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BULLETIN 47

STATE OF ILLINOIS
WILLIAM G. STRATTON, Governor

DEPARTMENT OF REGISTRATION AND EDUCATION
VERA M. BINKS, Director

Summary of Weather Conditions at Champaign-Urbana, Illinois

by S. A. CHANGNON, Jr.

ILLINOIS STATE WATER SURVEY
WILLIAM C. ACKERMANN, Chief

URBANA
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Summary of Weather Conditions at Champaign-Urbana, Illinois

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INTRODUCTION

Champaign-Urbana lies astride a northwest-southeast trending recessional moraine in the generally flat farmlands of east-central Illinois. Physiographically, the area is called the Bloomington Ridged Plain, which is principally the Wisconsin Drift, the moraines and plains of which are the geomorphic features of the present surface.[1] In general, the surface elevation of the moraine underlying Champaign-Urbana averages 50 to 100 feet above the surrounding flat plain.

This area of Illinois has a temperate continental-type climate and is far from the modifying influences of large water bodies. The typical summer is hot and humid with 59 percent of the normal annual precipitation, 36.30 inches, occurring in the warmer half-year. A characteristic winter has occasional cold periods but is not severe. Annual snowfall averages 20.3 inches, but its moisture contribution is only 13 percent of the total winter precipitation.

Maximum temperatures of 90 degrees or higher have occurred as frequently as 56 days in one year (1936), but the average is 26 days per year. Minimum temperatures of zero degrees or lower have been observed in 45 of the years between 1903 and 1956 and occur on an average of seven days per year. However, these temperatures have occurred as often as 19 days in one year (1905, 1936). The average growing season of 181 days lasts from April 22 through October 19 with May 25 being the latest date of freezing temperature recorded and September 16 the earliest date.

SOURCE AND DESCRIPTION OF DATA

This report provides a complete resume of the weather conditions measured and observed in the Champaign-Urbana area from 1901 through 1956. Detailed records of many weather phenomena have been kept by various university groups during these years. Their quantity and the need to summarize the data have suggested compiling the material into one publication. Available weather data are presented here in, what is hoped, a usable form. Averages, extremes, frequency distributions, and probabilities are applied to various daily, weekly, monthly, and annual periods of data. Historical graphs of various weather phenomena are employed to reveal past variability and to develop averages.

The periods of record vary with the different weather phenomena, but, in general, the material presented is based on weather conditions existing in Champaign-Urbana from 1901 through 1956, or portions thereof. Weather observations and data collection began locally in 1889, but the data prior to 1901 were not used in compiling this summary. To eliminate problems of data accuracy, the 1901-56 data were selected for use to conform generally with the period that the Urbana station has served as a U. S. Weather Bureau cooperative substation. The U. S. Weather Bureau personnel have checked all data collected at the Morrow Plots station since August 1902.

Records of other weather elements which were not collected under Weather Bureau supervision are generally not presented for the entire 1901-56 period. Any scanty or inaccurate data that had been collected were all or partially discarded as unreliable after careful examination. The specific period of record for each weather phenomenon is given in the text. If the collection of any data was at a location other than the Morrow Plots observation station, the site or sites are specifically mentioned in the text.

Much of the climatic data presented was collected at the principal weather station in Champaign-Urbana near the Morrow Plots on the University of Illinois campus, which divides the two cities. The station at the Morrow Plots, which have been used as agricultural experiment fields since 1876 by the University, is officially classified by the U. S. Weather Bureau as the Urbana station. Figure 1 is a reference map showing the station location. The elevation of the station is 743 feet above mean sea level, and its position is 40° 7' north latitude and 88° 13' west longitude.

Daily, weekly, and monthly weather data for the Morrow Plots have been entered on IBM punch cards for the 1903-55 period.[2] A summary of monthly weather conditions for Urbana, based on these punched cards, was published in 1955.[3] Since 1955, monthly and annual summaries of the local weather have been issued by the State Water Survey.

Some of the temperature and precipitation data summarized in this report have been collected at the Agronomy South Farm station which is approximately 1.2 miles south of the Morrow Plots station (Fig. 1). The radiation data were collected at a point 0.7 mile west of the Morrow Plots station, and have been made available through the Warm Air Heating Research Unit at the University of Illinois. The gages for the Champaign-Urbana rain gage network were provided by the Civil Engineering Department of the College of Engineering at the University. The State Water Survey has operated a complete weather station at the University of Illinois Airport since June 1952, and data from this station have been used in this report.

ACKNOWLEDGMENTS

This report was prepared under the general direction of William C. Ackermann, Chief of the Illinois State Water Survey, and the supervision of Glenn E. Stout, Head of the Meteorology Section. The author is indebted to Floyd A. Huff for his pertinent suggestions and guidance. Raymond Pittman and Ronald Gilbert drafted the illustrations and Dorothy Hiatt aided with the tabulation of the data. Others of the State Water Survey staff assisting in the data collection and tabulation include Douglas M. A. Jones and August H. Krueger.

Many persons and organizations, particularly the University of Illinois College of Agriculture and the U. S. Weather Bureau, have made this publication possible by their collection of weather data in the past 56 years. It would be impossible to indicate all the effort that has been required for the collection and dissemination of the weather data summarized herein.

Much of the collection of weather data prior to 1948 was done under the sponsorship of the University of Illinois College of Agriculture, with members of the University staff serving as weather observers from January 1889 through April 1948. The University-sponsored weather station became an official U. S. Weather Bureau reporting station beginning August 1902. Professor J. G. Mosier was the official observer from August 1902 until September 1920. He was succeeded by Dr. R. S. Smith who served as the official observer until December 1936. W. A. McIntire helped make observations from May 1911 to August 1929, O. J. Ellis from September 1929 to August 1930, and H. P. Etler from September 1930 through November 1936. Mr. Etler replaced Dr. Smith as the official observer in December 1936 and remained in this capacity until May 1948.

Beginning in May 1948, the State Water Survey assumed responsibility for the collection of weather data at the Morrow Plots and Agronomy South Farm stations, and has continued in this capacity to present. From 1948 through 1956, the official weather observers were R. D. Gilroy, G. F. Beatty, and D. Whitnah. W. J. Roberts of the State Water Survey Engineering Section furnished evaporation data collected under his supervision during the past eleven years.

The University of Illinois College of Agriculture has contributed funds for publication of this weather summary. For his interest and efforts which have made publication of this summary possible, appreciation is expressed to Dean Louis B. Howard of the College of Agriculture.

Credit is due Professor J. J. Doland of the Civil Engineering Department, who through his interest and cooperation, initiated the collection of data from a rain gage network in the Champaign-Urbana area. Credit is also due D. R. Bahnfleth and other personnel of the Warm Air Research Unit of the Mechanical Engineering Department who generously provided the solar radiation data in this report.

INSTRUMENTATION

The current Morrow Plots station consists of a Cotton Region type of shelter containing maximum and minimum thermometers, a psychrometer, and a hygrothermograph. There is also an 8-inch standard nonrecording rain gage and an 8-inch standard weighing-bucket recording rain gage as shown in Figure 2b. The weather shelter in use prior to June 10, 1948 (Fig. 2a), was located approximately 120 feet west of the shelter location shown in Figure 2b. At the South Farm installation there is also a Cotton Region shelter with a hygrothermograph, an 8-inch standard recording weighing-bucket rain gage, and a separate shelter which houses recording soil thermographs.

At the Water Resources Building, which is located 0.5 mile north-northwest of the Morrow Plots (Fig. 1), wind data are obtained by means of a recording wind instrument mounted 15 feet above the building. Areal distribution of rainfall in Champaign-Urbana was determined from 12 recording rain gages located at various sites within the urban area. The solar radiation data were collected with an Eppley pyrheliometer located at the instrument symbol labeled Warm Air on Figure 1.

Evaporation data were obtained with a U. S. Weather Bureau standard evaporation pan. Collection of evaporation data was made from 1950-56 at a site a few hundred feet southeast of the Water Resources Building (Fig. 1). From 1947 through 1949 the evaporation pan was located at the Urbana Water Works which is approximately 0.5 mile northeast of the Water Resources Building.

The Airport weather station consists of a Cotton Region shelter with maximum and minimum thermometers and an 8-inch standard recording rain gage. This station is located approximately 6 miles south of the Morrow Plots station. Cloud data used in this report were recorded at Chanute Air Force Base which is located 14.5 miles north of the Morrow Plots station.

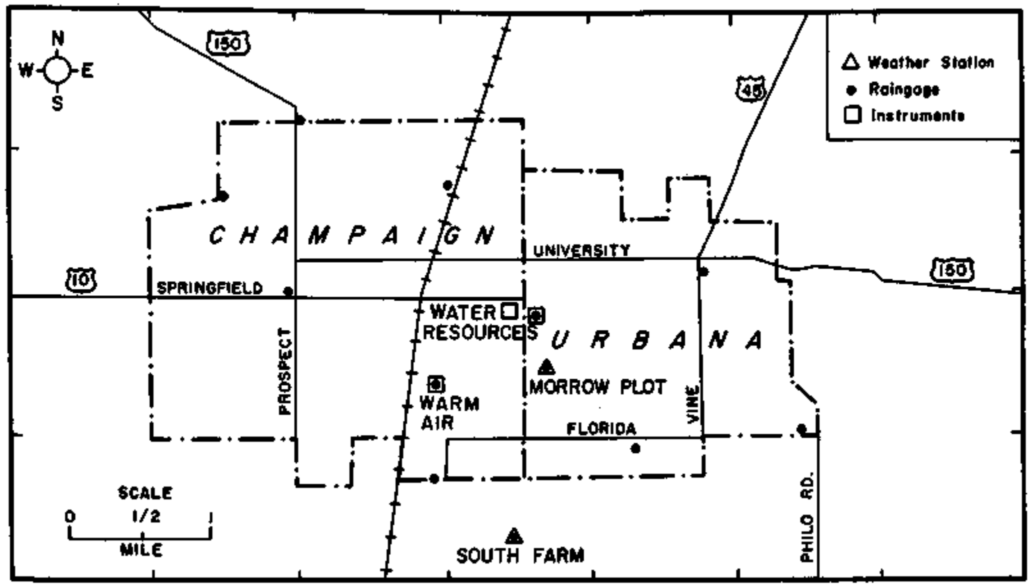
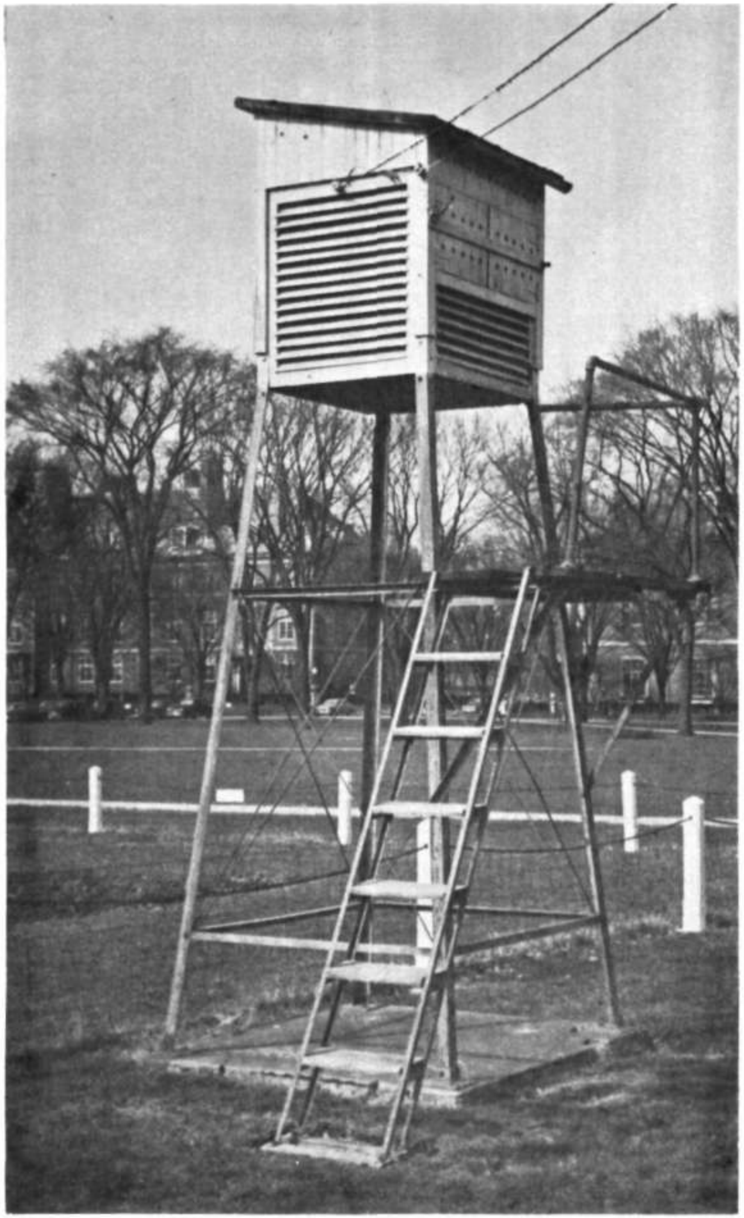
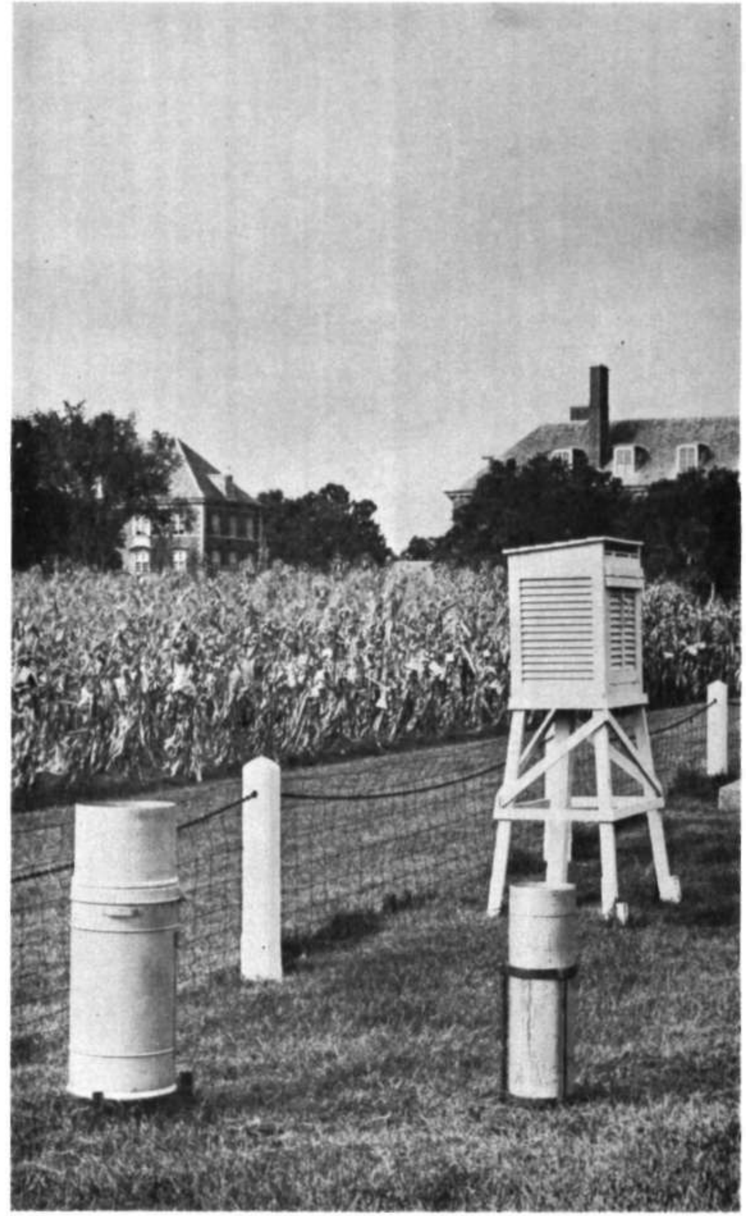


FIGURE 1 —REFERENCE MAP



(a) Weather shelter in use prior to June 10, 1948



(b) Cotton Region type shelter in use since June 10, 1948, and recording and nonrecording rain gages in the **foreground.**

FIGURE 2 — INSTALLATIONS FOR MORROW PLOTS WEATHER STATION

PRECIPITATION

ANNUAL AND WARMER HALF-YEAR PRECIPITATION

Figure 3 shows the amount of precipitation occurring each year from 1901 through 1956 and the amount each year during the warmer half-year (glossary). These data were obtained at the Morrow Plots station. Although the annual precipitation shows considerable change from year to year, the precipitation at Champaign-Urbana is considered climatologically reliable. The average is 36.30 inches, and the annual total has never been less than 24 inches. The warmer half-year precipitation averages 21.47 inches, or 59 percent of the annual average, and exhibits less yearly absolute variability, seldom departing more than 6 inches below the average. These curves illustrate the inadequacy of rainfall averages for predicting the rainfall that may occur in any particular year because the average value occurs infrequently.

The highest annual precipitation occurred in 1927 when 55.64 inches fell. The lowest amount occurred in 1914 when 24.68 inches were recorded. The wettest 5-year period in Urbana occurred from 1941 through 1945, when the annual average based on these 5 years reached 41.89 inches. The 1923-27 period was also quite wet with a 5-year annual average rainfall of 41.86 inches. The lowest 5-year average occurred from 1910 through 1914 when the annual average was 29.62 inches.

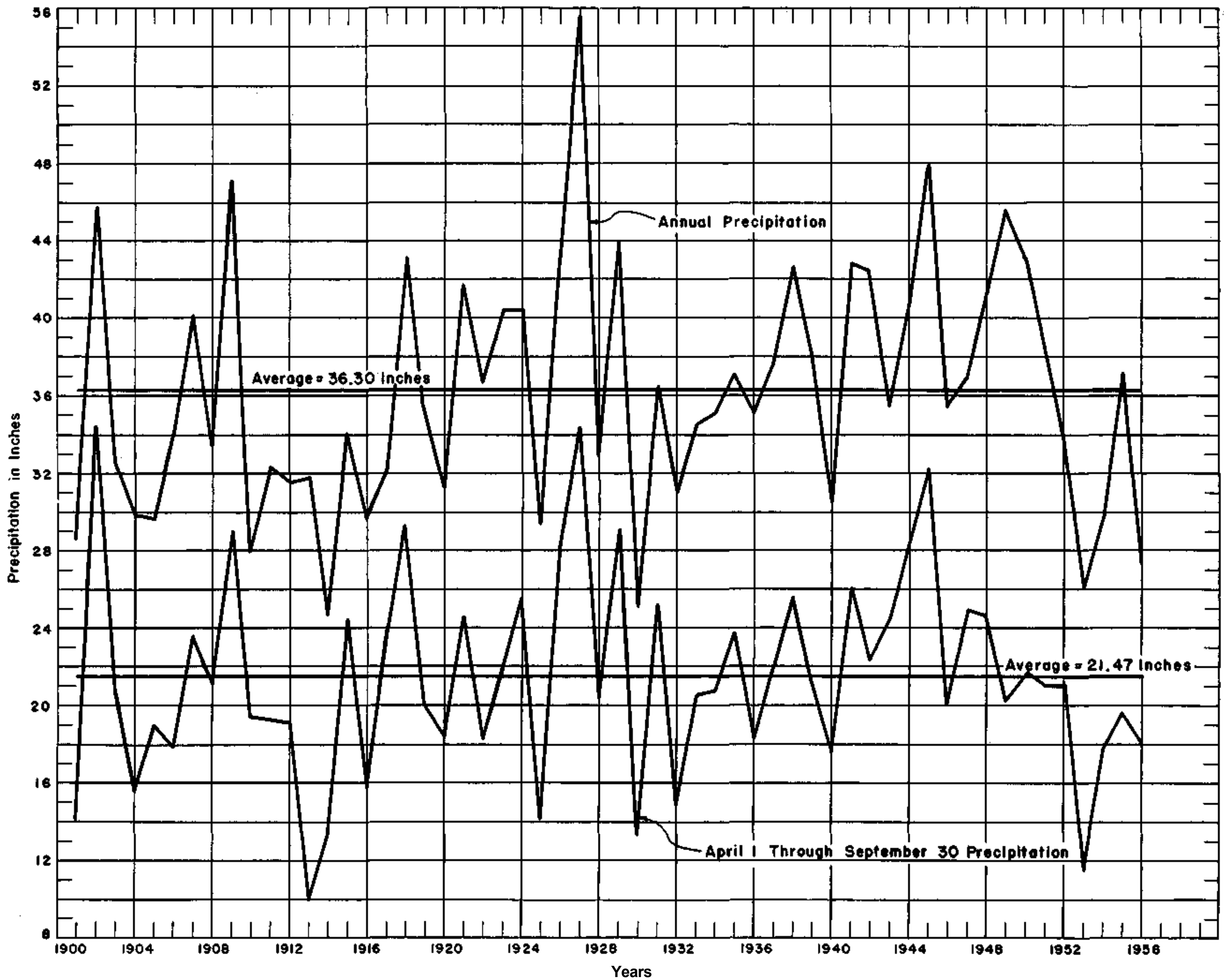


FIGURE 3 — ANNUAL AND WARMER HALF-YEAR PRECIPITATION

MONTHLY PRECIPITATION

Figure 4 shows the monthly average precipitation for each month based on the period of record at the Morrow Plots station from 1901 through 1956. Also shown are lowest and highest monthly amounts. February and December have the lowest average precipitation with 1.93 inches and 2.14 inches, respectively. May with an average of 4.07 inches has the maximum average amount and June with 3.92 inches ranks second. The highest monthly precipitation on record is 11.73 inches which was recorded in June 1902, and the second highest is 11.20 inches which occurred in May 1943. The lowest monthly precipitation total on record was a trace (glossary) in November 1904.

The greatest number of months with above average precipitation in any year was nine months in 1945. The longest continuous period of months with above average precipitation was seven, occurring from March through September 1945. The wettest three months recorded during the warmer half-year period were June through August in 1902 when 25.55 inches fell.

In any year the greatest number of months with below average precipitation has been 10, recorded in 1916 and 1930. The longest continuous periods with below average precipitation recorded were the 11 months from October 1910 through August 1911 and from May 1930 through March 1931. The driest period of three consecutive months on record was December 1919 through February 1920 when only 1.40 inches fell. Another extremely dry three-month period was October through December 1904 when 1.64 inches occurred. The driest three-month period ever recorded during the warmer half-year produced 3.62 inches (May-July 1925).

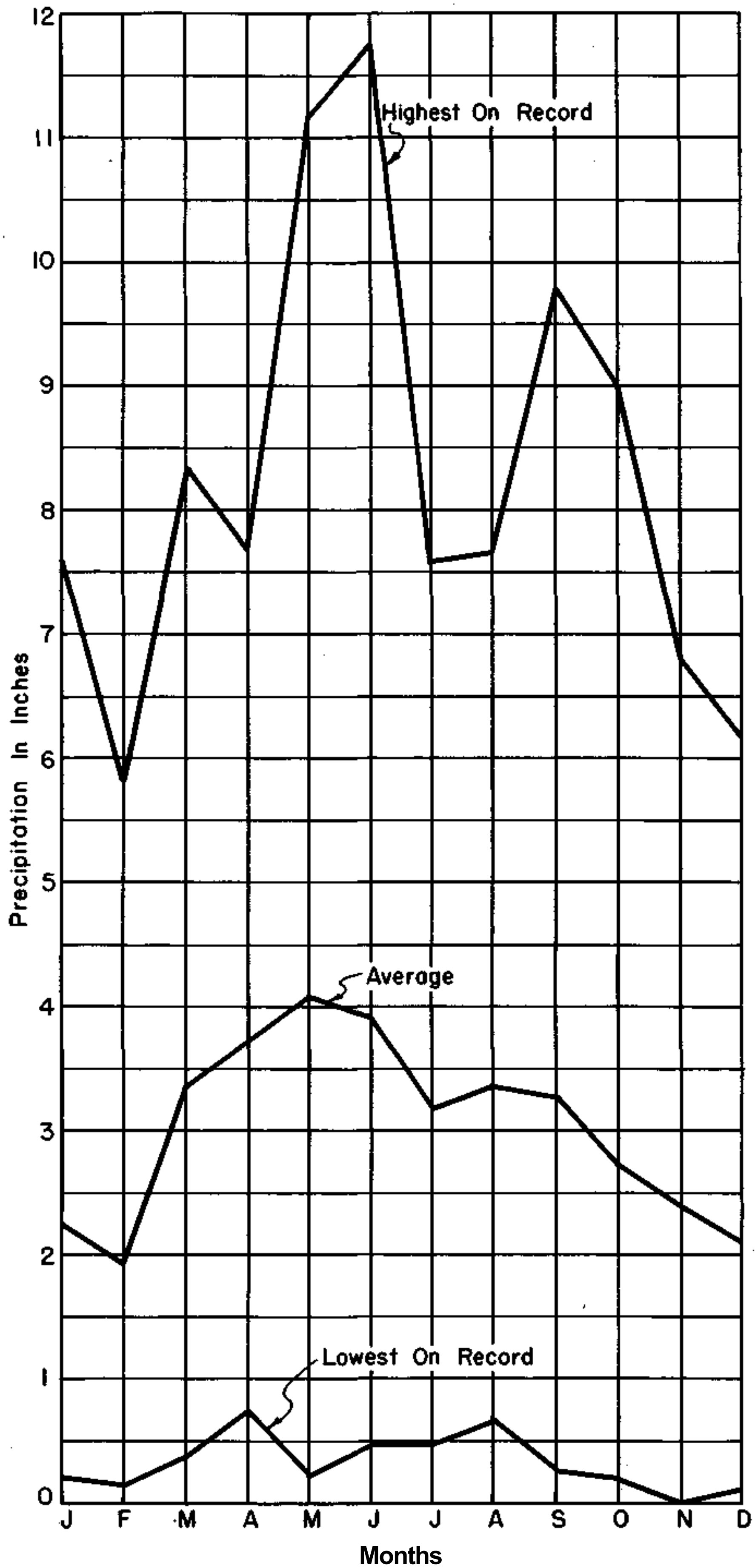


FIGURE 4 — MONTHLY PRECIPITATION

WEEKLY PRECIPITATION

The weekly average precipitation during the year is shown in Figure 5, based on records from 1903 through 1955. The week of April 5-11 has the highest weekly average with 1.12 inches. The averages for the weeks of June 21-27 and September 27-October 3 are also high. From April 1 through July 18, each week averages more than 0.8 inch of precipitation. The weeks of January 24-30 and February 7-13 have the lowest weekly averages, both with an average of 0.39 inch.

A probability curve with percent values labeled on the right-side ordinate is shown also. These probability values give for each week the chances that the weekly average precipitation will be equaled or exceeded. For 51 weeks of the year there is less than fifty percent probability that the weekly average precipitation will occur. Only for the week of November 7-13 is the weekly average likely to be equaled or exceeded over fifty percent of the time. In the week of October 24-30 chances are only 27 out of 100 that the weekly average will be equaled or exceeded. During four weeks of the year, the average is equaled or exceeded less than 30 percent of the time.

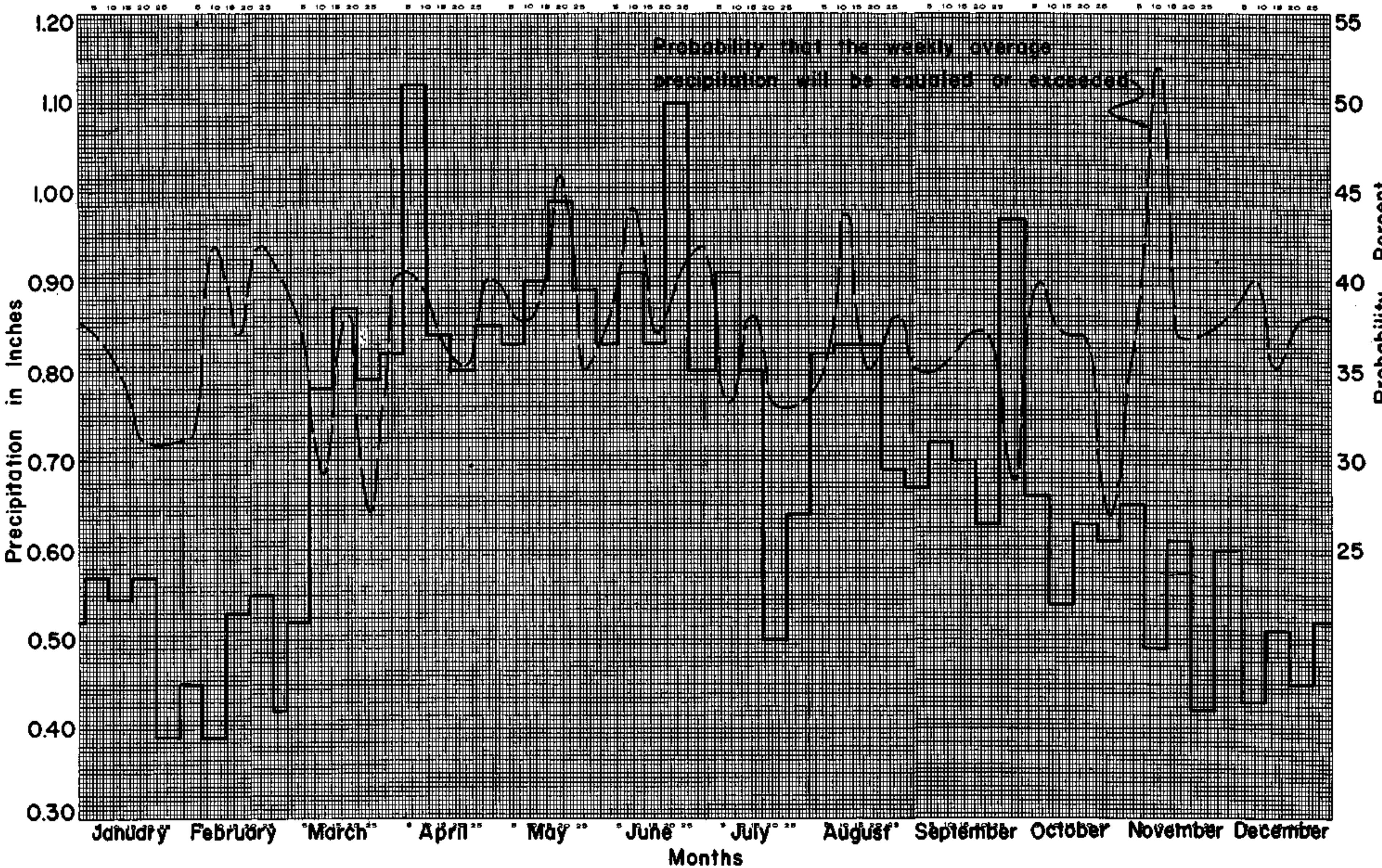


FIGURE 5 — WEEKLY AVERAGE PRECIPITATION AND PROBABILITY

DISTRIBUTION OF DAILY RAINFALL AMOUNTS

Figure 6 illustrates the frequency of occurrence of daily rainfall amounts based upon records for 1903-1956. During this period 5,913 (30 percent) of the 19,724 days had measurable rainfall; 2,421 had 0.1 inch or less rainfall and only 61 had amounts greater than 2 inches. The largest daily amount on record is 4.61 inches which occurred on May 26, 1921.[4] The maximum daily amounts in each month are shown in the table below.

More than 40 percent of the days in which there was rainfall had 0.1 inch or less. For the heavier daily rainfall amounts, those greater than two inches per day, an expanded scale is presented (Fig. 6). The days on which large amounts of rainfall occurred have been few, as revealed by the low percentages. The curve of cumulative percent, which is measured on the right-side ordinate of this figure, is an accumulation of the percent values in each amount reading from right to left: This curve reveals that only 10 percent of all the days with rain during the 54 years, 1903-56, had amounts greater than 0.9 inch. The dotted lines intersecting with the curve indicate that only 33 percent of the days with rain had amounts greater than 0.3 inch.

MAXIMUM 24-HOUR RAINFALL AMOUNTS FOR EACH MONTH, 1901-56

Month	*Amounts*	*Year*	*Month*	*Amounts*	*Year*
January	2.12	1937	July	3.40	1950
February	1.78	1939	August	4.20	1924
March	4.28	1939	September	4.07	1931
April	3.07	1944	October	3.66	1955
May	4.61	1921	November	4.14	1936
June	3.35	1939	December	2.97	1901

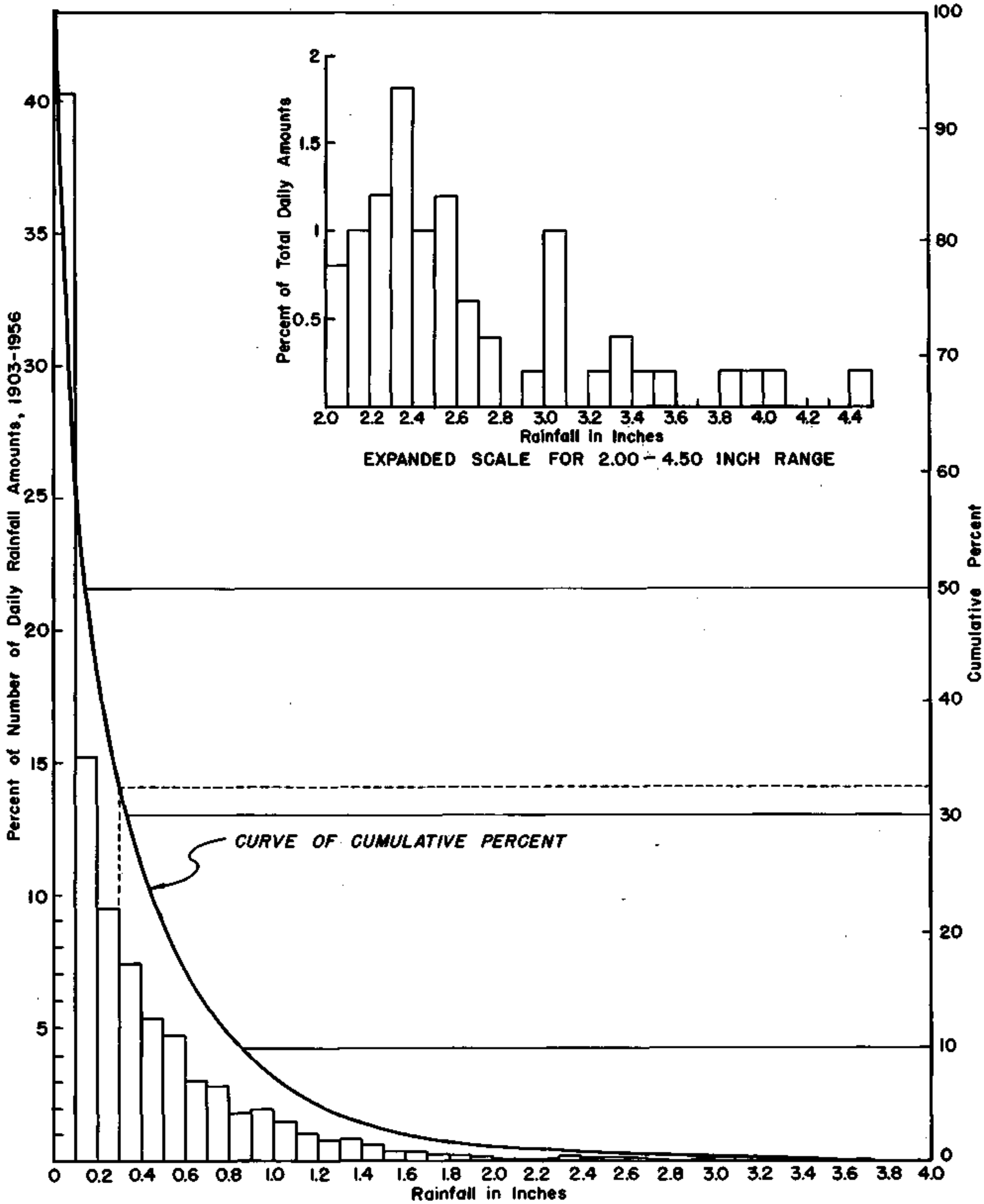


FIGURE 6 — FREQUENCY DISTRIBUTION OF DAILY RAINFALL AMOUNTS

DAYS WITH PRECIPITATION

The upper curve in Figure 7 reveals the number of days for each year in which a measurable amount of precipitation equal to or greater than 0.01 inch was observed. The lowest number of days in any year was 78 as recorded in 1901, and the greatest number was 137 days in 1951. The average annual number based on the 1901-1956 period is 108 days, as shown by the horizontal line in the upper portion of the graph.

