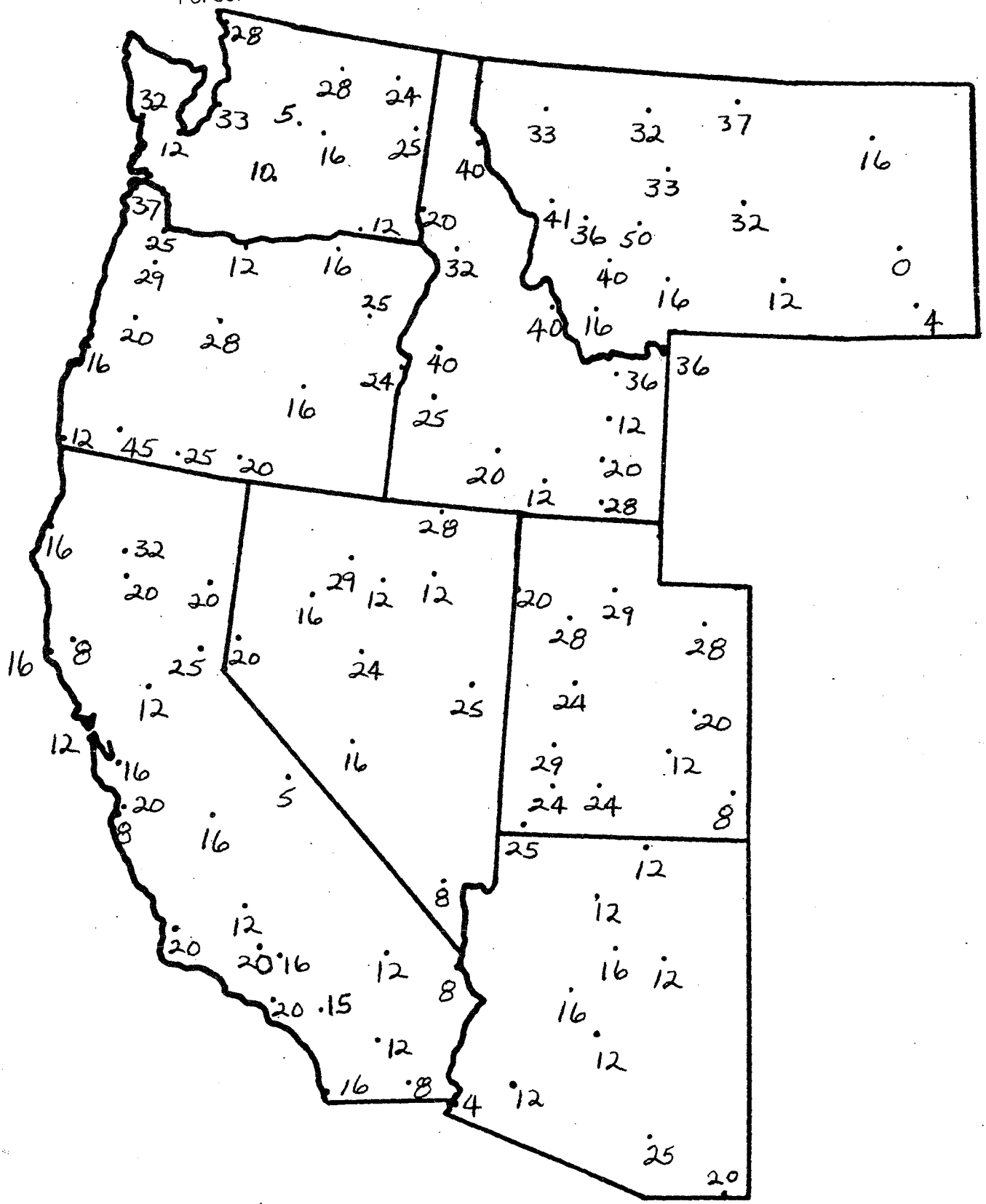
FALL TYPE 8

12Z September 12, 1966
25 Cases



FALL TYPE 8

Percent Frequency of Precipitation Occurrence



APPENDIX F

LISTING OF DATES WITHIN MAP TYPES

TYPE I - WINTER (DECEMBER)

DEC 61	DEC 62	DEC 63	DEC 64	DEC 65	DEC 66	DEC 67	DEC 68
4-00	3-12	5-12	1-00	1-00	8-00	8-00	1-00
4-12	4-00	6-00	1-12	1-12	8-12	8-12	1-12
5-00	4-12	6-12	2-00	3-00	9-00	9-00	2-00
5-12	5-00	7-00	3-00	12-00	9-12	9-12	2-12
6-00	6-12	7-12	3-12	12-12	10-00	10-00	3-00
6-12	7-00	8-00	4-12	17-12	10-12	10-12	3-12
7-00	7-12	8-12	5-00	18-00	11-00	11-00	4-00
7-12	19-12	9-00	8-12	18-12	14-12	11-12	4-12
8-00	20-00	9-12	9-12	19-00	15-00	12-00	5-00
10-12	20-12	14-00	10-00	19-12	15-12	12-12	5-12
12-00	21-00	14-12	10-12	20-00	16-00	21-12	6-00
16-12	21-12	15-00	13-00	20-12	16-12	22-00	6-12
17-00	22-00	15-12	13-12	21-00	17-00	22-12	7-00
17-12	22-12	16-00	14-00	22-00	17-12	23-00	7-12
18-00	23-00	16-12	14-12	24-00	18-00	23-12	12-00
18-12	23-12	17-00	15-00	27-00	20-12	24-00	12-12
19-00	24-00	17-12	15-12	27-12	21-00		13-00
19-12	27-00	18-00	16-00		21-12		13-12
20-00	27-12	18-12	16-12		22-00		17-00
21-12	28-00	19-12	17-00		25-00		17-12
22-00	28-12	20-12	17-12		25-12		18-00
22-12	29-00	21-12	18-00		26-00		18-12
23-00	29-12	22-00	18-12		26-12		19-00
23-12	31-12	22-12	22-00		28-12		22-00
24-12		23-00	22-12		29-12		22-12
25-00			23-00		31-12		23-00
25-12			23-12				23-12
26-00			24-00				27-00
26-12			24-12				27-12
27-00			25-00				28-00
27-12			25-12				28-12
			26-00				29-00
			26-12				29-12
							30-00
							30-12
							31-00
							31-12

TYPE I - WINTER (JANUARY)

JAN 62	JAN 63	JAN 64	JAN 65	JAN 66	JAN 67	JAN 68	JAN 69
4-12	1-00	1-00	8-00	2-12	1-00	1-00	1-00
6-00	1-12	1-12	8-12	3-00	1-12	1-12	1-12
6-12	2-00	2-00	9-00	3-12	2-00	2-00	2-00
12-00	2-12	2-12	9-12	6-00	2-12	2-12	2-12
12-12	3-00	3-00	10-00	6-12	3-00	3-00	3-00
13-00	3-12	3-12	10-12	7-00	3-12	3-12	3-12
13-12	4-00	4-00	11-00	7-12	4-00	4-00	5-00
14-00	4-12	4-12	11-12	9-00	4-12	5-00	5-12
14-12	8-12	5-00	12-00	9-12	5-00	5-12	6-00
15-00	9-00	5-12	12-12	10-00	5-12	6-00	6-12
15-12	9-12	6-00	20-12	10-12	6-00	6-12	7-00
16-12	10-00	6-12	21-00	11-00	6-12	7-00	7-12
17-00	10-12	7-00	21-12	11-12	7-00	7-12	8-00
17-12	11-00	7-12	22-00	12-00	7-12	8-00	8-12
18-00	16-00	8-00	22-12	12-12	8-00	8-12	9-00
19-00	16-12	8-12	23-00	13-00	8-12	9-00	9-12
19-12	17-00	9-12	23-12	13-12	9-00	9-12	10-00
20-00	17-12	10-00	24-00	14-00	11-12	11-12	10-12
20-12	18-00	10-12	24-12	14-12	12-00	12-00	17-00
24-12	18-12	11-00	25-00	15-00	12-12	18-00	17-12
25-00	23-00	11-12	25-12	18-00	13-00	25-00	18-00
25-12	24-00	12-00	26-00	18-12	13-12	25-12	18-12
26-00	24-12	14-00	26-12	19-00	14-00	26-00	19-00
26-12	25-00	14-12	27-00	19-12	14-12		23-00
27-00	25-12	15-00	27-12	20-00	15-00		23-12
27-12	26-00	15-12	28-00	20-12	15-12		24-00
	26-12	16-00	29-12	21-00	16-00		24-12
	27-00	17-00	30-00	21-12	16-12		25-00
	27-12	17-12	30-12	22-00	17-00		25-12
	28-00	18-00	31-00	22-12	17-12		31-00
	28-12	18-12	31-12	23-00	18-00		31-12
	29-00	19-00		23-12	18-12		
	30-12	19-12		24-00	19-00		
		20-00		24-12	19-12		
		24-00		25-00	20-00		
		24-12		25-12	26-00		
		25-00		26-00	26-12		
		25-12		26-12	27-00		
		26-00		27-00	27-12		
		26-12		27-12	31-00		
		27-00		28-00	31-12		
		27-12		28-12			
		28-00		31-00			
		28-12		31-12			
		30-12					
		31-00					
		31-12					

