Late Spring and Early Fall
Low Temperatures in Texas

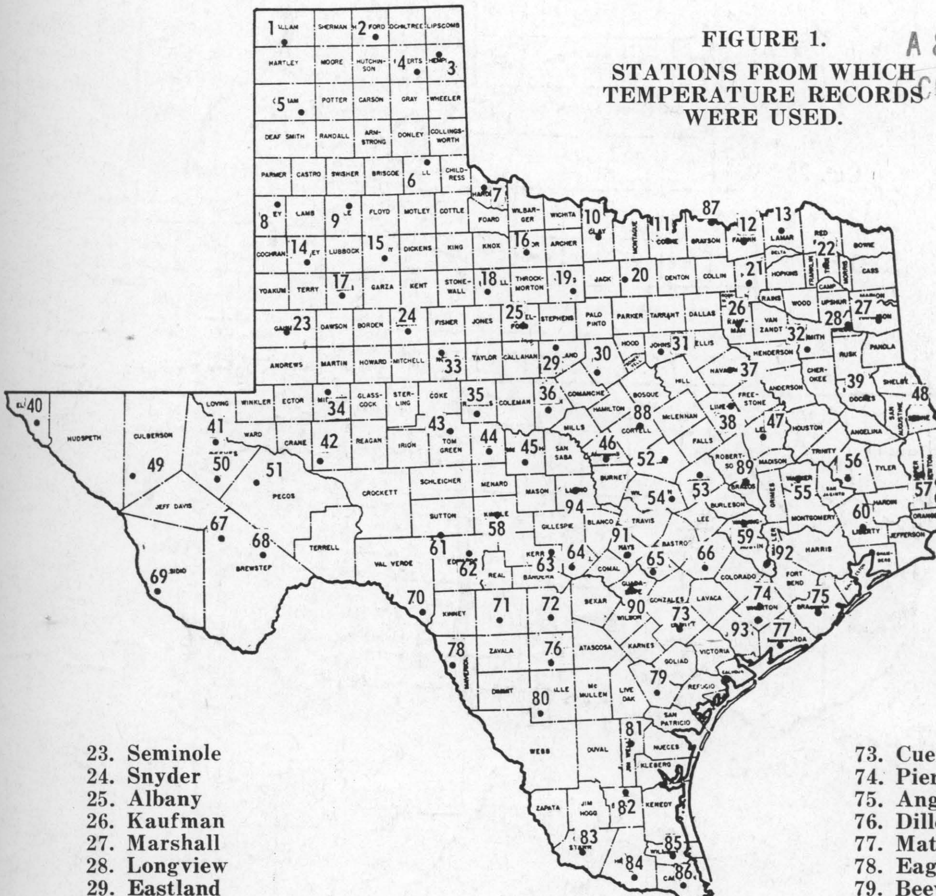

FIGURE 1.
STATIONS FROM WHICH TEMPERATURE RECORDS WERE USED.

1. Dalhart
2. Spearman
3. Canadian
4. Miami
5. Vega
6. Memphis
7. Quanah
8. Muleshoe
9. Plainview
10. Henrietta
11. Gainesville
12. Bonham
13. Paris
14. Levelland
15. Crosbyton
16. Seymour
17. Tahoka
18. Haskell
19. Graham
20. Bridgeport
21. Greenville
22. Mt. Pleasant
23. Seminole
24. Snyder
25. Albany
26. Kaufman
27. Marshall
28. Longview
29. Eastland
30. Dublin
31. Cleburne
32. Flint
33. Roscoe
34. Midland
35. Ballinger
36. Brownwood
37. Corsicana
38. Mexia
39. Nacogdoches
40. Ysleta
41. Pecos
42. McCamey
43. San Angelo
44. Eden
45. Brady
46. Lampasas
47. Centerville
48. Bronson
49. Van Horn
50. Balmohea
51. Fort Stockton
52. Temple
53. Cameron
54. Taylor
55. Huntsville
56. Livingston
57. Kirbyville
58. Junction
59. Brenham
60. Liberty
61. Substation No. 14
62. Rocksprings
63. Kerrville
64. Boerne
65. Luling
66. Flatonia
67. Alpine
68. Marathon
69. Presidio
70. Del Rio
71. Uvalde
72. Hondo
73. Cuero
74. Pierce
75. Angleton
76. Dilley
77. Matagorda
78. Eagle Pass
79. Beeville
80. Encinal
81. Alice
82. Falfurrias
83. Rio Grande City
84. Mission
85. Raymondville
86. Harlingen
87. Denison Dam
88. Gatesville
89. College Station
90. New Braunfels
91. San Marcos
92. Sealy
93. Danevang
94. Llano