The lower curve shows the number of days from April 1 through September 30 in each year in which there was a measurable amount of precipitation. The fewest number during this six-month period was 42 days which occurred in 1901 and again in 1914. The greatest number was 78 in 1945. The average number of days with measurable precipitation during this period is 56.

Precipitation normally occurs with the greatest frequency during April and May. During these months, precipitation in excess of a trace occurs on an average of 11 days. The average number of days per month with 0.01 inch or more and 0.25 inch or more is listed in the table below. On the average, there are 65 days per year with 0.10 inch or more and 23 days per year with 0.50 inch or more. Rainfall in excess of 1.00 inch occurs 8 days per year on the average.

MONTHLY AND ANNUAL AVERAGE NUMBER OF DAYS WITH 0.01 INCH OR MORE AND 0.25 INCH OR MORE PRECIPITATION

Months	*0.01 inch or more*	*0.25 inch or more*
January	9	3
February	8	3
March	10	4
April	11	5
May	11	5
June	10	4
July	8	3
August	8	3
September	8	4
October	8	3
November	8	3
December	9	3
ANNUAL	108	43

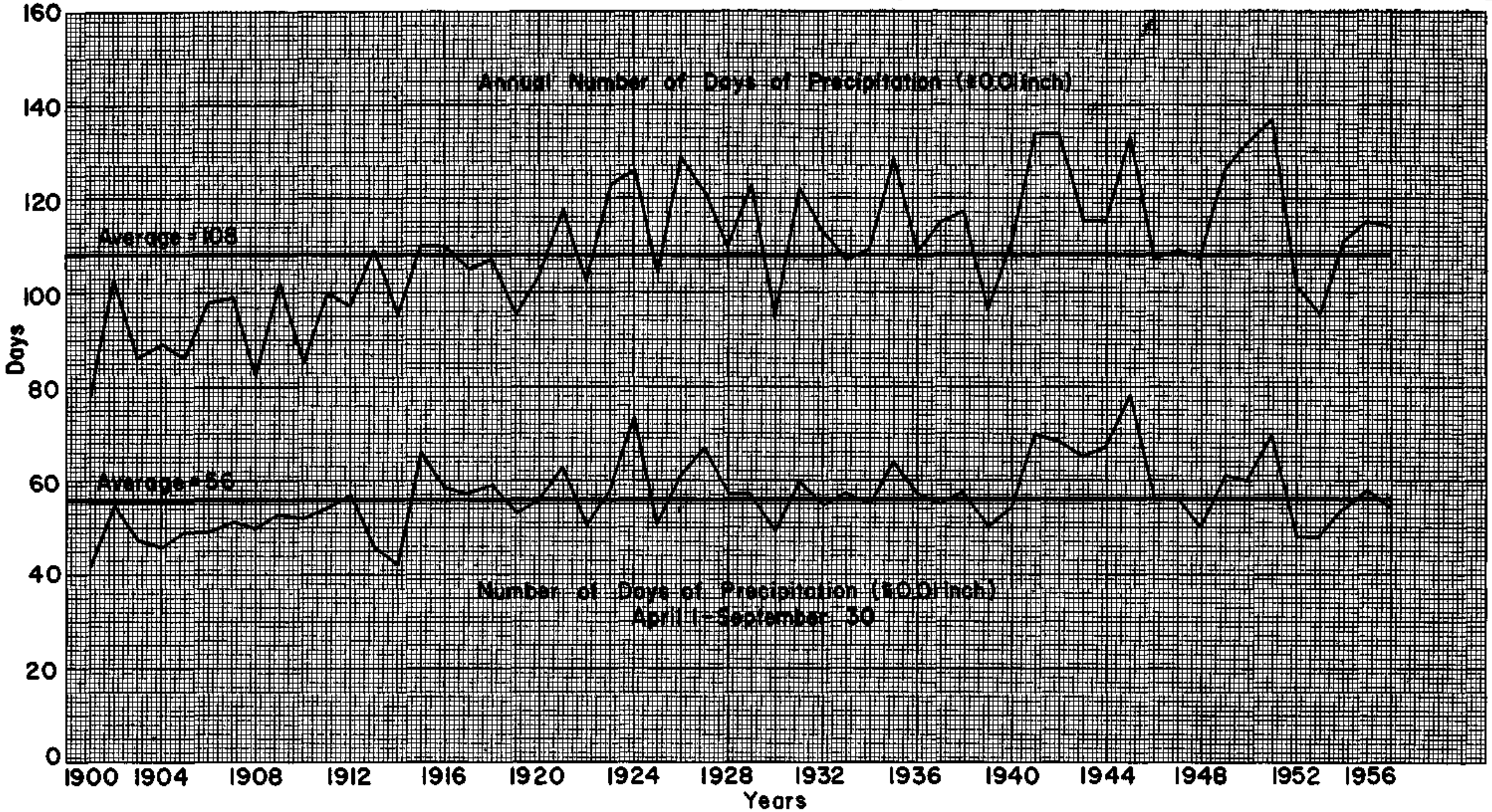


FIGURE 7 — NUMBER OF DAYS WITH PRECIPITATION OF 0.01 INCH OR GREATER

PROBABILITIES FOR ANNUAL PRECIPITATION AMOUNTS

Figure 8 presents a probability curve for the amount of annual precipitation, as based on records from 1901 to 1956. This type of graph permits computation of the chances for a given annual total to be equaled or exceeded. For instance, in 90 percent of the years, the annual precipitation, as measured at the Morrow Plots station, will be 28 inches or greater. Similarly, 50 percent of the time, the annual precipitation will be 35.30 inches or more although the arithmetic average is 36.30 inches. This indicates that the average is not too representative of the median occurrence of annual precipitation. Further examination of the probability curve shows that in 10 percent of the years the annual rainfall will be over 45 inches.

Analysis of the annual precipitation records indicates that the lowest 2-year total precipitation that will occur at least once in 50 years is 48 inches. The highest 2-year total precipitation that can be expected to occur at least once in 50 years is 98 inches.

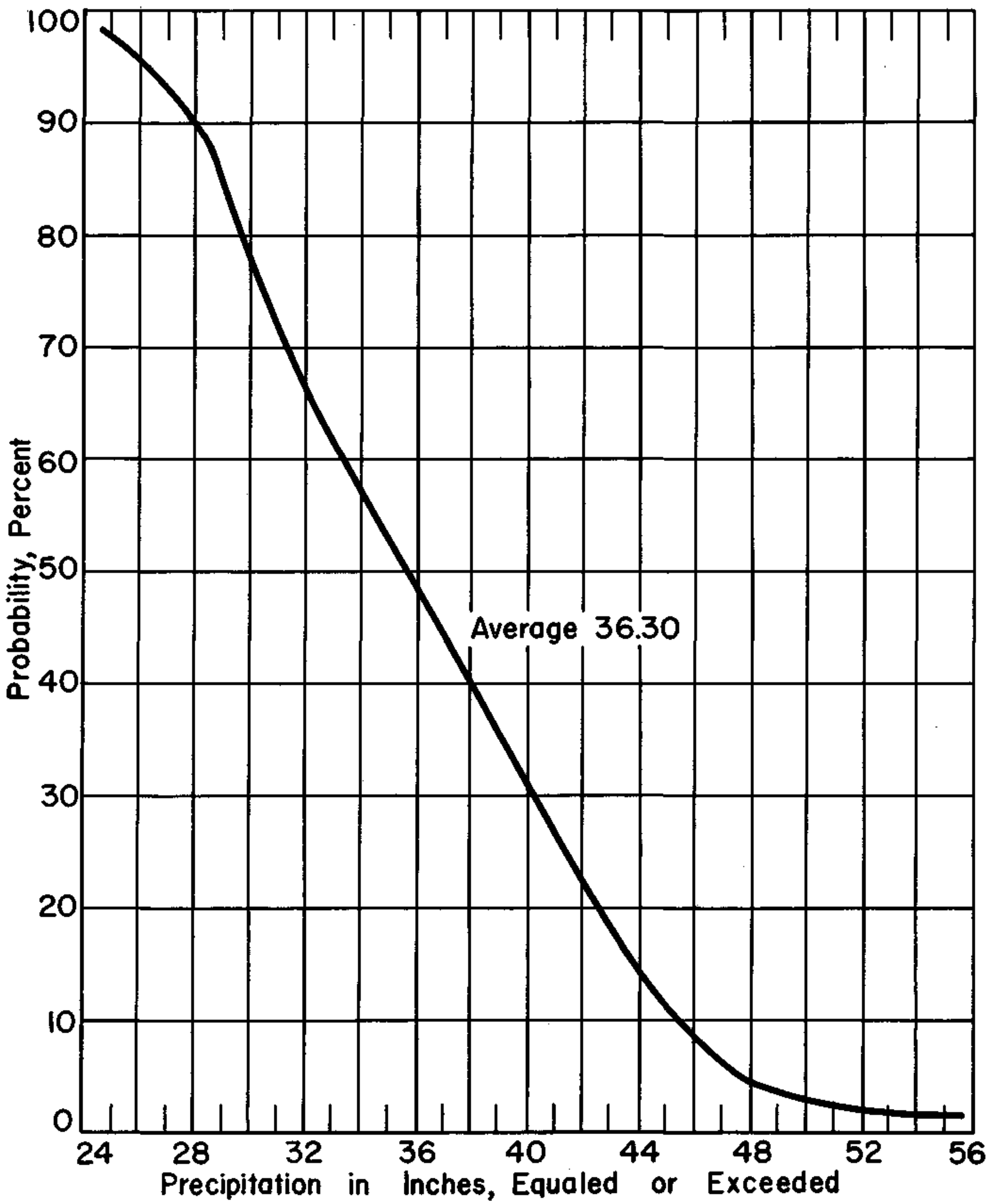


FIGURE 8 — PROBABILITY FOR ANNUAL PRECIPITATION

PROBABILITIES FOR MONTHLY PRECIPITATION AMOUNTS

Probability curves of precipitation for each month based on 1901-1956 data are presented in Figures 9-20. Figure 9 shows that in only 40 percent of the time does the January rainfall equal or exceed 2 inches. The average of 2.26 inches is equaled or exceeded only 36 percent of the time. The distribution of amounts is skewed and the average and median do not coincide. The average January precipitation is displaced from the median because a few January totals have been relatively large amounts.

In Figure 13, the probability curve for May shows that nearly 50 percent of the time the average of 4.07 inches will occur. Therefore, the May average is closer to the median than the January average. Actually, 50 percent of the time, 3.93 inches or more will occur, whereas 20 percent of the time, 5.15 inches or more will occur in May.

Similar use of the other figures in this series will permit the calculation of the probability for equaling or exceeding a given amount of precipitation in each month.

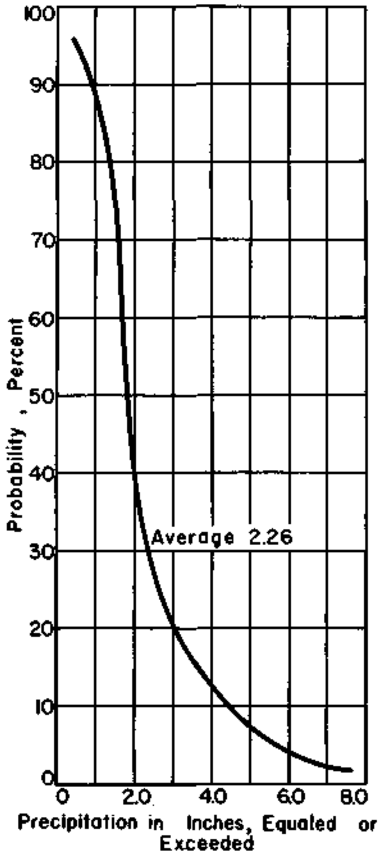


FIGURE 9 — PROBABILITY FOR JANUARY PRECIPITATION

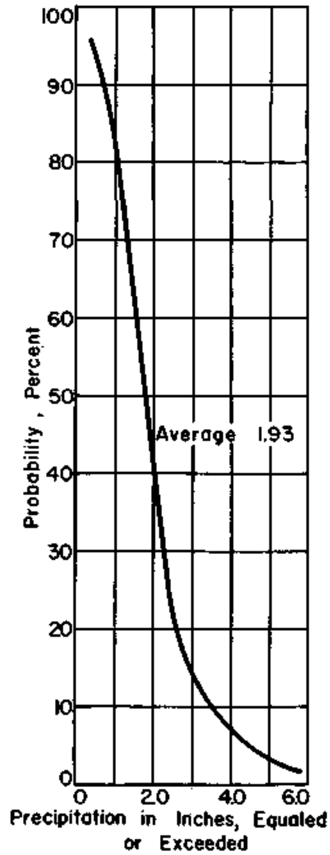


FIGURE 10 — PROBABILITY FOR FEBRUARY PRECIPITATION

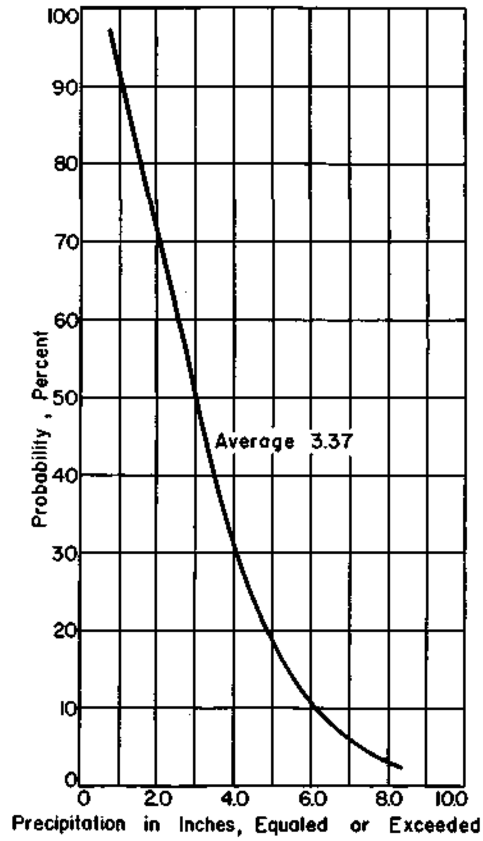


FIGURE 11 — PROBABILITY FOR MARCH PRECIPITATION

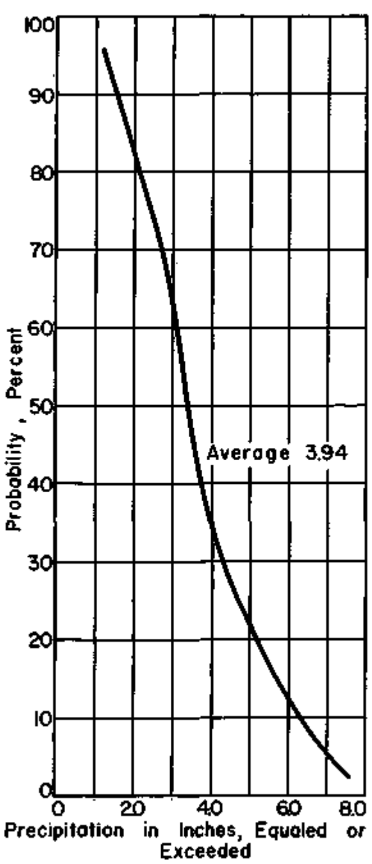


FIGURE 12 — PROBABILITY FOR APRIL PRECIPITATION

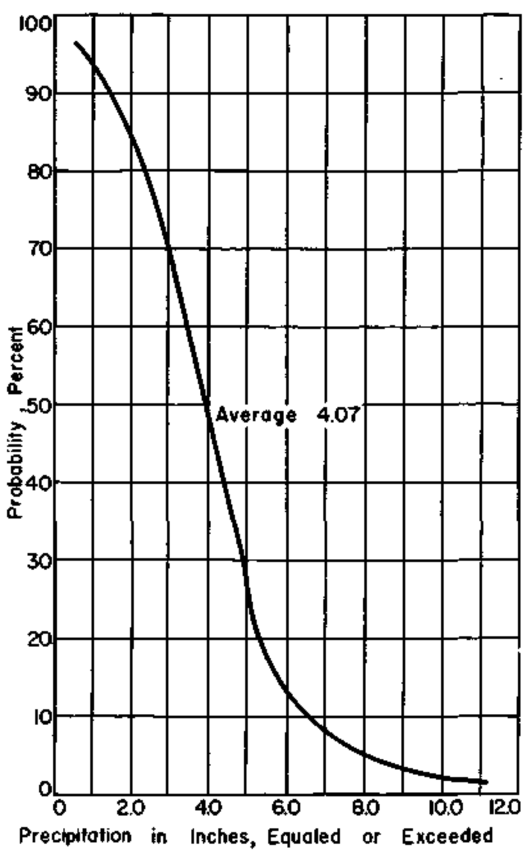


FIGURE 13 — PROBABILITY FOR MAY PRECIPITATION

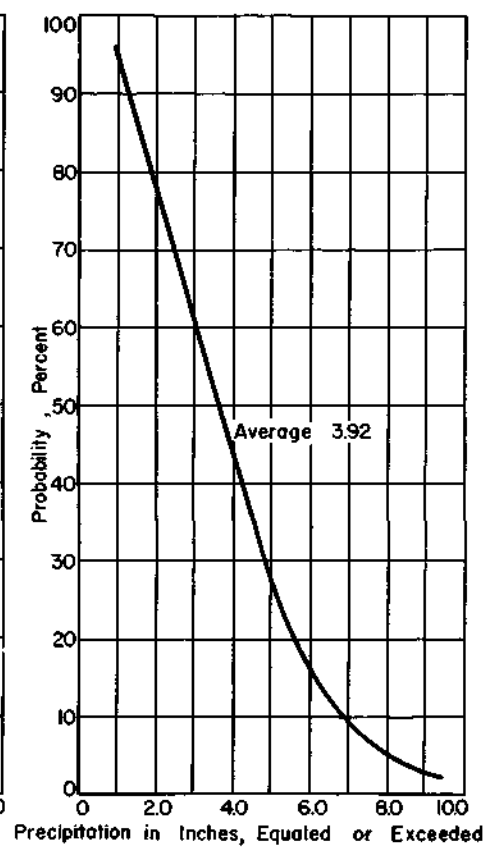


FIGURE 14 — PROBABILITY FOR JUNE PRECIPITATION

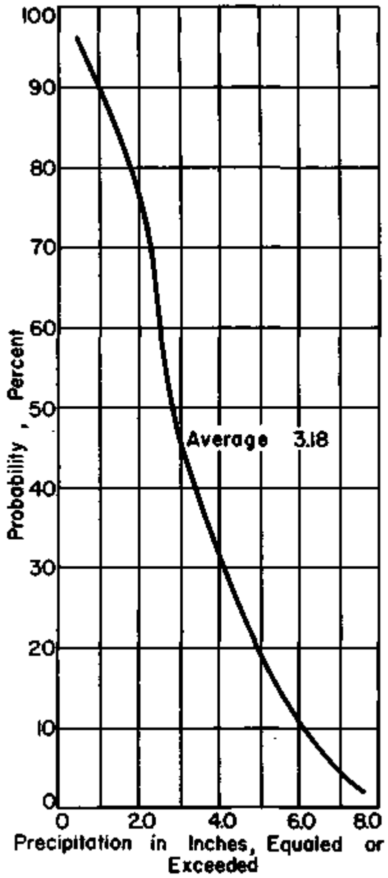


FIGURE 15 — PROBABILITY FOR JULY PRECIPITATION

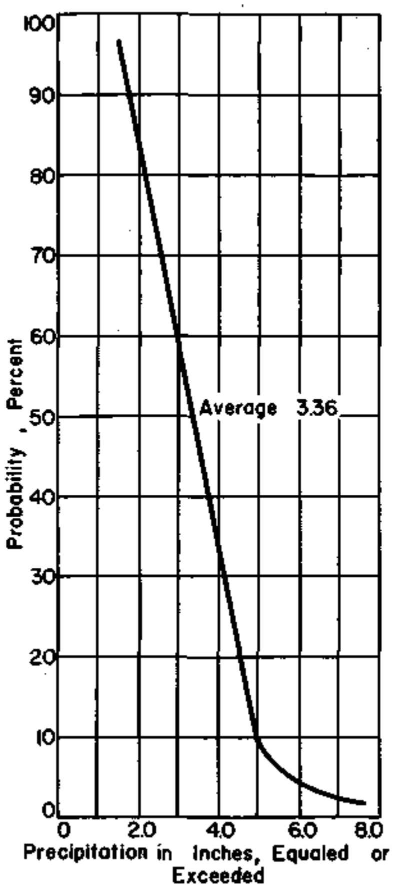


FIGURE 16 — PROBABILITY FOR AUGUST PRECIPITATION

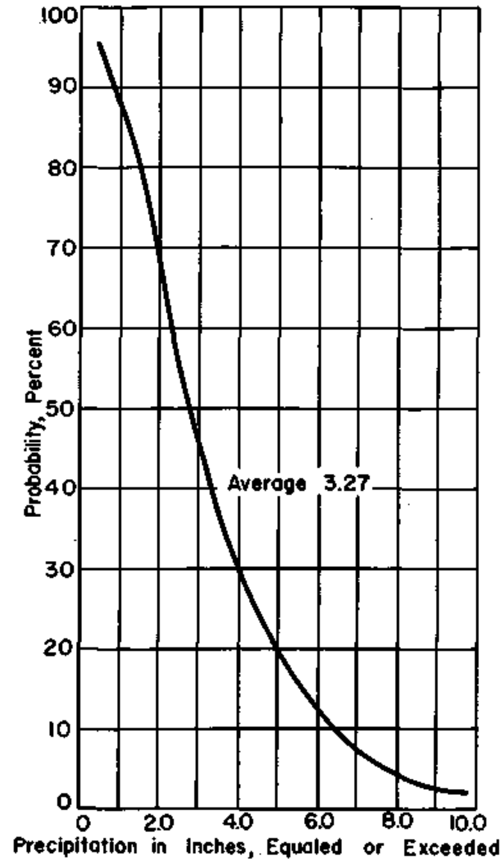


FIGURE 17 — PROBABILITY FOR SEPTEMBER PRECIPITATION

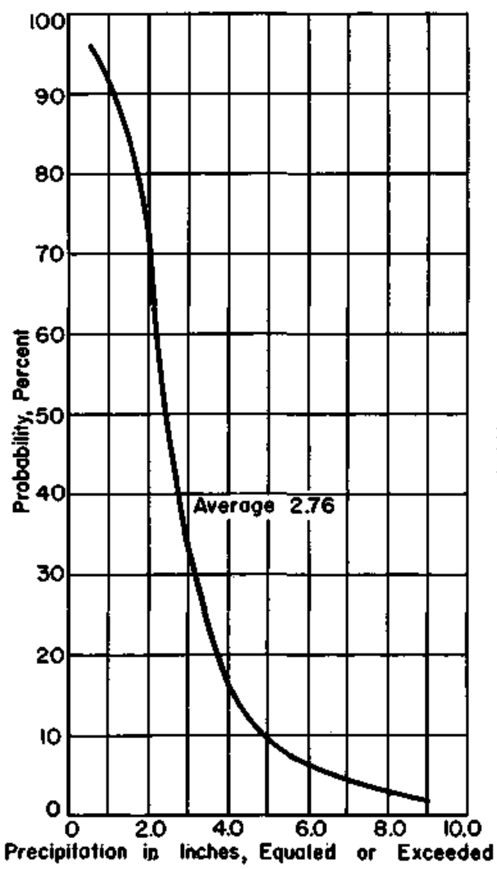


FIGURE 18 — PROBABILITY FOR OCTOBER PRECIPITATION

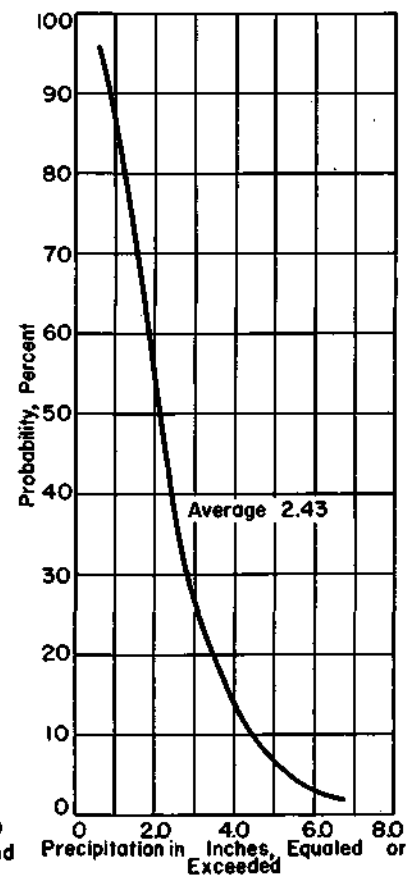


FIGURE 19 — PROBABILITY FOR NOVEMBER PRECIPITATION

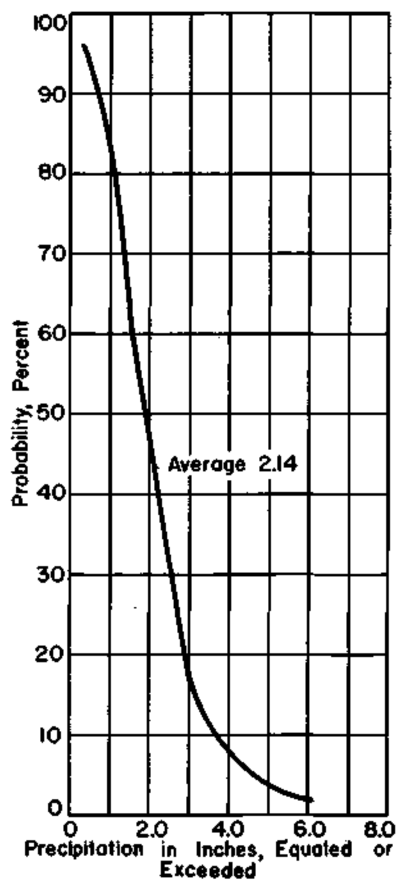


FIGURE 20 — PROBABILITY FOR DECEMBER PRECIPITATION

PROBABILITIES FOR DRY PERIODS

BASED ON 0.10-INCH AMOUNTS PER DAY

Probabilities for each date in the year to be "dry," with dry defined as less than 0.10 inch of precipitation per calendar day, are shown in Figure 21. No definite seasonal fluctuations appear, and the mean probability values for each month are approximately 90 percent. This indicates that for most days in any month, chances are that in 9 out of 10 years rainfall will be less than 0.1 inch. Individual daily probabilities can be ascertained. For instance, March 6 has a probability of 80 percent, indicating 8 out of 10 such dates will have less than 0:1 inch of rainfall. These probabilities are based on records from the Morrow Plots station for 1903 to 1956.[5] It is interesting to note that February 15th, September 5th, and October 2nd and 25th have very high probabilities for dryness. No precipitation exceeding 0.09 inch occurred on these four dates during the period of record.

Figure 22 also presents probabilities for dryness based on the 0.10-inch level, but the probabilities are for various lengths of continuous "dry" periods. The upper curve gives the probability that any date of the year will be in a five-day or longer dry period. During the year definite seasonal trends appear for all three curves on this graph. For instance, the highest probability or best opportunity that dry periods of these durations will occur is the latter part of January. For any month, the greatest chance of dryness can be ascertained for a 5-, 10-, or 20-day period. For instance, the greatest probability in July for a 5-day or longer dry period would be a 5-day period centered on July 23rd.

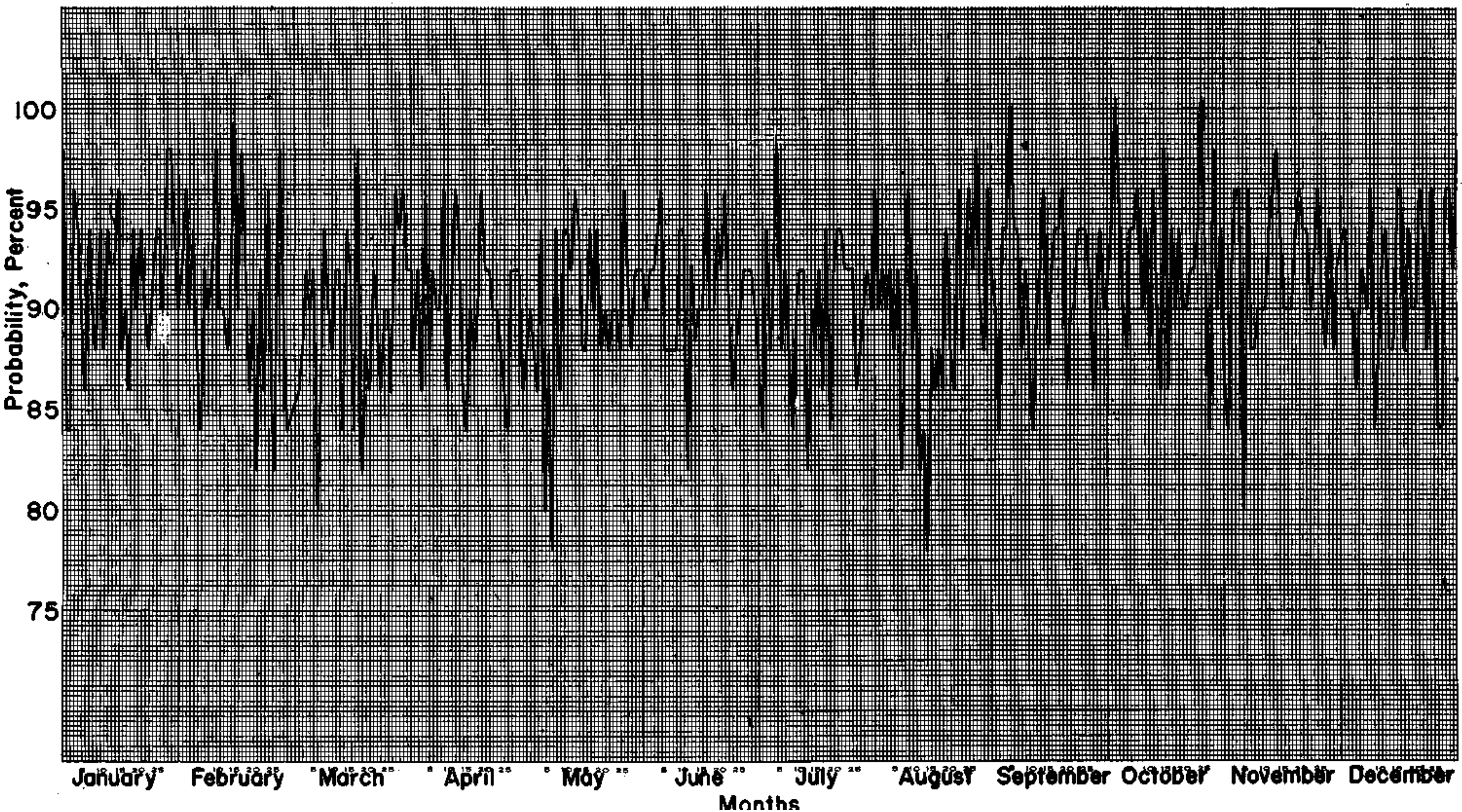


FIGURE 21 —PROBABILITY THAT ANY DATE WILL BE DRY, WITH DRYNESS DEFINED AS LESS THAN 0.10 INCH IN 24 HOURS

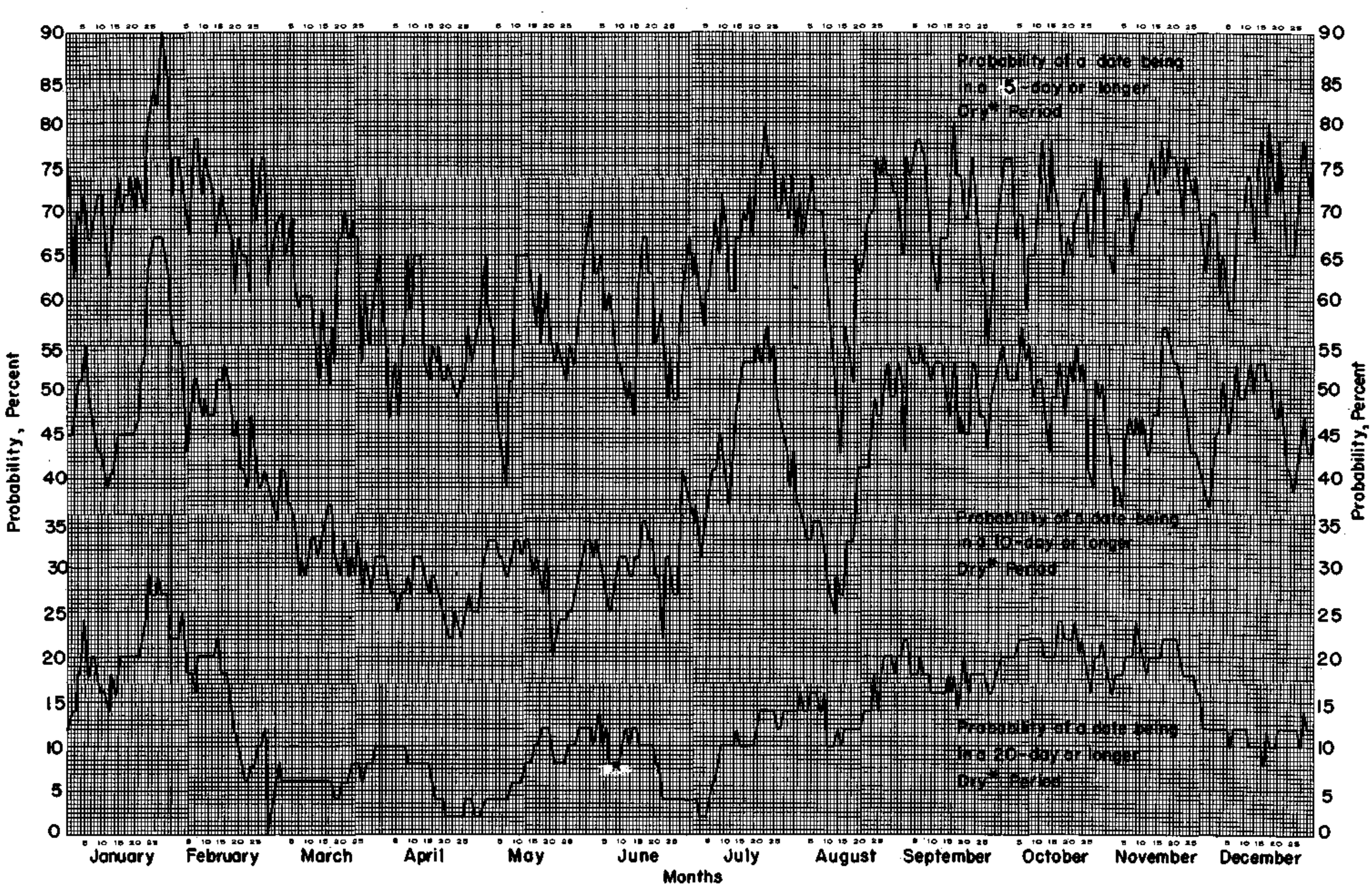


FIGURE 22 — PROBABILITY OF A DATE BEING IN VARIOUS LENGTH DRY PERIODS OF 0.10 INCH PER DAY OR LESS

PROBABILITIES FOR DRY PERIODS

BASED ON 0.25, 0.50, AND 1.00-INCH AMOUNTS PER DAY

Figures 23, 24, and 25 are probability graphs for dates being in "dry" periods of various length with dryness defined as less than 0.25, 0.50, and 1.00 inch of precipitation in 24 hours. As explained for Figure 22, periods during each month and season can be selected which would present the best chances for dry conditions. These data are based on calendar day precipitation records from 1903 through 1956 for the Morrow Plots station.