TYPE I - WINTER (FEBRUARY)

FEB 62	FEB 63	FEB 64	FEB 65	FEB 66	FEB 67	FEB 68
3-12	1-12	1-00	1-00	1-00	1-00	1-00
4-00	2-00	1-12	1-12	1-12	1-12	1-12
4-12	2-12	2-00	2-00	2-00	2-00	2-00
5-00	3-00	3-12	2-12	2-12	2-12	3-12
5-12	16-00	4-00	3-00	3-00	3-00	5-12
17-00	16-12	4-12	3-12	6-12	3-12	6-00
17-12	17-00	5-00	4-00	11-12	4-00	18-00
18-00	17-12	5-12	6-00	12-00	9-12	18-12
18-12	18-00	9-00	6-12	12-12	10-00	19-00
19-00	18-12	10-12	7-00	13-00	10-12	19-12
23-00	19-00	11-00	7-12	13-12	11-00	20-00
23-12	19-12	11-12	8-00	14-00	11-12	23-12
24-00	27-00	13-00	8-12	15-00	12-00	24-00
24-12	27-12	13-12	9-00	15-12	12-12	
28-00	28-00	14-00	9-12	16-00	13-00	
28-12	28-12	14-12	10-00	18-00	13-12	
		15-00	12-12	18-12	14-00	
		15-12	13-12	19-00	14-12	
		16-00	14-00	19-12	15-00	
		16-12	14-12	20-12	15-12	
		17-00	15-00	21-00	16-00	
		17-12	15-12	26-00	16-12	
		18-00	16-00	26-12	17-00	
		24-12	16-12	27-00	17-12	
		25-00	17-00	27-12	18-00	
		25-12	20-00	28-00	18-12	
		27-12	20-12	28-12	19-12	
		28-00	21-00		20-00	
		28-12	21-12		20-12	
		29-00	22-00		21-00	
		29-12	22-12		21-12	
			23-00		22-00	
			23-12		22-12	
			24-00		26-12	
			24-12		27-00	
			25-00			
			27-12			
			28-00			
			28-12			

TYPE 2 - WINTER (DECEMBER)

DEC 61	DEC 62	DEC 63	DEC 64	DEC 66
28-00	5-12	1-00	6-12	1-00
28-12	6-00	1-12	7-00	1-12
29-00	8-12	2-12	7-12	2-00
29-12	9-00	3-00	8-00	23-12
30-00	9-12	3-12		24-00
30-12	10-00	4-00		24-12
31-00	10-12	4-12		
	11-00	20-00		
	11-12	23-12		
	12-00			
	12-12			
	13-00			
	13-12			

TYPE 2 - WINTER (JANUARY)

JAN 64	JAN 65	JAN 66	JAN 67
12-12	16-00	29-00	10-12
13-00	16-12	29-12	
13-12	17-00	30-00	
	17-12	30-12	
	18-00		
	18-12		
	19-00		
	19-12		

TYPE 2 - WINTER (FEBRUARY)

FEB 62	FEB 63	FEB 64	FEB 65	FEB 66	FEB 67	FEB 68	
6-00	8-12	8-00	25-12	3-12	23-00	7-00	28-00
6-12	9-00	9-12	26-00	4-00	23-12	7-12	28-12
7-00	9-12	10-00			24-00	8-00	29-00
	12-00	22-00			24-12	8-12	29-12
	13-00				25-00	9-00	
	13-12					9-12	
	14-00					17-12	
	15-00					20-12	
	15-12					21-00	
	20-00					21-12	
	20-12					22-00	
	21-00					22-12	
	21-12					23-00	
	22-00					24-12	
	23-00					25-00	
	24-12					25-12	
	25-12					26-00	
	26-00					26-12	
						27-00	
						27-12	

TYPE 3 - WINTER (DECEMBER)

DEC 61	DEC 62	DEC 63	DEC 64	DEC 65	DEC 66	DEC 67	DEC 68
21-00	2-00	19-00	20-12	2-00	2-12	2-00	8-00
24-00	2-12	24-00	21-00	2-12	3-00	2-12	8-12
	3-00	24-12	21-12	4-00	3-12	3-00	9-00
	14-00	31-00	27-00	4-12	4-00	3-12	9-12
	14-12	31-12	27-12	5-00	4-12	7-00	10-00
	15-00			5-12	11-12		10-12
	16-12			6-00	12-00		11-00
	17-00			6-12	12-12		14-00
	17-12			7-00	13-00		14-12
	18-00			7-12	13-12		15-00
	18-12			8-00	14-00		15-12
	19-00			8-12	18-12		16-00
	30-00			24-12	19-00		24-00
	30-12			28-00	19-12		24-12
	31-00			28-12	20-00		25-00
					22-12		
					23-00		

TYPE 3 - WINTER (JANUARY)

JAN 63	JAN 64	JAN 65	JAN 66	JAN 67	JAN 68	JAN 69
31-00	20-12	3-00	5-12	11-00	10-00	11-00
31-12	21-00	5-12	8-00	20-12	12-12	11-12
	29-00	6-00	8-12	21-00	13-00	12-00
	29-12	6-12		21-12	13-12	12-12
	30-00			28-00	14-00	13-00
				28-12	14-12	13-12
				29-00	15-00	14-00
				29-12	15-12	26-00
				30-00	16-00	
				30-12	16-12	
					17-00	
					17-12	
					18-12	
					19-00	
					19-12	
					20-00	

TYPE 3 - WINTER (FEBRUARY)

FEB 63	FEB 65	FEB 66	FEB 67	FEB 68
1-00	4-12	4-12	25-12	2-12
3-12	5-00	5-00	26-00	3-00
4-00	5-12	5-12	27-12	4-00
4-12	26-12	6-00	28-00	4-12
5-00	27-00	20-00	28-12	5-00
5-12		21-12		
6-00		22-00		
6-12		22-12		
7-00		23-00		
7-12		23-12		
8-00		24-00		
		24-12		
		25-00		
		25-12		

TYPE 4 - WINTER (DECEMBER)

DEC 61	DEC 62	DEC 63	DEC 65	DEC 66	DEC 67	DEC 68
8-12	24-12	10-00	13-00	27-00	13-00	19-12
9-00	25-00	10-12	13-12	27-12	13-12	20-00
9-12	25-12	11-00	14-00	28-00	14-00	20-12
11-00	26-00	11-12	14-12	30-00	16-12	21-00
11-12		12-00	15-00	30-12	17-00	21-12
12-00		12-12	15-12	31-00	17-12	
12-12		13-00	16-00		18-00	
13-00		13-12	16-12		30-00	
13-12			17-00		30-12	
14-00					31-00	
14-12						
15-00						
15-12						
16-00						

TYPE 4 - WINTER (JANUARY)

JAN 62	JAN 63
21-00	11-12
21-12	12-00
22-00	12-12
22-12	13-00
23-00	19-00
23-12	19-12
24-00	

TYPE 4 - WINTER (FEBRUARY)

FEB 62	FEB 65	FEB 66
19-12	10-12	9-00
20-00	11-00	9-12
20-12		10-00
21-00		10-12
21-12		11-00
22-00		
22-12		
25-00		
25-12		
26-00		
26-12		
27-00		
27-12		

TYPE 5 - WINTER (FEBRUARY)

FEB 63	FEB 68
10-00	10-00
10-12	10-12
11-00	11-00
11-12	11-12
	12-00
	12-12
	13-00
	13-12

TYPE 6 - WINTER (DECEMBER)

DEC 61	DEC 62	DEC 63	DEC 67
31-12	8-00	2-00	24-12
	26-12	5-00	25-00
			25-12
			26-00
			26-12
			27-00
			27-12
			28-00
			28-12
			29-00
			29-12
			31-12

TYPE 6 - WINTER (JANUARY)

JAN 62	JAN 63	JAN 65	JAN 67	JAN 68	JAN 69
2-12	5-00	13-00	9-00	4-12	4-00
5-00	5-12	13-12	10-00	20-12	4-12
5-12	6-00	14-00		21-00	
11-00	6-12	14-12		21-12	
11-12	7-00	15-00		22-00	
28-00	7-12	15-12		22-12	
28-12	8-00	20-00		23-00	
29-00	13-12	28-12		23-12	
29-12	14-00	29-00		24-00	
30-00	14-12			24-12	
30-12	15-00				
31-00	15-12				
31-12	20-00				
	20-12				
	21-00				
	21-12				
	22-00				
	22-12				
	23-12				

