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IS OUR CLIMATE CHANGING? A STUDY OF LONG-TIME TEMPERATURE TRENDS

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[Weather Bureau, Washington, D.C., Sept. 29, 1933]

The present wide-spread and persistent tendency toward warmer weather, and especially the recent long series of mild winters, has attracted considerable public interest; so much so that frequently the question is asked "Is our climate changing?" Historic climate has always been considered by meteorologists and climatologists to be a rather stable thing, in marked contrast to geologic climate and to weather. We know there have been major geologic changes in climate and that weather, which is the meteorological condition at any particular time, or for a short period of time, such as a day or a month, is far from stable. Different kinds of weather come and go in comparatively brief, alternating spurts, as it were, or with short periods of irregular length—cool or cold, then warm, and vice versa—succeeding one another with a continuous recurrence that everyone takes for granted. However, an exhaustive statistical examination of these short-period temperature fluctuations fails to disclose any regularity that would afford a basis for forecasting future weather independent of the standard forecasting methods of the Weather Bureau, in which daily synoptic charts play an important role.

The phase of weather, or climate, that is attracting attention at the present time is not these short-period changes from warm to cool, and vice versa, for they are always present, but rather an apparent longer-time change to cool periods that seem to be less frequent and of shorter duration, and warm periods that are more pronounced and persistent. It has been thought that these fluctuations in temperature eventually neutralize one another, or smooth themselves out, when the long-time record is taken into account. In other words, meteorologists consider that climate, which is the normal run of the weather, for a long period of time, is a fairly stable thing, and that the average temperature for, say, any consecutive 20 years, selected at random from a long record, would not differ materially from that for any other consecutive 20 years so selected from that particular record. It appears, however, from the data presented with this study that the orthodox conception of the stability of climate needs revision, and that our granddad was not so far wrong, as we have been wont to believe, in his statements about the exit of the old-fashioned winter of his boyhood days. We are familiar with statements by elderly people, such as "The winters were colder and the snows deeper when I was a youngster", and the like.

Before taking up the matter of long-time temperature trends, a few facts, which prompted this study, and which have been responsible for numerous questions about a possible change in climate, may be cited. When we examine the winter temperature records for Washington, D.C., for example, it is found that for the last 21 winters, 1912–13 to 1932–33, inclusive, 18 have been warmer than normal; that every one of the last 13 of these has been mild, and that the warmest winter of record, going back considerably more than a century, was that of 1931–32. This is in marked contrast with "granddad's day", for the 19 winters of 1854–55 to 1872–73, 14 of which were colder than normal, with 1855–56 the coldest in more than 100 years. The record for New Haven, Conn., may be cited as another example. Here every one of the last 10 winters has averaged warmer than normal; so also have 18 of the last 21, and 33 of the last 45. This record, by the way, goes back to near the close of the Revolutionary War. Farther west, we pick up, at random, the St. Louis record, which shows 13 of tne last 15 winters to have had above-normal temperatures. These records are typical for the central and northern portions of the United States east of the Rocky Mountains.

When we examine the records for other seasons of the year, such as the spring and fall, similar conditions are disclosed. For the spring (March to May, inclusive) we find that in the case of New Haven 20 of the last 24 springs down to and including the spring of 1933, have had above-normal temperatures, which contrasts sharply with the 10 successive springs from 1866 to 1875, every one of which had a mean temperature below normal. The Washington, D.C., records show only eight springs with below-normal warmth during the last quarter of a century.

In St. Paul, Minn., more than 75 percent of the fall seasons for the last 43 years previous to 1933 have been relatively warm, in contrast to the 37-year period from 1840 to 1876, inclusive, during which only 9 were warmer than normal. In Washington, D.C., only 3 of the 25 falls since 1907 have had below-normal temperatures, while 15 of the last 17 months, up to and including September 1933, have had plus departures from normal. With these facts of record, it is not surprising that the even casual observer of weather should ask the question "Is our climate changing?"

It might be stated here, however, that the abnormally warm weather experienced in general for a long time past does not mean that cold periods have been entirely absent. On the contrary, the records indicate that occasional brief spells of abnormally cool, or extremely cold, weather are characteristic of prevailing high-temperature trends. The cold winter of 1917–18 may be cited as an example, coming at a time when the long-time trend was running comparatively high, and also the fact that the lowest official temperature of record for the United States—66° F. below zero—occurred in the Yellowstone National Park in February 1933.