As with the 0.10-inch definition, the higher probabilities for all three of these levels occur during the winter months, but the day-to-day fluctuations are not as great as those for the 0.10-inch level (Fig. 22). The lowest probabilities for dryness at these three levels are found during the spring months of the year. Another distinguishing feature of the curves in Figures 22, 23, and 24 is the rapidly increasing probabilities for dryness during July followed by a sudden decrease in the middle of August. At the 1-inch level (Fig. 25), the curves have a definite trend during the year, from lower probabilities during the warmer half-year to higher probabilities during the colder half-year (glossary).

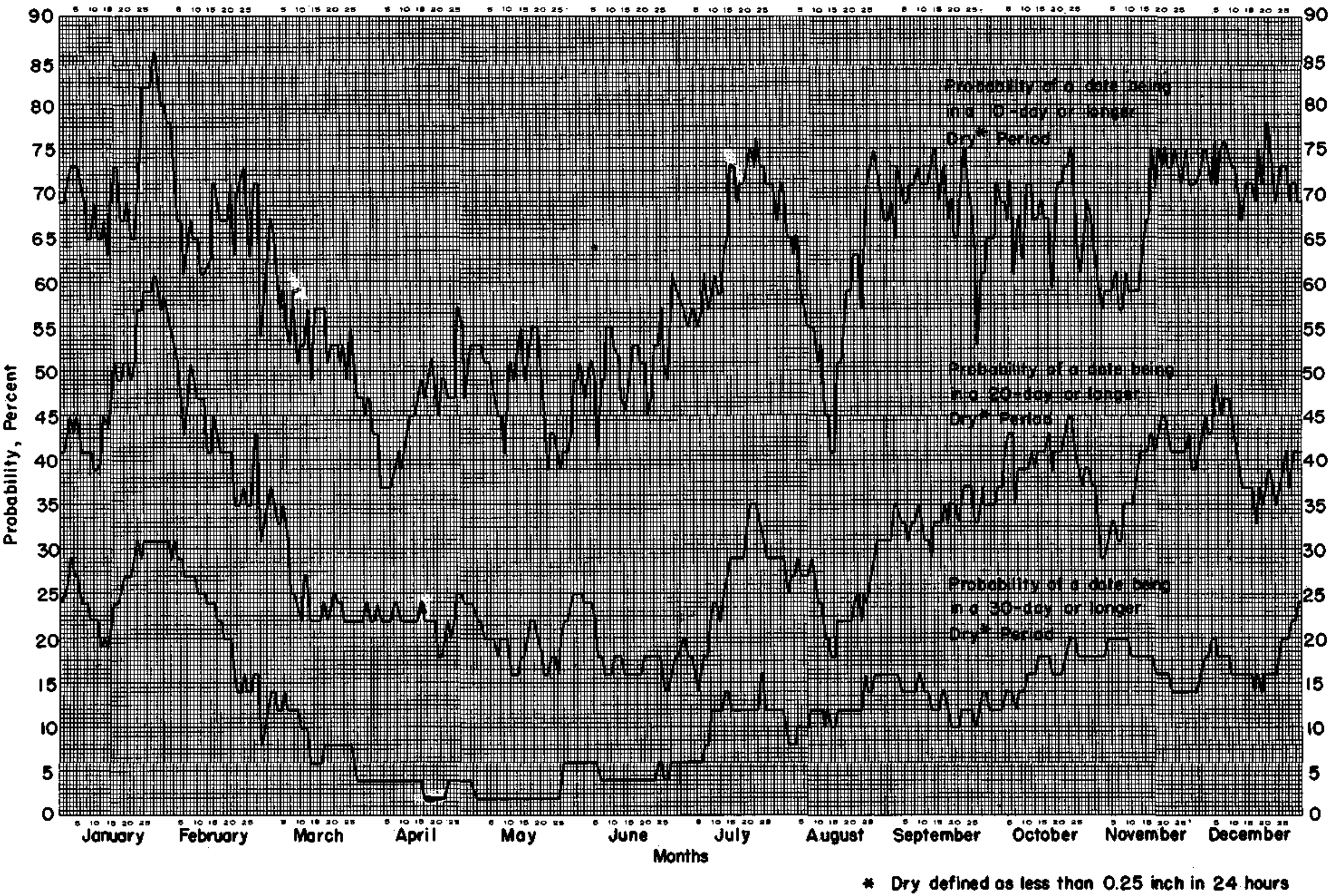


FIGURE 23 — PROBABILITY OF A DATE BEING IN VARIOUS LENGTH DRY PERIODS OF 0.25 INCH PER DAY OR LESS

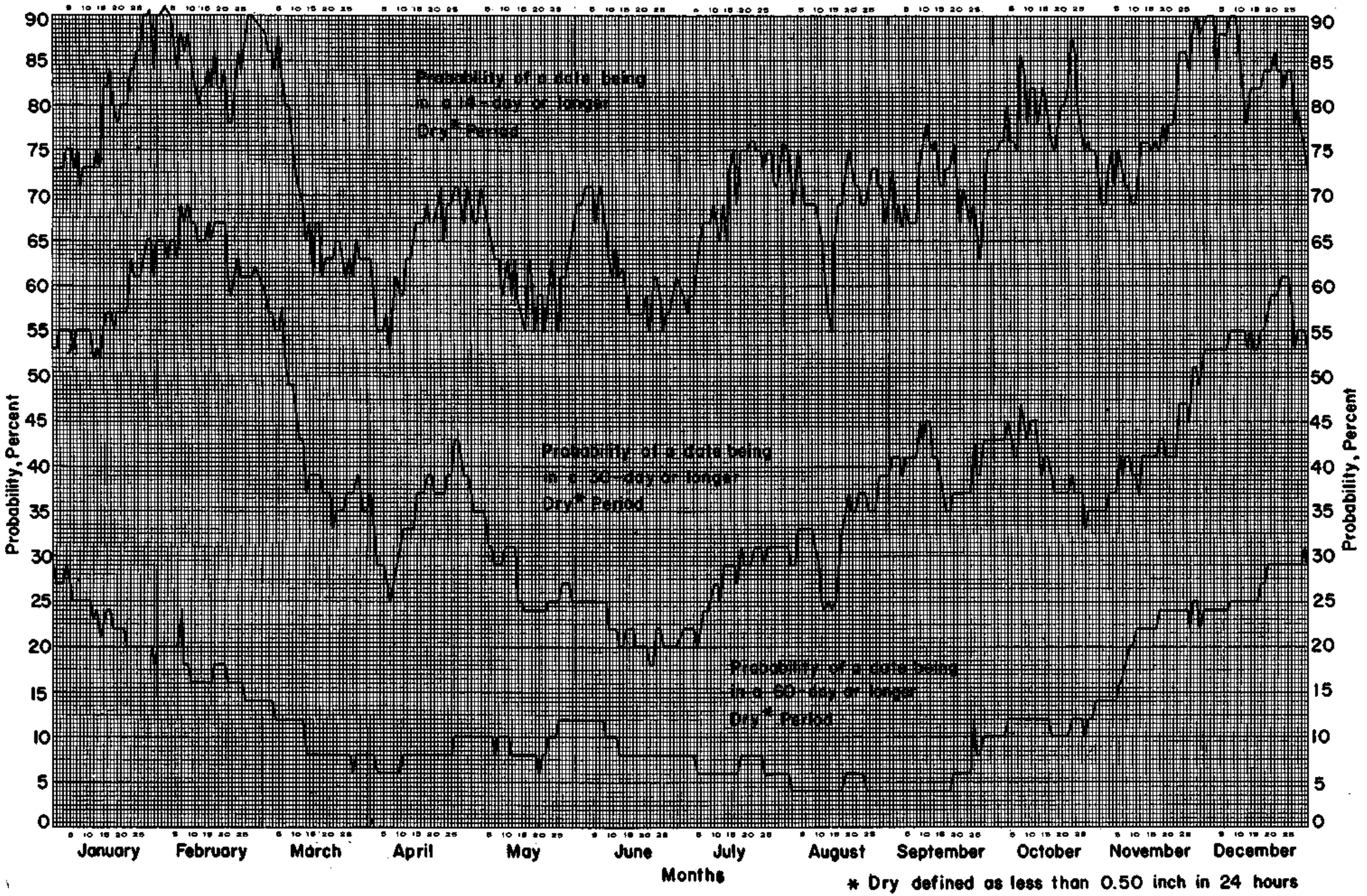


FIGURE 24 — PROBABILITY OF A DATE BEING IN VARIOUS LENGTH DRY PERIODS OF 0.50 INCH PER DAY OR LESS

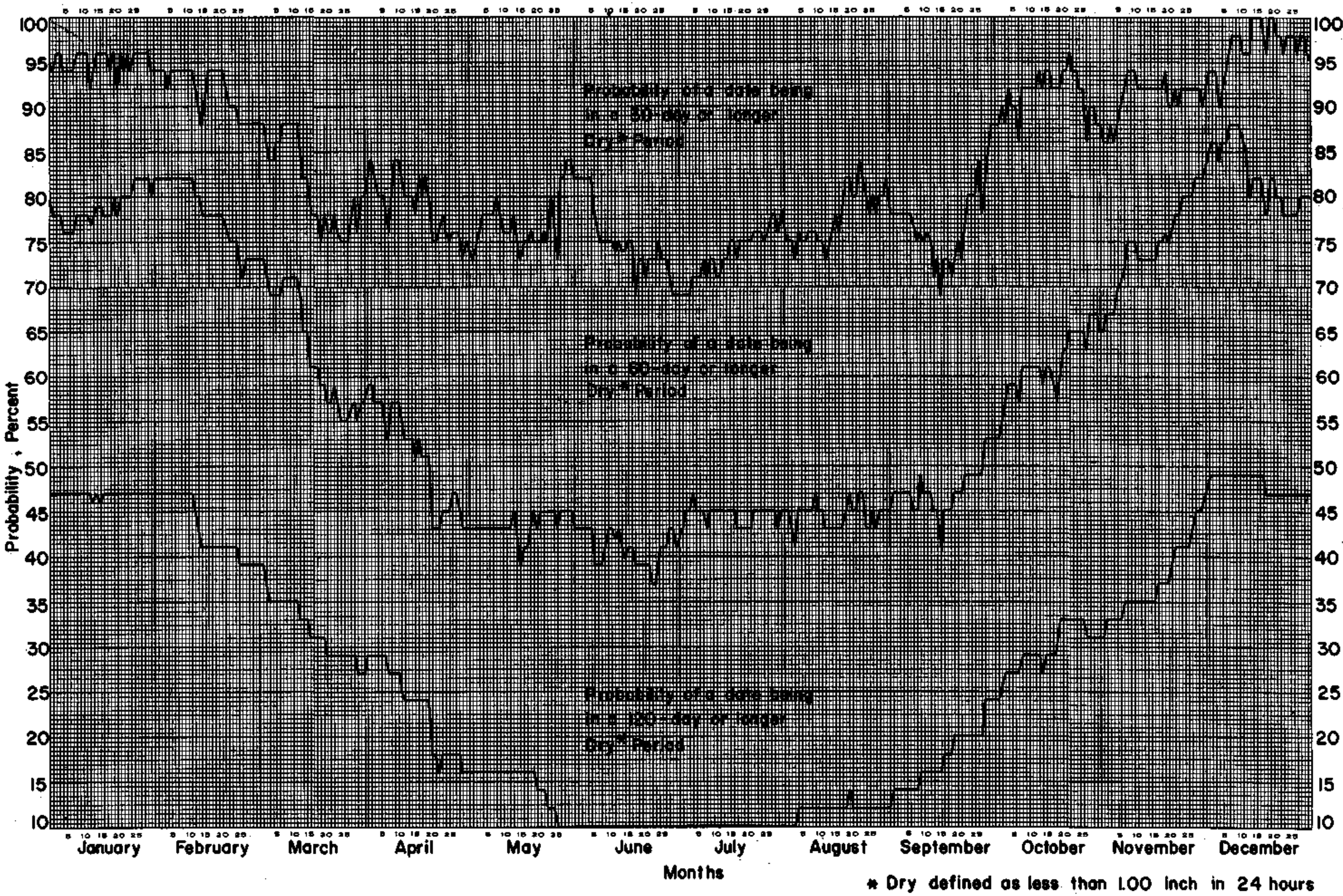


FIGURE 25 — PROBABILITY OF A DATE BEING IN VARIOUS LENGTH DRY PERIODS OF 1.00 INCH PER DAY OR LESS

Data that were collected from 12 recording rain gages located throughout the Champaign-Urbana area (Fig. 1) were analyzed to measure the spatial variability of precipitation. From this network, which includes the Morrow Plots gage, continuous data were obtained from 1949 to 1957.

Unfortunately, a 9-year period is too short to provide accurate annual and monthly precipitation averages. However, some confidence in the representativeness of the averages is gained from the fact that the average for the nine years was 35.07 inches at the Morrow Plots gage which is only 1.23 inches less than the 1901-1956 average for that gage. Figure 26 illustrates the distribution of the annual average precipitation which has a west-to-east increase from slightly less than 30 inches in west Champaign to over 35 inches in southwest Urbana.

Average precipitation for each month is shown in Figures 27, 28, and 29. Greater variability exists in the spring and summer months (Figs. 28-29) than during the cooler months of the year (Fig. 27). During these nine years of data collection, July had the highest average rainfall instead of May (Fig. 4), which is normally the month of highest average rainfall. September, rather than February, had the lowest averages during the period.

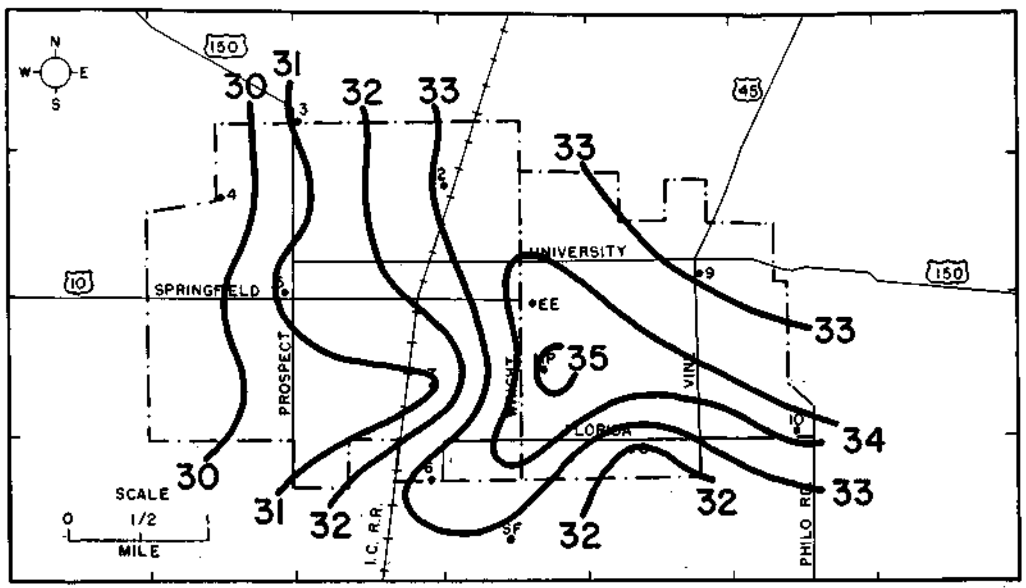


FIGURE 26 — ANNUAL AVERAGE PRECIPITATION, 1949-1957

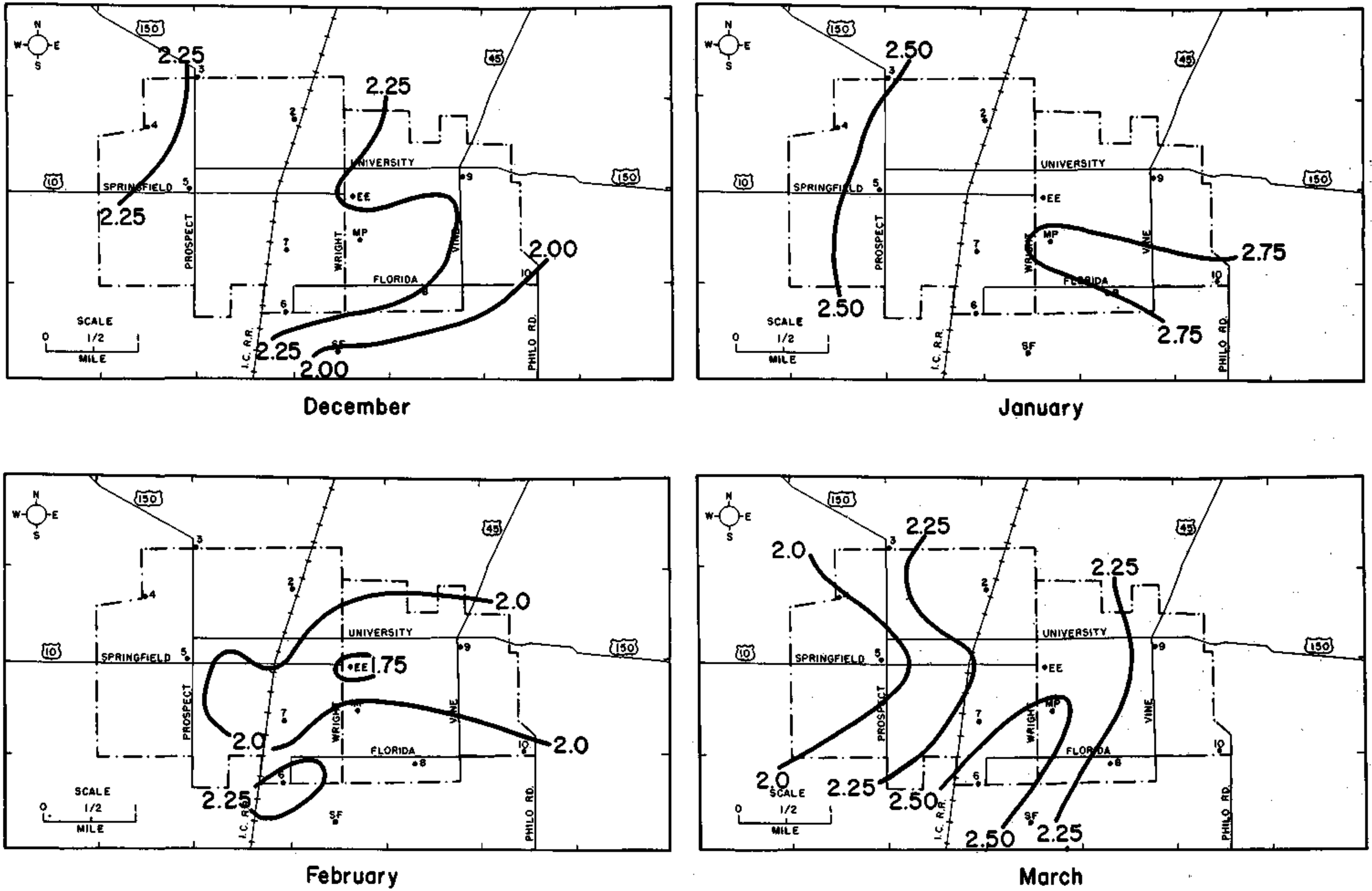


FIGURE 27 — MONTHLY AVERAGE PRECIPITATION FOR DEC, JAN., FEB., MARCH, 1949-1957

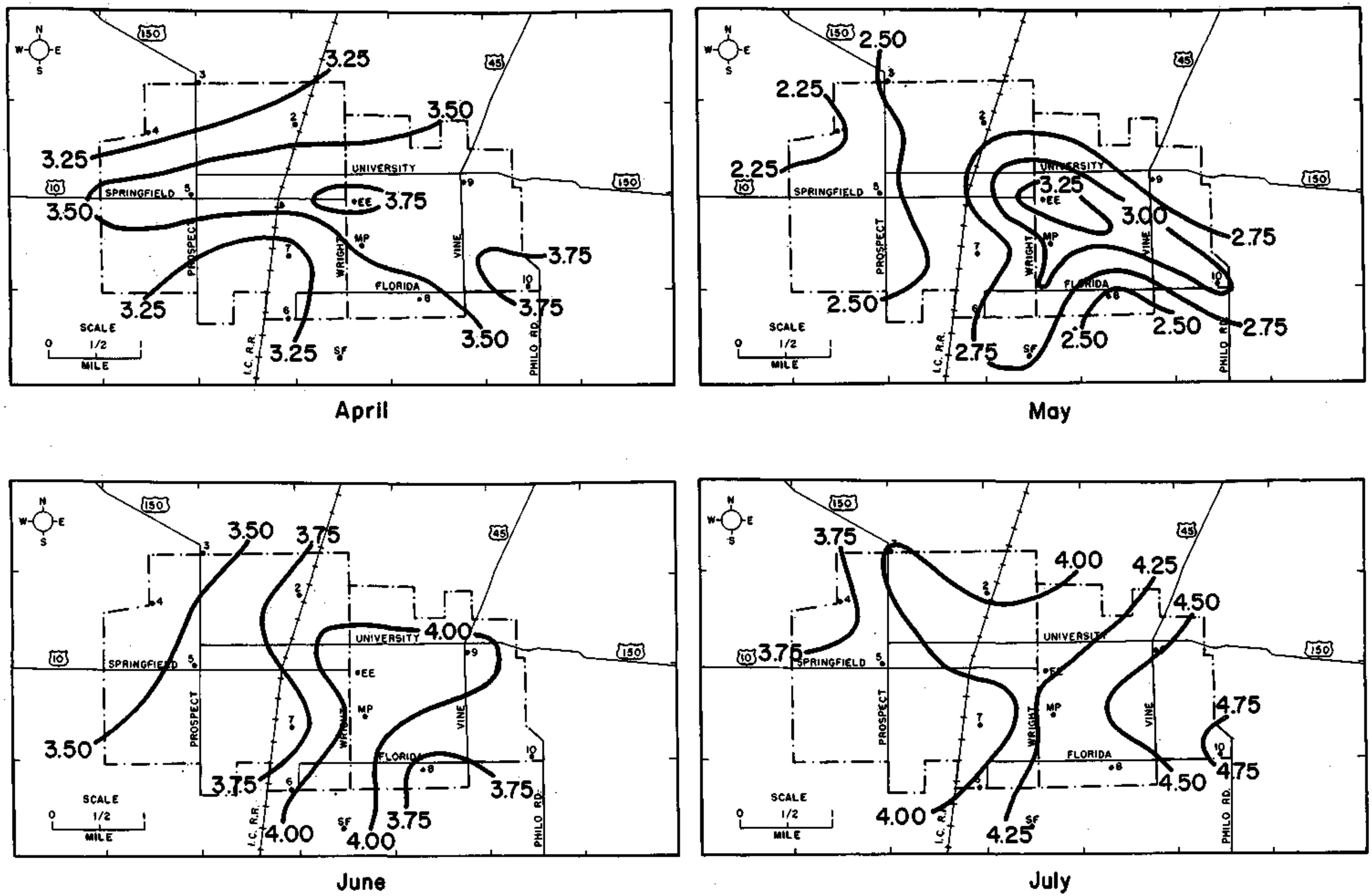


FIGURE 28 — MONTHLY AVERAGE PRECIPITATION FOR APR., MAY, JUNE, JULY, 1949-1957

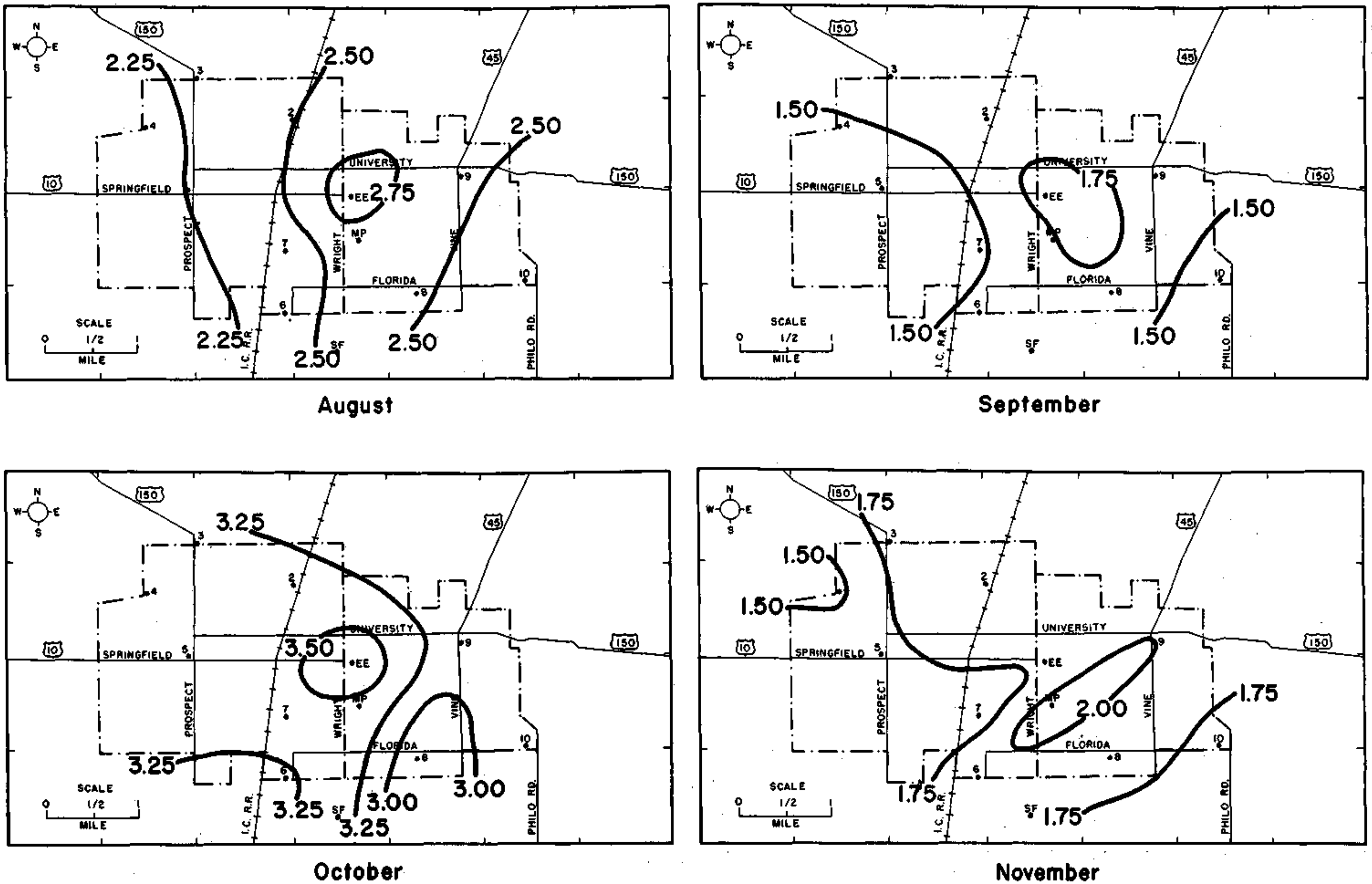


FIGURE 29 — MONTHLY AVERAGE PRECIPITATION FOR AUG., SEPT., OCT., NOV., 1949-1957

ANNUAL SNOWFALL

Annual snowfall for each year as measured at the Morrow Plots station from July 1, 1903 through June 30, 1956 is shown in Figure 30. Snowfall data for 1901 and 1902 are not shown because the data were not accurately measured. Annual is defined for snowfall as the total for the 12-month period ending June 30. For instance, the lowest total on record, 6.7 inches, occurred during the period from July 1, 1953 to June 30, 1954, and is shown as the 1954 value on the graph. The highest total was 39.9 inches which occurred in the year ending June 30, 1951. Annual average snowfall is 20.3 inches, although the year-to-year variation is extreme.

The two consecutive years having the greatest snowfall were 1951 and 1952, when the total fall was 70.4 inches. These two years were followed by the two consecutive years having the lowest fall, 1953 and 1954, when a total of 19.3 inches occurred.

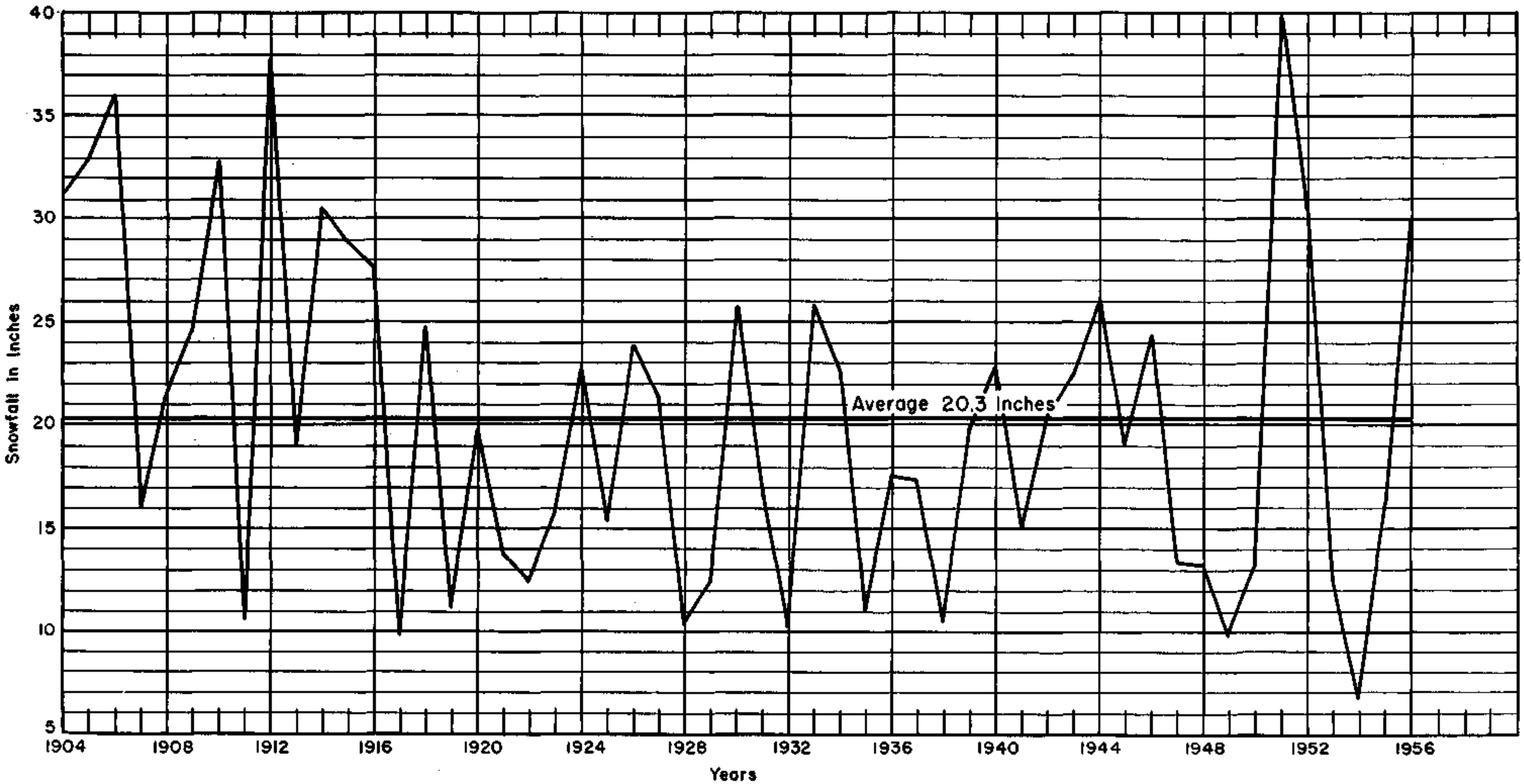


FIGURE 30 — ANNUAL SNOWFALL, 1904-1956

PROBABILITY FOR ANNUAL SNOWFALL

A graph to determine the probability for the annual amount of snowfall (glossary) is shown in Figure 31, as based on 1903-56 data. For example, the probability is 30 percent that the annual amount will be 25 inches or more, or in 3 out of 10 years the annual amount will equal or exceed 25 inches. Conversely, 70 percent of the years, or in 7 out of 10, the annual amount will be less than 25 inches. Similarly, in 80 percent of the years, the total will equal or exceed 12 inches.