TYPE 6 - WINTER (FEBRUARY)

FEB 62	FEB 63	FEB 64	FEB 65	FEB 66	FEB 67	FEB 68
1-00	23-12	23-12	13-00	16-12	4-12	6-12
1-12	24-00	24-00	17-12	17-00	5-00	
2-00		26-00	18-00	17-12	5-12	
2-12		26-12	18-12		6-00	
3-00		27-00	19-00		6-12	
			19-12		7-00	
					7-12	
					8-00	
					8-12	
					9-00	

TYPE 7 - WINTER (DECEMBER)

DEC 61	DEC 62	DEC 64	DEC 65	DEC 66	DEC 67	DEC 68
1-00	1-00	19-00	9-00	5-00	1-00	11-12
1-12	1-12	19-12	9-12	5-12	1-12	16-12
2-00		20-00	10-00	6-00	4-00	25-12
2-12		28-00	10-12	6-12	4-12	26-00
3-00		29-12	11-00	7-00	5-00	26-12
3-12		30-00	11-12	7-12	5-12	
		30-12	22-12		6-00	
		31-00	23-00		6-12	
		31-12	23-12		7-12	
			25-00		18-12	
			25-12		19-00	
			26-00		19-12	
			26-12		20-00	
			29-00		20-12	
			29-12		21-00	
			30-00			
			30-12			
			31-00			
			31-12			

TYPE 7 - WINTER (JANUARY)

JAN 64	JAN 65	JAN 66	JAN 67	JAN 68	JAN 69
21-12	1-00	1-00	22-00	10-12	14-12
22-00	1-12	1-12	22-12	11-00	15-00
22-12	2-00	2-00	23-00	26-12	15-12
23-00	2-12	4-00	23-12	27-00	16-00
23-12	3-12	4-12	24-00	27-12	16-12
	4-00	5-00	24-12	28-00	19-12
	4-12		25-00	28-12	20-00
	5-00		25-12	29-00	20-12
	7-00			29-12	21-00
	7-12			30-00	21-12
				30-12	22-00
				31-00	22-12
				31-12	26-12
					27-00
					27-12
					28-00
					28-12
					29-00
					30-00
					30-12

TYPE 7 - WINTER (FEBRUARY)

FEB 66
7-00
7-12
8-00
8-12

TYPE 8 - WINTER (DECEMBER)

DEC 67

14-12
15-00
15-12
16-00

TYPE 9 - WINTER (JANUARY)

JAN 62	JAN 66
7-00	15-12
7-12	16-00
8-00	16-12
8-12	17-00
9-00	17-12
9-12	
10-00	
10-12	

TYPE 9 - WINTER (DECEMBER)

DEC 66

29-00

TYPE 9 - WINTER (FEBRUARY)

FEB 64

2-12
3-00
6-00
6-12
7-00
7-12
8-12
18-12
19-00
19-12
20-00
20-12
21-00
21-12
22-12
23-00

TYPE 10 - WINTER (FEBRUARY)

FEB 62	FEB 68
7-12	14-00
8-00	14-12
8-12	15-00
	15-12
	16-00
	16-12
	17-00

TYPE 10 - WINTER (JANUARY)

JAN 63

29-12
30-00

TYPE I - SPRING (MARCH)

Mar 62	Mar 63	Mar 64	Mar 65	Mar 66	Mar 67
1-00					
1-12	4-12	1-00	16-00	1-00	2-00
2-00	5-00	1-12	16-12	1-12	2-12
2-12	12-12	2-00	26-12	2-00	3-00
3-00	13-00	2-12	27-00	7-12	3-12
3-12	13-12	3-00	27-12	11-12	4-00
7-12	14-00	3-12	28-00	12-00	9-00
8-12	14-12	5-00	28-12	12-12	9-12
9-00	15-00	5-12	29-00	13-00	10-00
9-12	15-12	6-00	29-12	13-12	10-12
10-00	16-00	6-12	30-00	14-00	11-00
15-00	16-12	7-00	30-12	20-00	11-12
15-12	17-00	7-12	31-00	20-12	12-00
16-12	17-12	8-00	31-12	21-00	12-12
17-00	18-00	8-12		21-12	13-00
17-12	18-12	9-00		22-00	13-12
18-00	19-00	9-12		22-12	14-00
18-12	19-12	10-00		23-12	14-12
19-12	20-00	10-12		24-00	15-00
20-00	22-12	11-00			18-12
20-12	23-00	11-12			19-00
21-00	23-12	12-00			19-12
21-12	26-00	12-12			21-00
22-00	26-12	13-00			21-12
22-12	27-00	13-12			22-00
23-00	27-12	14-00			23-12
23-12	28-00	14-12			24-00
26-12	28-12	15-00			25-00
27-00	31-12	17-12			25-12
27-12		18-00			26-00
		18-12			26-12
		20-00			27-00
		20-12			27-12
		21-00			28-00
		21-12			28-12
		22-00			29-00
		22-12			29-12
		25-12			

TYPE I - SPRING (APRIL)

Apr 62	APR 63	APR 64	APR 65	APR 66	APR 67	APR 68
5-00	1-00	1-00	1-00	10-00	1-12	1-00
5-12	1-12	1-12	1-12	10-12	2-00	1-12
6-00	2-00	2-00	2-00	15-00	2-12	2-00
20-00	3-00	2-12	2-12	15-12	3-00	2-12
20-12	3-12	5-00	5-00	16-00	3-12	3-00
21-00	4-00	7-12	5-12	20-12	4-00	3-12
21-12	4-12	8-00	6-00	21-12	4-12	4-00
22-00	5-00	9-00	6-12	22-00	5-00	4-12
22-12	5-12	9-12	7-00	22-12	5-12	5-00
24-12	6-00	10-00	7-12	23-00	6-00	5-12
25-00	6-12	10-12	8-00	23-12	6-12	6-00
25-12	7-00	11-00	8-12	24-00	7-00	6-12
26-00	15-12	11-12	9-00	24-12	7-12	7-00
26-12	16-00	12-00	9-12	25-00	8-00	7-12
27-00	17-12	12-12	13-12	25-12	8-12	8-00
27-12	18-00	13-00	14-00	26-00	9-00	9-12
28-00	18-12	15-12	16-12	26-12	9-12	10-00
28-12	19-00	16-00	17-00	27-00	10-00	10-12
29-00	19-12	16-12	17-12	27-12	10-12	11-00
	20-00	18-00	18-00	28-00	11-00	11-12
	20-12	18-12	18-12	28-12	11-12	12-00
	22-12	19-00	19-00	29-00	15-00	12-12
	23-00	19-12	19-12	29-12	15-12	13-00
	23-12	20-00	20-00	30-00	16-00	13-12
	24-00	20-12	20-12	30-12	16-12	14-00
	24-12	21-00	21-00		17-00	14-12
	25-00	21-12	21-12		17-12	15-00
	25-12	22-00	22-00		18-00	15-12
	26-00	22-12	22-12		18-12	16-00
		23-00	23-00		19-00	16-12
			23-12		19-12	17-00
			24-00		22-00	18-00
			24-12		22-12	18-12
			25-00		23-00	19-00
			30-00		23-12	19-12
			30-12		24-00	20-00
					24-12	23-00
					25-00	23-12
					25-12	24-00
					26-00	24-12
					26-12	28-00
					27-00	28-12
					27-12	
					28-00	
					28-12	
					29-00	
					29-12	
					30-00	

TYPE I - SPRING (MAY)