For a more fundamental study of the matter, we have adopted a system of moving 20-year summations of temperature data, employing the longest records available. That is, on the accompanying graphs, the first point represents the sum of the mean annual temperature data for the first 20 years of the record, or years nos. 1 to 20; the second point a like sum for the years nos. 2 to 21, and so on, step by step, throughout the entire record. This, of course is equivalent to the usual floating, or moving-average tabulation; summations were used instead of averages to simplify the operation and obviate residuals resulting from computation of means.

The moving average, or summation, expedient is a much better statistical method of approach to questions of this kind than that, frequently used, of computing averages of successive intervals, such as dividing the record into decades, or into 20-year periods, and comparing the means for the successive periods. This is too much of a hit-or-miss affair, with chances great that any existing

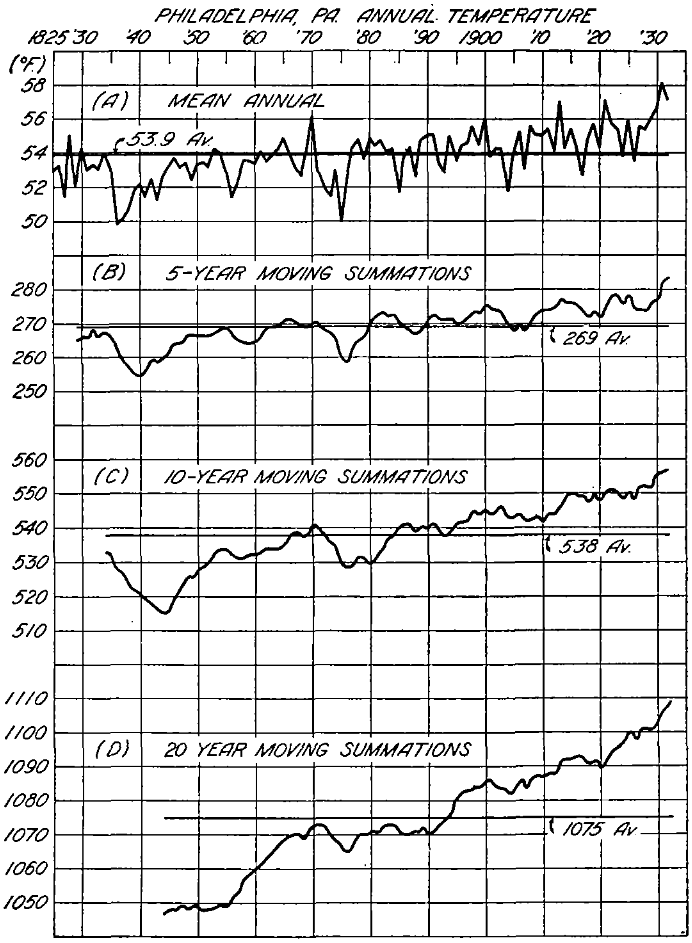

Figure 1.—Mean annual temperature, Philadelphia, Pa.; (A) Successive annual means; (B), (C), and (D), 5-year, 10-year, and 20-year moving summations of annual means, respectively. Data in table 1.

trend, especially a short-period one, would be blanketed out by the arbitrary division of periods, depending upon the particular year for which the record may begin, which determines the division points between the periods.

This study shows, as indicated in the accompanying graphs, that temperature trends in middle latitudes of the Northern Hemisphere, and also, though less pronounced, in the Southern Hemisphere, have been prevailingly high for a long time. When the short-period fluctuations in the records are smoothed, by the method just described, into long-time trends (the longest available covering more than 100 years) there is a somewhat irregular, but very definite, upward swing in the curves, shown to have been in progress for more than half a century; and there is, as yet, no evidence of a recession.

The records for the different seasons of the year show that the winters are the most erratic, with up-and-down trends of greater frequency and shorter duration than the other seasons. For the spring and fall the trends have been more uniformly upward, with fewer interruptions