The median value is 19.5 inches which is slightly less than the average. The average will be equaled or exceeded only 48 percent of the time according to Figure 31.

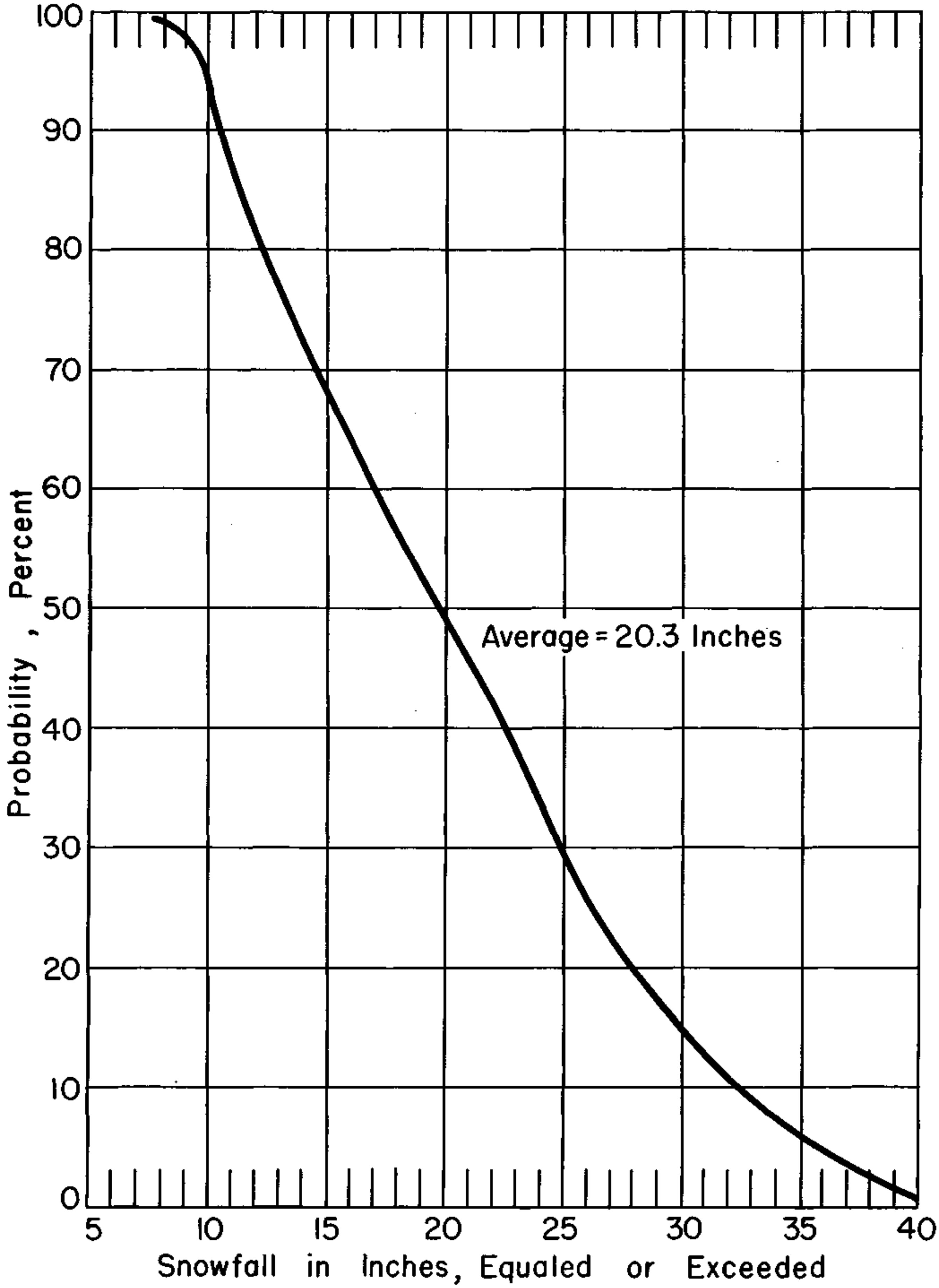


FIGURE 31 —PROBABILITY FOR ANNUAL SNOWFALL

MONTHLY SNOWFALL

In Figure 32 the monthly average snowfall amounts are shown as points on the graph. These points are connected by the lower curve, and the actual values in inches for each month are labeled. January and February have equal averages of 4.9 inches and are the months with the highest averages. Of the months having sufficient snowfall to produce averages, October with an average of 0.1 inch has the lowest monthly value.

The upper curve in Figure 32 connects points representing the highest amounts on record for each month during 1903-56. Three of the months had peak values near 18 inches, but March 1906 with 32.0 inches had the highest monthly amount on record.

No curve is presented to show the lowest monthly amounts on record, because during the 1903-56 period a trace of snowfall (glossary) has been recorded at least once for December, January, and February; and in several years October, November, March, and April have had no snowfall.

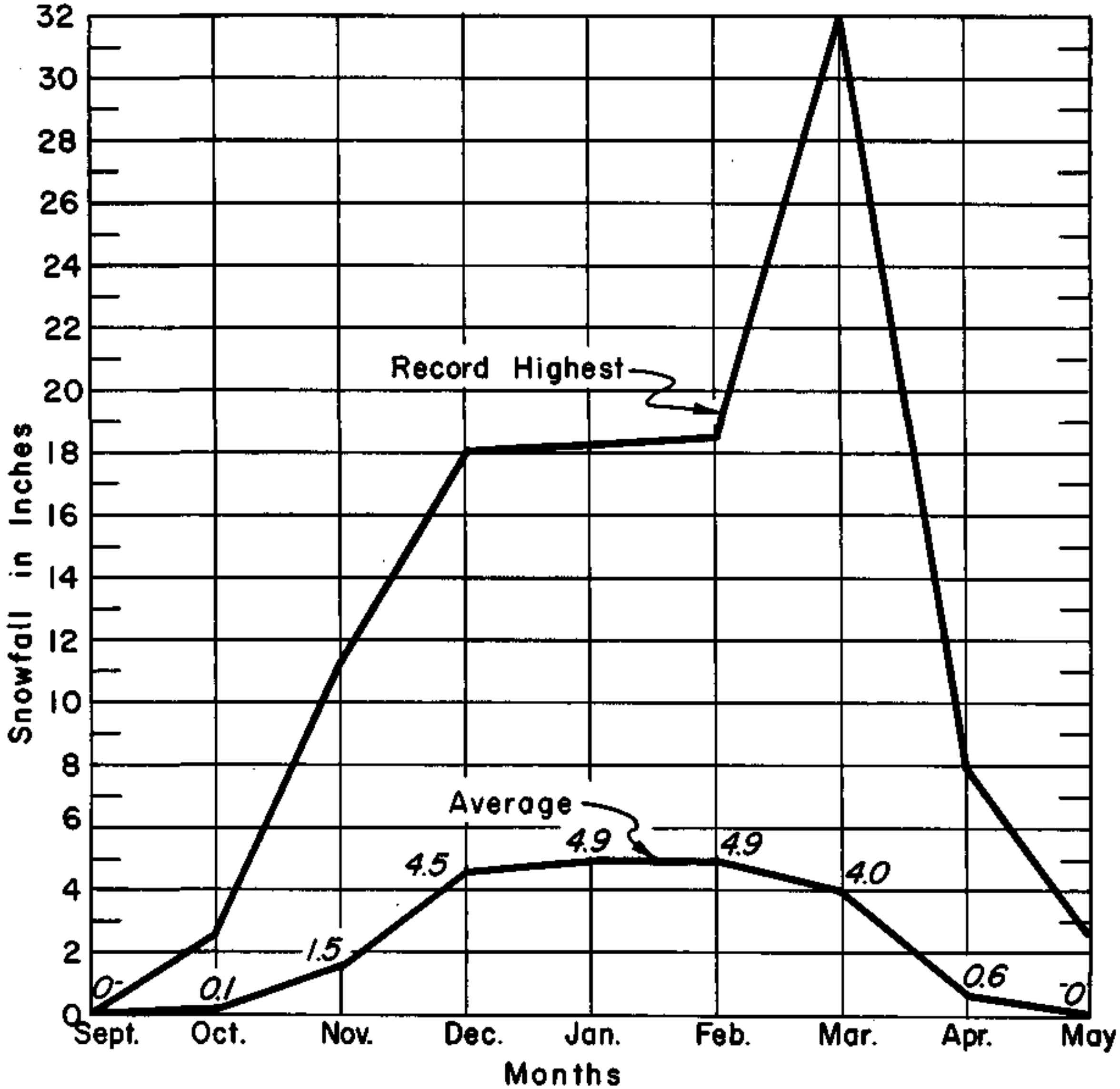


FIGURE 32 — MONTHLY AVERAGE AND EXTREME SNOWFALL

DAYS WITH SNOWFALL

The upper graph on Figure 33 shows the number of days on which a trace or more of snowfall was reported for each year from 1903-56. Considerable year-to-year variability is present. The annual (glossary) average number of days of snowfall is 39, but a high of 54 days occurred in three different years, while as few as 18 have been reported in a single year.

The lower curve shows the annual number of days with one inch or more of snowfall. The annual average is 6 days, 33 days less than the average number of days with snowfall of a trace or more. Thus, on most days when snow occurs, less than one inch falls. The highest number on record is 14 days in 1904. As few as two days with one inch or more have occurred in one year.

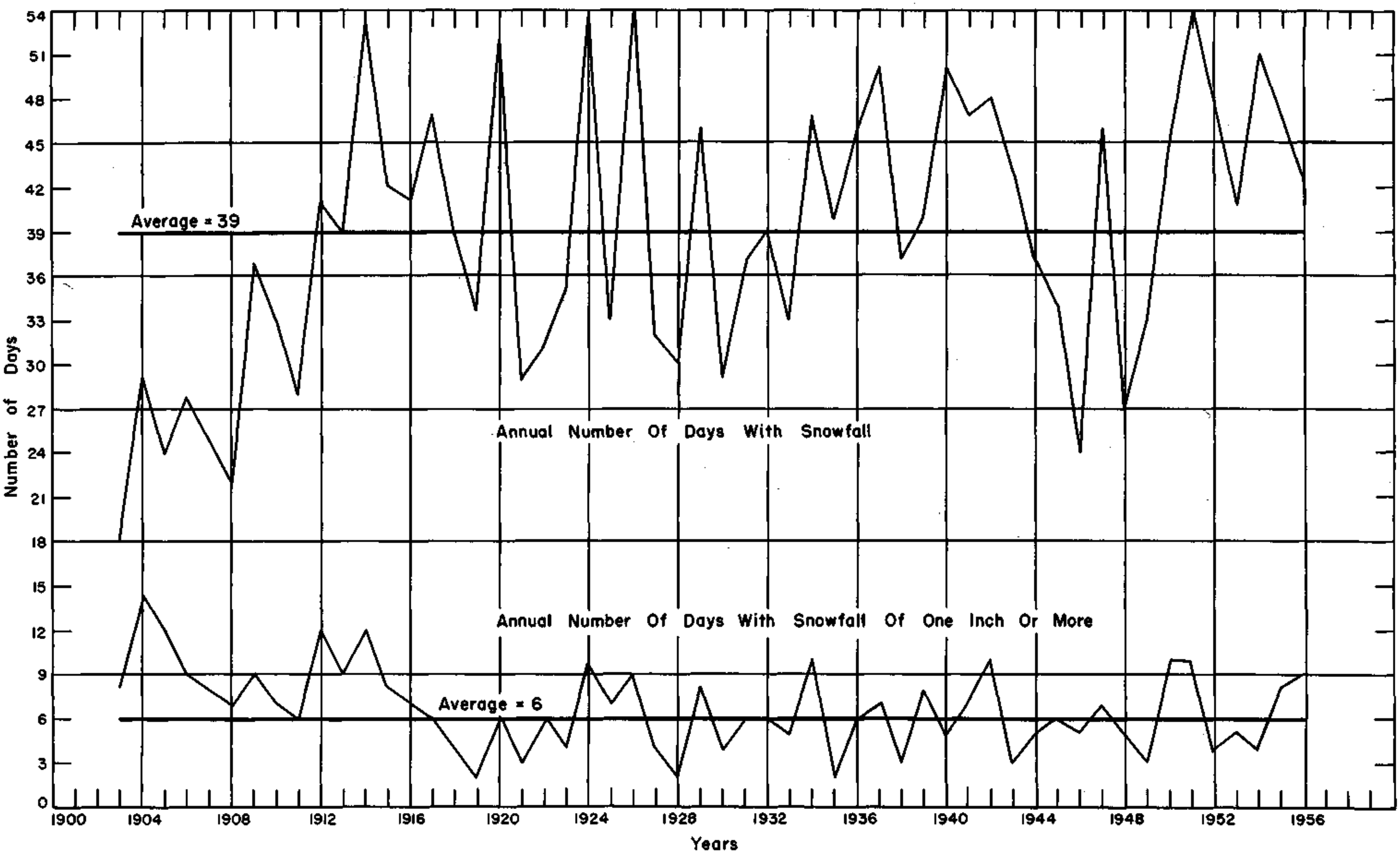


FIGURE 33 — ANNUAL NUMBER OF DAYS OF SNOWFALL WITH A TRACE OR MORE AND WITH ONE INCH OR MORE

DAYS WITH SNOW ON THE GROUND

Records of snow on the ground, or snow cover, at the Morrow Plots station were not accurate prior to September 1932, but were reliable from October 1932 to present. The upper curve of Figure 34 shows the number of days in each year with a trace or more of snow on the ground (glossary). Excessive fluctuation is apparent from year to year, with as few as 25 days in 1949 and 1954 and as many as 85 days in 1951 having snow on the ground of a trace or more. The annual average number of days is 53.

The lower curve shows the annual number of days with snow on the ground of one inch or more, and again considerable variability is present. A total of 57 days had one inch or more of snow on the ground in 1945, while the annual minimum, 5 days, occurred in 1949. The average is 25 days per year, or almost one-half the average number of days with a trace or more of snow on the ground.

On the average, 12 days each winter have 3 or more inches of snow on the ground.

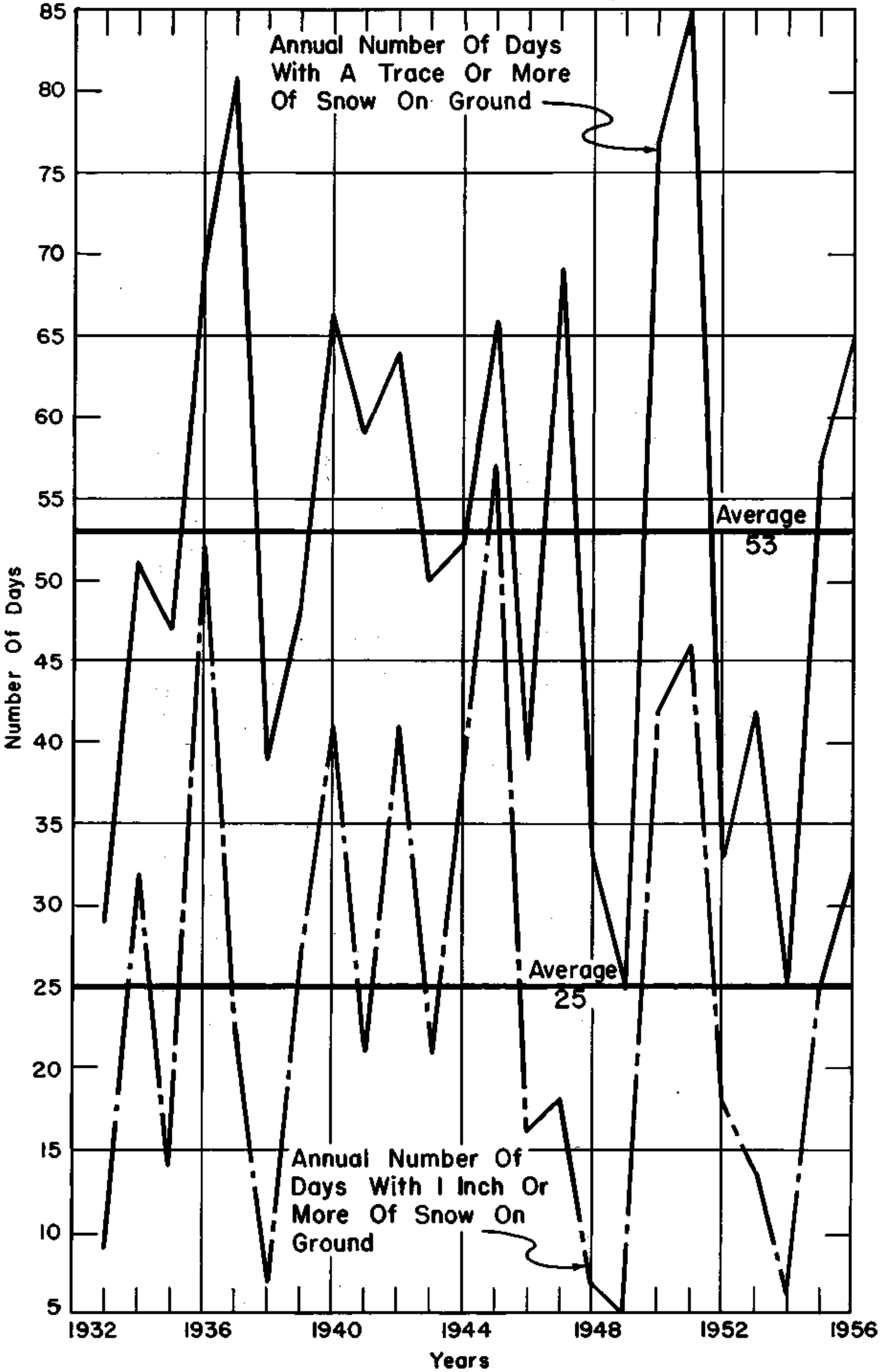


FIGURE 34 — ANNUAL NUMBER OF DAYS WITH SNOW ON THE GROUND, OF TRACE OR MORE AND WITH ONE INCH OR MORE, 1932-1956

TEMPERATURE

ANNUAL MEAN TEMPERATURES

The annual mean temperature is 52° F. as shown at the center of Figure 35. Indicated also is the mean temperature for each year from 1901-1956. The annual mean temperature has been within the range from 50 to 55 degrees during 49 of these 56 years. The highest annual mean recorded was 55.4 degrees in 1931 while the lowest was 48.4 degrees in 1917. All temperature data were collected at the Morrow Plots station. The warmest five consecutive years were in the 1930-1934 period when the annual mean was 53.5 degrees. The coldest five consecutive years were from 1901 through 1905 when the annual mean equaled 49.9 degrees.

The annual mean maximum temperatures for each year are shown in the top curve. Their average value is 61.8 degrees and a 5-degree range between 60 and 65 degrees contains all but 10 of the 56 annual values. The highest annual mean maximum was 65.5 degrees in 1953 while the lowest was 58.1 degrees in 1917.

The annual mean minimum temperatures for each year are shown in the lower curve. Their average value is 42.3 degrees with most values ranging from 40 to 45 degrees. Only seven years have had values outside this 5-degree range. The highest annual mean minimum on record is 46.2 degrees in 1931 while the lowest is 38.0 degrees in 1904.

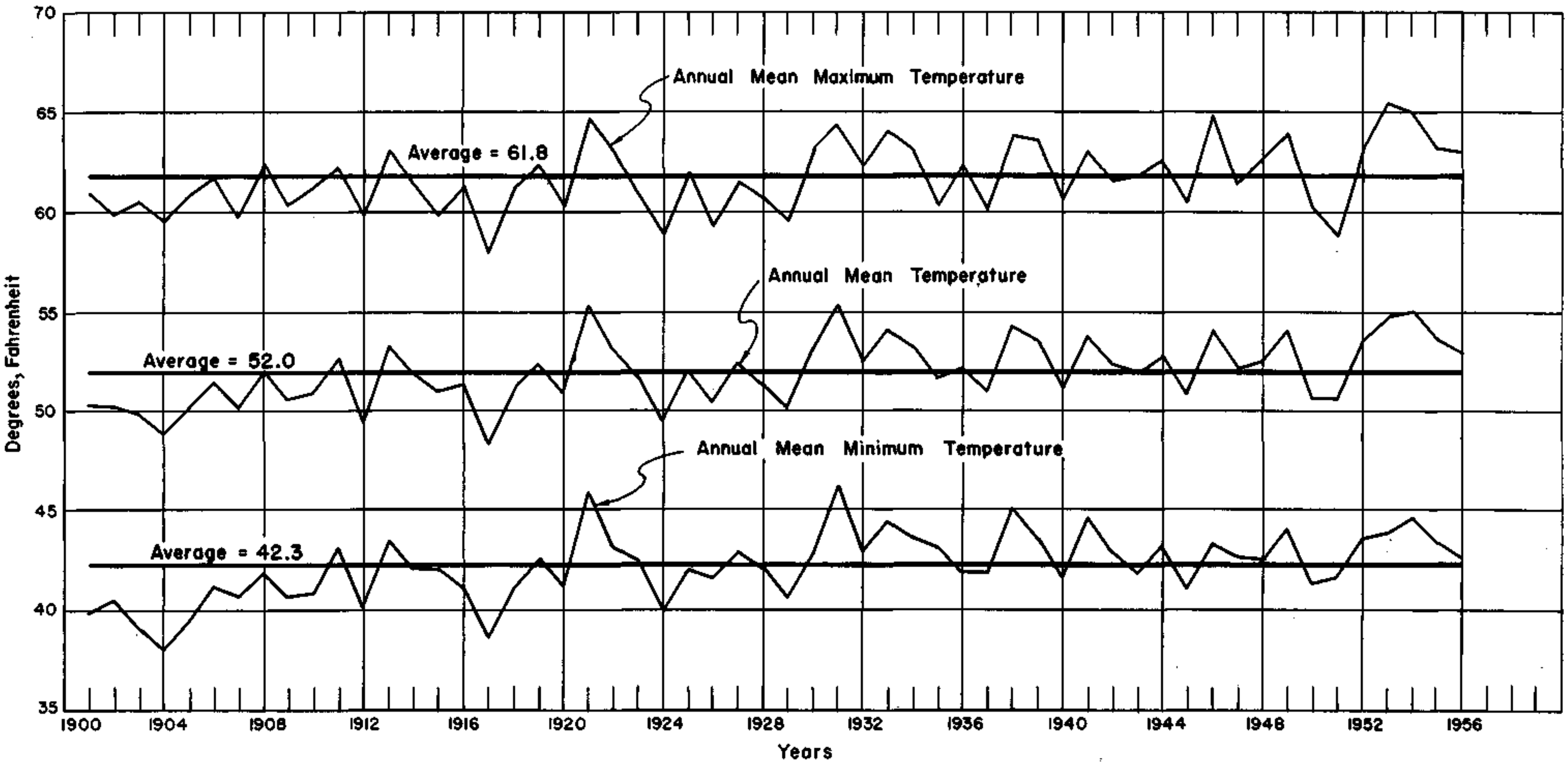


FIGURE 35 — ANNUAL MEAN, MEAN MAXIMUM, AND MEAN MINIMUM TEMPERATURES

MONTHLY MEAN TEMPERATURES

The monthly mean, mean maximum, and mean minimum temperatures are shown in Figure 36. Highest mean maximum and minimum on record are shown also for each month. These data are based on temperature records made at the Morrow Plots station from 1901 through 1956.

Monthly mean temperatures vary 48.2 degrees during the year. The coldest month, January, has a mean of 27.3 degrees, while July, the warmest month, has a mean of 75.5 degrees. The monthly mean maximum and mean minimum temperatures have ranges similar to the monthly mean value. The average difference in degrees between them is smallest in January, 14.3 degrees, and is greatest in July when the range is 22.6 degrees.

The highest monthly mean maximum temperatures on record for each month are shown as the uppermost curve, while the lowest monthly mean minimum temperatures on record for each month are shown as the lowermost curve. The highest monthly mean maximum on record, 95.9 degrees, was recorded in July 1936, while the lowest monthly mean minimum was 3.5 degrees for January 1918.

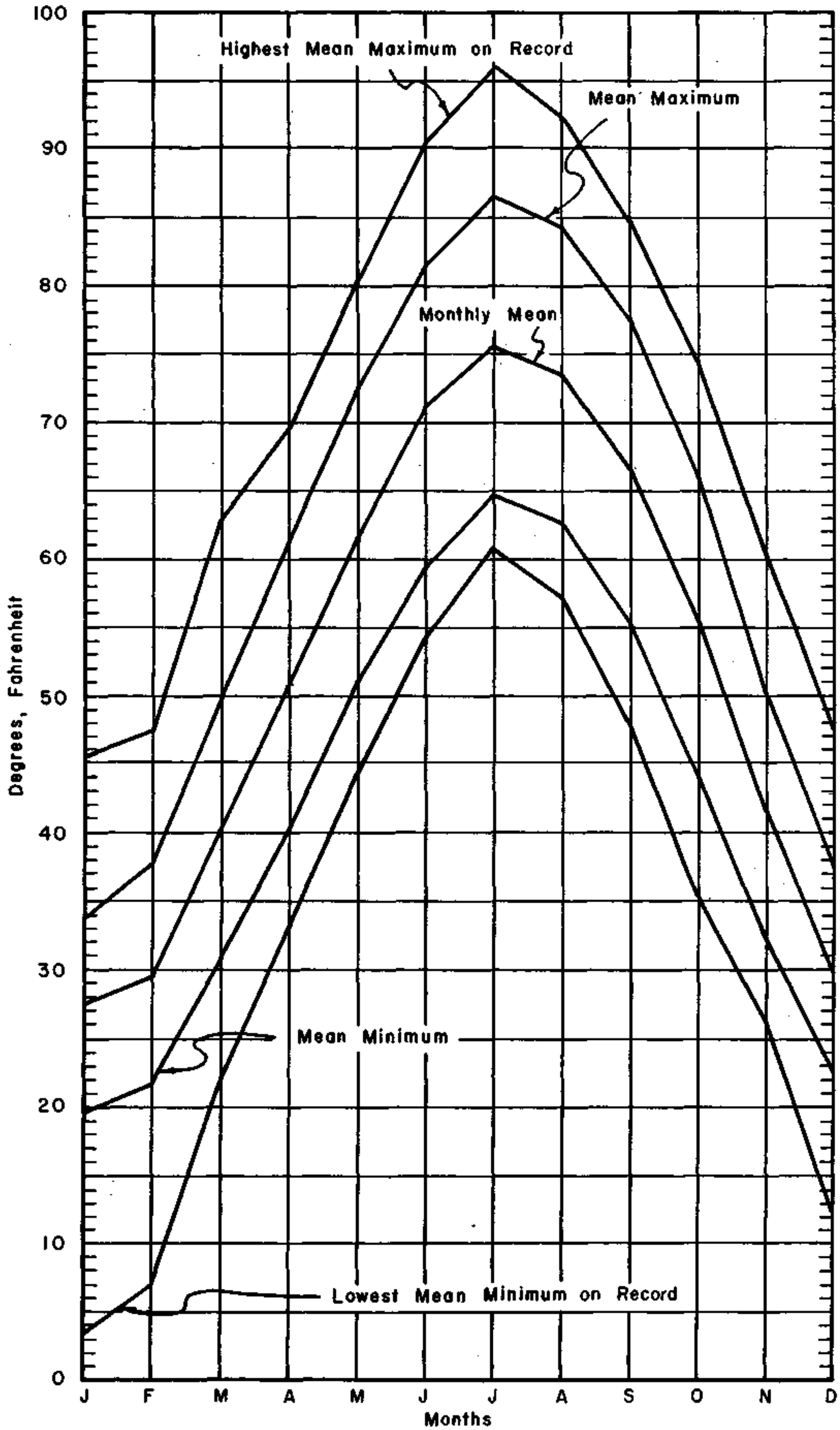


FIGURE 36 — MONTHLY MEAN TEMPERATURES

URBAN VERSUS RURAL MONTHLY MEAN TEMPERATURES

To illustrate the slightly lower temperatures recorded in rural locations, the monthly mean maximum and mean minimum temperatures recorded at the University of Illinois Airport station have been compared (Fig. 37) with the Morrow Plots station monthly values. The Airport weather station is approximately six miles south of the Morrow Plots station. Figure 37, which is based on data from both locations for the period of July 1952 through June 1957, shows the average departures of the Airport monthly mean maximum and mean minimum values. The mean minimum at the Airport has a greater departure than the mean maximum in most months. The monthly mean minimum temperatures are nearly two degrees lower than the values at Morrow Plots station from September through February. The Morrow Plots site is considered an excellent observation location for precipitation and temperature; thus, this graph illustrates how urban temperature records can be somewhat unrepresentative of temperature conditions existing in nearby rural areas.

The greatest difference in monthly mean minimum values, 3.5 degrees, was recorded in October 1952. The Airport mean minimum values were higher than those for Morrow Plots in only six of the 60 months compared.

The greatest difference in monthly mean maximum temperatures was 3.1 degrees in April 1954. The Airport values exceeded the Morrow Plots values in only eight months during this 5-year period.

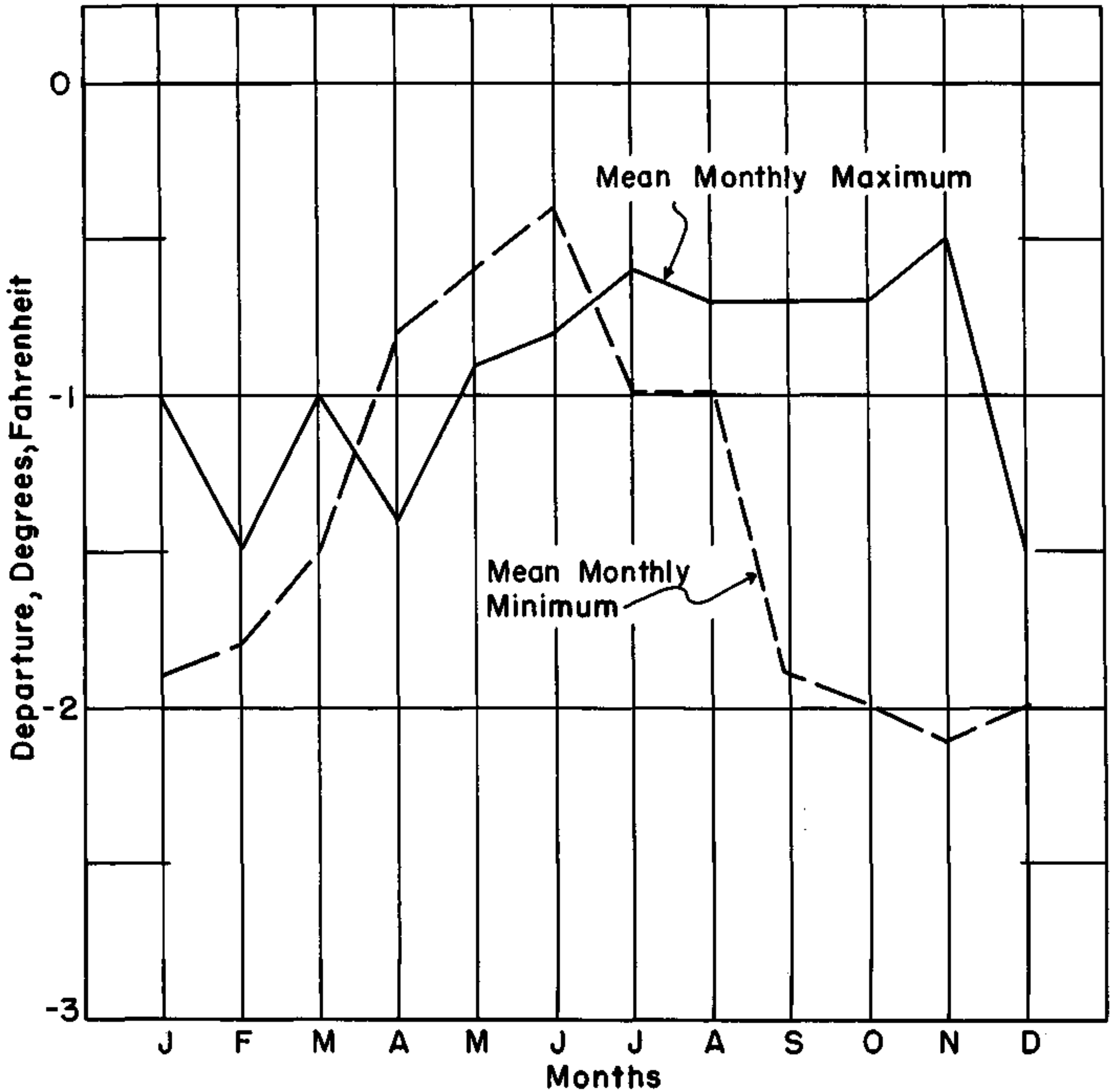


FIGURE 37 — MONTHLY AVERAGE DEPARTURES OF TEMPERATURE AT AIRPORT BELOW TEMPERATURE AT MORROW PLOTS, 1952-1957

WEEKLY MEAN TEMPERATURES

Weekly mean temperatures are shown on Figure 38. The data are based on Morrow Plots station records from 1903-56.[6] The warmest week of the year is July 26-August 1 which has a weekly mean temperature of 76.5 degrees. The coldest week is January 24-30 when the mean is 25.9 degrees.