MAY 62	MAY 63	MAY 64	MAY 65	MAY 66	MAY 67	MAY 68
1-12	3-12	9-12	1-00	1-00	4-12	1-12
2-00	7-12	10-00	1-12	1-12	5-00	2-00
3-00	8-00	10-12	2-12	4-12	8-12	2-12
3-12	8-12	11-00	3-00	13-00	9-00	3-00
4-00	9-00	11-12	3-12	14-00	9-12	3-12
4-12	9-12	12-00	4-00	14-12	10-00	4-12
5-00	10-00	12-12	5-00	16-12	10-12	5-00
5-12	10-12	13-00	11-12	17-00	11-00	5-12
6-00	11-00	13-12	12-00	17-12	11-12	6-00
6-12	11-12	14-12	12-12	20-12	12-00	6-12
7-00	12-12	15-00	13-00	21-00	12-12	8-00
7-12	13-00	15-12	13-12	21-12	13-00	8-12
8-00	13-12	16-00	14-00	22-00	13-12	9-00
8-12	14-00	20-12	15-00	22-12	14-00	10-00
9-00	14-12	21-00	15-12	23-00	17-12	10-12
9-12	15-00	21-12	16-00	23-12	18-00	11-00
10-00	15-12	22-00	16-12	24-00	18-12	11-12
10-12	16-00	22-12	17-00	24-12	19-00	12-00
11-00	16-12	23-00	17-12	25-00	19-12	12-12
11-12	17-00	23-12	18-00		23-12	13-00
12-00	17-12	24-00	18-12		24-00	15-00
12-12	23-12	24-12	19-12		24-12	15-12
13-00	24-00		20-00		25-00	16-00
13-12	24-12		20-12		25-12	
14-00	25-00		21-00		26-00	
18-12	25-12		22-00		26-12	
19-00	26-00		22-12		27-00	
19-12	26-12		23-00		27-12	
20-00	27-00		28-12		28-00	
20-12	27-12		29-00		28-12	
	28-00		29-12		29-00	
	28-12		30-00			
	29-00		31-00			
	29-12		31-12			
	30-00					
	30-12					
	31-00					
	31-12					

TYPE 2 - SPRING (MARCH)

MAR 62	MAR 63	MAR 64	MAR 66	MAR 67
26-00	20-12	29-12	5-12	1-00
	21-00	30-00	6-00	16-00
	21-12	30-12	6-12	16-12
	22-00	31-00	7-00	17-00
		31-12	9-00	17-12
			9-12	18-00
			19-00	22-12
			19-12	23-00
			27-00	
			27-12	
			28-12	
			29-00	
			30-00	
			30-12	
			31-00	
			31-12	

TYPE 2 - SPRING (APRIL)

APR 62	APR 63	APR 65	APR 66	APR 68
12-12	13-00	28-12	1-00	29-00
13-00		29-00	1-12	29-12
13-12		29-12	2-00	30-00
14-00			9-00	30-12
14-12			14-12	
15-00				
15-12				
16-00				
16-12				
17-00				
17-12				
18-00				
18-12				
19-00				
23-12				
24-00				

TYPE 2 - SPRING (MAY)

MAY 63	MAY 64	MAY 66	MAY 67	MAY 68
6-00	14-00	2-00	16-12	1-00
6-12	16-12	2-12	17-00	4-00
7-00	18-00	3-00	20-00	19-00
18-00	19-00	3-12	20-12	19-12
18-12	19-12	7-00	21-00	20-00
19-00	20-00	7-12	21-12	20-12
20-00	31-00	8-00	22-00	21-00
20-12	31-12	8-12	22-12	21-12
21-00		25-12	23-00	22-00
21-12		26-00		28-12
22-00		26-12		29-00
22-12		27-00		29-12
23-00		28-00		30-00

TYPE 3 - SPRING (MARCH)

MAR 62	MAR 63	MAR 64	MAR 65	MAR 66	MAR 67
12-00	1-00	4-00	1-00	23-00	4-12
12-12	1-12	4-12	1-12	24-12	5-00
13-00	2-00	15-12	2-00	26-12	5-12
13-12	5-12	16-00	9-00		6-00
14-00	6-00	16-12	9-12		6-12
14-12	6-12	17-00	10-00		7-00
	7-00	19-00	10-12		7-12
	7-12	19-12	11-00		8-00
	8-00	26-00	11-12		8-12
	8-12	26-12	12-00		
	9-00	27-12	12-12		
	9-12	28-00	13-00		
	10-00	28-12	13-12		
	10-12	29-00	14-00		
	11-00		14-12		
	11-12		15-00		
	12-00		15-12		
	19-12		17-00		
			17-12		
			18-00		
			18-12		
			19-00		
			20-00		
			21-00		
			22-12		
			23-00		
			23-12		
			24-00		
			24-12		
			25-00		
			26-00		

TYPE 3 - SPRING (APRIL)

APR 62	APR 64	APR 65	APR 66	APR 68
6-12	7-00	25-12	2-12	8-12
7-00	13-12	26-00	3-00	9-00
8-00	14-00	26-12	3-12	25-00
8-12	14-12	27-00	4-00	25-12
9-00			4-12	26-00
9-12			5-00	26-12
10-00			5-12	27-00
11-12			6-00	27-12
12-00			6-12	
			7-12	
			8-00	
			8-12	
			16-12	
			17-00	
			17-12	

TYPE 3 - SPRING (MAY)

MAY 63	MAY 65	MAY 66	MAY 67	MAY 68
19-12	27-00	11-00	1-00	16-12
	27-12	18-00	1-12	17-00
	28-00	18-12	2-00	17-12
		19-00	2-12	18-00
		19-12	3-00	
		20-00	3-12	
			4-00	
			7-00	
			7-12	
			8-00	
			14-12	
			15-00	
			15-12	
			16-00	

TYPE 4 - SPRING (MARCH)

MAR 62	MAR 63	MAR 66	MAR 67
4-00	29-00	4-00	20-00
4-12		4-12	20-12
24-00		5-00	24-12
25-00		8-00	
25-12		8-12	
		10-00	
		10-12	
		11-00	
		14-12	
		15-00	
		15-12	
		16-00	
		16-12	
		17-00	
		17-12	
		18-00	
		18-12	

TYPE 4 - SPRING (APRIL)

APR 62	APR 63	APR 64	APR 65	APR 66	APR 67
30-00	8-00	26-12	25-12	11-00	13-00
30-12	10-12	27-00		11-12	13-12
	11-12	27-12		12-00	14-00
	27-00	28-00		12-12	14-12
	27-12	28-12		13-00	
		29-00		13-12	
		29-12		14-00	
		30-00			
		30-12			

TYPE 4 - SPRING (MAY)

MAY 62	MAY 64	MAY 66	MAY 67	MAY 68
29-12	1-00	13-12	29-12	22-12
30-00	1-12	15-00		23-00
30-12	2-00	15-12		23-12
31-00	2-12	16-00		24-00
31-12				24-12
				25-00
				25-12
				26-00
				26-12
				27-00
				27-12
				28-00
				30-12
				31-00
				31-12

TYPE 5 - SPRING (MARCH)

MAR 62	MAR 64	MAR 65	MAR 66	MAR 67
10-12	23-00	25-12	2-12	30-00
11-00	23-12		3-00	30-12
	24-00		3-12	31-00
	24-12			31-12
	25-00			

TYPE 5 - SPRING (APRIL)

APR 62	APR 63	APR 64	APR 65	APR 66	APR 67	APR 68
29-12	2-12	5-12	3-00	18-00	1-00	17-12
	16-12	6-00	3-12	18-12	12-00	20-12
	17-00	6-12	10-00	19-00	12-12	21-00
	21-00	23-12	10-12	20-00	20-00	21-12
	21-12	24-00	11-00		20-12	22-00
	22-00	24-12	11-12		21-00	22-12
		25-00			21-12	
		25-12			30-12	
		26-00				

TYPE 5 - SPRING (MAY)

MAY 62	MAY 64	MAY 65	MAY 66	MAY 68
14-12	3-00	5-12	12-12	7-00
15-00	3-12	6-00		7-12
15-12	4-00	7-00		13-12
16-00	4-12	7-12		14-00
16-12	5-00	8-00		14-12
17-12	5-12	8-12		
18-00	6-00	9-00		
21-00	6-12	9-12		
21-12	7-00	23-12		
	8-00	24-00		
	8-12	24-12		
		25-12		
		26-00		
		26-12		

TYPE 6 - SPRING (MARCH)

MAR 63	MAR 67
25-00	15-12
25-12	

TYPE 6 - SPRING (APRIL)

APR 63	APR 65
12-00	14-12
12-12	15-00
28-00	15-12
	16-00

TYPE 6 - SPRING (MAY)

MAY 63	MAY 64	MAY 66	MAY 68
4-00	17-00	5-12	9-12
4-12	17-12	6-00	
5-00	27-12	6-12	
5-12	28-00		
12-00	28-12		
	29-00		
	29-12		
	30-00		
	30-12		

TYPE 7 - SPRING (MARCH)

MAR 62	MAR 66
8-00	25-00
	25-12

TYPE 7 - SPRING (APRIL)

APR 64	APR 65
3-00	4-0
3-12	4-12
4-00	12-00
4-12	12-12
	13-00

TYPE 7 - SPRING (MAY)

MAY 64	MAY 65	MAY 66	MAY 67
9-00	10-00	9-12	5-12
	10-12	10-00	6-00
		10-12	6-12

TYPE 8 - SPRING (APRIL)

APR 63
8-12
9-00
9-12
10-00

TYPE 8 - SPRING (MAY)

MAY 66
28-12
29-00
29-12
30-00
30-12
31-00
31-12

TYPE 9 - SPRING (MARCH)