TEXAS AGRICULTURAL EXPERIMENT STATION - - - TEXAS AGRICULTURAL EXTENSION SERVICE
College Station, Texas

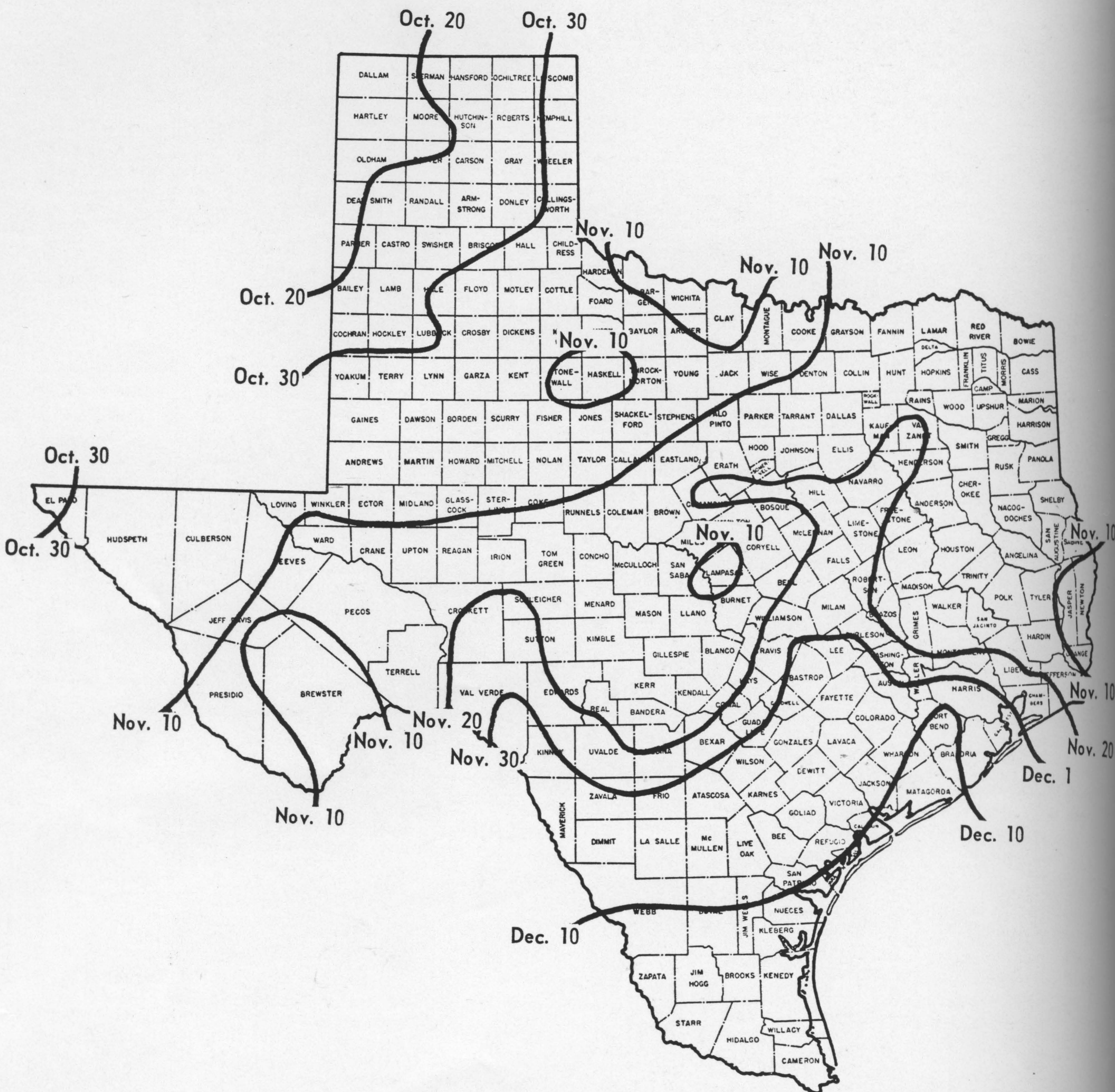

Figure 2. Average date of first occurrence of 32° temperatures in the fall.

Late Spring and Early Fall Low Temperatures in Texas

Richard D. Blood aud R. J. Hildreth *

FARMERS FACE MANY RISKS. Climate is one of the major factors causing variations in yield. This is especially true of low temperatures, which cause frost damage and injury to plants and animals.

Low temperatures in the late spring may damage young crops and make necessary their replanting. If replanting is not necessary, yields often are reduced. Early blooming fruit and vegetable crops often are either damaged or destroyed by late spring frosts. Crops which mature in the spring and early summer, such as oats and wheat, also may be damaged by low temperatures during this season.

Freezes in the fall damage late maturing crops. Often farmers are forced to plant their crops late by unfavorable weather in the spring. When this occurs the farmers often desire some knowledge of the probability that a crop will mature before a damaging freeze occurs.

The relative shortness of the growing season, "frost-free days," influences greatly the choice and use of many crops and varieties by the farmer. For example, cotton is not grown in the northern and higher parts of the High Plains because of the shortness of the growing season.

This report should enable a Texas farmer to obtain some idea of the probabilities of the occurrence of low temperatures in his area. Thus he could be able to determine better the chance that an early-planted crop may be damaged by a late spring or a late-planted crop by an early autumn freeze. The information on the number of "frost-free days" should enable the farmer to make better decisions concerning new varieties and crops for his area.

This report presents an analysis of low temperature data for 94 climatological stations in Texas. The occurrence of 32-degree temperature is presented for both the spring and fall. The term "fall" is used to mean the period from mid-summer to December 31, and "spring" the period from January 1 to mid-summer. The dates after and before which a 20 percent and a 5 percent chance of occurrence of the temperature also are presented. The average number of days between the occurrence of certain critical low temperatures also are presented.

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SOURCE OF DATA

Ninety-four climatological stations in Texas which have continuous temperature records are the source of temperature data presented in the accompanying charts. The length of time for which records are available range from 9 to 30 years. The probabilities were derived from a statistical analysis of temperature records made by the U. S. Weather Bureau National Weather Records Center. The location of these stations is shown in Figure 1. Temperatures obtained should be representative of the general area, except in the mountainous terrain of the Big Bend country.

Standard equipment for observing daily extremes of temperature at U. S. Weather Bureau cooperative meteorological stations consists of a self-indicating maximum thermometer and a self-indicating minimum thermometer, both of which are exposed in a shelter. This is a box with louvered sides and a slotted floor which is mounted on a stand so that the thermometer bulbs are approximately 4 feet from the surface of the ground. The louvers permit the air to flow freely around the thermometers, yet protect them from radiation from the sun during the day and direct loss of heat to the sky at night. The data used for this analysis are based on the dates of occurrence of low temperatures as recorded in the instrument shelter. It is realized that on calm, clear nights freezing temperatures can occur at grass level, a few inches above the ground, when shelter temperatures remain several degrees above 32 degrees F.

Local Influences on Temperature

After sunset, the ground cools rapidly and as a result of loss of heat by radiation its temperature soon falls below that of the layer of air in contact with it. Owing to the loss of heat by conduction, the surface air becomes cooler and denser than that above, and instead of rising as it did during the day, it tends to be kept in contact with the ground by its own density. Over level areas on clear, calm nights, a relatively thin layer of cold air is found near the ground with warmer air above it.