As with the monthly mean maximum and minimum temperatures, the weekly mean maximum and minimum temperatures have their greatest differences in the summer and their least in winter. Interesting features shown by the weekly mean temperatures include a cold week from December 12-18, irregularities in the cooling trend in November, and no decrease in the mean minimum during the week of August 26-September 1.

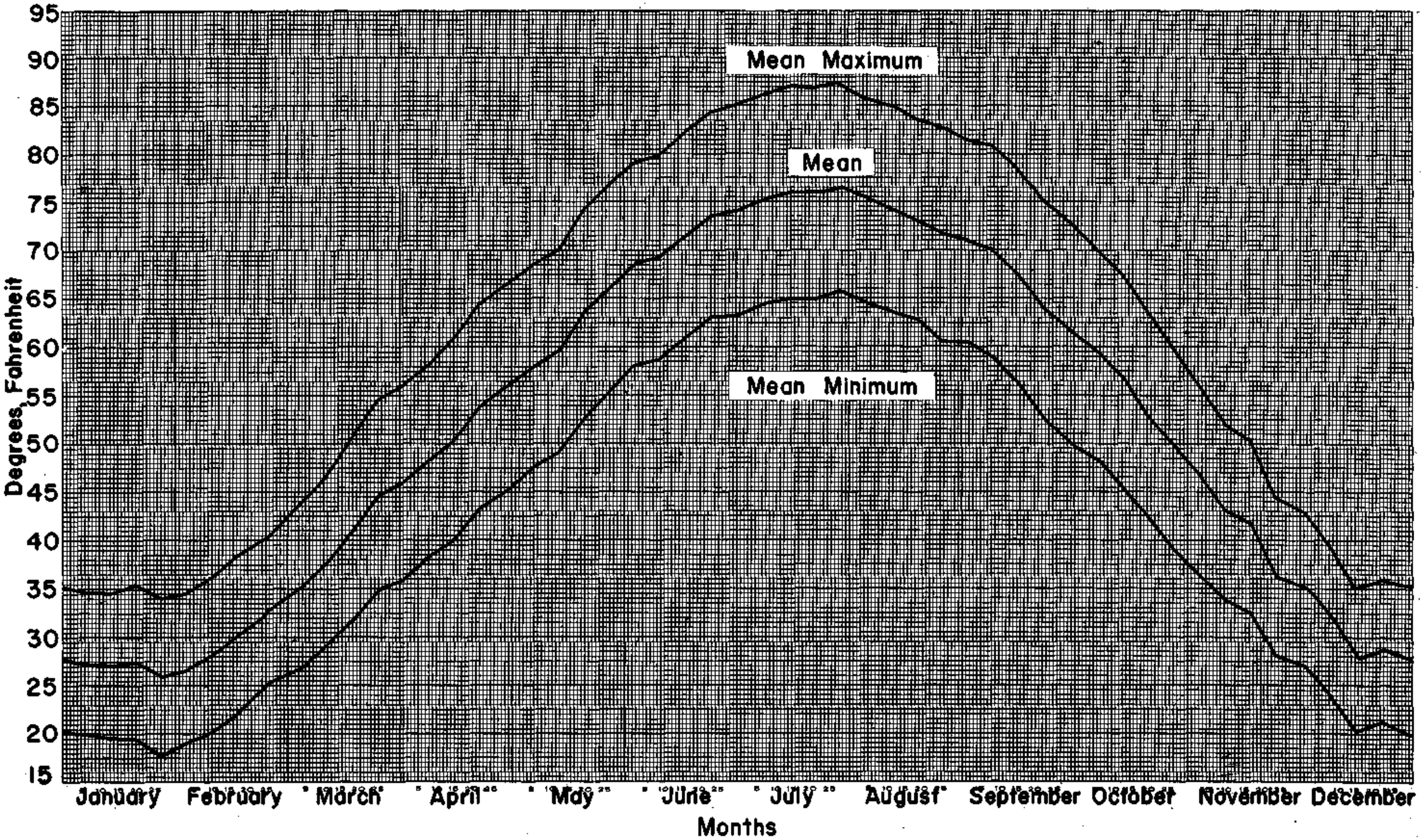


FIGURE 38 — WEEKLY MEAN TEMPERATURES

DAILY TEMPERATURES

The daily mean maximum and the daily mean minimum temperatures, as shown by the two inner curves in Figure 39, are based on data for the 1903-1956 period. The general trend of the curves throughout the year is quite similar to that of the weekly mean maximum and minimum temperatures, except that the day-to-day irregularities shown in Figure 39 do not appear in the weekly curves. The warmest day of the year, on the average, is July 28 when the mean maximum is 88.2 degrees and the mean minimum is 66.9 degrees. The average coldest day of the year is January 28 when the mean minimum is 17.0 degrees and the mean maximum is 34.0 degrees.

The two curves immediately above and below the mean maximum and mean minimum curves are calculations of the 90 percent limits for daily maximum and minimum temperatures. For instance, on January 15, the mean maximum temperature, as computed from the 53 years of record, is 36.2 degrees; and 90 percent of the time, or in 9 out of 10 years, the maximum temperature on that date will not exceed 55 degrees. Similarly, on July 15 the mean minimum is 64.5 degrees and in 9 out of 10 years the minimum temperature on that day will not go below 57 degrees.

The highest and lowest temperatures on record for each day are shown as the upper and lower curves. The highest to be recorded was 109 degrees on July 14, 1954, while the lowest was -25 degrees on February 9, 1905.

The unusual feature shown on this graph is that although the daily mean maximum and mean minimum temperatures have a greater difference in summer than in winter, the actual temperature variation from day to day is often greater in the winter than in the summer. This is reflected by the two 90 percent curves, where the range between them is approximately 5 to 9 degrees more in winter than in summer.

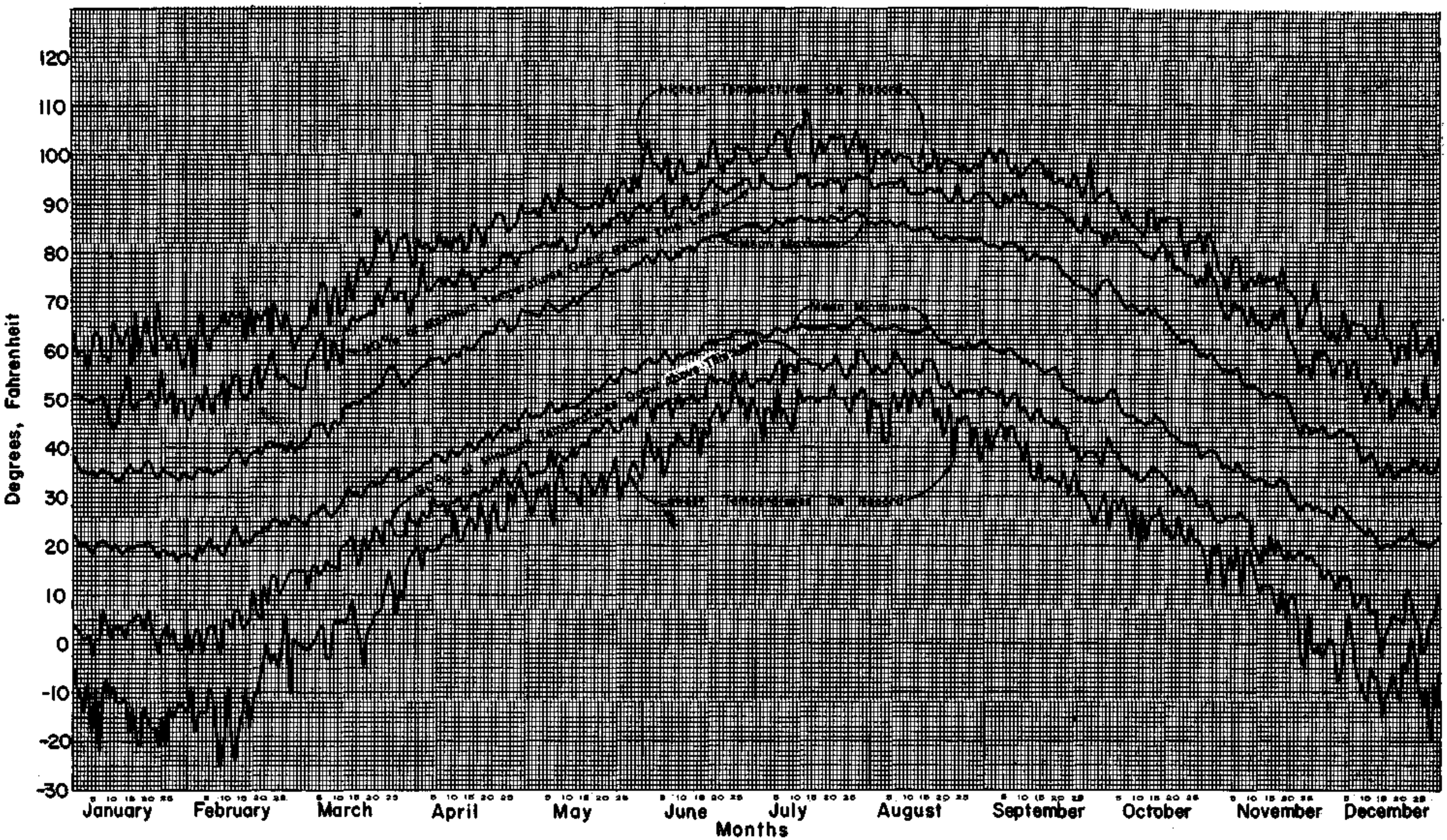


FIGURE 39 — DAILY MEAN TEMPERATURES AND EXTREMES

MONTHLY DEGREE DAYS

Heating degree days are used as an indication of heating requirements during the year (glossary). In Figure 40 the average number of degree days for each month is shown, along with curves for the highest and lowest monthly values recorded between 1903 and 1956. January has the highest average with 1172 degree days, and the lowest average is 3 in July. The highest number of degree days ever recorded was 1667 in January 1918. Normally June, July and August have no degree days.

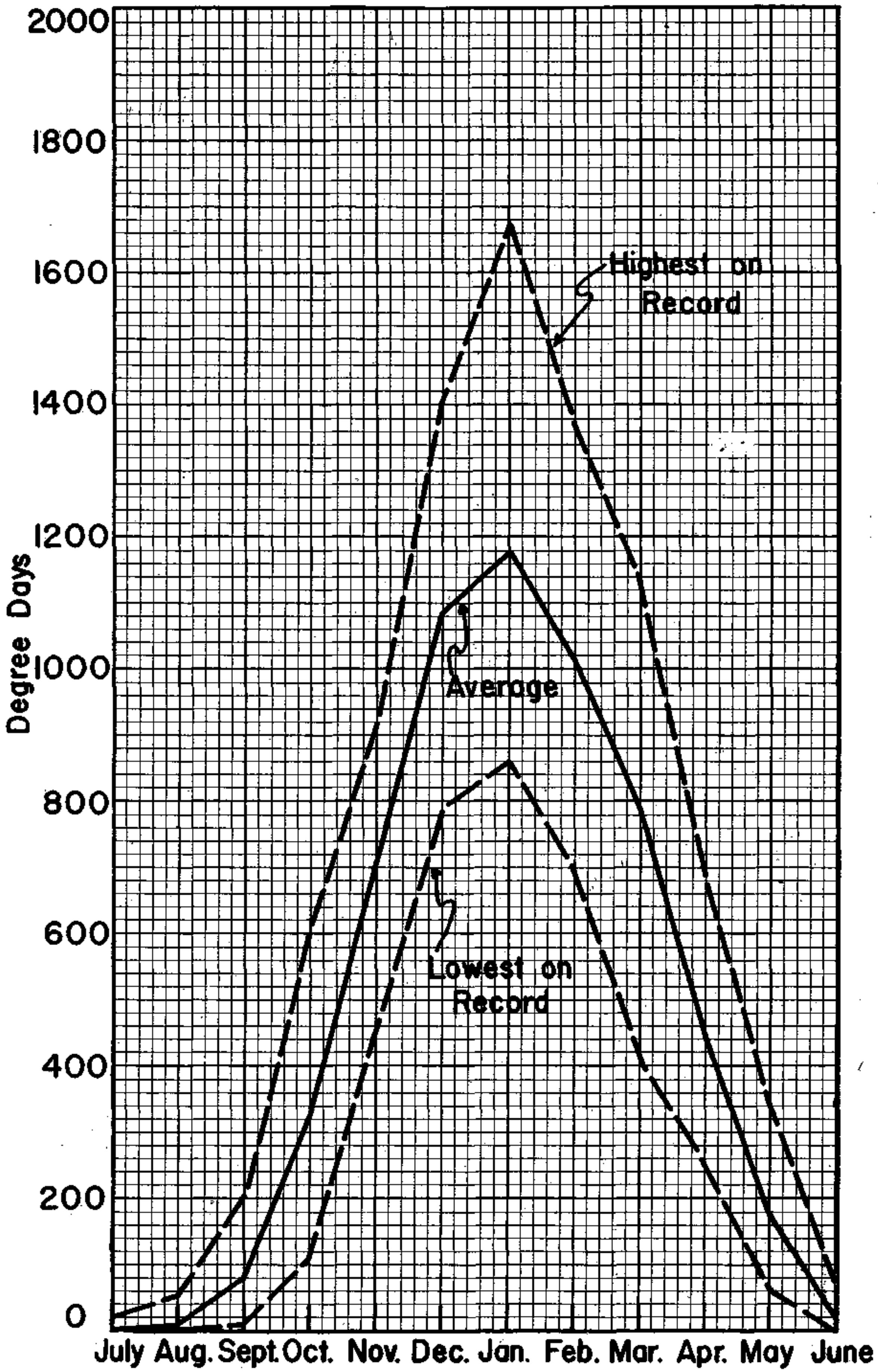


FIGURE 40 — MONTHLY DEGREE DAYS

PROBABILITIES FOR ANNUAL AND MONTHLY DEGREE DAYS

The annual average number of degree days is 5782. A probability graph for annual number of degree days, which is computed on a 12-month basis extending from July 1 to June 30, is shown in Figure 41. As many as 7023 degree days have been recorded on one year, 1903-04, and as few as 4757 have been recorded in one year, 1931-32. Reference to the curve in Figure 41 reveals that in 8 out of 10 years the annual number of degree days will be 5400 or more.

Figures 42 through 46 show the probability for the occurrence of various numbers of degree days in the five coldest months of the year. Normally these five months, November, December, January, February, and March, produce 82 percent of the total annual number of degree days. Figure 42 shows, for example, that the number of degree days equaled or exceeded 30 percent of the time in November, totals 790 or more. Likewise, 80 percent of the time, the number of degree days in November would be 630 or greater.

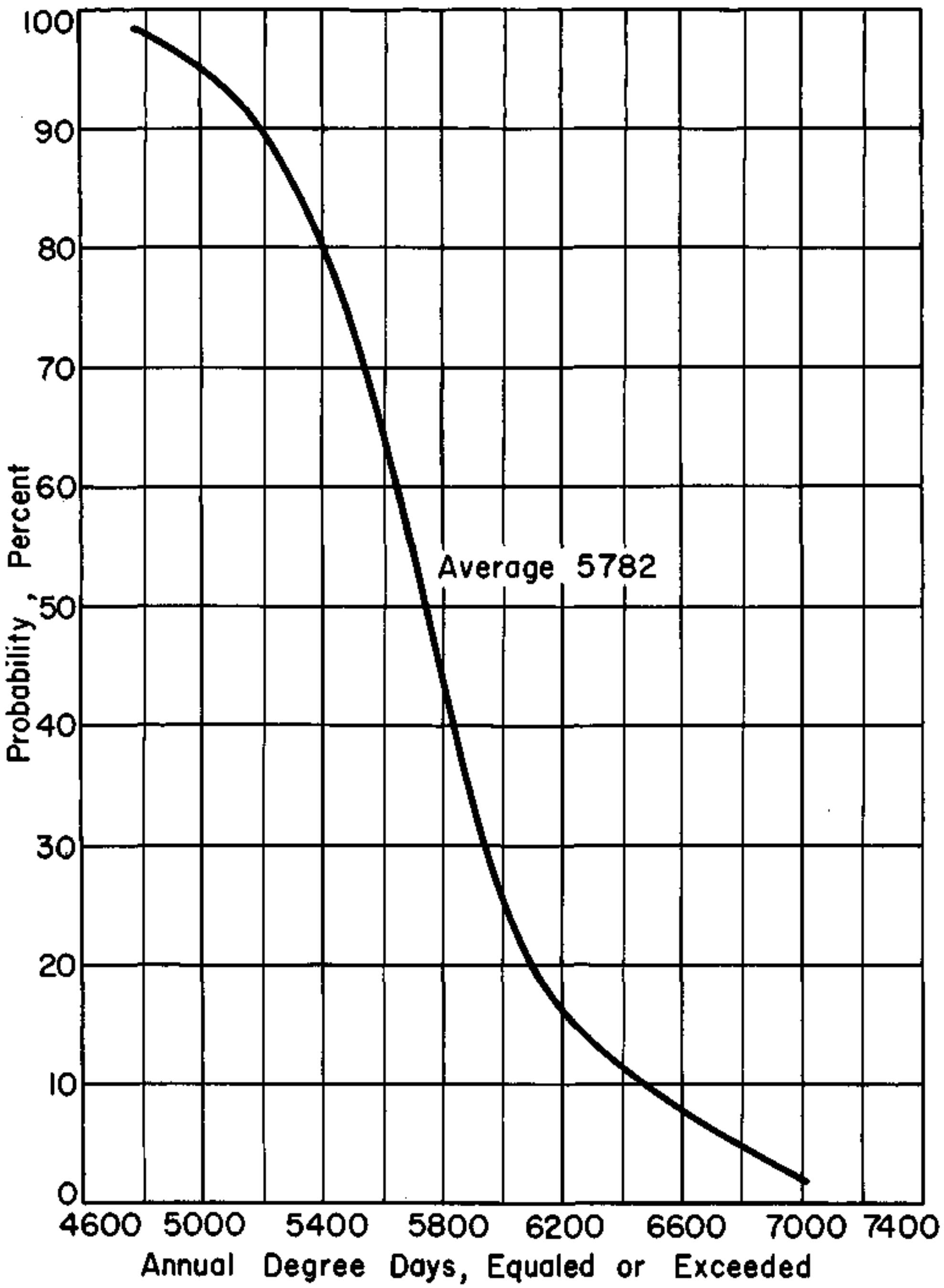


FIGURE 41 — PROBABILITY FOR ANNUAL DEGREE DAYS

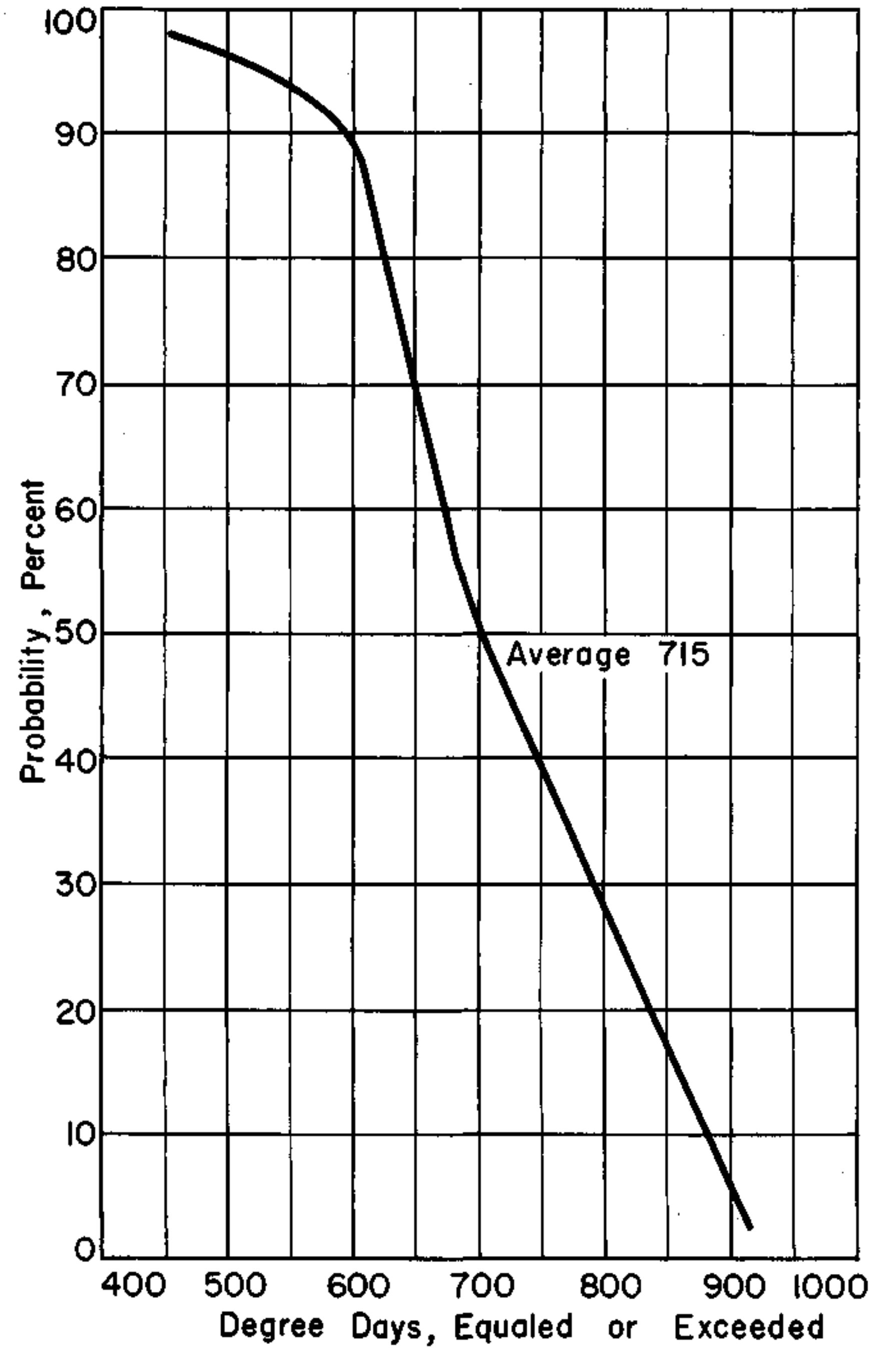


FIGURE 42 — PROBABILITY FOR NOVEMBER DEGREE DAYS

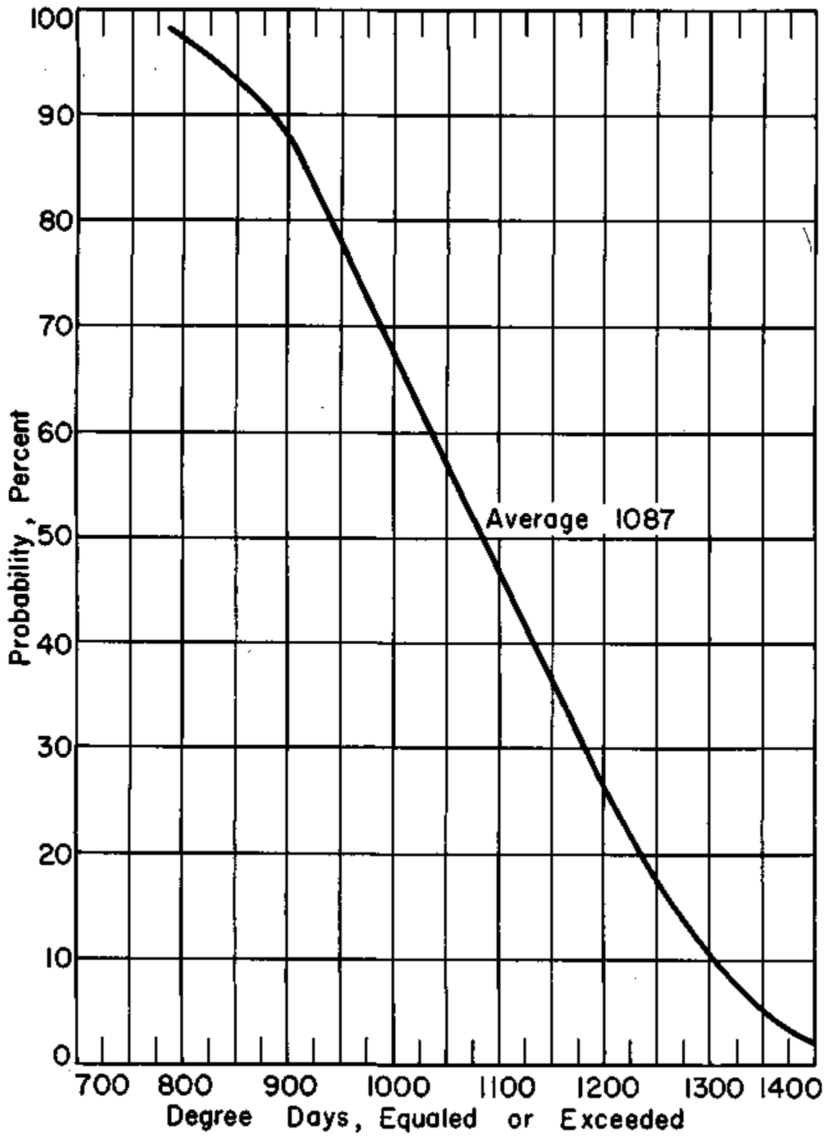


FIGURE 43 — PROBABILITY FOR DECEMBER DEGREE DAYS

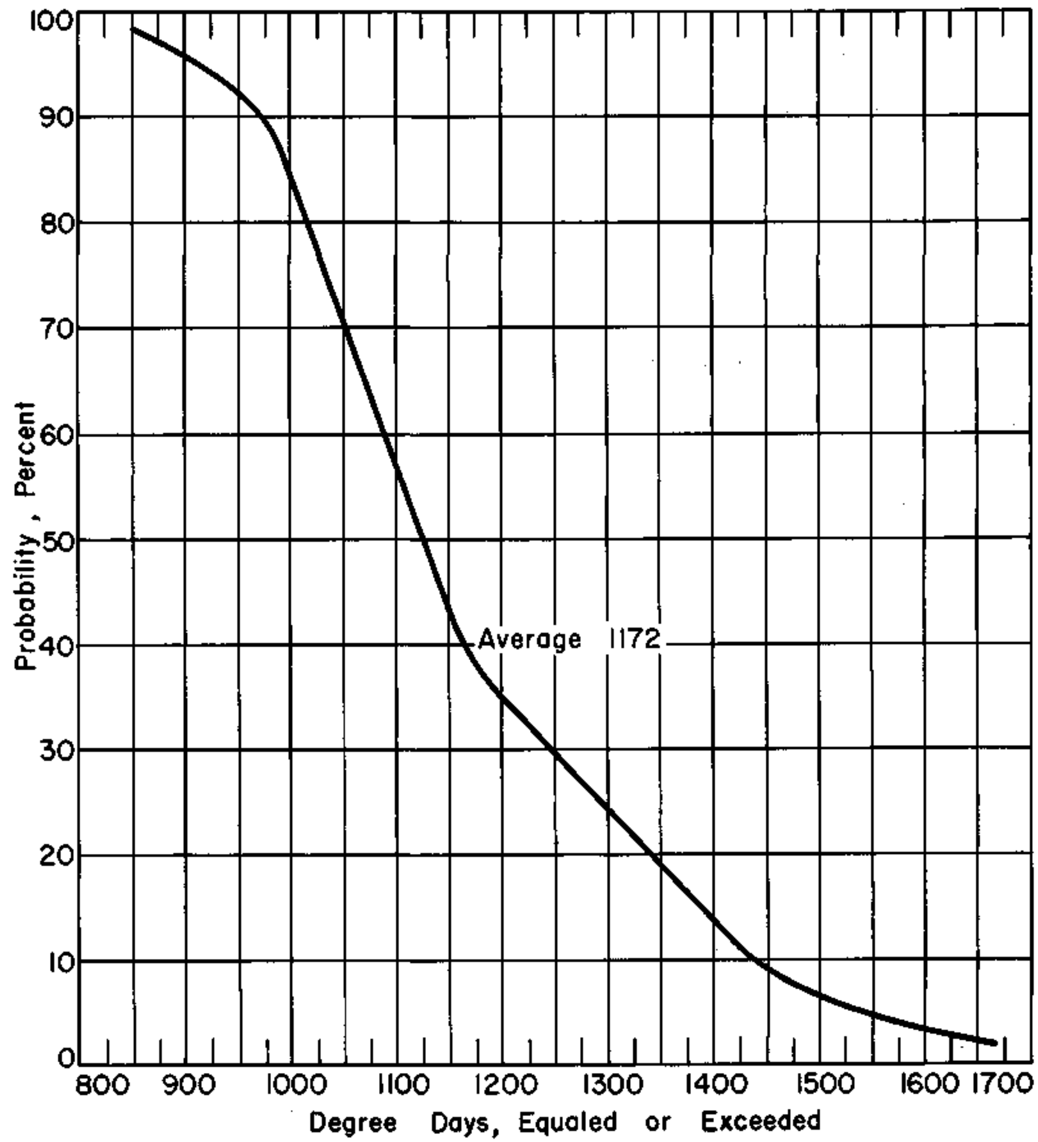


FIGURE 44 — PROBABILITY FOR JANUARY DEGREE DAYS

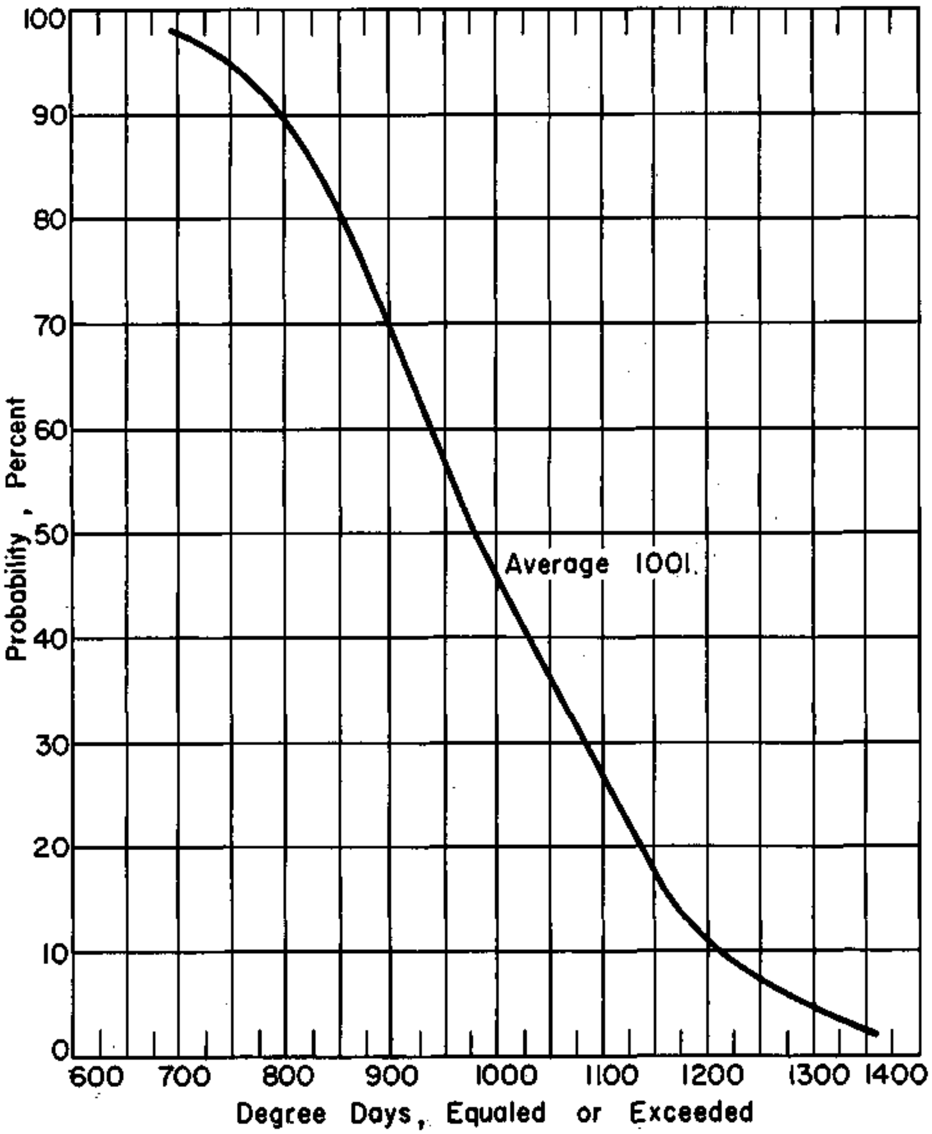


FIGURE 45 — PROBABILITY FOR FEBRUARY DEGREE DAYS

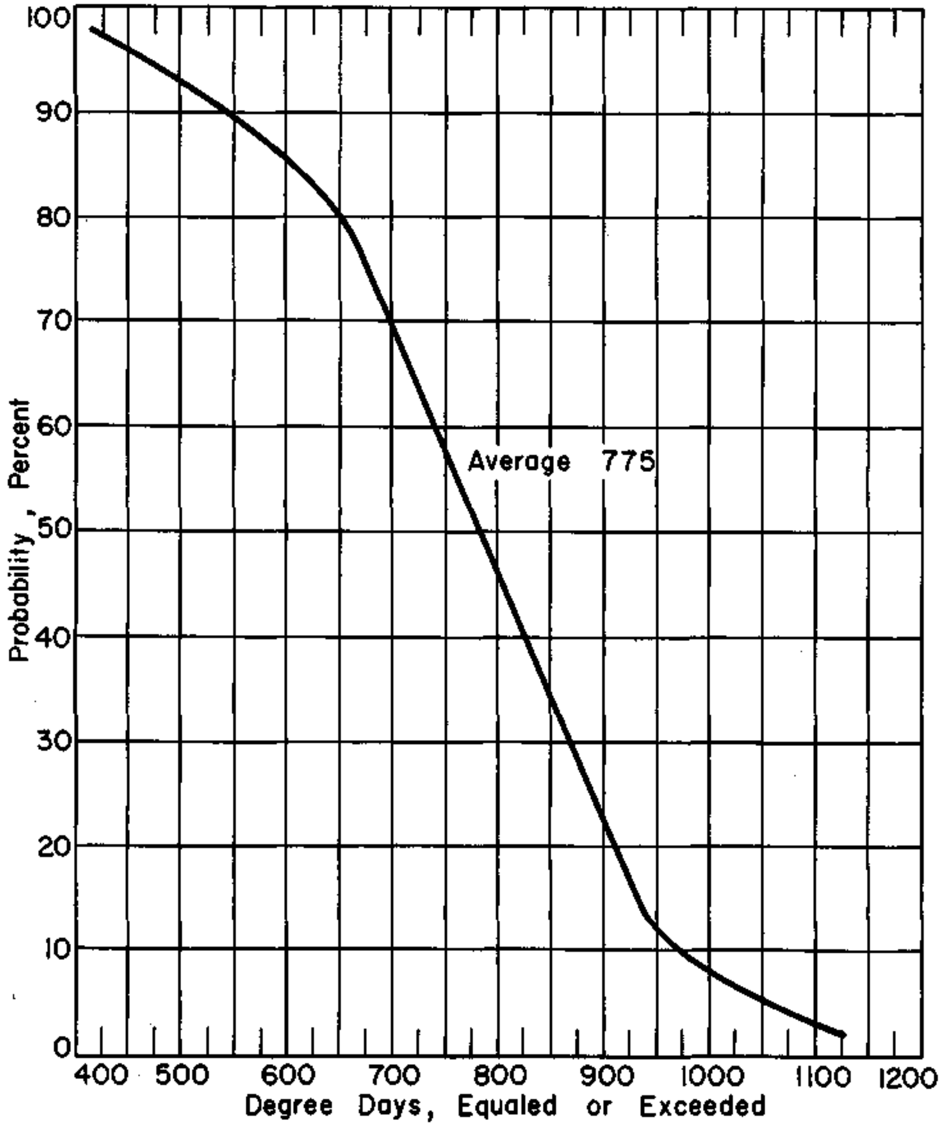


FIGURE 46 — PROBABILITY FOR MARCH DEGREE DAYS

GROWING SEASON

The average length of the growing season in Champaign-Urbana is 181 days, as shown by the horizontal line on Figure 47. The definition of growing season is given in the glossary. The annual number of days in the growing season for each year from 1901-1956 is also shown in Figure 47. The length of growing season has been as short as 129 days in 1928 and as long as 220 days in 1931. Considerable year-to-year variation in length of season is in evidence. The average date for the last killing frost in spring is April 21 while the average date for the first killing frost in fall is October 20.