MAR 65
5-00
5-12
6-00
6-12
7-00
7-12
8-00
8-12

TYPE 10 - SPRING (MARCH)

MAR 62
5-00
5-12
6-00
6-12
7-00

TYPE I - SUMMER (JUNE)

JUN 62	JUN 63	JUN 64	JUN 65	JUN 66	JUN 67	JUN 68
18-00	1-00	7-00	5-00	3-00	3-12	3-12
18-12	2-00	10-12	5-12	3-12	4-00	4-12
19-00	13-00	11-00	6-00	4-00	4-12	5-00
19-12	13-12	11-12	7-00	4-12	5-00	5-12
20-00	14-00	12-00	7-12	5-00	5-12	13-00
20-12	14-12	12-12	8-00	5-12	6-00	13-12
21-00	15-00	13-00	8-12	6-00	6-12	14-00
22-00	24-00	13-12	20-00	6-12	7-00	14-12
23-00	24-12	14-00	20-12	12-12	7-12	15-00
24-00	26-00	14-12	21-12	26-00	8-00	15-12
27-12	26-12	15-00	22-00	26-12	8-12	16-00
28-00	27-00	16-00	22-12		9-00	16-12
28-12	27-12	16-12	23-00		9-12	17-00
29-00	28-00	17-00	28-00		10-00	17-12
29-12	28-12	17-12	28-12		15-00	18-00
30-00		19-12	29-00		15-12	18-12
30-12		20-00	29-12		16-00	19-00
		20-12	30-00		18-00	19-12
		21-00	30-12		18-12	20-00
		21-12			19-00	20-12
		22-00			19-12	21-00
		22-12			20-00	21-12
		23-00			20-12	22-00
		23-12			21-00	22-12
		24-00			21-12	30-12
		24-12			25-12	
		25-00			26-00	
		25-12			26-12	
		26-00			27-00	
		26-12			27-12	
		28-00			28-00	
		29-00			30-00	
		29-12			30-12	
		30-00				
		30-12				

TYPE I - SUMMER (JULY)

JUL 62	JUL 63	JUL 64	JUL 65	JUL 66	JUL 67	JUL 68
4-00	3-00	1-00	1-00	4-12	5-12	1-00
4-12	12-00	1-12	1-12	5-00	6-00	1-12
6-00	12-12	2-00	2-00	7-12	6-12	2-12
6-12	13-00	2-12	2-12	8-00	7-00	3-00
7-00	13-12	3-00	3-00	8-12	7-12	6-00
7-12	14-00	3-12	3-12	9-00	8-00	6-12
8-00	14-12	4-00	4-00	9-12	8-12	7-00
8-12	15-00	4-12	4-12	10-00	9-00	7-12
9-00	15-12	5-00	5-12	10-12	9-12	8-00
9-12	16-00	14-12	6-00	11-00	10-00	8-12
10-00	17-00	15-00	6-12	11-12	10-12	9-00
10-12	17-12	16-12	7-00	12-00	11-00	9-12
11-00	18-00	17-00	7-12	12-12	15-12	10-00
11-12	18-12	17-12	8-00	13-00	16-00	10-12
12-00	19-00	18-00	11-00	13-12	16-12	11-00
19-12	19-12	19-00	11-12	14-00	17-00	11-12
20-00	20-00	19-12	12-00	14-12	20-12	12-00
20-12	20-12	20-00	12-12	15-00	21-00	12-12
27-00	26-00	20-12	13-00	17-00	21-12	13-00
28-00	26-12	23-00	13-12	17-12	22-00	13-12
28-12	27-00	23-12	14-00	18-00	22-12	14-00
29-00	27-12	24-00	14-12	18-12	23-00	14-12
29-12	28-00	24-12	15-00	21-00	23-12	15-00
30-00	29-12	25-00	15-12	21-12	24-00	15-12
	30-00	25-12	16-00	22-00	24-12	16-00
	30-12	26-00	16-12	22-12	25-00	16-12
	31-00	26-12	17-00	23-00	25-12	17-00
	31-12	27-00	17-12	23-12	26-00	17-12
		27-12	18-00	24-00	26-12	18-00
		28-00	18-12	24-12	27-00	18-12
		28-12	19-00	25-00	27-12	19-00
		29-00	21-12	25-12	28-00	19-12
		29-12	22-00	26-00	28-12	20-00
		30-00	22-12	26-12	30-12	20-12
		30-12	23-00	27-00	31-00	21-00
		31-00	23-12	27-12	31-12	21-12
			24-00	28-00		22-00
			24-12	28-12		22-12
			25-00	29-00		23-00
			25-12	29-12		23-12
			26-00	30-00		
				30-12		
				31-00		
				31-12		

TYPE I - SUMMER (AUGUST)

AUG 62	AUG 63	AUG 64	AUG 65	AUG 66	AUG 67	AUG 68
3-00	1-00	2-12	4-12	1-00	1-00	9-12
3-12	1-12	3-00	5-00	1-12	1-12	10-00
4-00	2-00	3-12	5-12	2-00	2-00	10-12
4-12	2-12	4-00	6-00	2-12	2-12	11-00
5-00	3-00	4-12	6-12	3-00	4-12	11-12
5-12	3-12	5-00	7-00	3-12	5-00	12-00
9-00	4-00	5-12	7-12	4-00	5-12	12-12
9-12	4-12	6-00	8-00	4-12	6-00	13-00
10-00	5-00	6-12	8-12	5-00	6-12	13-12
10-12	5-12	7-00	10-00	14-00	7-00	14-00
11-00	6-00	7-12	10-12	14-12	7-12	14-12
15-00	6-12	8-00	11-00	15-00	8-00	15-00
15-12	7-00	9-00	11-12	15-12	8-12	15-12
16-00	7-12	9-12	12-00	16-00	9-00	16-00
18-00	8-00	10-00	12-12	17-00	9-12	16-12
18-12	8-12	10-12	13-00	17-12	12-12	17-00
19-12	9-00	14-00	13-12	18-00	13-00	17-12
20-00	9-12	14-12	15-00	18-12	13-12	20-00
20-12	10-00	15-00	15-12	24-00	14-00	20-12
23-12	10-12	15-12	16-00	24-12	14-12	21-00
24-00	11-00	25-00	16-12	25-00	15-00	21-12
24-12	11-12	25-12	17-00	25-12	15-12	22-00
25-00	12-00	26-12	23-00	26-00	16-00	30-12
25-12	18-00	27-00	23-12	26-12	16-12	31-00
26-00	18-12	27-12	24-00	27-00	17-00	
26-12	19-12	28-00	24-12	27-12	18-00	
27-00	20-00	31-00	25-00	28-00	23-00	
27-12	20-12		25-12	28-12	23-12	
28-00	21-12		26-00	29-00	24-00	
28-12	22-00		26-12	29-12	24-12	
31-00	23-12		29-12	30-00	25-00	
31-12	24-00		30-00		25-12	
	24-12		30-12		26-00	
	25-00		31-12		26-12	
	26-00				27-00	
	26-12				27-12	
	27-00				28-00	
	27-12				28-12	
	28-00				29-00	
	28-12					
	29-00					
	30-00					
	30-12					
	31-00					
	31-12					

TYPE 2 - SUMMER (JUNE)

JUN 62	JUN 63	JUN 64	JUN 65	JUN 66	JUN 67	JUN 68
3-00	2-12	7-12	14-00	1-00	12-00	7-00
3-12	3-00	8-00	14-12	23-00	12-12	28-12
4-00	3-12	28-12	15-00	23-12		
4-12	4-00		15-12	24-00		
5-00	5-00		18-00	24-12		
5-12	21-00			30-00		
6-00	21-12			30-12		
9-12	22-00					
12-00	22-12					
12-12	23-00					
13-00	23-12					
13-12	25-00					
14-00	25-12					
27-00	29-00					
	29-12					
	30-00					

TYPE 2 - SUMMER (JULY)

JUL 62	JUL 63	JUL 64	JUL 65	JUL 66
2-00	10-00	31-12	19-12	1-00
2-12	10-12		20-00	1-12
3-00	11-00		20-12	2-00
3-12			21-00	2-12
18-00				3-00
18-12				3-12
19-00				4-00

TYPE 2 - SUMMER (AUGUST)

JUL 63	JUL 64	JUL 66	JUL 68
22-12	1-00	30-12	28-00
	28-12	31-00	28-12

TYPE 3 - SUMMER (JUNE)

JUN 62	JUN 63	JUN 64	JUN 65	JUN 66	JUN 68
24-12	16-00	1-00	9-12	7-00	2-00
25-00	16-12	1-12	10-00	7-12	12-00
	17-12	2-00	10-12	8-00	12-12
	18-00	2-12		8-12	25-00
	18-12	3-00		13-12	25-12
	19-00	3-12		14-00	26-00
	19-12	4-00		14-12	
		4-12		15-00	
		5-00		15-12	
		5-12		16-00	
		6-00		16-12	
		6-12		17-00	
		15-12		17-12	
				18-00	
				18-12	
				19-00	