Over sloping ground the surface air which has been cooled through contact with the ground tends to drain to lower levels and to collect in depressions or hollows. Local topography has a significant influence on the incidence of frost. For example, at Junction, which is in a valley,

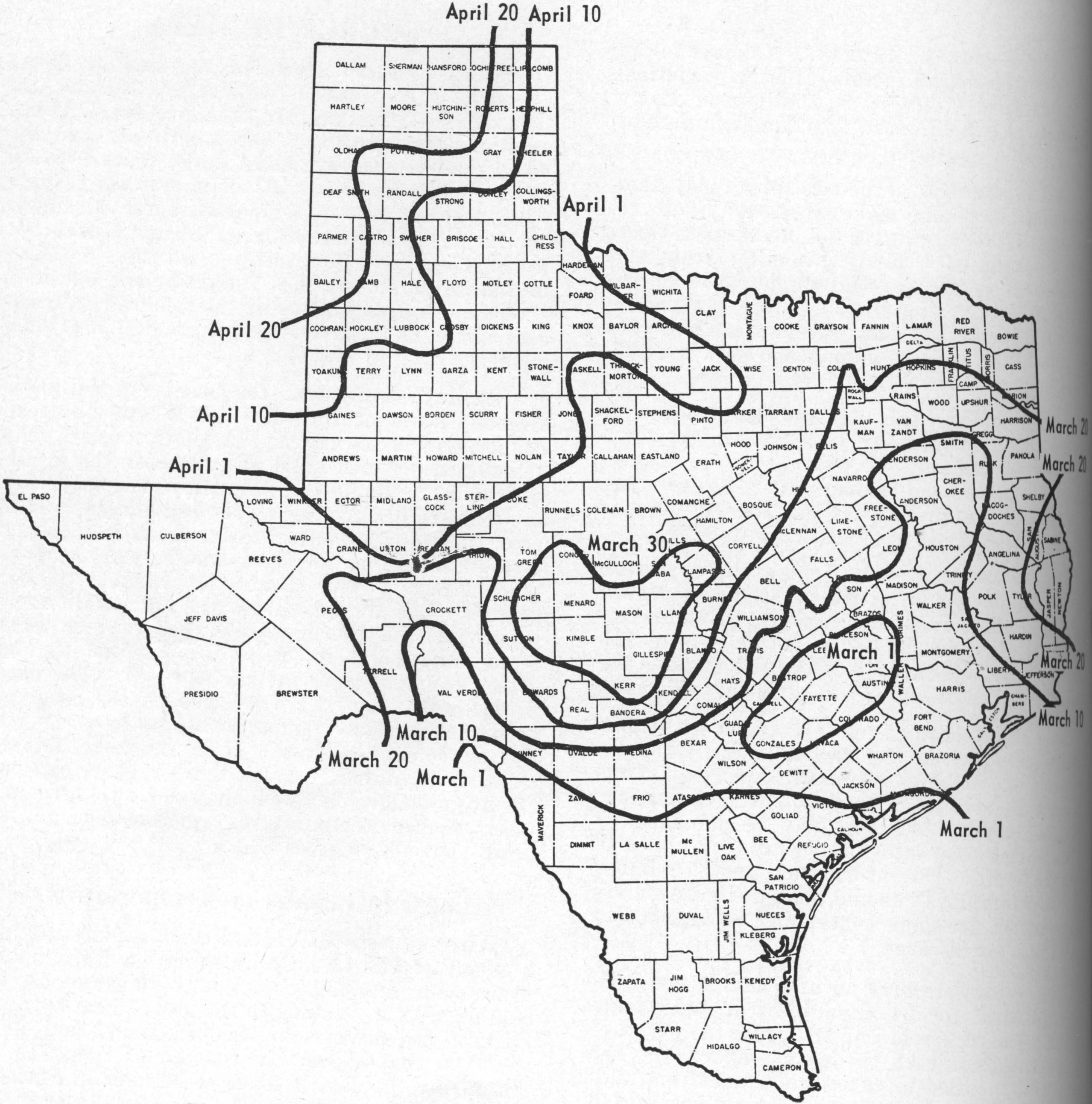

Figure 3. Average date of last occurrence of 32° temperatures in the spring.