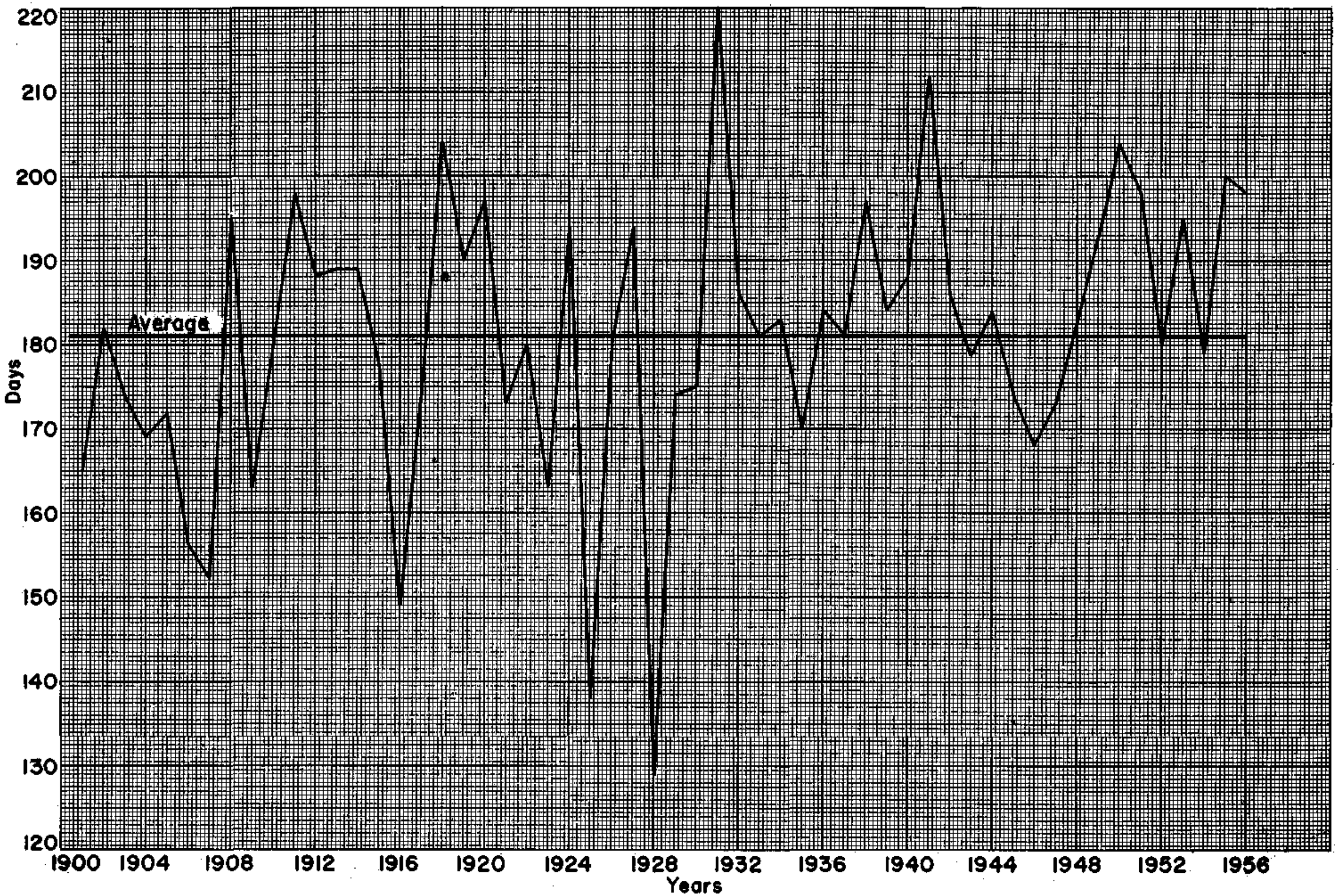


FIGURE 47 — LENGTH OF GROWING SEASON

PROBABILITY FOR FREEZES

Probability graphs for fall and spring freezes in Champaign-Urbana, based on 1903-56 temperature data from the Morrow Plots station, are shown in Figures 48 and 49. On each graph three probability curves are given, one for a light freeze, a second for a moderate freeze, and a third for a severe freeze[7] (glossary). These levels of freezing are used because various types of plants are critically affected at different temperature levels.

An example of how to use the graphs follows. At the 20 percent probability level (Fig. 48), or in 2 out of 10 years, the first light freeze has occurred on or before October 9, while in 2 out of 10 years the first moderate freeze may be expected on or before October 20. By October 30, the first severe freeze has occurred 20 percent of the time.

Chances for the last freezes on or after given dates in the spring are shown in Figure 49. For example, 80 percent of the time, or in 8 out of 10 years, the last moderate freeze will occur on or after March 30. That is, in 8 out of 10 years the last moderate freeze has occurred on or before March 30. Furthermore, in 6 out of 10 years the final light freeze can be expected to occur on or after April 20.

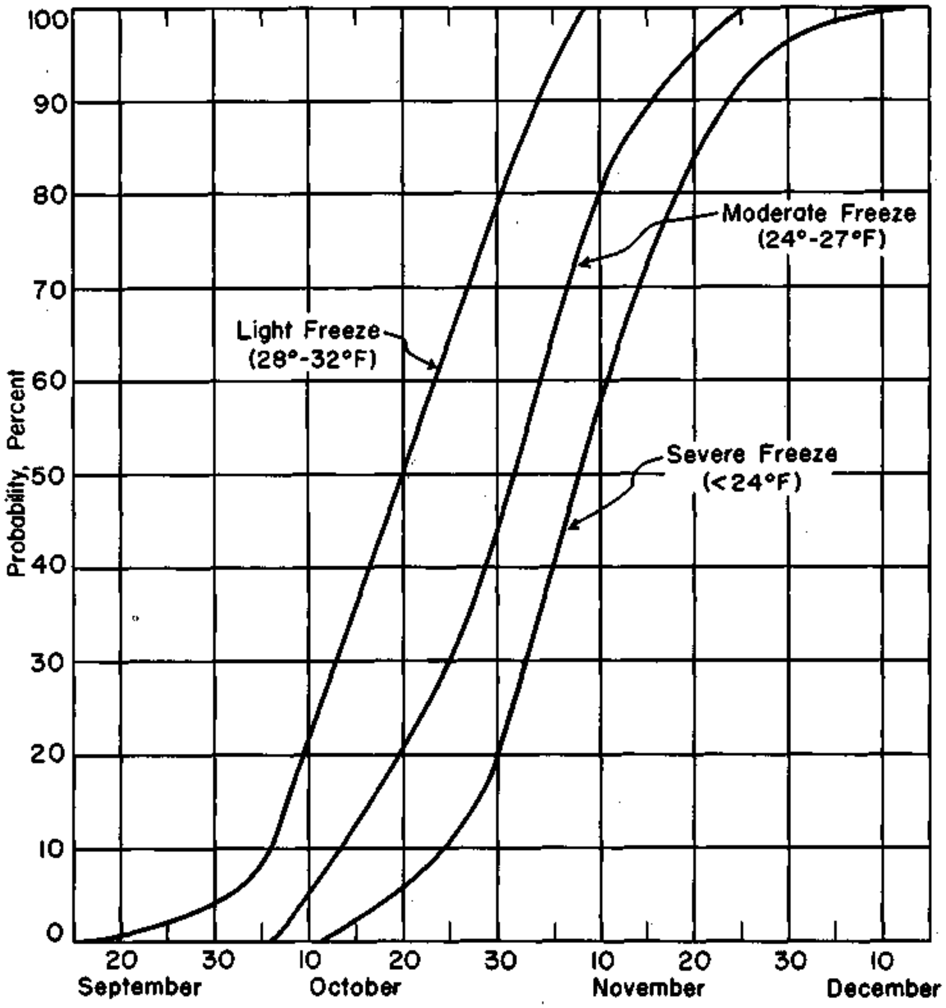


FIGURE 48 — PROBABILITY FOR FIRST FALL FREEZE ON OR BEFORE A GIVEN DATE

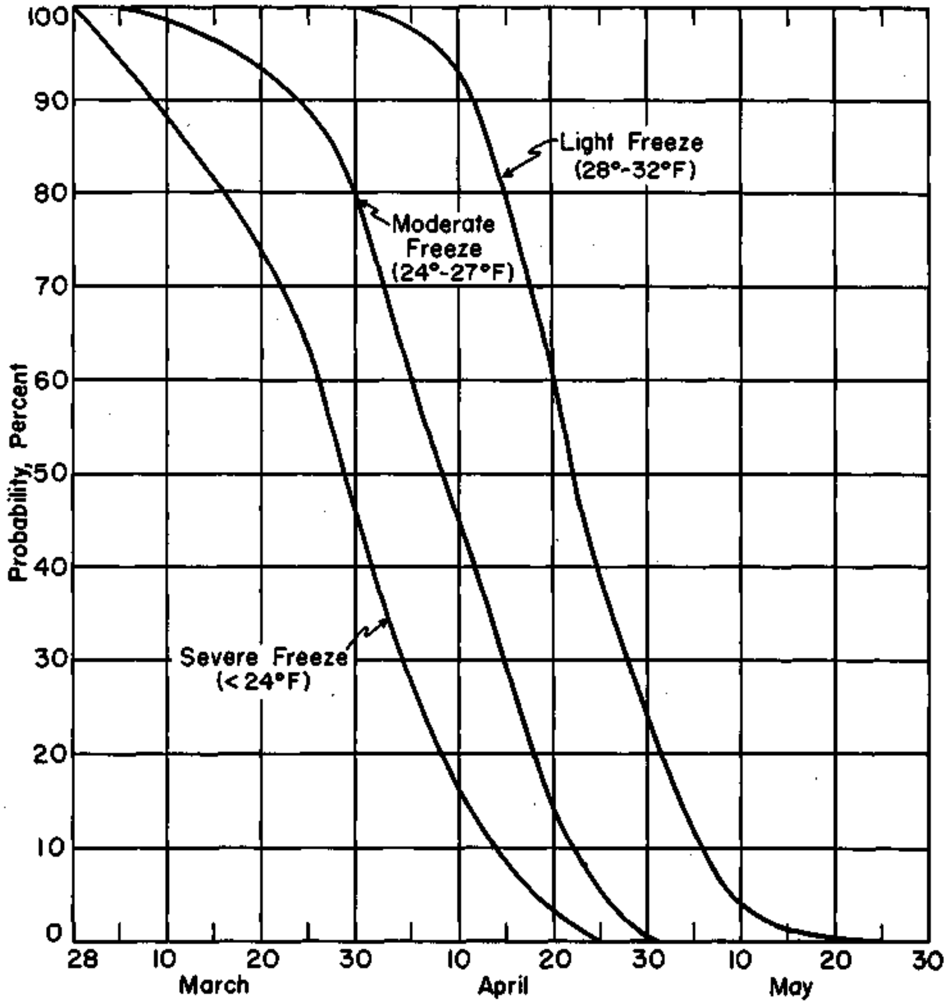


FIGURE 49 — PROBABILITY FOR LAST SPRING FREEZE ON OR AFTER A GIVEN DATE

MONTHLY MEAN SOIL TEMPERATURES AT FOUR DEPTHS

Figure 50 shows monthly mean soil temperatures for four depths beneath the surface of the ground, from records made at the Agronomy South Farm station. The periods of record vary for each level because records were not made continuously. The 4-inch depth averages are based on data for 1936-1956, the 12-inch depth averages on data for 1897-1904 and 1932-1956, the 24-inch depth averages on data for 1912-1924 and 1936-1948, and the 36-inch depth on data for 1900-1924 and 1932-1948.

Nearness to the surface determines the range of the average values during the year as well as the time lag in the heating and cooling beneath the surface. For instance, at the 4-inch depth the monthly temperatures from October through March are the coldest of the four depths, but are the warmest of the four depths from June through August. The extreme difference in range at the 4-inch depth during the year is 45.3 degrees, ranging from 27.0 degrees in January to 72.3 degrees in August. However, at the 36-inch depth the coldest month is February with a 38.8-degree mean temperature and the warmest month is August with a 68.9-degree mean for an annual range of only 30.1 degrees. At the two greater depths, the temperatures are higher in the winter and cooler in the summer than those at the 4- and 12-inch depths.

January is the coldest month according to air temperatures (Fig. 36). However, at the 12-, 24-, and 36-inch depths February is the coldest month. Only at the 4-inch depth is January the coldest month. This one-month difference at the lower three depths illustrates the lag in cooling at the greater depths. July is the warmest month for air temperatures, but for all four levels of soil temperature August has the highest monthly mean temperature, revealing the lag in heating below the surface.

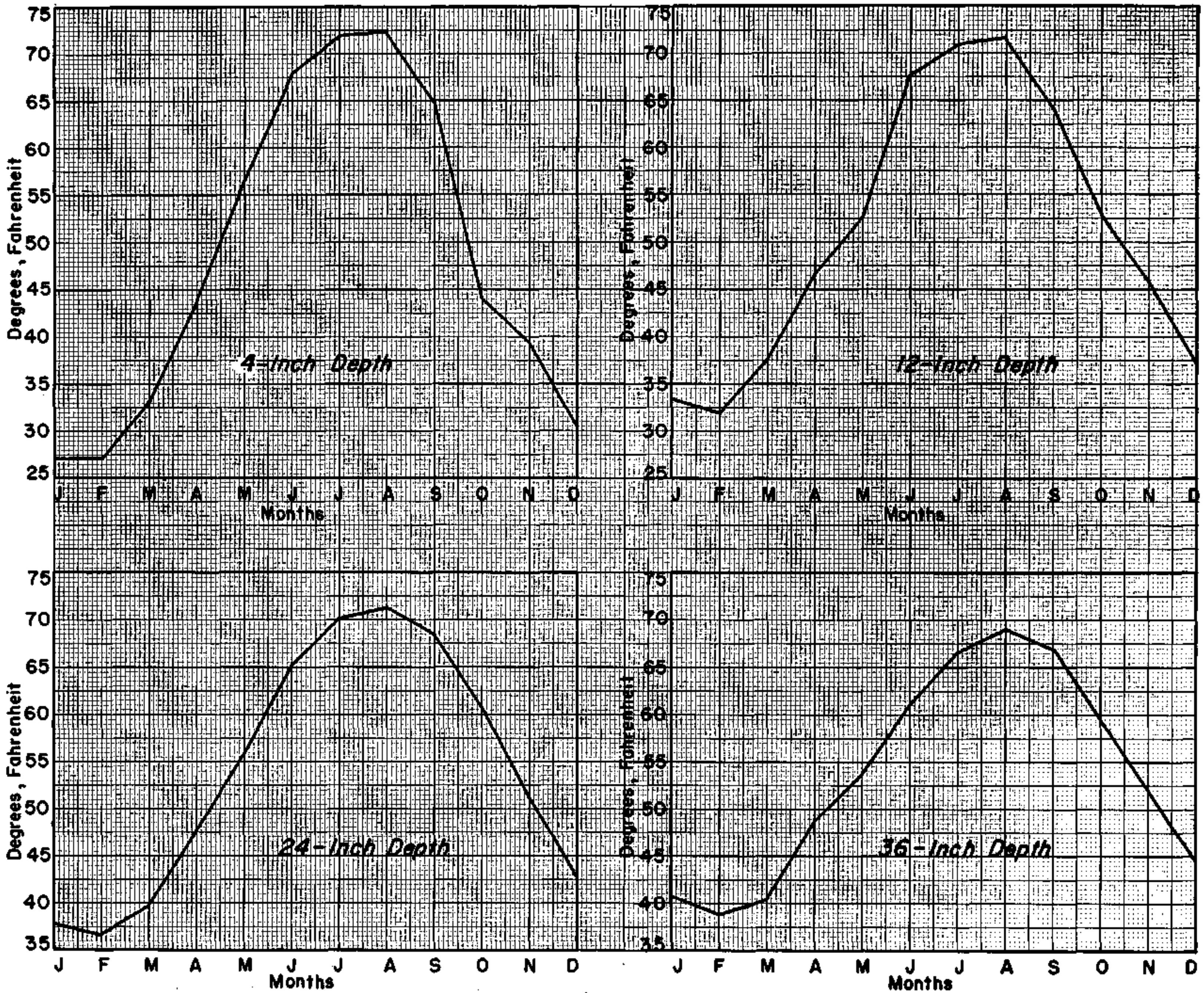


FIGURE 50 — MONTHLY AVERAGE SOIL TEMPERATURES

DAILY AVERAGE AND EXTREME SOIL TEMPERATURES AT 4-INCH DEPTH

The daily average soil temperatures at the 4-inch depth are shown by the middle curve in Figure 51. These data are based on Agronomy South Farm soil temperature records from 1936 through 1956. Daily maximum and minimum values were obtained from a recording soil thermograph. The daily temperature fluctuations on the average range only 5 to 10 degrees in the summer and 1 to 4 degrees in the winter. The daily average curve is the average of the 21 daily mean temperatures for each date. On the average, the soil temperature at four inches below the surface goes below 32 degrees on December 9 and remains below freezing until March 12.

The highest daily maximum soil temperatures on record are plotted as the upper curve. Continuously high temperatures in July 1936 produced the peak values extending from July 6 to 12 on this curve. The lowest daily minimum temperatures on record during these 21 years are plotted as the bottom curve. The lowest daily temperature on record occurred on February 1, 1945, when the temperature was 10 degrees.

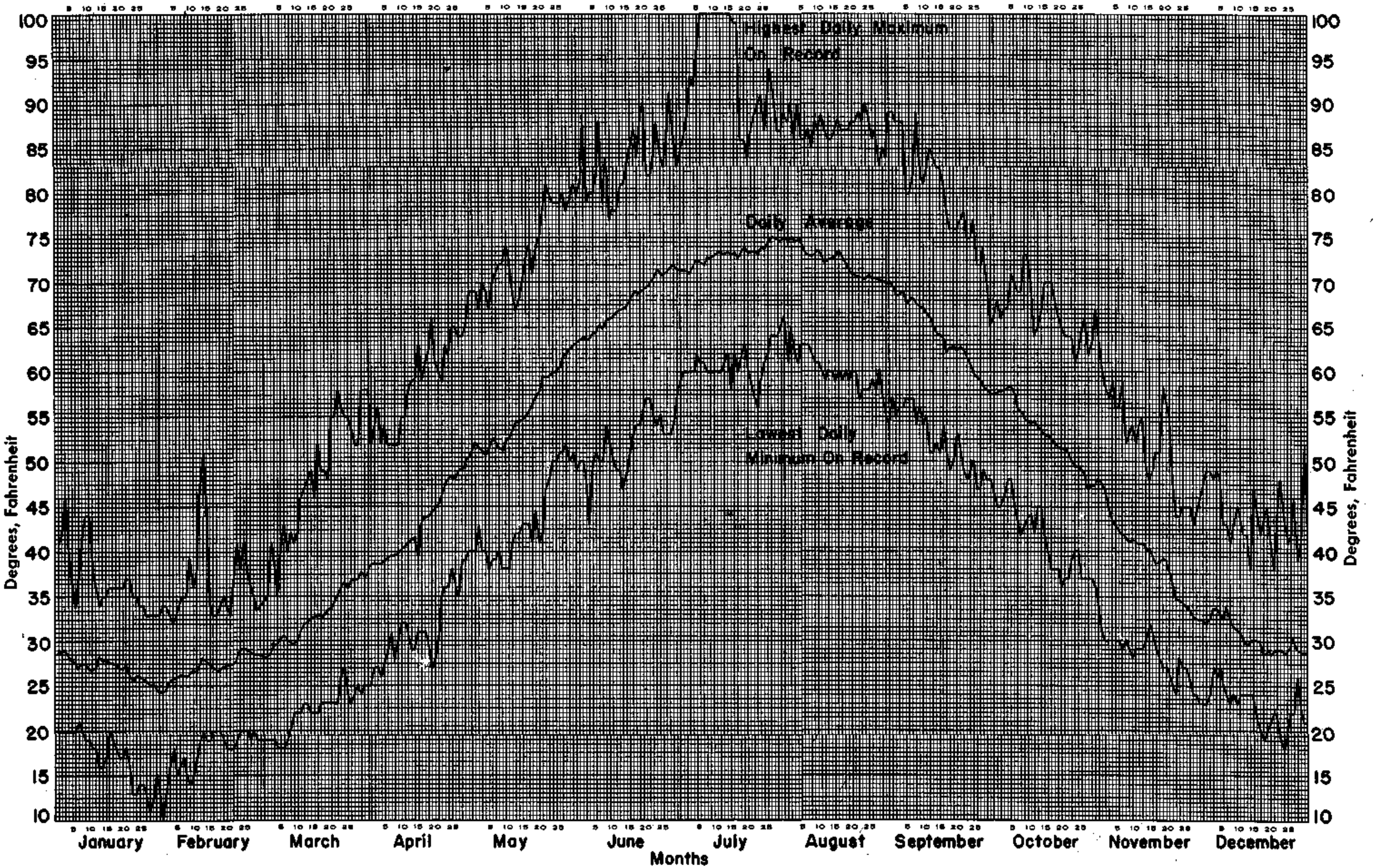


FIGURE 51 —DAILY AVERAGE AND EXTREME TEMPERATURES AT 4-INCH DEPTH, 1936-1956

DAILY AVERAGE AND EXTREME SOIL TEMPERATURES AT 12-INCH DEPTH

Daily average soil temperatures for the 12-inch depth, as measured at the South Farm station, are plotted as the middle curve on Figure 52. The daily average temperature curve at the 12-inch depth has fewer and less pronounced day-to-day fluctuations than the curve for the 4-inch depth. However, comparison of the daily average curves in Figures 51 and 52 reveals that both have some similar unusual fluctuations. For instance, sudden temperature increases occur in the October 4-5 and October 31-November 1 periods, and abrupt temperature decreases occur during the July 1-3 period. In general, daily average values at the 4-inch depth are 4 to 5 degrees lower than the 12-inch values in the winter and 4 to 6 degrees higher than the 12-inch depth in the summer.

The highest maximum daily temperature for the 12-inch depth was 86 degrees recorded on July 14, 1936, while the lowest minimum daily on record was 22 degrees reached on two dates in January, and 17 days in February. These 17 days in February with low values all occurred during February 1951.

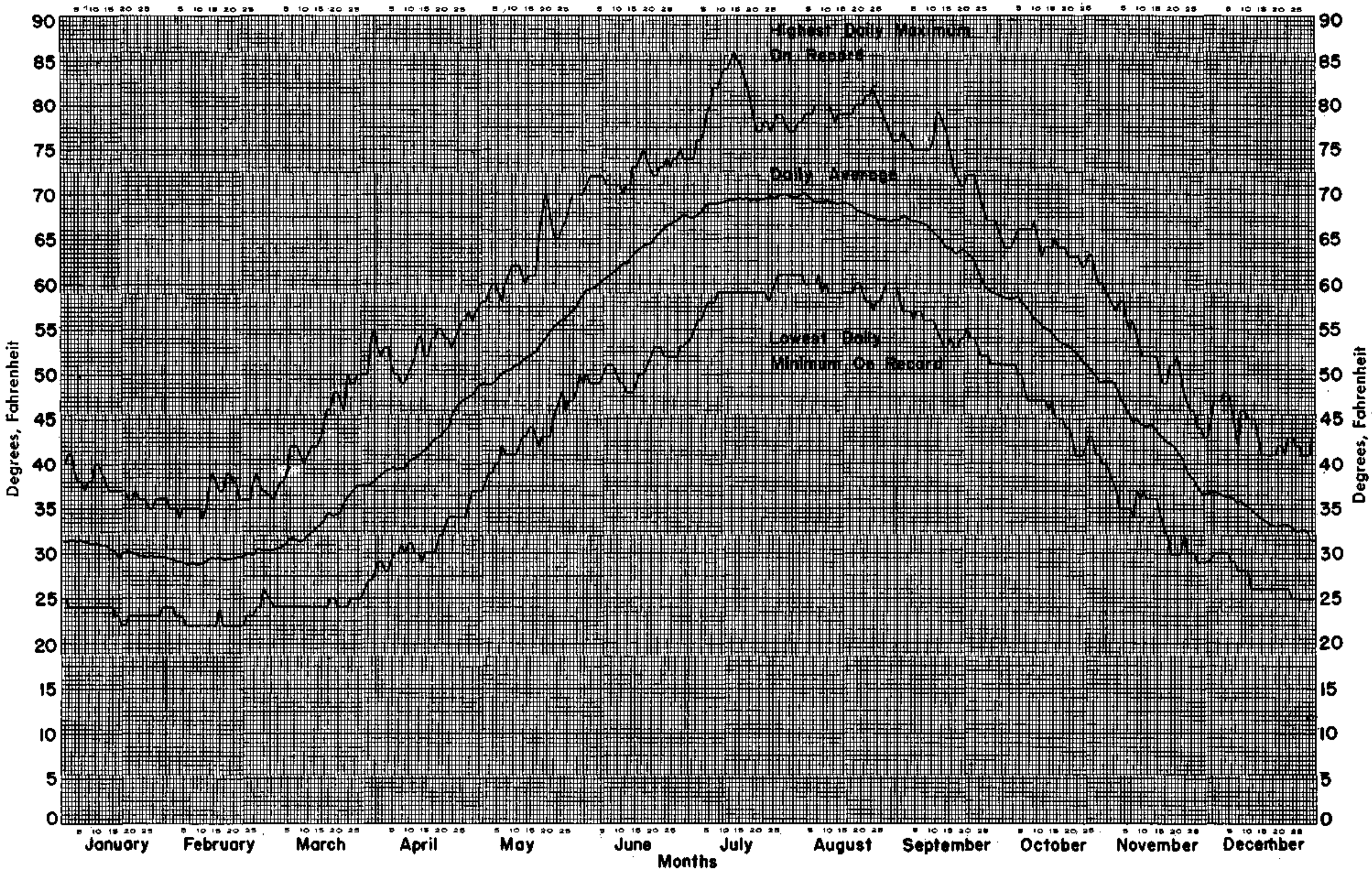


FIGURE 52 — DAILY AVERAGE AND EXTREME TEMPERATURES AT 12-INCH DEPTH, 1935-1956

MISCELLANEOUS WEATHER PHENOMENA

SKY CONDITIONS AND SUNSHINE

From 1951 through 1957, records on the daily condition of the sky have been collected. From daily visual observations at 7 A.M., 1 P.M., and 7 P.M., the average sky conditions over Champaign-Urbana were determined and classified as clear, partly cloudy, or cloudy (glossary). From these seven years of data, annual and monthly average sky cover conditions have been calculated and are shown in Figure 53.

On an annual average basis, 36 percent of the days, or approximately 131 days, are partly cloudy; 33 percent, or 121 days, are clear; and 31 percent, or 113 days, are cloudy. The highest annual number of partly cloudy days was 154 reported in 1954, and the fewest number was 113 in 1952. The highest number of clear days was 139 in 1953 and the lowest was 94 in 1954. The highest number of cloudy days was 125 in 1957 and the fewest in one year was 101 in 1953. Cloudy days predominate from November through April, partly cloudy predominate from May through August, and clear days predominate in September and October.

In Figure 54 the monthly average number of hourly occurrences of the seven major cloud types is shown. These data were recorded from 1949 through 1955 at Chanute Air Force Base, which is 14.5 miles northeast of the Morrow Plots station. The Chanute data are considered representative of the types of clouds occurring over the Champaign-Urbana area.[8]

Sunshine records made on a triple register recorder, which was located just north of the Morrow Plots station from 1931 through 1940, indicate that the annual average percent of possible sunshine occurring in the Champaign-Urbana area is 61. That is, 61 percent of the time when sunshine can occur during the year there is sunshine, while 39 percent of the time the sun is obscured. July has the highest monthly average percent of possible sunshine with an average of 79 percent. The December monthly average is the lowest with a value of 39 percent possible sunshine. The monthly averages are shown below.

MONTHLY AVERAGE PERCENT OF POSSIBLE SUNSHINE

January	42	July	79
February	48	August	77
March	51	September	73
April	57	October	67
May	62	November	57
June	73	December	39

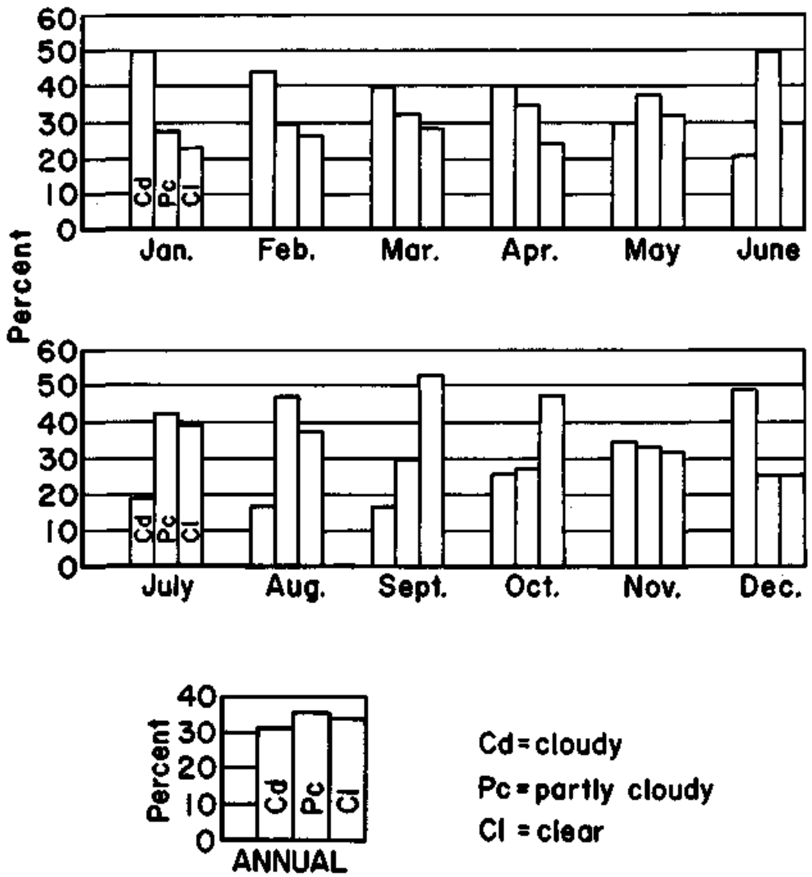


FIGURE 53 — PERCENT OF CLOUDY, PARTLY CLOUDY, AND CLEAR DAYS

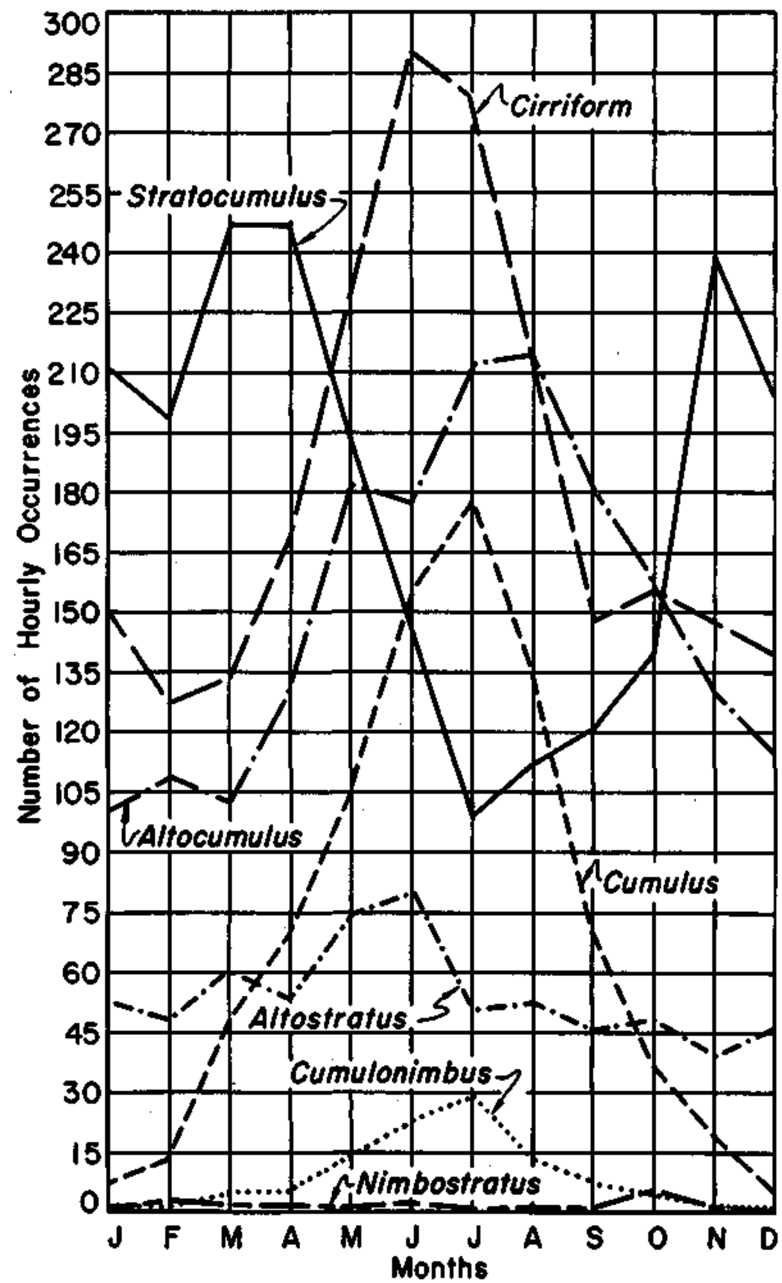


FIGURE 54 — MONTHLY AVERAGE NUMBER OF CLOUD OCCURRENCES AT RANTOUL, 1949-1955

DAILY AND MONTHLY SOLAR RADIATION

Solar radiation data, measured in Langleys (glossary), were collected from 1950 through 1956. Solar radiation, or insolation, is the radiant energy received from the sun at the earth's surface.