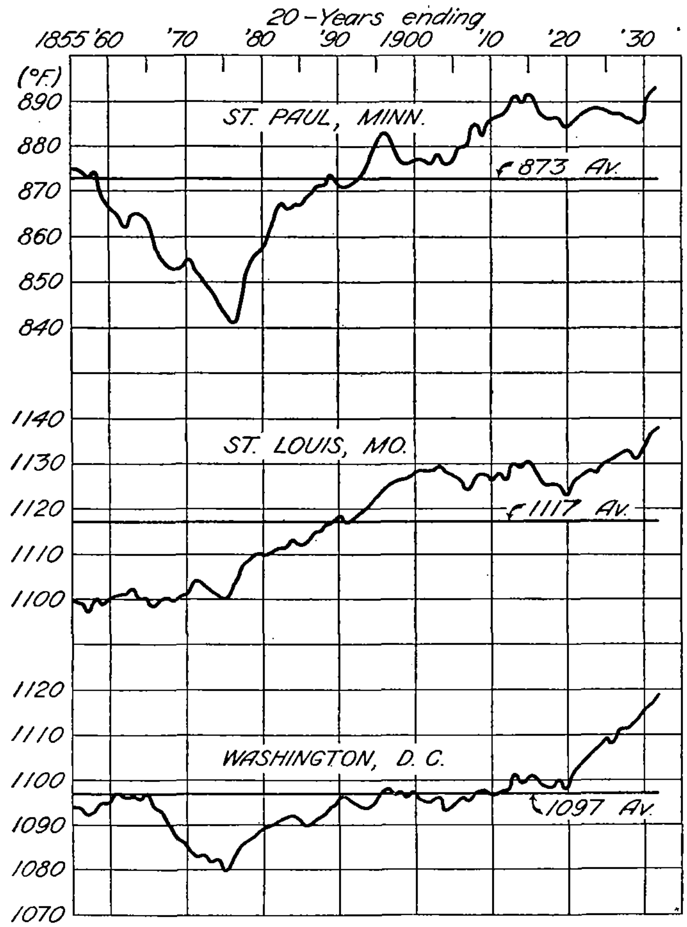

Figure 2.—20-year moving temperature summations; St. Paul, Minn., St. Louis, Mo., and Washington, D.C. Data in table 1.

by short cold spells. The curves for the fall season show a remarkably steady upward trend for nearly a century; that is, for nearly a hundred years, our fall seasons have been trending progressively to warmer. The summer curve shows a slight recession from about 1875 to 1912,

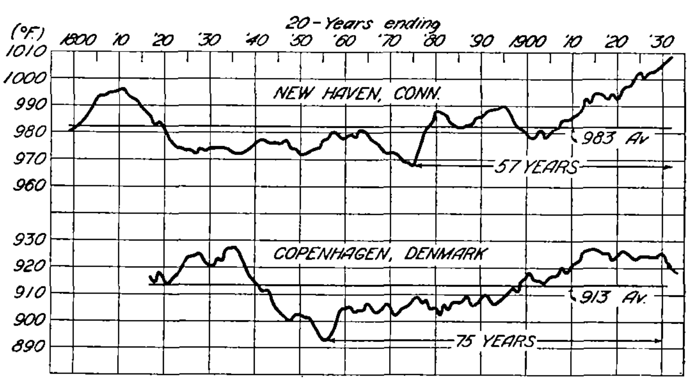

Figure 3.—20-year moving temperature summations; New Haven, Conn., and Copenhagen, Denmark. Data in table 1.

but thereafter a moderate rise. For the fall, winter, and spring seasons the averages in temperature for the past 20 years to and including 1933 are from 2.5° to nearly 4° higher than similar averages 60 or 70 years ago. Temperature records of other countries of the Northern

Hemisphere, and also of the Southern Hemisphere, show strikingly similar conditions.

In addition to the graphic presentation, there are included tables giving the temperature records, year by year, on which the respective graphs are based. In table 1, for example, under New Haven, the sum of the first 20 years of data, from 1780 to 1799, is 980.4, charted