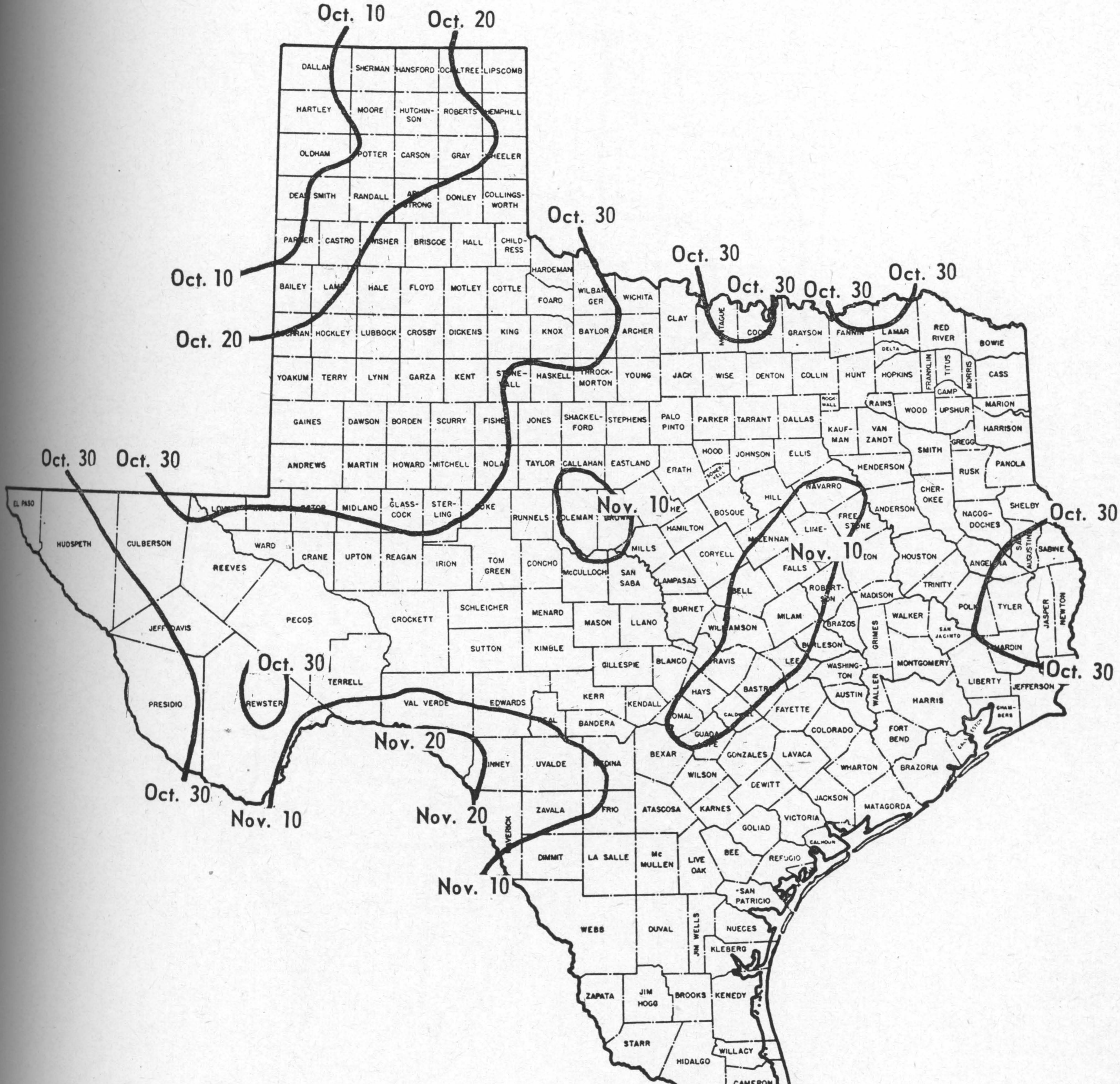

Figure 4. Dates in the fall before which there is a 20 percent chance of 32° temperatures occurring.

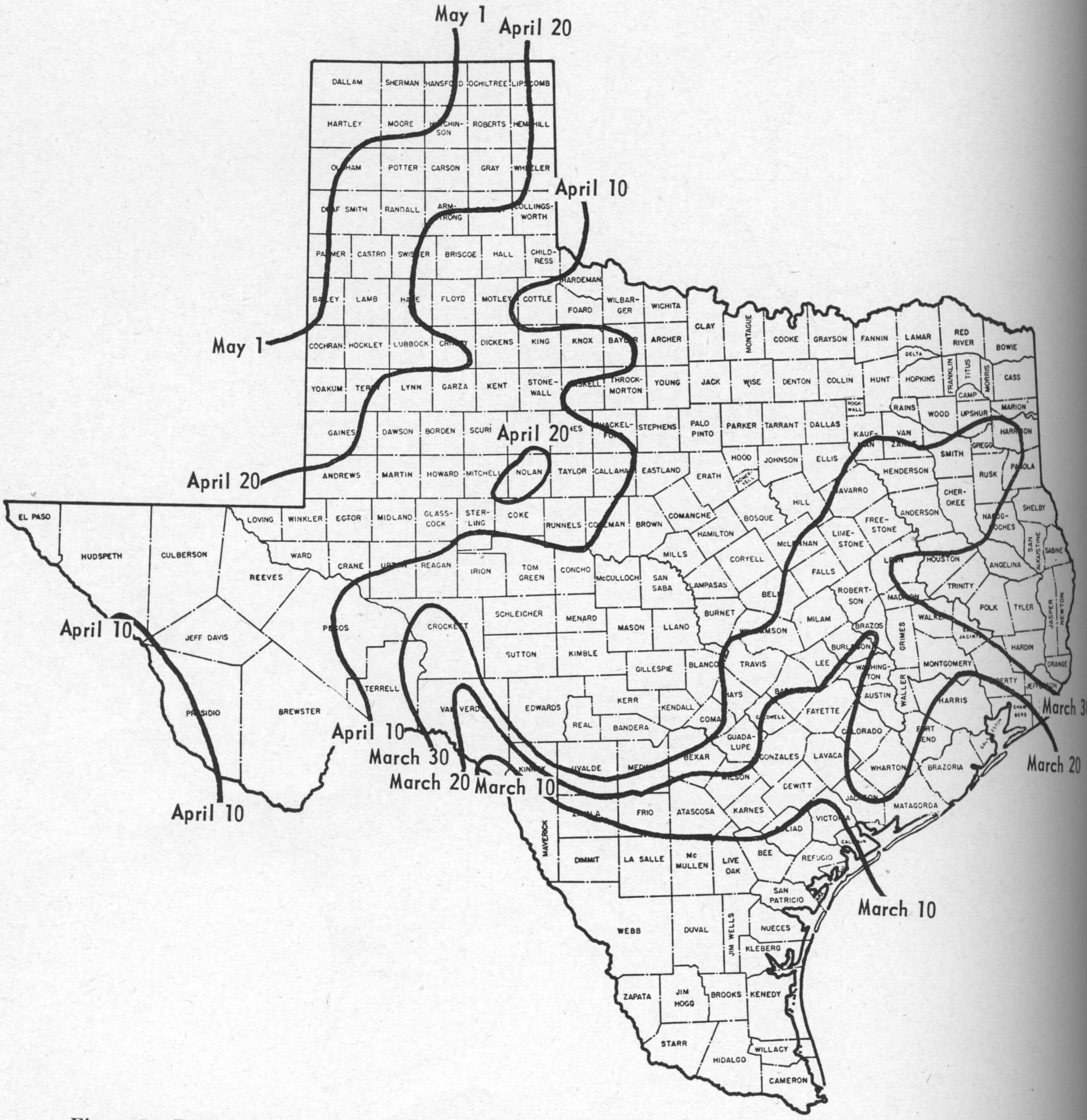

Figure 5. Dates in the spring after which there is a 20 percent chance of 32° temperatures occurring.