TYPE 3 - SUMMER (JULY)

JUL 62	JUL 65	JUL 66	JUL 67	JUL 68
21-00	26-12	19-00	11-12	3-12
21-12	27-00		12-00	4-00
22-12	28-12		12-12	4-12
23-00	29-00		13-00	5-00
23-12	29-12		13-12	5-12
25-00	30-00		14-00	
25-12	30-12		14-12	
26-00	31-00		15-00	
26-12	31-12		29-00	
			29-12	
			30-00	

TYPE 3 - SUMMER (AUGUST)

AUG 62	AUG 63	AUG 64	AUG 65	AUG 66	AUG 67
16-12					
17-00	12-12	11-12	1-00	5-12	3-12
17-12	13-00	12-00	1-12	6-00	4-00
	13-12	12-12	2-00	6-12	10-00
	14-00	13-00	2-12	7-00	10-12
	14-12	13-12	3-00	7-12	18-12
	15-00	16-12	3-12	8-00	19-00
	15-12	17-00	9-00		19-12
	16-00		9-12		20-00
	16-12		27-00		20-12
	17-00		27-12		21-00
	17-12		28-00		29-12
					30-00
					30-12
					31-00
					31-12

TYPE 4 - SUMMER (JUNE)

JUN 62	JUN 64	JUN 65	JUN 66	JUN 68
1-00	27-00	13-00	19-12	2-12
1-12		13-12	20-00	3-00
10-00		23-12	20-12	
10-12		24-00	21-00	
11-00		24-12	21-12	
11-12		25-00	28-00	
25-12			28-12	
26-00			29-00	
26-12			29-12	

TYPE 4 - SUMMER (JULY)

JUL 62	JUL 63	JUL 64	JUL 66	JUL 67
1-00	2-12	6-00	15-12	17-12
1-12	3-12	6-12	16-00	18-00
	4-00	7-00	16-12	18-12
	4-12	7-12	19-12	19-00
	5-00	8-00	20-00	19-12
	5-12	8-12	20-12	20-00
	6-00	9-00		
	6-12	9-12		
	7-12	10-00		
	8-00	10-12		
	8-12	11-00		
	9-00	15-12		
	21-00	16-00		
	25-12	18-12		
		21-00		
		21-12		
		22-00		
		22-12		

TYPE 4 - SUMMER (AUGUST)

AUG 64	AUG 68
1-12	24-12
2-00	25-00
8-12	25-12
17-12	26-00
18-00	26-12
18-12	27-00
	27-12

TYPE 5 - SUMMER (JUNE)

JUN 62	JUN 63	JUN 65	JUN 67	JUN 68
15-12	6-00	1-00	10-12	8-00
16-00	6-12	1-12	11-00	8-12
	7-00	2-12	11-12	
	7-12	3-00	13-00	
	8-00	3-12	13-12	
	8-12	4-00	14-00	
	9-00	4-12	14-12	
	9-12	18-12		
	10-00	19-00		
	10-12	19-12		
	11-00			
	12-00			
	12-12			

TYPE 5 - SUMMER (JULY)

JUL 63
11-12

TYPE 5 - SUMMER (AUGUST)

AUG 62	AUG 64	AUG 66
22-00	30-00	31-12
22-12	30-12	
23-00	31-12	

TYPE 6 - SUMMER (JUNE)

JUN 63	JUN 65	JUN 66	JUN 67	JUN 68
20-00	6-12	13-00	28-12	26-12
20-12	21-00		29-00	27-00
			29-12	27-12
				28-00

TYPE 6 - SUMMER (JULY)

JUL 62	JUL 63	JUL 67
14-00	28-12	2-00
15-00	29-00	2-12
15-12		3-00
16-00		3-12
16-12		4-00
17-00		4-12
		5-00

TYPE 6 - SUMMER (AUGUST)

AUG 64	AUG 65	AUG 66	AUG 67	AUG 68
16-00	28-12	8-12	21-12	29-00
19-00	29-00	9-00	22-00	29-12
19-12		9-12	22-12	31-12
20-00		10-00		
20-12		10-12		
21-00		11-00		
21-12		11-12		
22-00		12-00		
22-12		12-12		
23-00		13-00		
26-00		13-12		
29-00		22-00		
29-12				

TYPE 7 - SUMMER (JUNE)

JUN 62	JUN 63	JUN 64	JUN 65	JUN 66	JUN 68
2-00	1-12	18-00	11-00	9-12	1-00
2-12	4-12	18-12	12-00	10-00	1-12
7-12			12-12	10-12	6-00
8-00			25-12	11-00	6-12
8-12			26-00	11-12	7-12
16-12			26-12	12-00	9-00
17-00			27-00	22-00	9-12
17-12			27-12	22-12	10-00
				25-00	10-12
				25-12	11-00
				27-00	11-12
				27-12	

TYPE 7 - SUMMER (JULY)

JUL 62
14-12

TYPE 7 - SUMMER (AUGUST)

AUG 68
18-00
18-12
19-00
19-12
22-12
23-00
23-12
24-00

TYPE 8 - SUMMER (JUNE)

JUN 63	JUN 64	JUN 65	JUN 67	JUN 68
15-12	9-00	9-00	16-12	23-00
17-00	9-12		17-00	23-12
	10-00		17-12	24-00
			22-00	24-12
			22-12	29-00
			23-00	29-12
			23-12	30-00
			24-00	
			24-12	
			25-00	

TYPE 8 - SUMMER (JULY)

JUL 62	JUL 65	JUL 66	JUL 67	JUL 68
12-12	5-00	5-12	1-00	28-00
13-12	8-12	6-00	1-12	28-12
24-00	9-00	6-12		30-00
24-12	9-12	7-00		30-12
	10-00			31-00
	10-12			31-12

TYPE 8 - SUMMER (AUGUST)

AUG 62	AUG 64	AUG 65	AUG 66	AUG 67
29-00	11-00	17-12	19-00	3-00
29-12	23-12	18-00	19-12	17-12
30-00	24-00	18-12	20-00	
30-12	24-12	19-00	20-12	
		19-12	21-00	
		20-00	21-12	
		20-12	22-12	
		21-00	23-00	
		21-12	23-12	
		22-00		
		22-12		
		31-00		

TYPE 9 - SUMMER (JUNE)

JUN 62	JUN 67
14-12	1-00
15-00	1-12
	2-00
	2-12
	3-00

TYPE 10 - SUMMER (JULY)

JUL 64
11-12
12-00
12-12
13-00
13-12
14-00

TYPE 10 - SUMMER (AUGUST)

AUG 67
11-00
11-12
12-00

TYPE I - FALL (SEPTEMBER)

SEP 62	SEP 63	SEP 64	SEP 65	SEP 66	SEP 68
1-00	1-00	3-00	1-00	1-00	1-00
1-12	1-12	4-00	1-12	1-12	1-12
2-00	2-00	4-12	2-00	2-00	2-00
2-12	2-12	5-00	2-12	2-12	2-12
3-00	3-00	5-12	3-00	3-00	3-00
3-12	11-12	6-00	3-12	3-12	3-12
4-00	12-00	7-00	4-00	4-00	4-00
4-12	14-12	7-12	4-12	4-12	4-12
5-00	15-00	8-00	5-00	13-12	5-00
6-00	15-12	10-00	5-12	14-00	5-12
6-12	19-00	10-12	6-00	14-12	6-00
7-12	19-12	11-00	8-00	15-00	6-12
8-00	20-00	11-12	9-00	24-12	7-00
8-12	20-12	12-12	9-12	25-00	7-12
9-00	21-00	13-00	10-00	25-12	8-00
9-12	30-12	13-12	10-12	26-00	8-12
10-00		14-00	11-00	26-12	9-00
10-12		14-12	11-12	27-00	9-12
11-00		15-00	12-00	27-12	16-00
11-12		15-12	12-12	28-00	16-12
12-00		16-00	13-00		17-00
12-12		16-12	13-12		17-12
13-00		17-00	14-00		18-00
13-12		18-12	14-12		18-12
14-00		19-00	15-00		23-00
14-12		19-12	15-12		23-12
15-00		20-00	25-12		24-00
15-12		20-12	26-00		24-12
16-00		21-12	26-12		25-00
16-12		22-00	27-00		25-12
17-00		22-12	27-12		26-12
17-12		25-00	28-00		27-00
21-00		25-12	28-12		27-12
21-12		27-12	29-00		28-00
22-00		28-00	30-00		29-00
23-00		28-12	30-12		29-12
23-12		29-00			30-00
24-00		29-12			30-12
24-12		30-00			