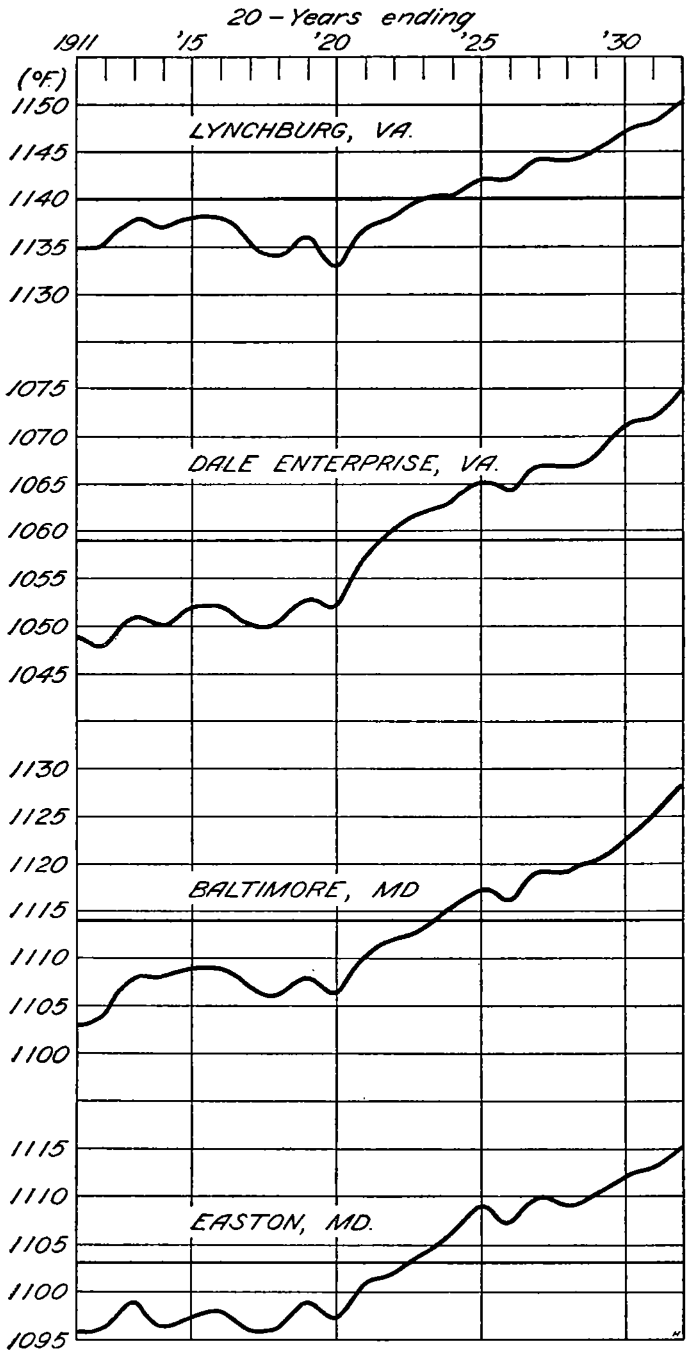

Figure 4.—20-year moving temperature summations; Lynchburg and Dale Enterprise, Va., and Baltimore and Easton, Md. Data in table 1.

on the graph under 1799 on figure 3; the second point represents a similar summation from 1781 to 1800, inclusive, charted under the latter year, and so on down to 1932. Dividing these sums by 20, gives, of course, the corresponding averages for the respective 20-year periods.

Figure 1 is based on the temperature record of Philadelphia (table 1) and illustrates the statistical method employed in developing long-time trends. This record began in 1825, by authority of the Pennsylvania Hospital, and was continued by that institution up to and including 1882. Records by the Weather Bureau began with 1872, which gives an overlapping period of 11 years for which two sets of data are available. For this 11-year period the Hospital records average 0.6° higher than those made by the Weather Bureau. It is believed this fairly

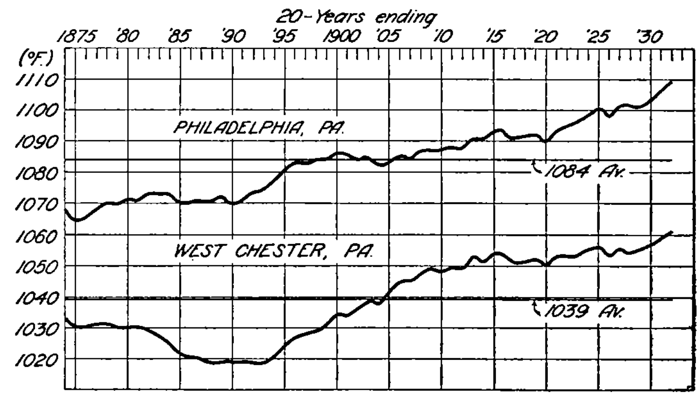

Figure 5.—20-year moving temperature summations; Philadelphia and West Chester, Pa. Data in table 1.

represents the difference in the records and, accordingly, 0.6° was subtracted from the Hospital records for each year from 1825 to 1871, inclusive, to make them comparable with the Weather Bureau data; from 1872 to 1932 Weather Bureau records were used.

Figure 1 A represents the mean annual temperature at Philadelphia for the successive years of the entire period,