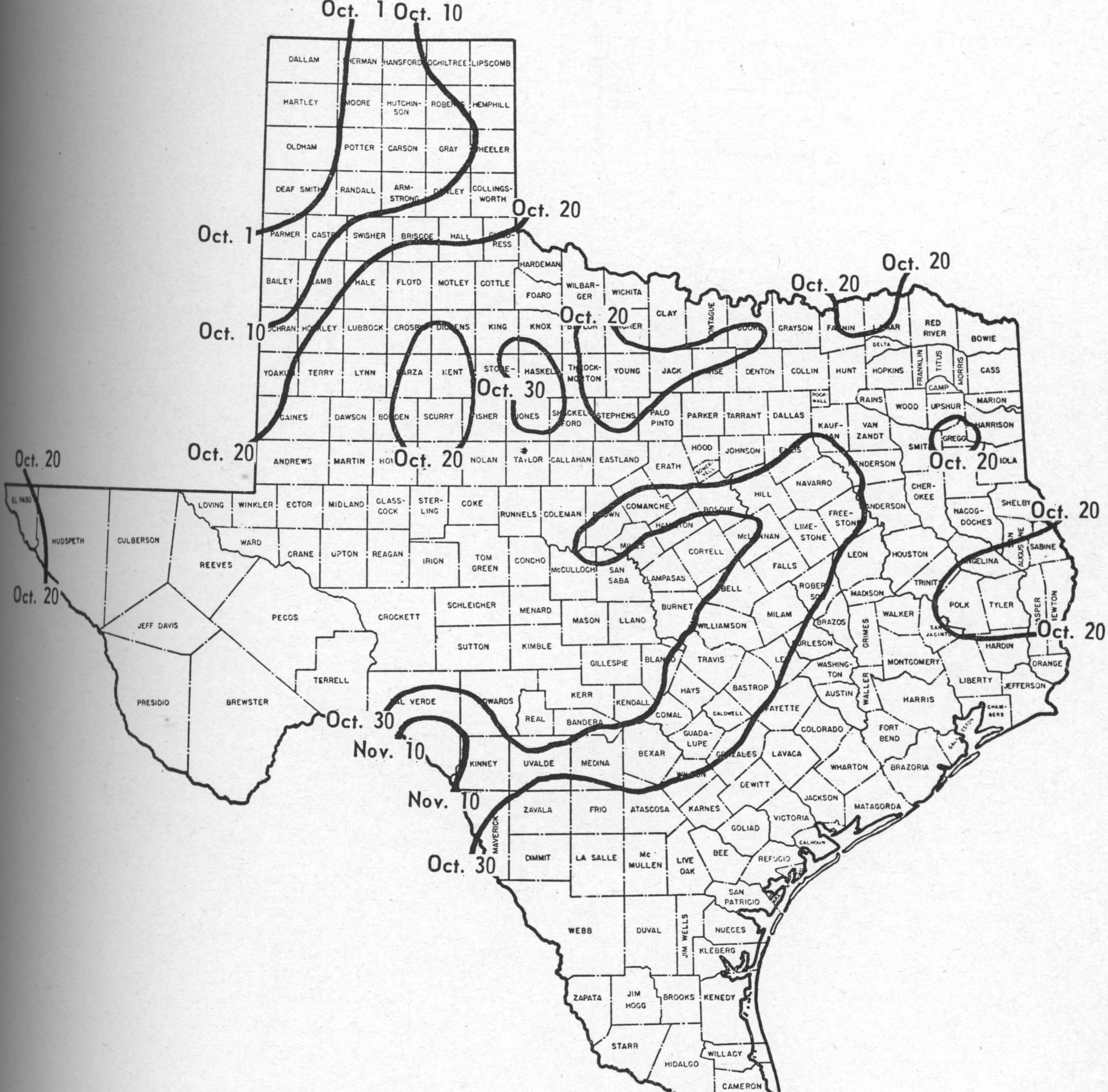

Figure 6. Dates in the fall before which there is a 5 percent chance of 32° temperatures occurring.