TYPE I - FALL (OCTOBER)

OCT 62	OCT 63	OCT 64	OCT 65	OCT 66	OCT 67	OCT 68
15-12	1-00	1-00	1-00	1-12	6-12	1-00
16-00	1-12	1-12	1-12	2-00	7-00	1-12
18-12	2-00	2-00	2-00	4-00	7-12	2-00
19-00	2-12	2-12	3-00	4-12	8-00	2-12
19-12	3-00	3-00	3-12	5-00	8-12	3-00
20-00	7-00	3-12	6-12	5-12	9-00	3-12
20-12	7-12	4-00	7-00	6-00	12-12	4-00
21-00	25-12	8-12	7-12	6-12	13-00	4-12
21-12	26-12	9-12	9-00	7-00	13-12	5-00
27-12	27-00	10-00	9-12	7-12	14-00	5-12
	27-12	10-12	10-00	8-00	14-12	6-00
	28-00	11-00	10-12	8-12	15-00	6-12
	28-12	16-12	11-00	9-00	15-12	7-00
	30-00	17-00	11-12	9-12	16-00	7-12
	30-12	17-12	12-12	10-00	16-12	8-00
	31-00	18-00	13-00	10-12	17-00	8-12
	31-12	18-12	13-12	11-00	17-12	9-00
		23-12	14-00	11-12	18-12	9-12
		24-00	14-12	12-00	19-00	10-00
		24-12	15-00	12-12	19-12	10-12
		25-00	20-00	13-00	20-00	11-00
		25-12	20-12	13-12	20-12	16-00
		26-00	29-00	14-00	21-00	16-12
		26-12	29-12	14-12	21-12	17-00
		27-00	30-00	15-00	22-12	17-12
		27-12	30-12	15-12	23-00	18-00
		28-00	31-00	16-00	23-12	18-12
		28-12	31-12	16-12	24-00	19-00
		29-00		17-00	24-12	19-12
		29-12		17-12	25-00	20-00
		30-00		18-00	25-12	20-12
		30-12		18-12	26-00	21-00
				19-00	26-12	21-12
				19-12	27-00	22-00
				20-00	27-12	22-12
				21-12	28-00	23-00
				22-00	28-12	23-12
				22-12	29-00	26-12
				23-00	29-12	27-00
				23-12	30-00	27-12
				24-00	30-12	
				24-12	31-00	
				25-00	31-12	
				25-12		
				26-00		
				26-12		
				27-00		
				27-12		
				28-00		
				28-12		
				29-00		
				29-12		
				30-00		
				30-12		
				31-00		

TYPE I FALL (NOVEMBER)

NOV 61	NOV 62	NOV 63	NOV 64	NOV 65	NOV 66	NOV 67	NOV 68
1-12	5-00	1-00	6-00	1-00	5-00	1-00	1-00
3-00	5-12	1-12	6-12	1-12	5-12	1-12	1-12
3-12	6-00	2-00	7-00	2-12	6-00	2-00	2-00
4-00	7-12	3-00	7-12	3-00	6-12	2-12	2-12
4-12	8-12	3-12	8-00	3-12	7-00	3-00	3-00
5-00	9-00	4-00	8-12	4-00	7-12	3-12	3-12
5-12	10-12	4-12	9-00	5-00	9-00	4-00	4-00
6-00	11-00	5-00	9-12	5-12	9-12	5-00	4-12
6-12	11-12	5-12	11-12	6-00	10-00	7-12	5-00
7-00	12-00	6-00	12-12	6-12	10-12	8-00	5-12
11-12	12-12	6-12	13-00	7-00	11-00	8-12	6-00
12-00	13-00	10-00	22-12	7-12	11-12	9-00	6-12
12-12	13-12	10-12	23-00	8-12	12-00	9-12	7-00
13-00	14-00	15-00	23-12	9-00	12-12	10-00	7-12
13-12	14-12	15-12	24-00	9-12	13-00	10-12	8-00
14-00	15-00	16-00	24-12	10-00	13-12	11-00	8-12
14-12	15-12	16-12	25-00	10-12	14-00	11-12	9-00
15-00	16-00	17-00	25-12	11-00	16-00	12-00	9-12
16-12	16-12	17-12	26-00	11-12	16-12	12-12	10-00
17-00	17-00	18-00	26-12	12-00	17-00	13-00	10-12
17-12	17-12	18-12	27-00	12-12	17-12	15-00	11-00
18-00	18-00	19-00	27-12	13-00	18-00	15-12	11-12
18-12	18-12	19-12	28-00	13-12	18-12	16-00	12-00
19-00	19-00	20-00	28-12	14-00	19-00	16-12	12-12
19-12	19-12	20-12	29-00	14-12	19-12	17-00	13-00
20-00	20-00	21-00	29-12	15-00	23-00	17-12	13-12
20-12	20-12	21-12	30-00	15-12	23-12	18-00	14-00
21-00	21-00	22-00	30-12	16-00	24-00	18-12	14-12
21-12	21-12	22-12		16-12	24-12	24-12	15-00
22-00	22-00	23-00		17-00	25-00	25-00	15-12
22-12	22-12	23-12		17-12	25-12	25-12	16-00
23-00	23-00	24-12		18-00	26-00	26-00	16-12
23-12	23-12	25-00		18-12	26-12	26-12	17-00
24-00	24-00	25-12		19-00	27-00	27-00	17-12
24-12	24-12	26-00		19-12	27-12	27-12	18-00
26-00		26-12		20-00	28-00	28-00	18-12
26-12		27-00		20-12	29-00	28-12	21-00
27-00		27-12		21-00	29-12	29-00	21-12
27-12		28-00		21-12	30-00	29-12	22-00
28-00		28-12		22-00	30-12	30-00	22-12
28-12		29-00		22-12		30-12	23-00
29-00				23-00			23-12
29-12				23-12			24-00
30-00				24-00			24-12
30-12				24-12			25-00
				25-00			25-12
				25-12			26-00
				26-12			26-12
				27-00			27-00
				27-12			27-12
				28-00			28-00
				28-12			28-12
				29-00			29-00
				29-12			29-12
				30-00			30-12
				30-12			

TYPE 2 - FALL (SEPTEMBER)

SEP 62	SEP 63	SEP 64	SEP 66	SEP 68
22-12	13-12	17-12	6-12	11-00
27-12	14-00	18-00	7-00	11-12
28-00	16-00	30-12	7-12	12-00
28-12	21-12		8-00	12-12
29-00	22-00		8-12	13-00
29-12	22-12		9-00	13-12
30-00	23-00		9-12	14-00
	23-12		10-00	14-12
	24-00		10-12	15-00
	24-12		11-00	15-12
			18-12	19-00
			19-00	19-12

TYPE 2 - FALL (OCTOBER)

OCT 62	OCT 63	OCT 64	OCT 65	OCT 66	OCT 67	OCT 68
3-00	3-12	14-00	5-00	20-12	1-00	11-12
3-12	4-00	14-12	5-12	21-00	1-12	12-00
4-00	4-12	15-00	6-00		2-00	12-12
4-12	5-00	15-12	15-12		2-12	13-00
5-00	9-00	16-00	16-12		3-00	13-12
5-12	9-12	31-00	17-00		3-12	14-00
6-00	11-12	31-12	17-12		4-00	14-12
7-00	12-00		18-00		4-12	15-00
7-12	12-12		18-12		5-00	15-12
8-00	13-00		19-00		5-12	30-00
8-12	13-12		19-12		6-00	30-12
9-00	14-00				11-12	31-00
9-12	14-12				12-00	31-12
10-00	15-12				22-00	
10-12	16-12					
11-00	17-00					
11-12	17-12					
12-12	18-00					
13-00	18-12					
13-12	19-12					
14-00	20-00					
14-12	20-12					
15-00	21-00					
	21-12					
	22-00					
	22-12					
	23-00					
	23-12					
	24-00					
	24-12					
	25-00					
	29-00					
	29-12					

TYPE 2 - FALL (NOVEMBER)

NOV 61	NOV 62	NOV 63	NOV 64	NOV 65	NOV 66	NOV 68
10-00	25-00	2-12	1-00	2-00	15-00	30-00
10-12	25-12	7-00	1-12	4-12	15-12	
11-00	26-00	7-12	2-00		20-00	
	26-12	8-12	2-12		20-12	
	27-00	9-00	3-00		21-00	
	27-12	9-12	3-12			
	28-00	14-12	4-00			
	28-12		4-12			
	29-00		5-00			
	29-12		5-12			
	30-00		10-00			
	30-12		11-00			
			12-00			

TYPE 3 - FALL (SEPTEMBER)