Daily average values, as smoothed by averaging 10 daily values together, are shown in Figure 55. This smoothing was done to eliminate the extreme day-to-day variation in daily averages resulting from the short-duration records. The available records indicate that the maximum period of incoming solar radiation is the last 10 days of June, while the lowest daily average values occur in the December 25-January 5 period.

The highest and lowest daily values recorded during the seven years were averaged also into 10-day periods and are shown by the dashed lines. The highest value, as smoothed by the 10-day averaging process, was 655 Langleys per day for the June 1-10 period. The lowest value, obtained by the 10-day averaging process, was 35 per day for the December 11-20 period. The highest single day value measured during the period of record was 850 Langleys on June 8, 1950, while the lowest value was zero on several days.

The average monthly solar radiation values in Langleys, as shown in the following table, are highest in July and lowest in December.

MONTHLY AVERAGE SOLAR RADIATION 1950-1956

Month	*Langleys*	*Month*	*Langleys*
January	3816	July	16441
February	5667	August	14674
March	9037	September	11357
April	10134	October	8498
May	12769	November	5251
June	15743	December	3625

The distribution of the daily values of solar radiation for each month of the colder half-year (glossary) are shown as bar graphs in Figure 56. These figures indicate that 47 percent of all January days have values from 0 to 100 Langleys, while in October only 13 percent of the days have values in this range. The distribution of the daily values in increments of 100 Langleys for the months of the warmer half-year (glossary) is shown as bars in Figure 57.

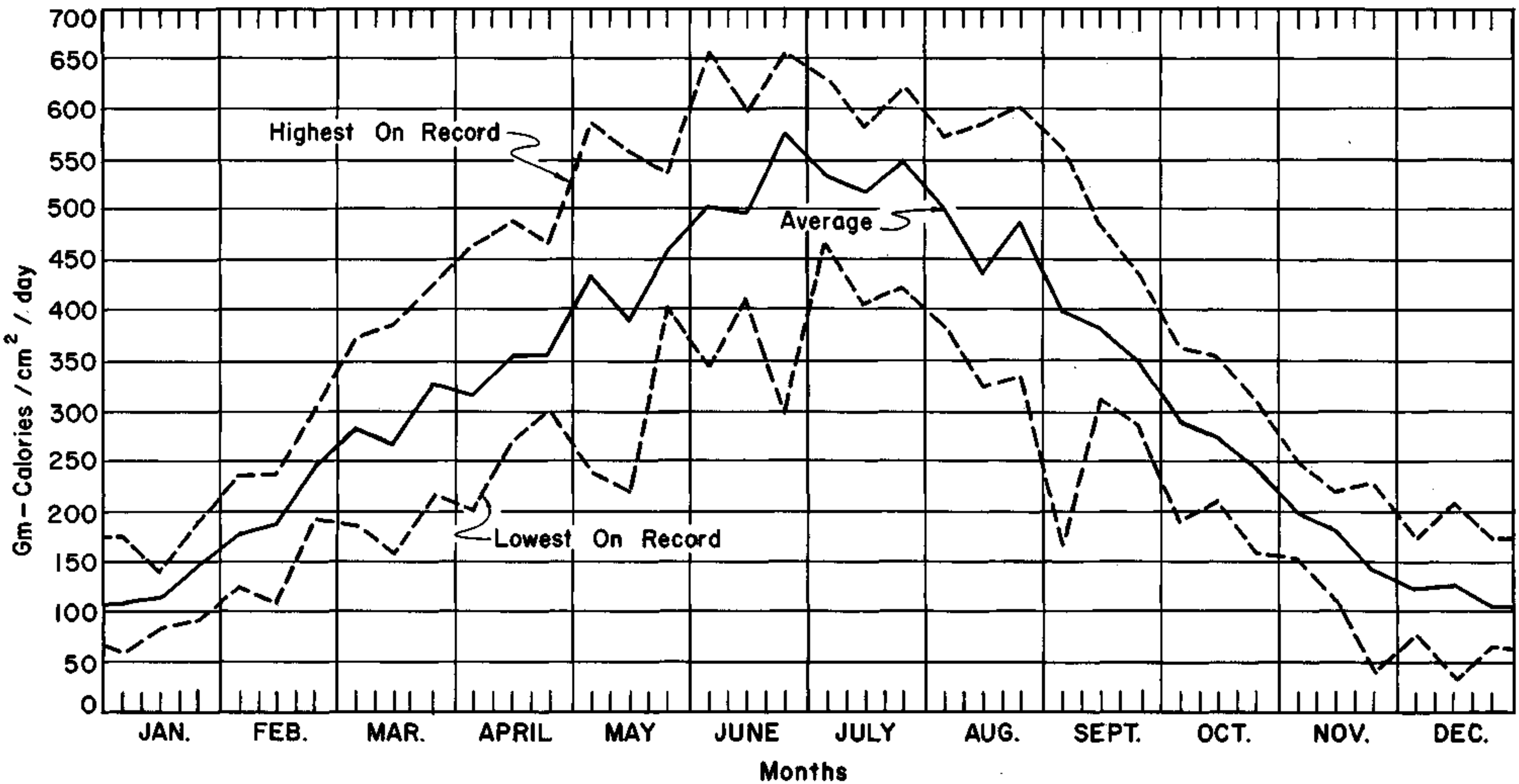


FIGURE 55 — DAILY AVERAGE SOLAR RADIATION, 1950-1956, WITH DATA SMOOTHED BY 10-DAY AVERAGES

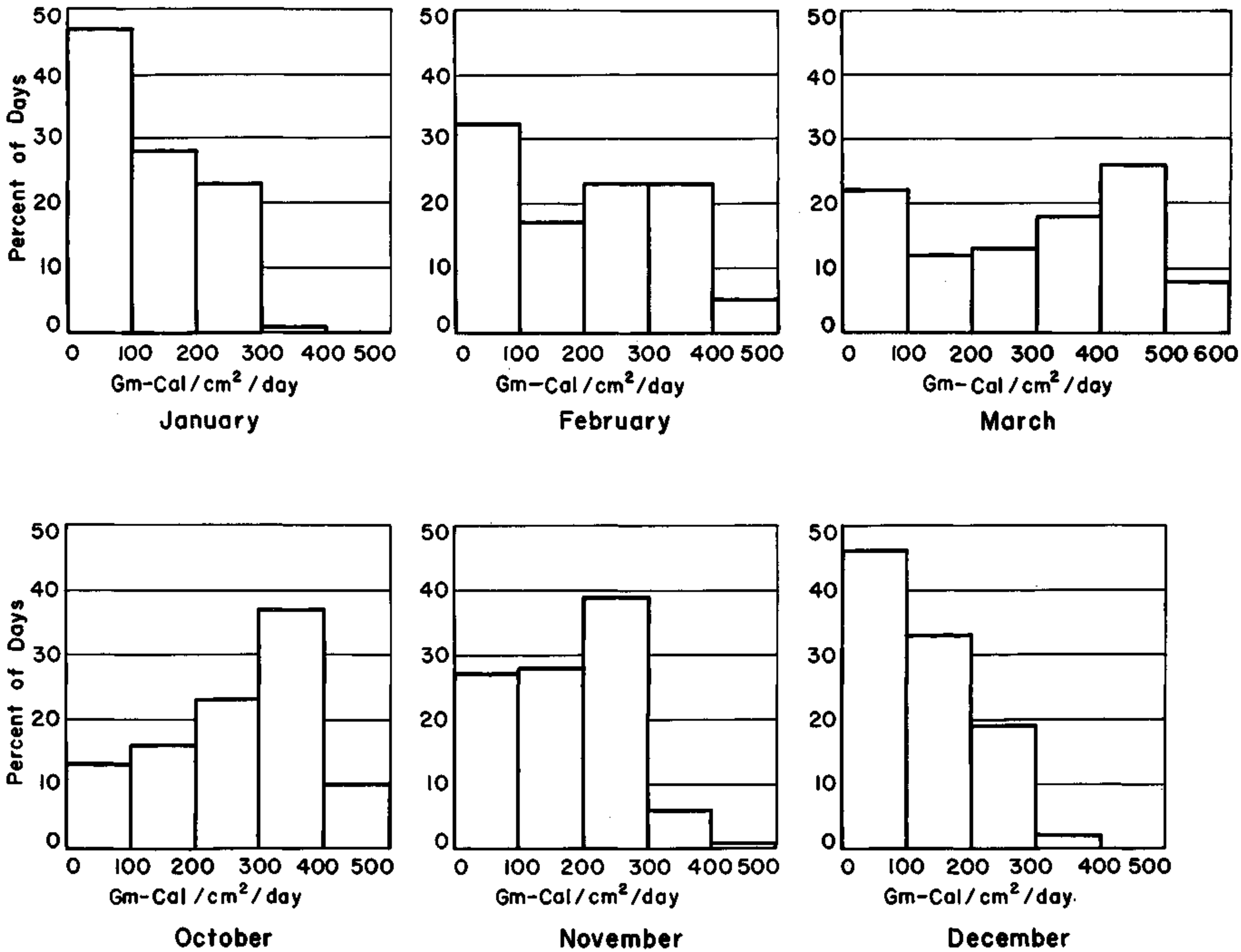


FIGURE 56 — MONTHLY DISTRIBUTION OF DAILY SOLAR RADIATION VALUES FOR COLDER HALF-YEAR, 1950-1956

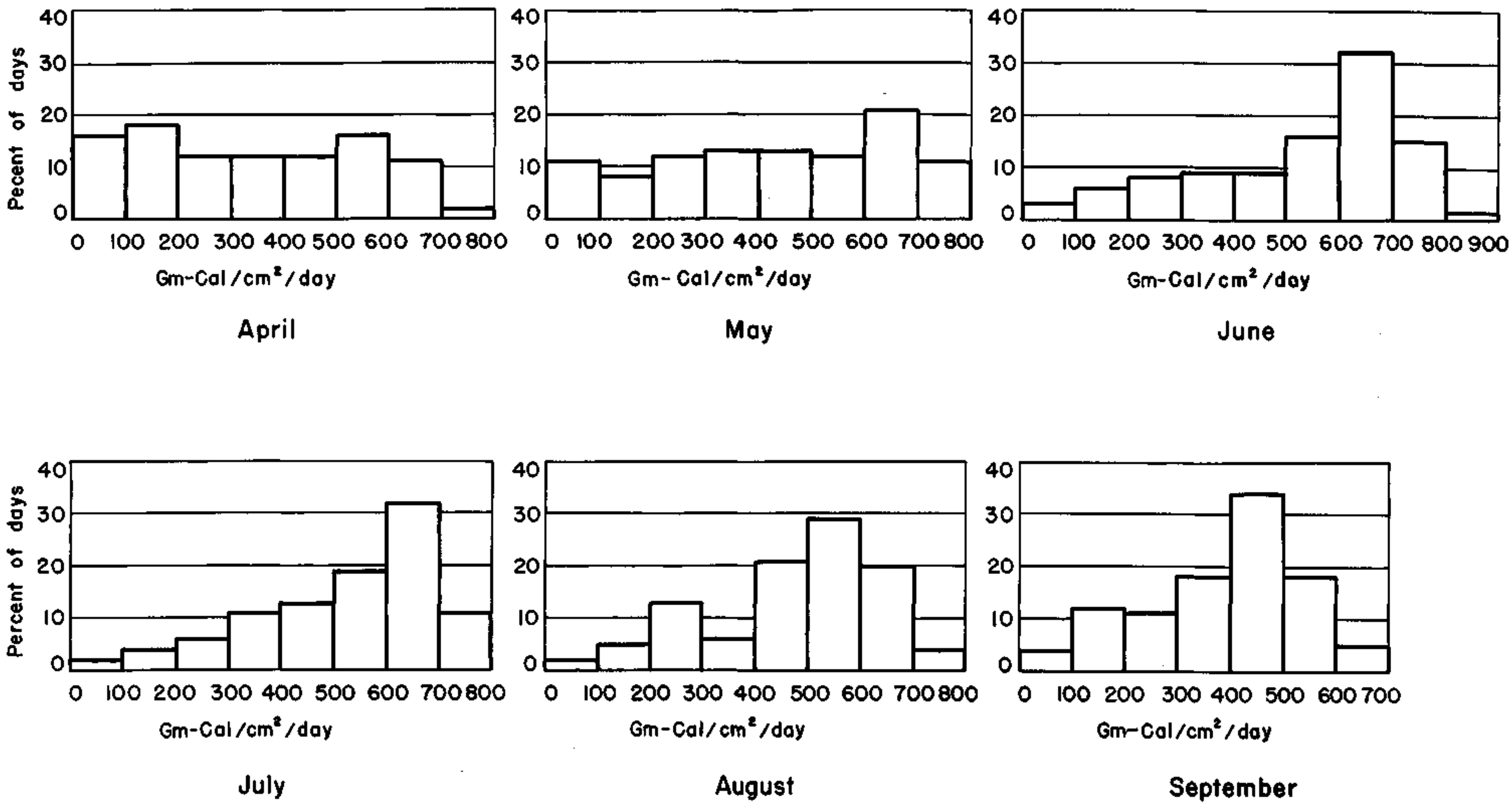


FIGURE 57 — MONTHLY DISTRIBUTION OF DAILY SOLAR RADIATION VALUES FOR WARMER HALF-YEAR, 1950-1956

EVAPORATION

The annual average amount of evaporation, as based on evaporation pan records from 1947 through 1957, is 41.77 inches.[9] The monthly average amounts are shown in Figure 58. July with 6.47 inches evaporation has the highest average. The largest monthly value to be measured during the 11 years of record was 8.22 inches in July 1954. Maximum values for other months with appreciable evaporation are 6.39 inches in May 1949, 7.52 inches in June 1954, 7.18 inches in August 1947, 5.79 inches in September 1955, and 5.89 inches in October 1949.

Standard evaporation pans (glossary) do not give an accurate measure of actual evaporation. The factor used to convert pan measured evaporation to actual evaporation from a large body of water is called the pan coefficient, and this has been estimated to be approximately 0.7.[10] Therefore, the actual annual average evaporation is approximately 29 inches (41.77 inches x 0.7).

Figure 59 illustrates the daily pan evaporation for an average summer and an average winter day. The data for both days are presented by cumulative amounts during the day. For instance, from midnight to 8 A.M. on an average summer day there has been no evaporation, but by 2 P.M. there has been evaporation of 0.11 inch. This graph shows that on an average summer day there is evaporation of almost 0.20 inch and on an average winter day there is evaporation of 0.03 inch from the frozen water surface of the pan.

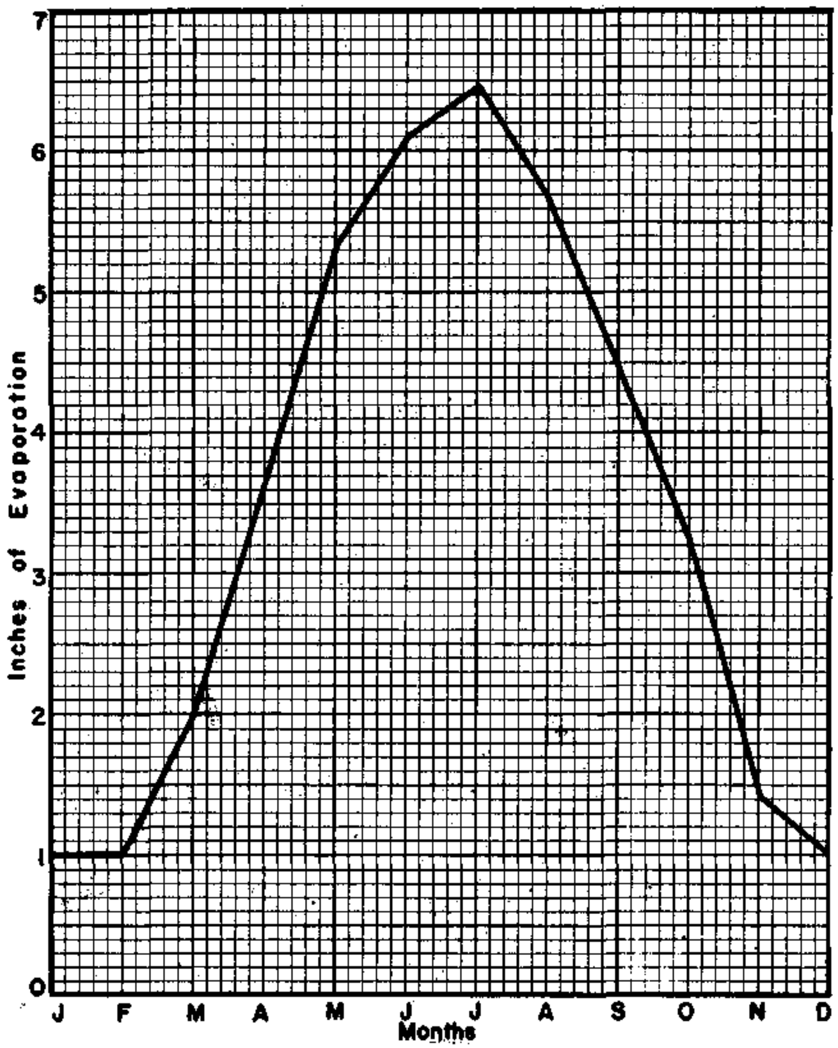


FIGURE 58 — MONTHLY AVERAGE EVAPORATION, 1947-1957

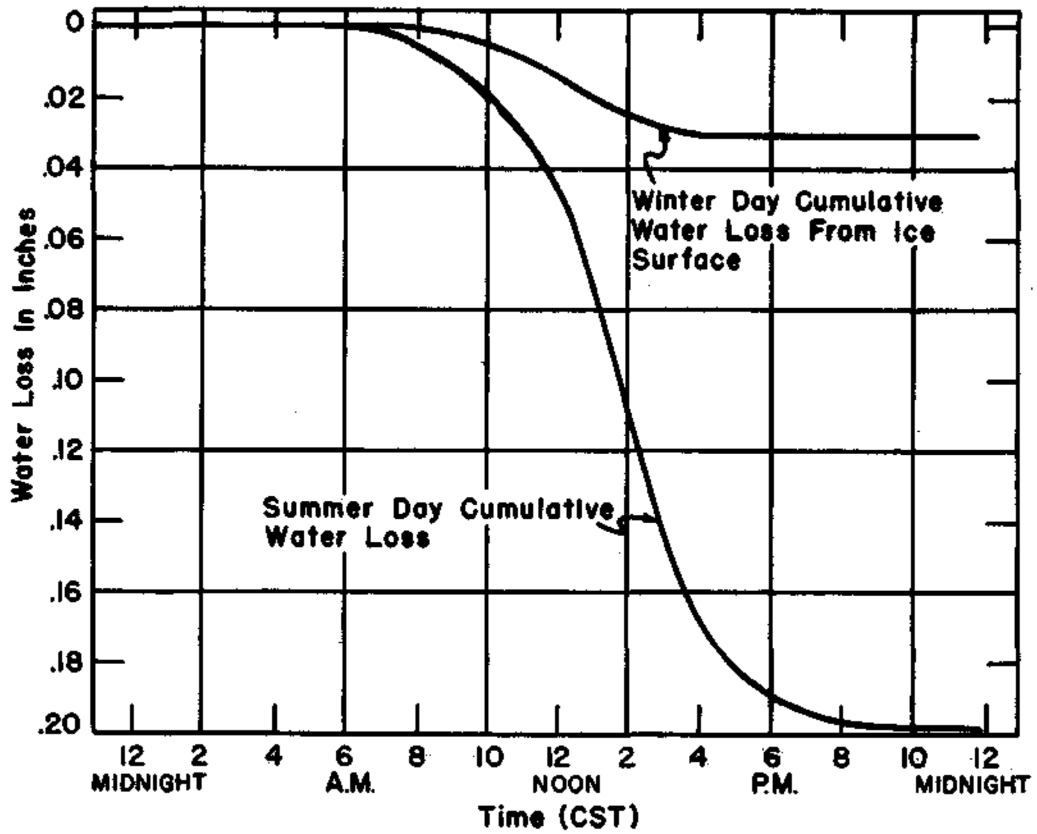


FIGURE 59 — DAILY AVERAGE CUMULATIVE EVAPORATION

PREVAILING WIND DIRECTION AND SPEED

A daily wind rose, which is based on daily average wind speed and direction data collected from 1951 through 1957 at the Water Resources Building, is shown in Figure 60. Wind direction and speeds are shown for 16 points, or every 22.5 degrees, on the compass. In this 7-year period the frequency of days with wind from each of the 16 directions is expressed as a percent of the total days in the period of study. That is, on 14.8 percent of the days the wind was from the south, the predominating direction. The least frequent direction for the daily average prevailing winds was east-southeast, from which they occur only 2.9 percent of the days.

The frequency of daily average wind speed intensities from each direction is indicated by the length of the different bar widths along the direction barbs in Figure 60. For instance, measurement of wind at 8 to 12 mph on the south wind barb gives 6.2 percent. During the seven years, on 6.2 percent of the total days, the average daily wind speed was 8 to 12 mph from the south. The circle around the center of the rose shows that the wind was calm on 2.8 percent of the days. Some of the wind speed classifications do not appear on certain direction barbs, indicating that certain daily average wind speeds were not observed with winds from these directions.

The prevailing wind direction in all months except February varies from south to southwest. In February the predominating direction is northwest.

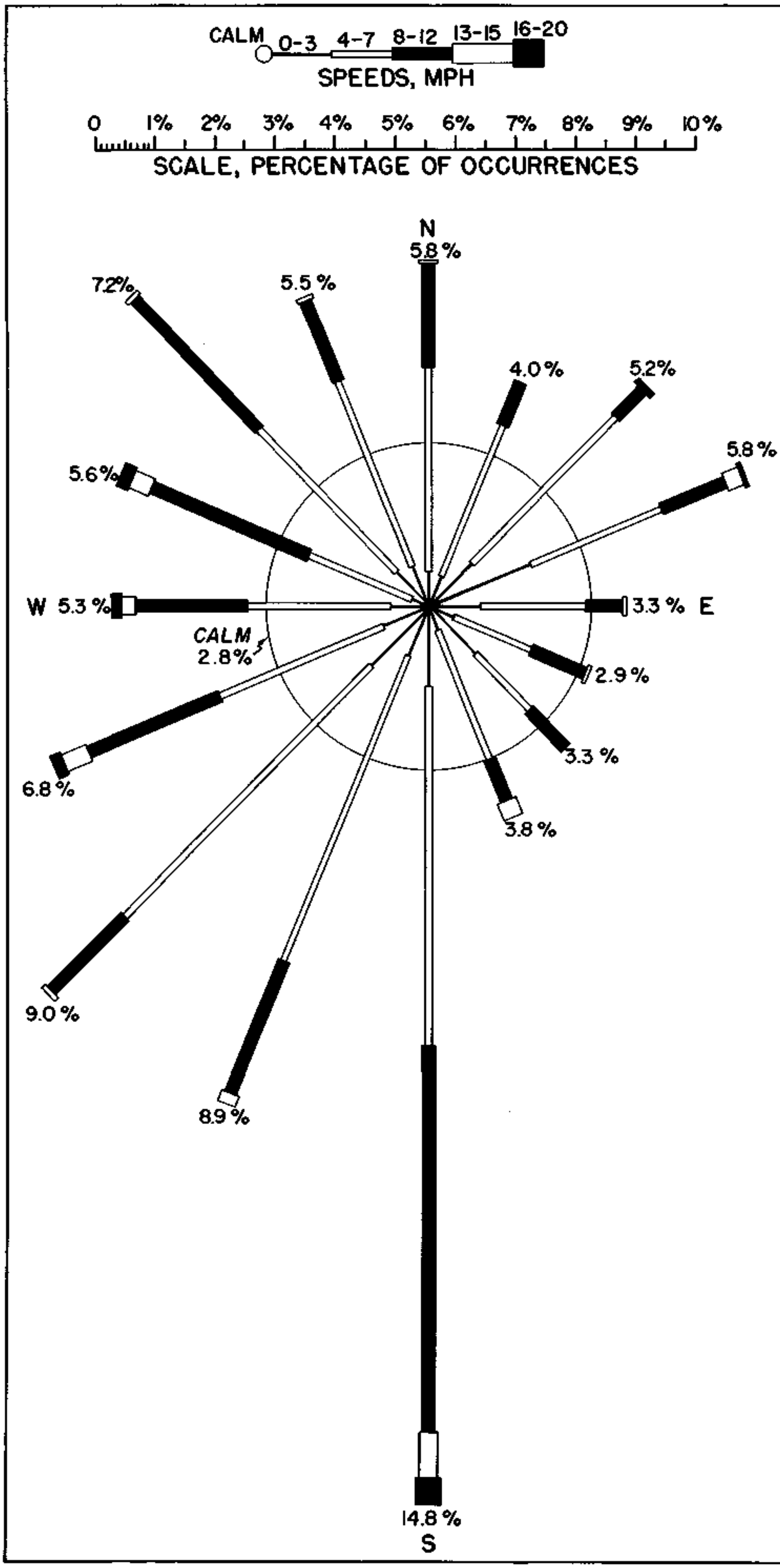


FIGURE 60 — DAILY WIND ROSE, 1951-1957

DAILY AVERAGE WIND SPEEDS

Wind records for 1951 through 1957 were used to compile the curves shown on Figure 61. The lower curve shows the average wind speed for each day of the year based upon the 7-year period. Despite considerable fluctuation in the values from day to day, an annual cycle is detectable. Average daily wind speeds are highest during February and March and are lowest in August. The difference in this change is more than 100 percent, ranging from 4 mph in August to 8.5 mph in March.

The upper curve, labeled the average maximum daily wind speed, is a daily average based on the peak gust recorded for each day during the seven years of data. For example, the peak gust for each January 10 was recorded, and these seven values were averaged to produce an average maximum speed of 24 mph. This curve reflects the same cycle shown by the average daily wind speed, but its seasonal change is more pronounced. Several dates have an average maximum speed greater than 30 mph with the highest being 31.7 mph on March 22. The lowest speed is 12.2 mph for August 10.

Although seven years of wind speed data are too few to provide accurate averages, these curves give some measure of the range of values which can be expected during various portions of the year.

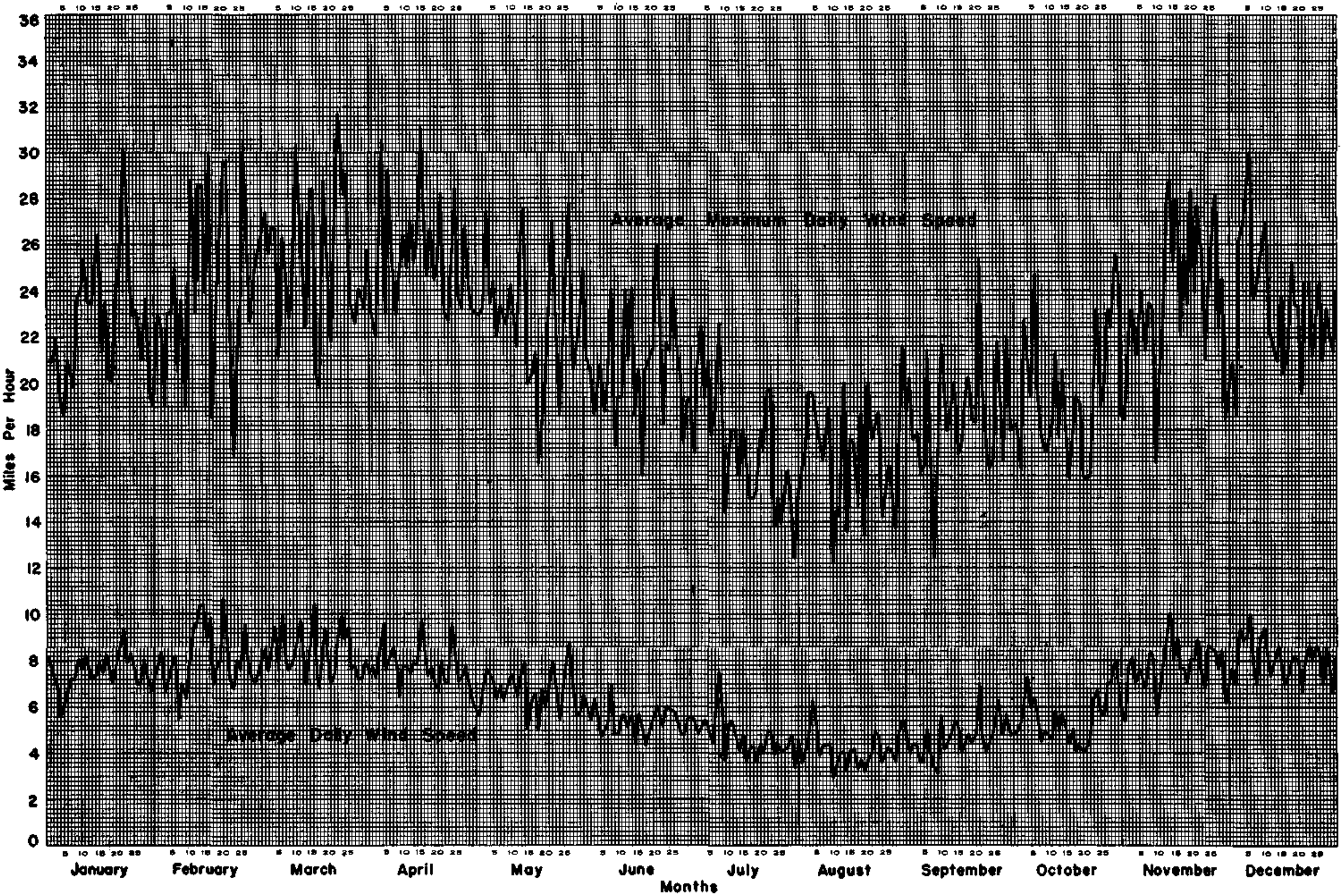


FIGURE 61 —DAILY AVERAGE WIND SPEED AND DAILY AVERAGE MAXIMUM WIND SPEED, 1951-1957

MONTHLY AVERAGE RELATIVE HUMIDITY

Monthly average relative humidity (glossary) values expressed in percent, based on observations made at three different times during the day, are shown in Figure 62. These averages are based on data from 1903 through 1956 as collected at the Morrow Plots station. The relative humidity at 7 A.M. has the highest average in all months, ranging from 89.1 percent in January to 79.7 percent in July.

For the 7 A.M. readings, the monthly average relative humidity has been as high as 99 percent in February 1903 and as low as 60 percent for June 1946. For the 9 P.M. readings the highest monthly average on record is 97 percent for January 1901, while the record lowest average is 40 percent for May 1934. For the 2 P.M. relative humidity values, the record highest monthly average is 91 percent for February 1903, and the record lowest was 26 percent for September 1953.