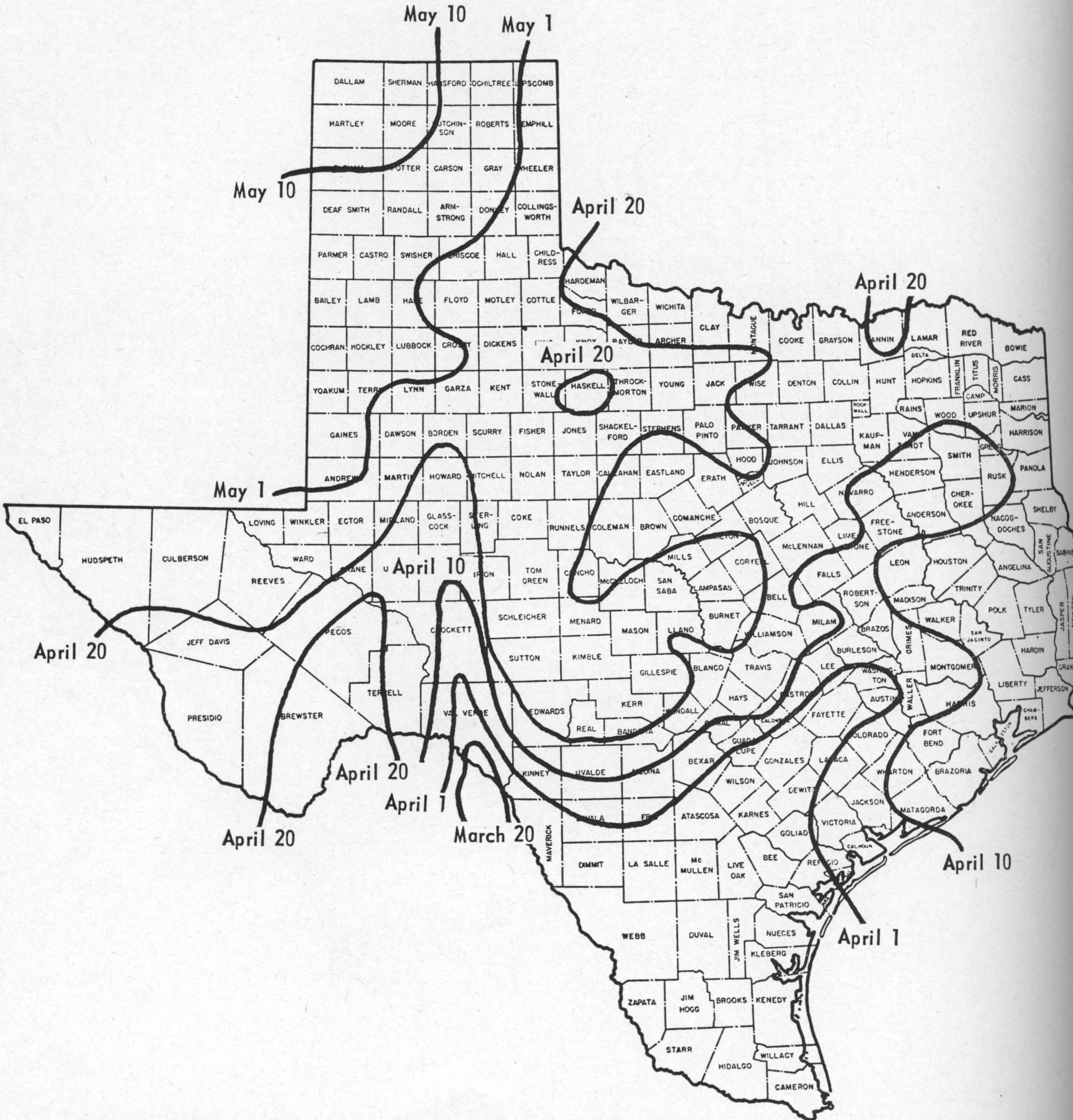

Figure 7. Dates in the spring after which there is a 5 percent chance of 32° temperatures occurring.

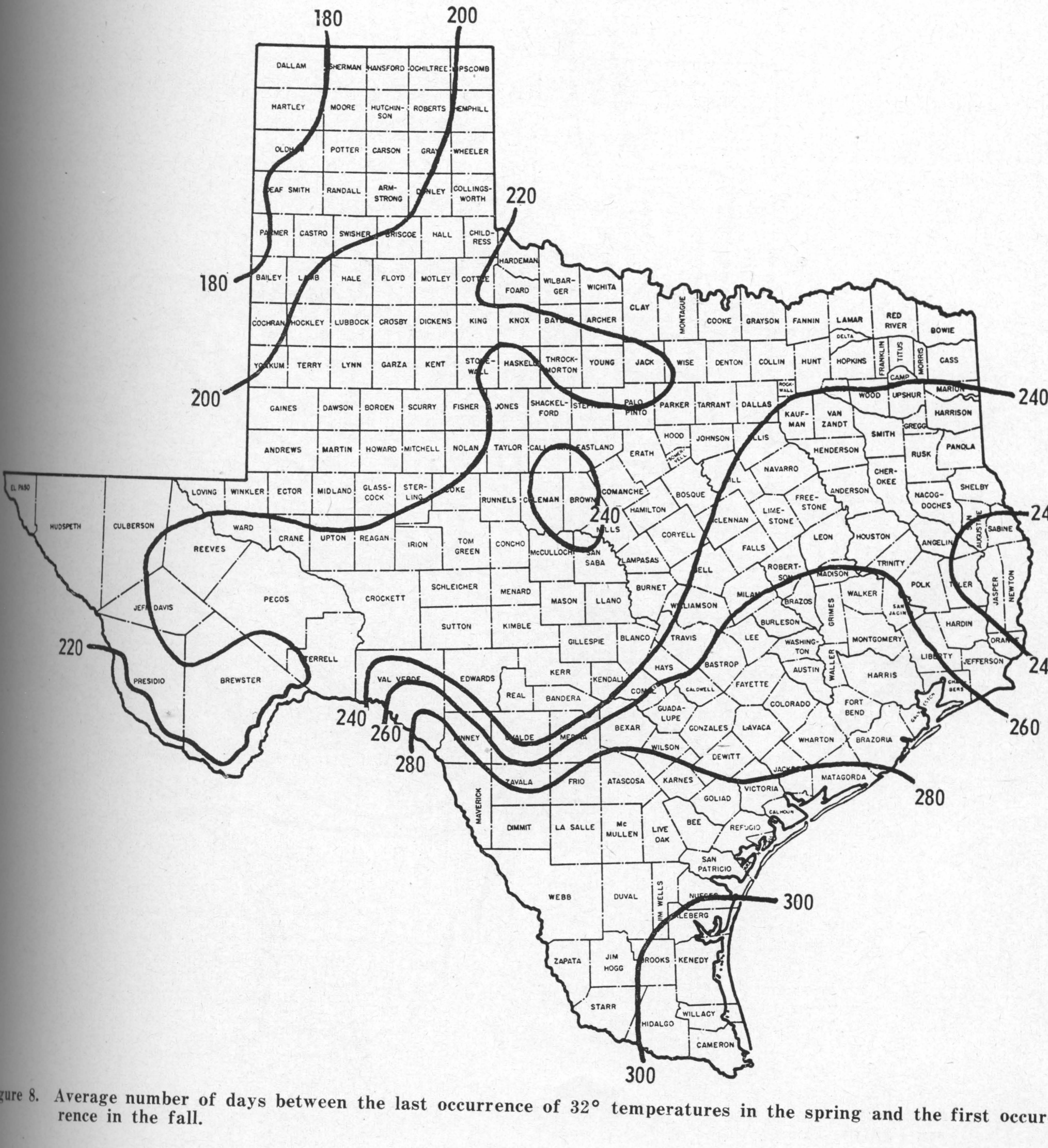

Figure 8. Average number of days between the last occurrence of 32° temperatures in the spring and the first occurrence in the fall.