SEP 62	SEP 63	SEP 66	SEP 68
18-00	8-00	5-00	26-00
18-12	28-00	21-12	
19-00	28-12	22-00	
19-12	30-00	22-12	
20-00		23-00	
20-12		23-12	
25-00		24-00	
		28-12	
		29-00	
		31-12	

TYPE 3 - FALL (OCTOBER)

OCT 62	OCT 64	OCT 65	OCT 66	OCT 67	OCT 68
22-00	4-12	8-00	31-12	9-12	24-00
22-12	5-00	8-12		10-00	24-12
23-00	5-12	12-00		18-00	25-00
23-12	6-00	22-00			25-12
24-00	6-12	22-12			26-00
24-12	7-00	23-00			28-00
25-00	7-12	23-12			28-12
25-12	8-00	24-00			29-00
26-00	9-00	24-12			
26-12	19-00	25-00			
27-00	19-12	25-12			
29-12	20-12	26-00			
30-00	21-00	26-12			
30-12	21-12	27-00			
31-00	22-00	27-12			
31-12	22-12	28-00			
	23-00	28-12			

TYPE 3 - FALL (NOVEMBER)

NOV 61	NOV 62	NOV 63	NOV 64	NOV 66	NOV 67	NOV 68
7-12	1-00	29-12	20-12	1-00	4-12	19-00
8-00	1-12	30-00	21-00	1-12	5-12	19-12
8-12	3-12	30-12	21-12	2-00	6-00	20-00
9-00	4-00		22-00	2-12	6-12	20-12
	4-12			3-00	7-00	
				3-12	13-12	
					14-00	

TYPE 4 - FALL (SEPTEMBER)

SEP 64	SEP 65	SEP 68
2-12	17-00	20-12
	17-12	21-00
	18-00	21-12
	18-12	22-00
	19-00	22-12
	19-12	

TYPE 4 - FALL (OCTOBER)

OCT 65
16-00

TYPE 4 - FALL (NOVEMBER)

NOV 61	NOV 64	NOV 65
2-00	13-12	26-00
2-12	14-12	
	15-00	
	16-00	
	16-12	

TYPE 5 - FALL (SEPTEMBER)

SEP 62	SEP 63	SEP 66	SEP 68
25-12	8-12	5-12	10-00
26-00	9-00	6-00	10-12
26-12	9-12	15-12	
27-00	10-00	16-00	
30-12	10-12	16-12	
	11-00	17-00	
	12-12	17-12	
	13-00	18-00	
	25-00		
	25-12		
	26-00		
	26-12		
	27-00		
	27-12		
	29-12		

TYPE 5 - FALL (OCTOBER)

OCT 62	OCT 63	OCT 64	OCT 65	OCT 67	OCT 68
1-00	8-00	11-12	4-00	10-12	29-12
1-12	8-12	12-00	4-12	11-00	
2-00	10-00	12-12	21-00	14-12	
2-12	10-12	13-00	21-12		
28-00	11-00	13-12			
28-12	15-00				
29-00					

TYPE 5 - FALL (NOVEMBER)

NOV 61	NOV 62	NOV 63	NOV 65	NOV 66
9-12	8-00	11-00	8-00	14-12
		11-12		28-12
		12-00		
		12-12		
		13-00		
		13-12		
		14-00		

TYPE 6 - FALL (SEPTEMBER)

SEP 62	SEP 64	SEP 65	SEP 66	SEP 68
5-12	23-00	16-00	29-12	28-12
	23-12	16-12	30-00	
	24-00	20-00	30-12	
	24-12	20-12		
	26-00	21-00		
	26-12	21-12		
	27-00	22-00		
		22-12		
		23-00		
		23-12		
		24-00		
		24-12		
		25-00		

TYPE 6 - FALL (OCTOBER)

OCT 62	OCT 66
18-00	1-00
	2-12
	3-00
	3-12

TYPE 6 - FALL (NOVEMBER)

NOV 61	NOV 64	NOV 66
16-00	17-00	4-00
	17-12	4-12
	18-00	8-00
	18-12	8-12
	19-00	19-00
	19-12	19-12
	20-00	20-00
		20-12
		21-00
		21-12
		22-00
		22-12
		23-00
		23-12
		24-00

TYPE 7 - FALL (SEPTEMBER)

SEP 66

19-12
20-00
20-12
21-00

TYPE 8 - FALL (SEPTEMBER)

SEP 63	SEP 64	SEP 65	SEP 66	SEP 68
16-12	1-00	6-12	11-12	20-00
17-12	1-12	7-00	12-00	
18-00	2-00	7-12	12-12	
18-12	8-12	8-12	13-00	
	9-00			

TYPE 8 - FALL (OCTOBER)

OCT 63

5-12
6-00
6-12
16-00

TYPE 8 - FALL (NOVEMBER)

NOV 66

21-12
22-00
22-12

Western Region Technical Memoranda: (Continued)

No. 45/2 Precipitation Probabilities in the Western Region Associated with Spring 500-mb Map Types. Richard P. Augulis, January 1970. (Out of print.) (PB-189434)
No. 45/3 Precipitation Probabilities in the Western Region Associated with Summer 500-mb Map Types. Richard P. Augulis, January 1970. (Out of print.) (PB-189414)
No. 45/4 Precipitation Probabilities in the Western Region Associated with Fall 500-mb Map Types. Richard P. Augulis, January 1970. (Out of print.) (PB-189435)
No. 46 Applications of the Net Radiometer to Short-Range Fog and Stratus Forecasting at Eugene, Oregon. L. Yee and E. Bates, December 1969. (PB-190476)
No. 47 Statistical Analysis as a Flood Routing Tool. Robert J. C. Burnash, December 1969. (PB-188744)
No. 48 Tsunami. Richard P. Augulis, February 1970. (PB-190157)
No. 49 Predicting Precipitation Type. Robert J. C. Burnash and Floyd E. Hug, March 1970. (PB-190962)
No. 50 Statistical Report on Aeroallergens (Pollens and Molds) Fort Huachuca, Arizona, 1969. Wayne S. Johnson, April 1970. (PB-191743)
No. 51 Western Region Sea State and Surf Forecaster's Manual. Gordon C. Shields and Gerald B. Burdwell, July 1970. (PB-193102)
No. 52 Sacramento Weather Radar Climatology. R. G. Pappas and C. M. Veliquette, July 1970. (PB-193347)
No. 53 Experimental Air Quality Forecasts in the Sacramento Valley. Norman S. Benes, August 1970. (Out of print.) (PB-194128)
No. 54 A Refinement of the Vorticity Field to Delineate Areas of Significant Precipitation. Barry B. Aronovitch, August 1970.
No. 55 Application of the SSARR Model to a Basin Without Discharge Record. Vail Schermerhorn and Donald W. Kuehl, August 1970. (PB-194394)
No. 56 Areal Coverage of Precipitation in Northwestern Utah. Philip Williams, Jr., and Werner J. Heck, September 1970. (PB-194389)
No. 57 Preliminary Report on Agricultural Field Burning vs. Atmospheric Visibility in the Willamette Valley of Oregon. Earl M. Bates and David O. Chilcote, September 1970. (PB-194710)
No. 58 Air Pollution by Jet Aircraft at Seattle-Tacoma Airport. Wallace R. Donaldson, October 1970. (COM-71-00017)
No. 59 Application of P.E. Model Forecast Parameters to Local-Area Forecasting. Leonard W. Snellman, October 1970. (COM-71-00016)

NOAA Technical Memoranda NWS

No. 60 An Aid for Forecasting the Minimum Temperature at Medford, Oregon. Arthur W. Fritz, October 1970. (COM-71-00120)
No. 61 Relationship of Wind Velocity and Stability to SO_2 Concentrations at Salt Lake City, Utah. Werner J. Heck, January 1971. (COM-71-00232)
No. 62 Forecasting the Catalina Eddy. Arthur L. Eichelberger, February 1971. (COM-71-00223)
No. 63 700-mb Warm Air Advection as a Forecasting Tool for Montana and Northern Idaho. Norris E. Woerner, February 1971. (COM-71-00349)
No. 64 Wind and Weather Regimes at Great Falls, Montana. Warren B. Price, March 1971.
No. 65 Climate of Sacramento, California. Wilbur E. Figgins, June 1971. (COM-71-00764)
No. 66 A Preliminary Report on Correlation of ARTCC Radar Echoes and Precipitation. Wilbur K. Hall, June 1971. (COM-71-00829)
No. 67 Precipitation Detection Probabilities by Los Angeles ARTC Radars. Dennis E. Ronne, July 1971. (Out of print.) (COM-71-00925)
No. 68 A Survey of Marine Weather Requirements. Herbert P. Benner, July 1971. (Out of print.) (COM-71-00889)
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