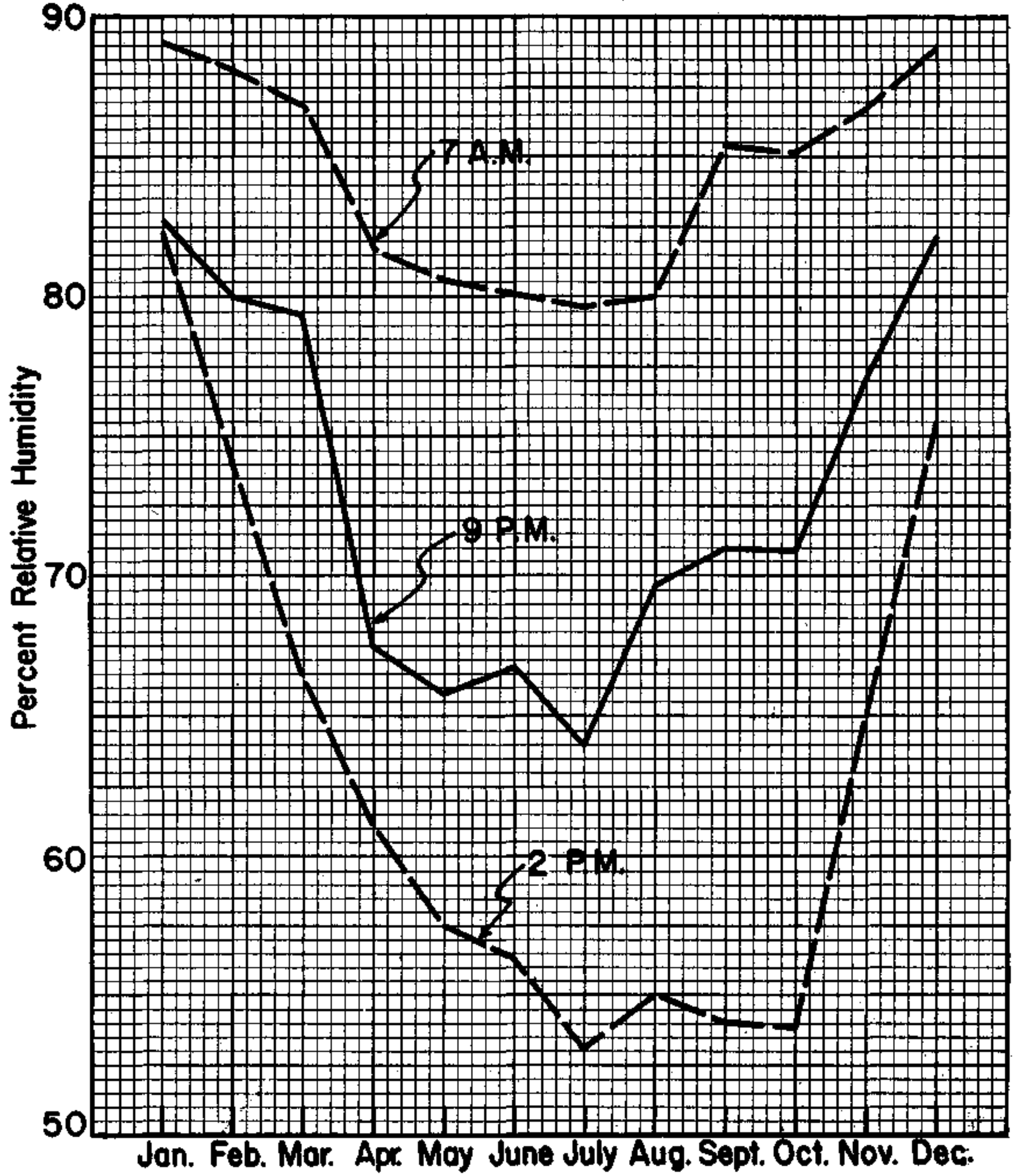


FIGURE 62 — MONTHLY AVERAGE RELATIVE HUMIDITY

FREQUENCY OF DAILY RELATIVE HUMIDITY

Figures 63-65 show the distribution of daily relative humidity values in percent at three times during the day for the four warmest months of the year. The period of record analyzed for these data was from 1935 through 1955. For each of the four months, the total days in each 10 percent increment of relative humidity are expressed as the percent of the total days in that month for the 21 years of data. For instance, in Figure 63, 33 percent of all the days in June had relative humidity values between 80 and 90 percent at 7 A.M., while only four percent of the total June days had 7 A.M. relative humidity readings between 50 and 60 percent. At 7 A.M., the relative humidity increment of 80 to 90 percent includes the greatest number of days in all four months.

Frequency distributions of the daily relative humidity readings made at 2 P.M. and at 9 P.M. are shown in Figures 64 and 65, respectively. At 2 P.M. the relative humidity increment with the highest percent of days is the 50 to 60 percent level in June and August. In July and September, the 40 to 50 percent increment has the highest percent. At 9 P.M. the 50 to 60 percent relative humidity interval predominates in all months except August, when the 60 to 70 percent relative humidity values have the highest frequency of occurrence.

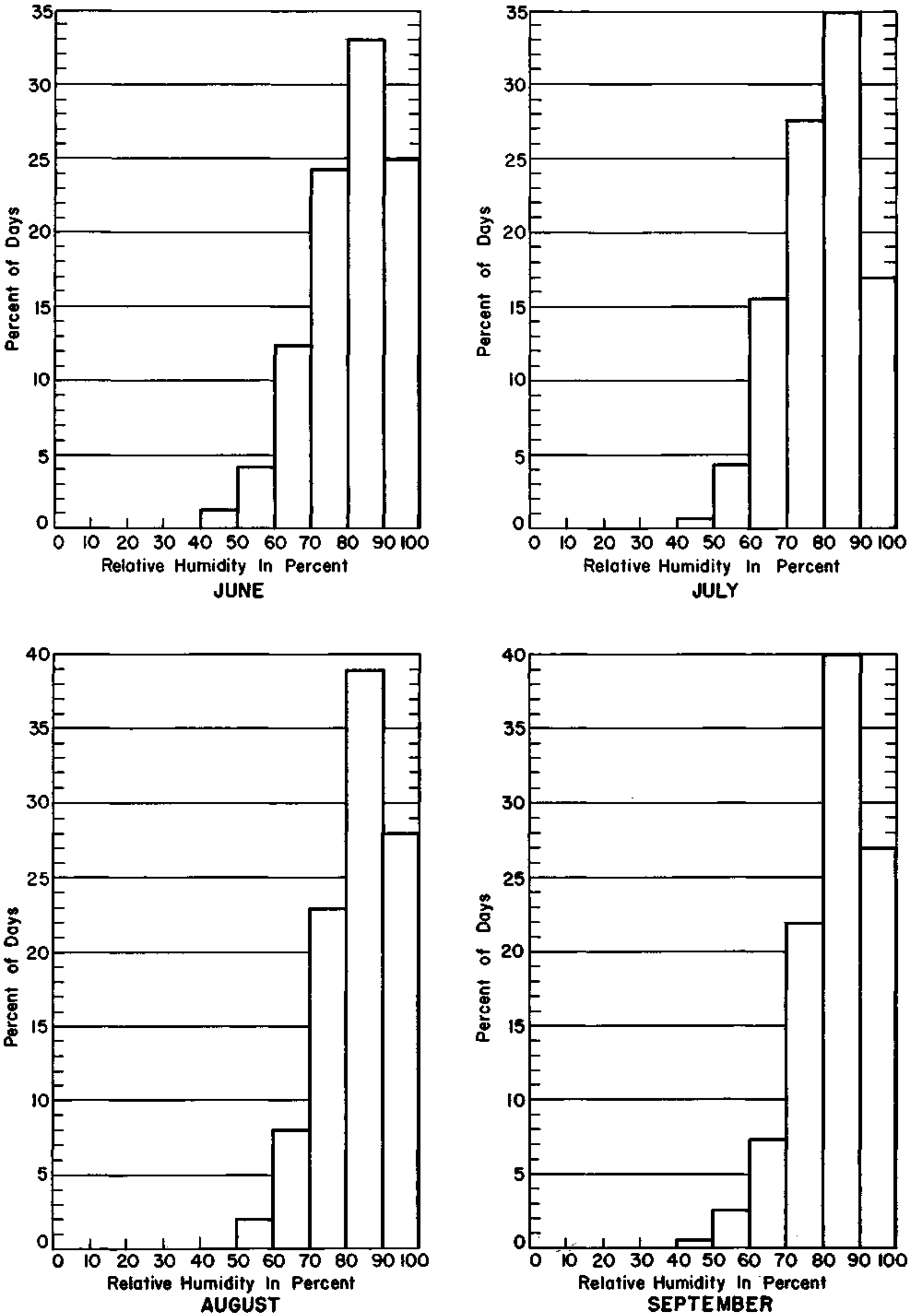


FIGURE 63 — DISTRIBUTION OF RELATIVE HUMIDITY AMOUNTS AT 7 A.M.

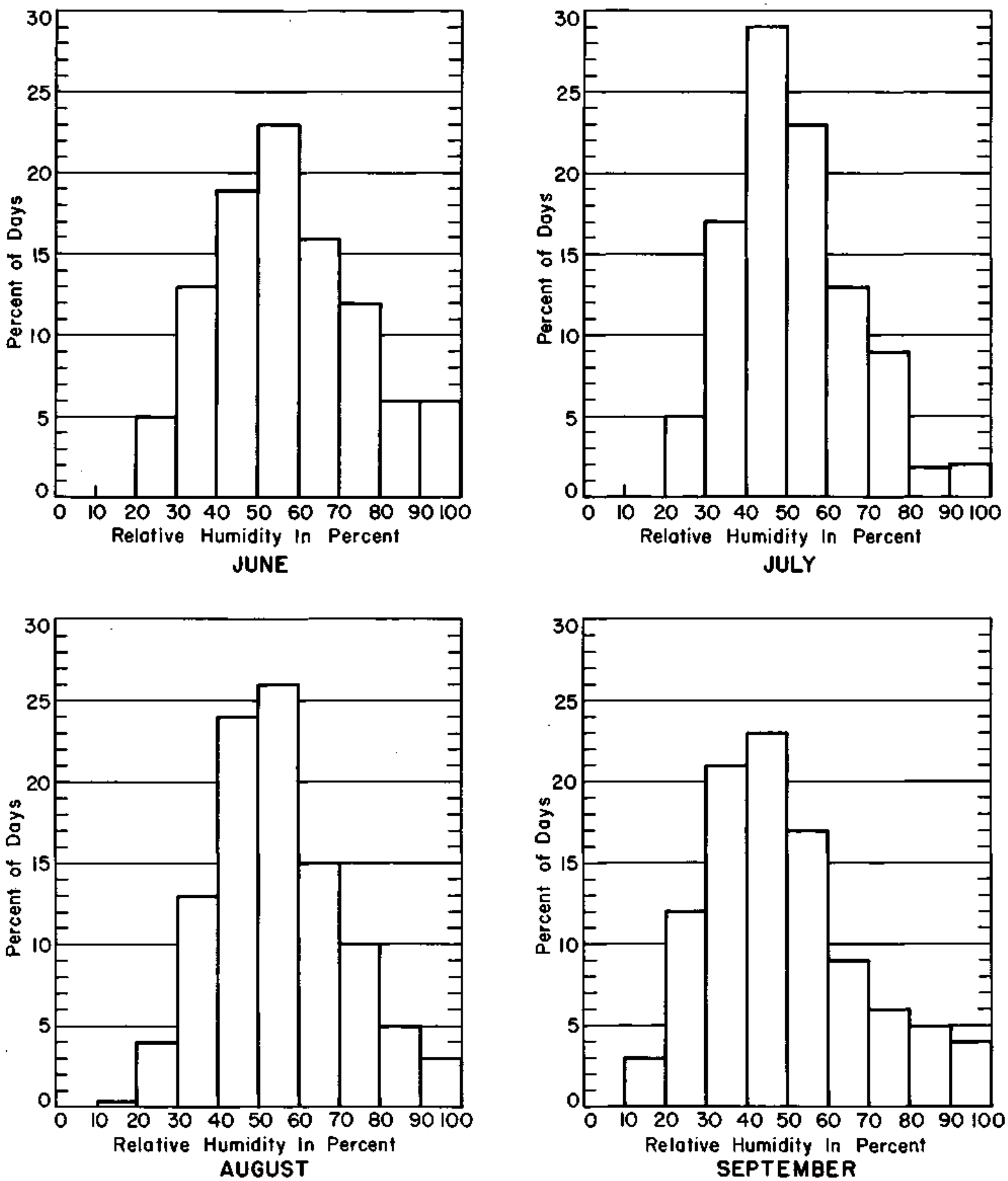


FIGURE 64 — DISTRIBUTION OF RELATIVE HUMIDITY AMOUNTS AT 2 P.M.

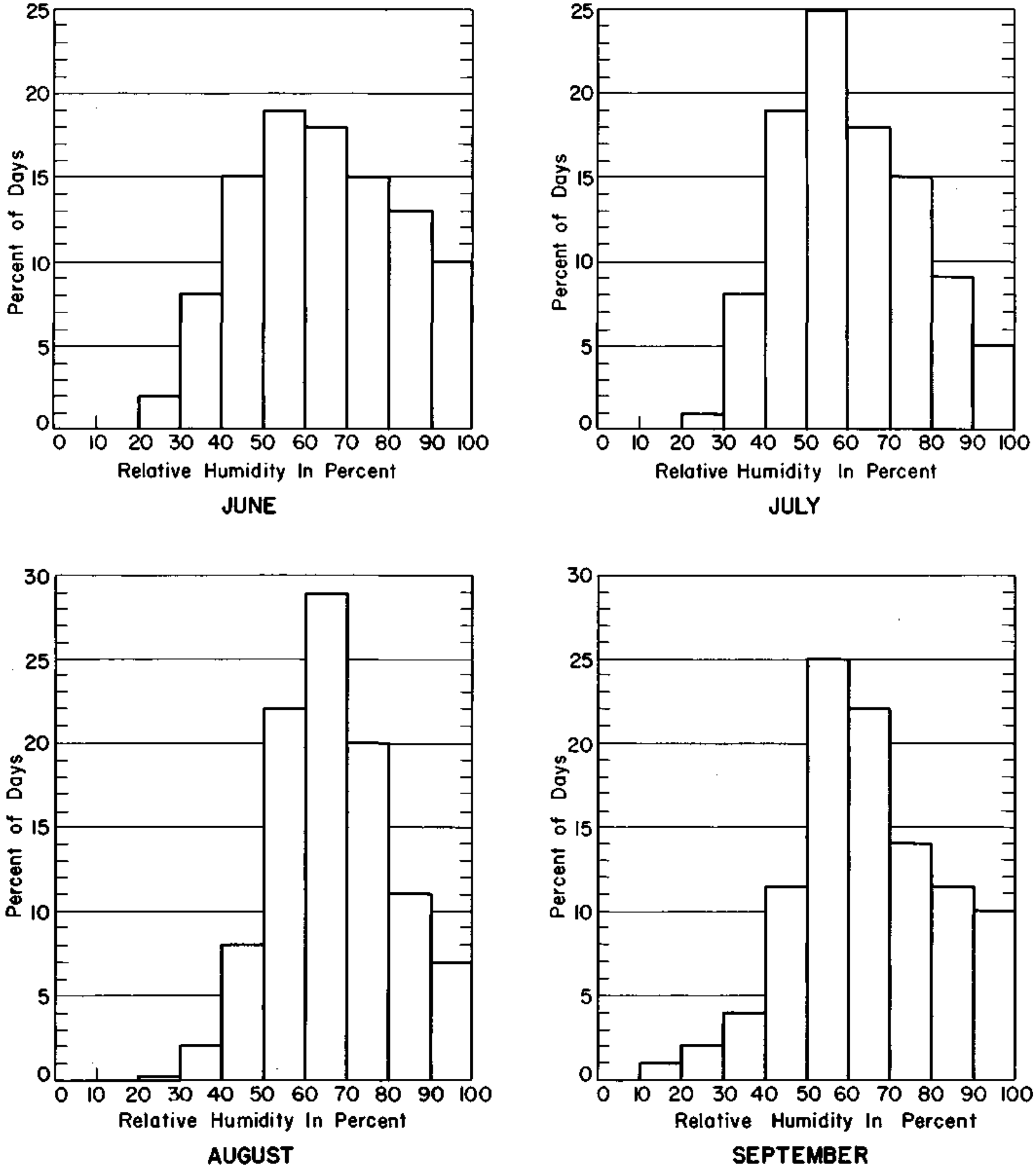


FIGURE 65 — DISTRIBUTION OF RELATIVE HUMIDITY AMOUNTS AT 9 P.M.

MONTHLY AVERAGE DEW POINT AND WET BULB TEMPERATURES

The monthly average dew point temperatures and wet bulb temperatures, measured at three times during the day, are shown in Figures 66 and 67 for the seven warmest months of the year. The wet bulb temperature (glossary) is used for computing dew point temperatures and relative humidity values, as well as an aid for computing air-conditioning requirements.

The dew point temperature (glossary) is often preferred over relative humidity as an indicator of the moisture content in the air. The monthly average dew point temperatures for the months from April to October are shown in Figure 66. The highest temperatures reached at 2 P.M. and 9 P.M. occur in August with values of 63.9 degrees and 64.1 degrees, respectively. The highest monthly average at 7 A.M. is 63.6 degrees in July. The lowest average in these seven months occurs in April for all three observation times.

The average monthly wet bulb temperatures from April through October are shown in Figure 67, and are lowest in April and highest in July. The 2 P.M. values are the highest in all the seven months with the 9 P.M. values ranking second and the 7 A.M. values lowest.

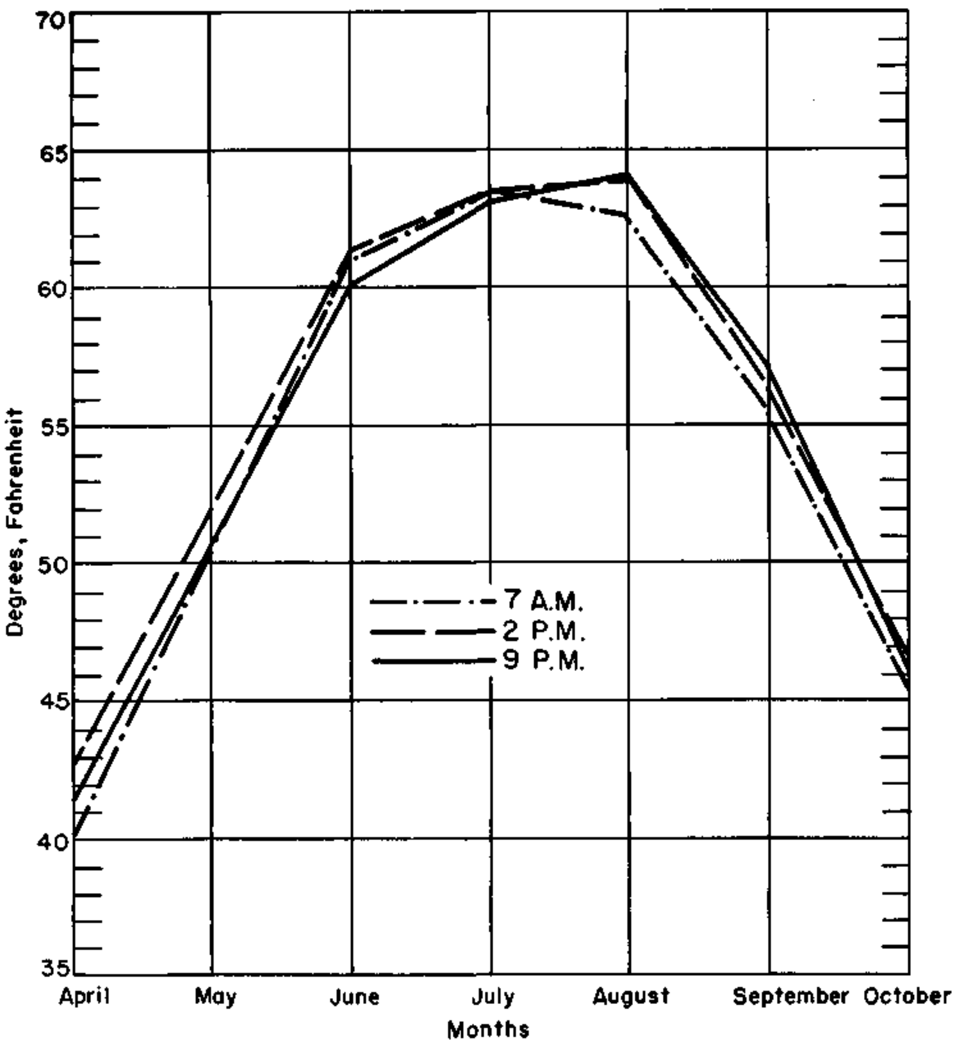


FIGURE 66 — MONTHLY AVERAGE DEW POINT TEMPERATURES, 1928-1947

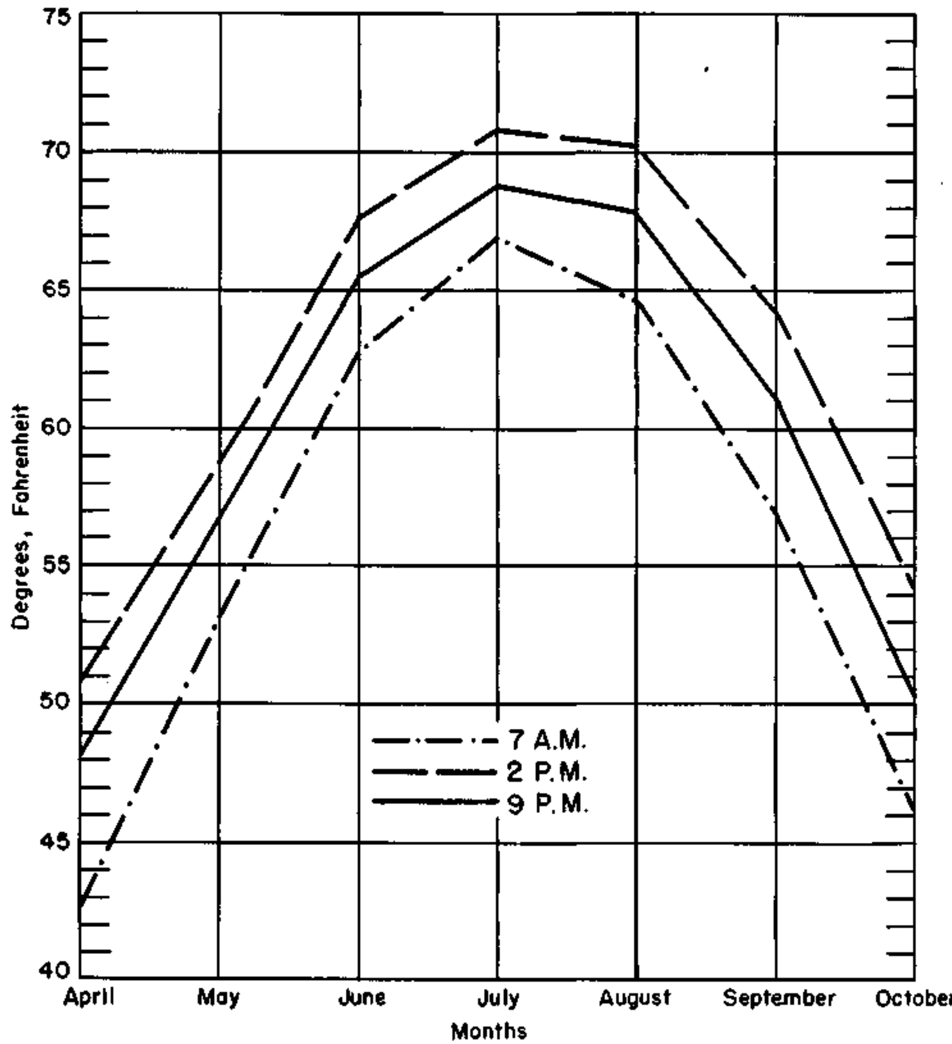


FIGURE 67 — MONTHLY AVERAGE WET BULB TEMPERATURES, 1928-1947

Thunderstorms

The annual average number of days with thunderstorms (glossary) is 41 as based on 44 years of data from 1908 to 1944 and 1949 to 1955. As many as 62 days with thunderstorms have occurred, in 1954, and as few as 19 days, in 1930. The annual average number of days with thunderstorms, producing 0.10 inch or more precipitation per day, is 26.[11] The average number of days per month with thunderstorms ranges from a high of eight in July to a low of less than one per month in January and December. The monthly average number of days with thunderstorms is shown in Figure 68.

Approximately forty percent of the annual average precipitation is produced by thunderstorms, and the average monthly percentages are shown in Figure 69. Sixty-nine percent of the August average precipitation is derived from thunderstorms, while only 5 percent of the January precipitation comes from thunderstorms. The annual average precipitation derived from the thunderstorms is 14.67 inches, and the highest monthly average amount is 2.44 inches in August as shown in Figure 69. The lowest monthly average is 0.11 inch in both January and December.

Hail

The annual average number of days with hail is slightly more than two per year. In an average 10-year period, 21 days with hail occur. The highest number reported in any year was 8 days with hail in 1955, but in several years no hail occurred. Satisfactory hail records were kept in the 1908-1944 and 1949-1957 periods, resulting in a total of 46 years of record. The total number of hail occurrences per month during these 46 years is shown in Figure 68. May with 23 occurrences ranks first, while January, October, and November had only one day with hail. The occurrence of hail is generally associated with the occurrence of thunderstorms. However, the records indicate that 21 percent of the days with hail have not had thunderstorms.[11]

Sleet and Glaze

The annual average number of days reporting sleet is six per year as based on records from 1908-1945 and 1949-1955. However, as many as 18 days in one year, 1954, have had sleet while in many years no sleet has occurred. The maximum sleet activity occurs in February and March. During the 47 years of reliable sleet records, 12 percent of the days with sleet have also had thunderstorms.[11]

Glaze, or freezing rain, occurs on an average of two days per year. As many as seven days with glaze have occurred in one year, 1951 and 1956, and in many years no days with glaze have occurred.

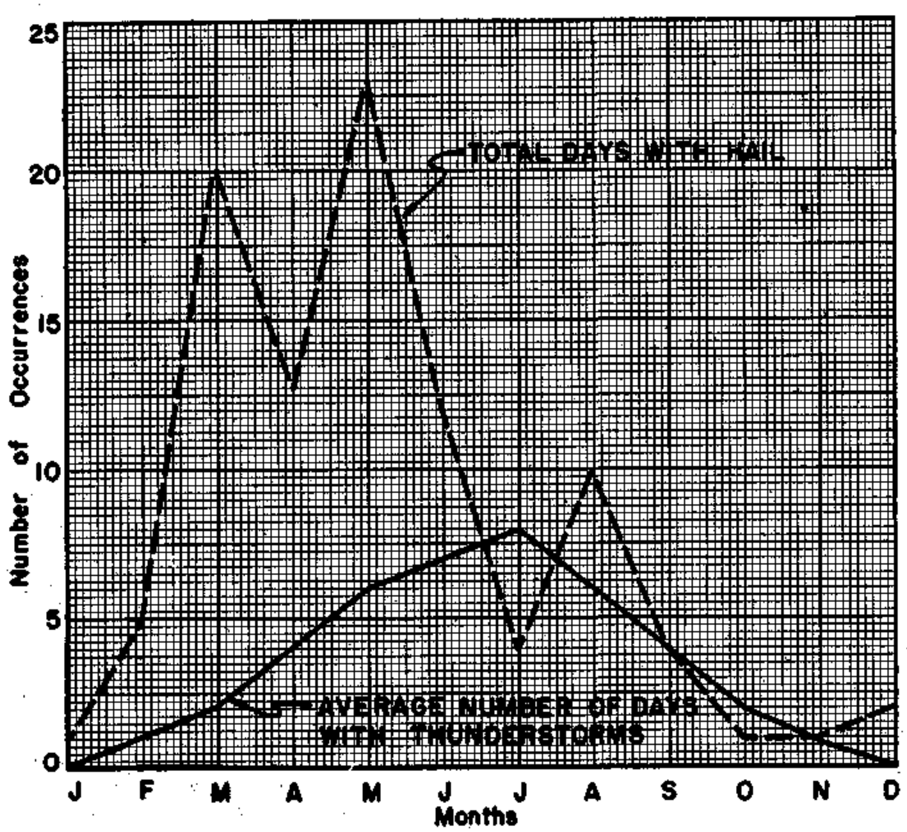


FIGURE 68 — MONTHLY AVERAGE NUMBER OF DAYS WITH THUNDERSTORMS AND TOTAL MONTHLY NUMBER OF DAYS WITH HAIL, 1908-1944, 1949-1957

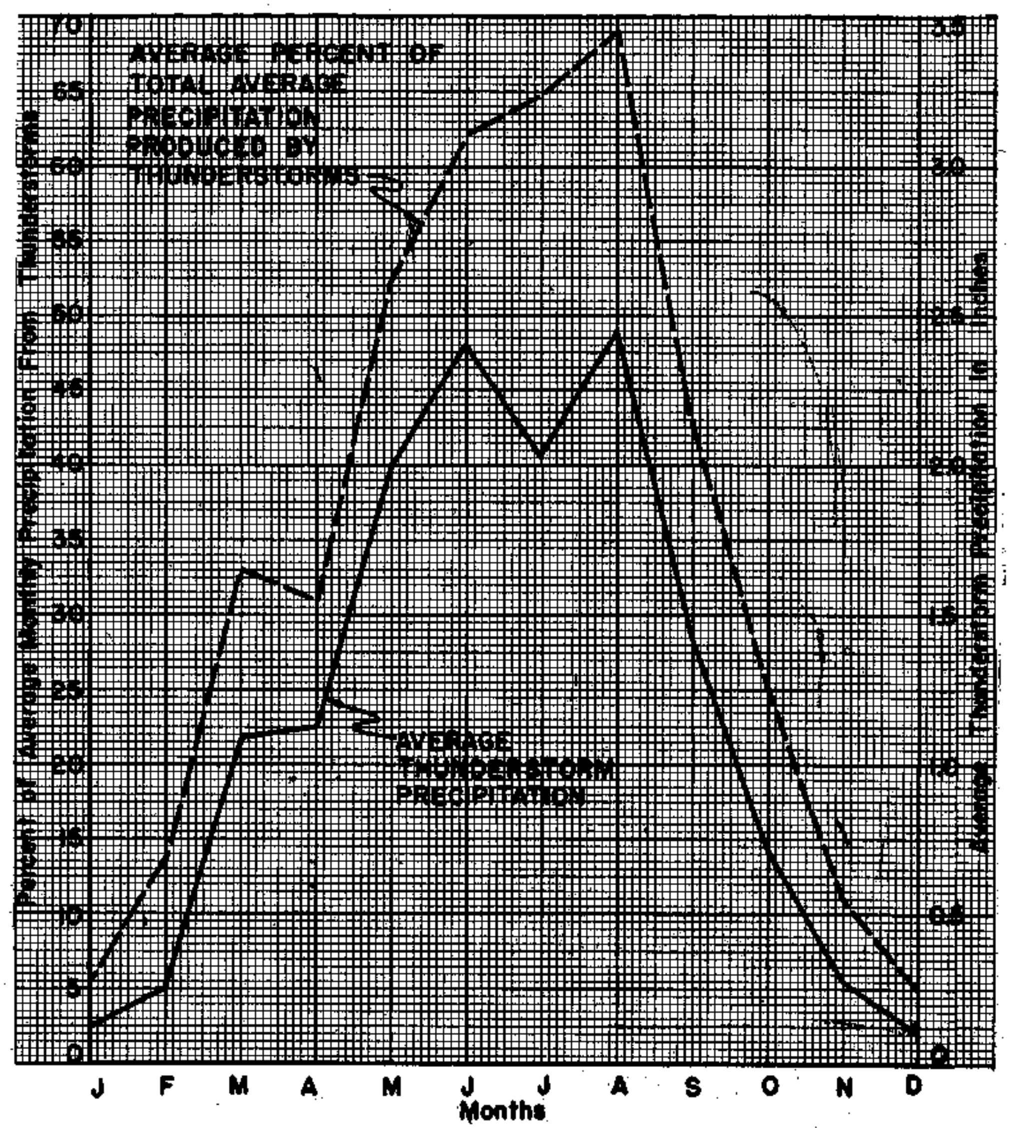


FIGURE 69 — MONTHLY AVERAGE THUNDERSTORM PRECIPITATION AND ITS PERCENT OF THE TOTAL MONTHLY AVERAGE PRECIPITATION

GLOSSARY

Annual Snowfall and Snow Cover Conditions. Annual measurements are based on the 12-month period of July 1 through June 30 and recorded as the year ending June 30.

Average. Average values for any weather data are computed by summing the values and dividing the summation by the number of values.

Clear, Partly Cloudy, and Cloudy Days. If the average daily cloud cover is 0.3 or less, the day is classified as clear. The total sky from horizon to horizon is considered as ten tenths. Partly cloudy conditions for the day are recorded if the sky cover average ranges from an 0.4 to an 0.7. If the sky cover is 0.8 to 1.0 (overcast), the day is classified as cloudy.

Colder Half-Year. The 6-month period from October 1 through March 31 is defined as the colder half-year in this report.

Day With Thunderstorms. If thunder is audible at an observation station, it is recorded as a day with thunderstorms.

Degree Days. Heating degree days are calculated by subtracting the daily mean temperature from 65 degrees. A day with a 55-degree mean temperature has 10 degree days. The 65-degree level is used as a computation base since heating is usually required below this level.

Dew Point Temperature. The dew point is the temperature to which a sample of humid air must be cooled to become saturated, with the pressure and water vapor content remaining constant. If the air is cooled below the dew point temperature, condensation occurs.

Evaporation Pan. The standard U. S. Weather Bureau (Class A) evaporation pan is a metal pan 4 feet in diameter and 10 inches deep.

Growing Season. The growing season is defined as the number of days between the last day of killing frost in the spring and the first day with a killing frost in the fall. This time is usually determined by the last spring and the first fall temperature of 32 degrees or lower.

Langley. A Langley is a unit of heat measurement defined as a gram-calorie received per square centimeter.

Light, Moderate, and Heavy Freezes. Research(7) has shown that in the temperature range from 28 to 32 degrees or light freeze, there is little or no damage to most plants, but there is heavy damage to tender plants and to semi-hardy plants growing in low lands. The moderate freeze, 24 to 27 degrees, produces some damage to all plants with heavy damage to fruit blossoms and to tender and semi-hardy plants. The severe freeze, as defined by a temperature less than 24 degrees, produces heavy damage to all plants. These freezes are based on temperatures measured in U. S. Weather Bureau standard instrument shelters.

Median. The mid-point value in a series of data values is the median, and has half of the values on each side of it.

Precipitation. All forms of moisture that fall to the earth's surface either in liquid or solid form are considered precipitation. These include rain, snow, hail, and sleet.

Relative Humidity. The relative humidity is the ratio of the vapor pressure of water vapor in the air to the saturation vapor pressure that would exist if the sample of air were saturated at the same pressure and temperature.

Trace of Precipitation. A measurement of rainfall that is less than 0.005 inch.

Trace of Snowdepth. A trace of snow on the ground is an amount less than 0.6 inch.

Trace of Snowfall. A trace of snowfall is an amount measuring less than 0.1 inch.

Warmer Half-Year. The 6-month period from April 1 through September 30 is considered the warmer half-year in this report. This period roughly approximates the average growing season in this area.

Wet Bulb Temperature. The wet bulb temperature is the lowest temperature to which the air can be cooled at constant pressure by evaporating water into the air,

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