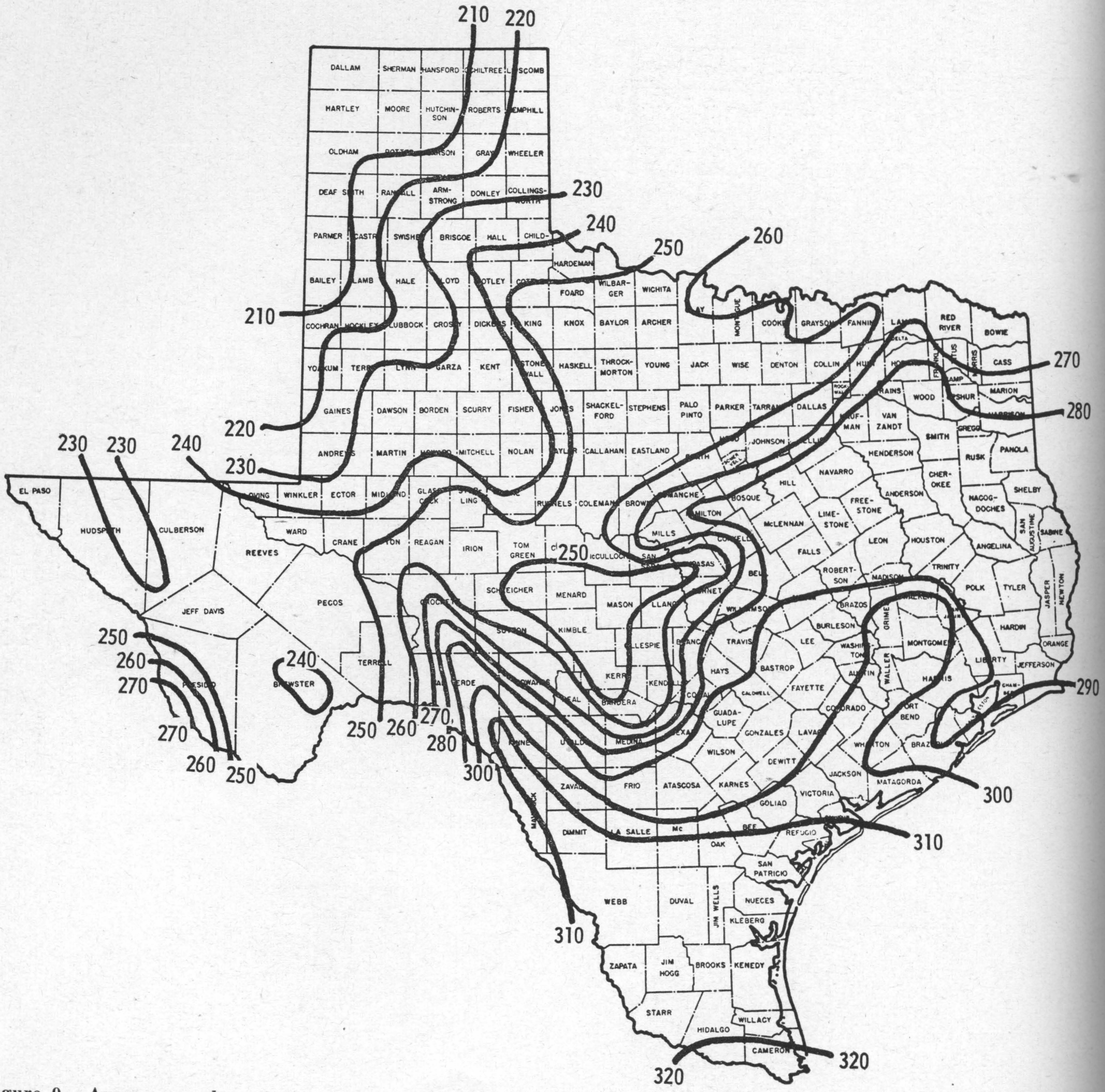

Figure 9. Average number of days between the last occurrence of 28° temperatures in the spring and the first occurrence in the fall.

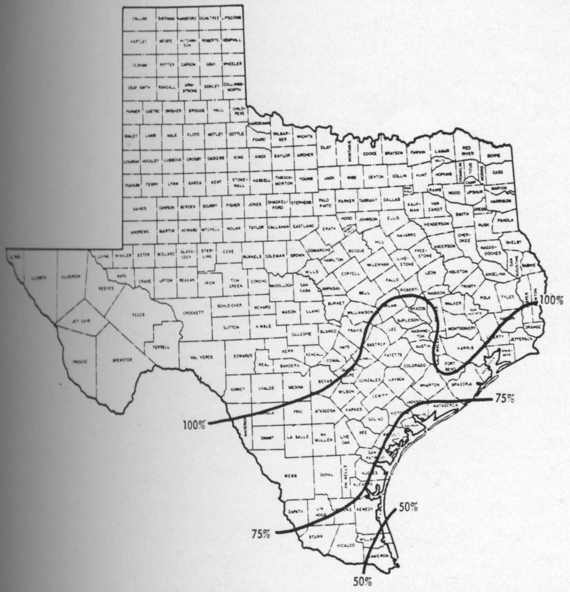

Figure 10. **Probability of 32° temperatures occurring in the fall.**

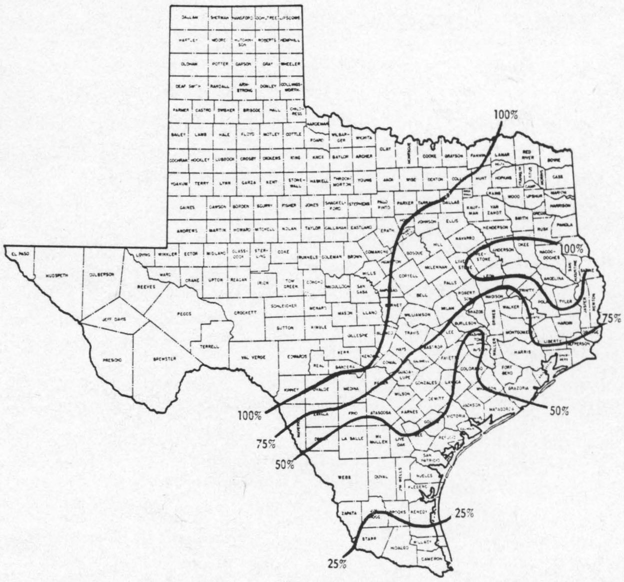

Figure 12. Probability of 28° temperatures occurring in the fall.

drainage of cold air into the depression causes frosts much later in the spring and earlier in the fall than at surrounding stations. Also, every farmer is familiar with "frost pockets" and knows that depressions should be avoided when growing crops susceptible to frost.

Night winds have a great influence on temperature differences between hillsides and valleys on clear nights. The best conditions for air drainage are found when there is no general air movement in the area. Even a light wind will serve to mix the relatively warm air above and away from the slopes with the thin layer of surface air which has cooled through contact with the ground. Moderate winds may prevent stratification entirely, resulting in little or no difference in temperature between the hills and valleys.

Stations located on a hillside will generally tend to have longer frost-free periods than neighboring stations on lower ground or in a valley.

The differences in average 32° F. occurrences on account of variations in topography, proximity of bodies of water and air drainage, contribute to the difficulties of mapping the data. Any attempt to draw isolines (line of equal date or percentage) which fit all the data would require a very large scale map. Consequently, in the accompanying maps the isolines are drawn to give only a general picture of the aerial distribution of low temperatures and their probabilities of occurrence.

Figure 11. **Probability of 32° temperatures occurring in the spring.**

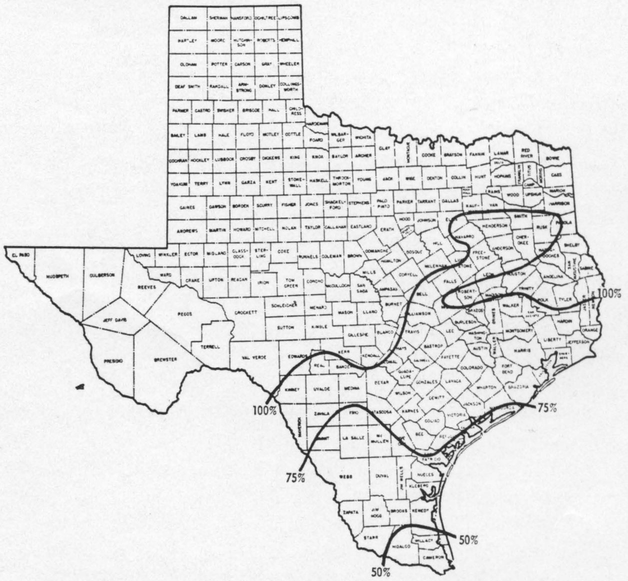

Figure 13. Probability of 28° temperatures occurring in the spring.

Temperature and Damage to Vegetation

The appearance of frost has been associated commonly with plant injury. Frost is defined as the deposit of atmospheric moisture in the form of feathery ice crystals on the ground or other surfaces, the temperature of which has fallen to 32° or lower. Frost and dew are formed by the same physical process, the only difference being that, in the case of frost, the atmospheric moisture (water vapor) is deposited as ice crystals instead of water droplets when the temperature of the air is at the freezing point (32° F.) or below at the surface. Dew or frost can be expected to occur only on clear, still nights. Since sub-freezing temperatures can and often do occur without the appearance of frost, plant injury may occur in the absence of frost. For this reason, air temperature usually is considered a better criterion for measuring the extent of plant injury than the occurrence or non-occurrence of frost.

The relationship between 32° temperature and plant development is not a simple one. Some plants are killed at the first occurrence of this temperature, while others will be affected adversely only if the temperature drops several degrees below freezing. In certain plants, the susceptibility to low temperatures depends on the stage of development. For example, peach trees in bud may be able to stand 25° temperature, but only 28° in bloom and 30° in fruit.

The length of time of the low temperature is an important factor. An occurrence of a 25° temperature for a short period may damage a plant less than 5 or 6 hours of a temperature of 32°. Other factors influencing relationship between low temperature and plant injury are level of soil moisture and amount of ground cover.

Previous weather often will determine the resistance of a plant, as will the species and phase of development. If there is warm, sunny weather for a few days prior to the occurrence of low temperatures, the plant system will have adjusted for rapid growth, then low temperatures may cause severe damage. If the previous weather has been cool, the plant is conditioned and will withstand lower temperatures.

Late and Early Low Temperatures

The accompanying charts give a general indication of the risk of the occurrence of low temperatures in different parts of Texas after specific dates in the spring and before specific dates in the fall. Dates for three levels of risk—50, 20 and 5 percent—for 32° and 28° temperatures, are shown for spring and fall.

The chart used for any operation will depend on the amount of risk or chance the operator wishes to take. For example, if a farmer, growing a crop which would be killed or severely damaged by 32° temperatures, decides it would be advantageous economically to risk damage 2 years out of 10 in order to reach an earlier market, he should refer to Figure 5 (20 percent chance of 32° temperatures) and plan his spring planting operations accordingly.

Figure 2 shows the average date of the first occurrence of 32° temperatures in the fall. Approximately half the time a 32° temperature will be reached earlier and half the time later than this date. Therefore, this date may be taken as the date of 50 percent risk. A large range from north to south, 53 days, should be noted between the earliest and latest dates of occurrence for stations reporting 32° temperatures every year, from October 18 at Dalhart to December 10 at Del Rio. Not all stations considered in this study have had temperatures of 32° every year.

Similarly, Figure 3 shows the date after which there is a 50 percent risk of the occurrence of a 32° temperature in the spring. The range between the earliest and latest dates of 32° temperatures' occurring is 71 days: from February 12 at Del Rio to April 23 at Dalhart.

Figures 4 to 7 show the dates in the fall and spring for a 20 and a 5 percent chance of occurrence. For example, Figure 4 shows the dates in the fall before which there is a 20 percent chance of 32° temperature occurring.

Figure 8 shows the average number of days between the last occurrence of 32° temperatures in the spring and the first occurrence in the fall. This ranges from 178 days at Dalhart to 311 days at Harlingen and Mission.

Figure 9 shows the average number of days between the last occurrence of 28° temperatures in the spring and the first occurrence in the fall. This ranges from 201 days at Dalhart to 328 days at Harlingen and Mission.

Figure 10 shows the probability of occurrence of 32° temperatures in the fall, since not every station in this study has 32° temperatures every fall. For example, at Brownsville, less than half the years have freezing temperatures in the fall.

Figure 11 shows the probability of the occurrence of 32° temperatures in the spring.

Figure 12 shows the probability of the occurrence of 28° temperatures in the fall, since not every station in this study has 28° temperatures every fall.

Figure 13 shows the probability of the occurrence of 28° temperatures in the spring.

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