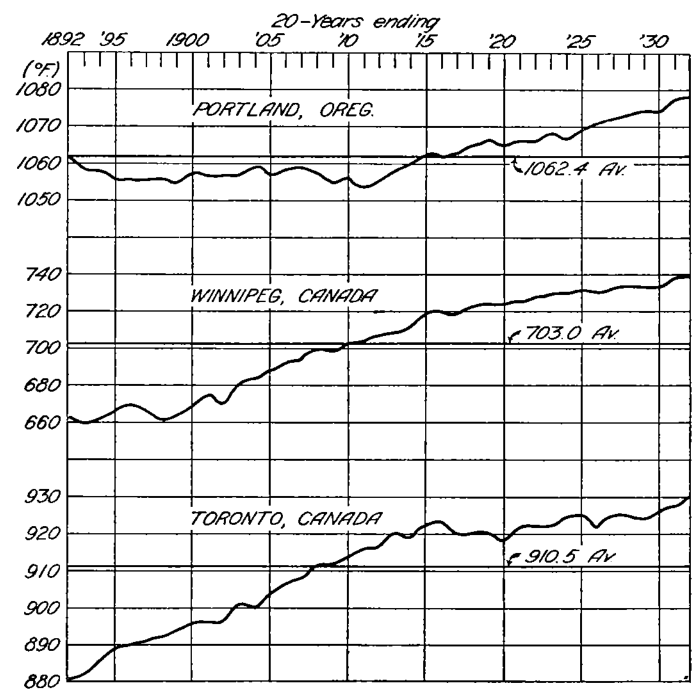

Figure 6.—20-year moving temperature summations, representing northern North America (Portland, Oreg., and Winnepeg and Toronto, Canada). Data in table 1.

108, all told. While the annual fluctuations in the graph tend to obscure the long-time trend, there is clear evidence of a very definite upward tendency through nearly the entire record.

The general appearance of the lines from, say, 1835 to 1870 (Hospital record) is strikingly similar to that for 1875 to 1932 (Weather Bureau records). This tends to establish confidence in the old records; also it is obvious that a least-square, straight-line trend would fit the data nicely from start to finish.

Sub B, figure 1, shows the data smoothed by 5-year moving summations. That is, the first point on the graph represents the sum of the annual temperature values for the 5 years from 1825 to 1829, inclusive; the

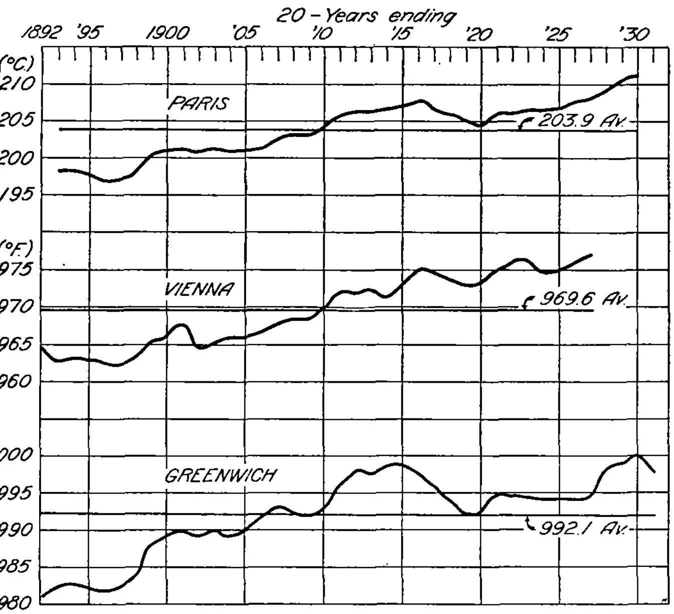

FIGURE 7.—20-year moving temperature summations, representing Europe (Paris, Vienna, and Greenwich). Data in table 1.

second point a like sum from 1826 to 1830, and so on through the record. This brings out, more definitely, the general trend, but at the same time emphasizes short-period fluctuations.

Next, sub C, represents 10-year moving summations, and more graphically establishes the trend, while sub D

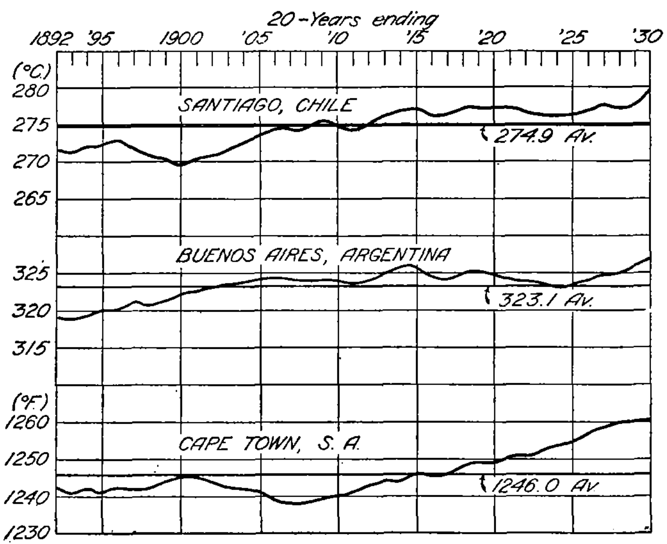

FIGURE 8.—20-year moving temperature summations, representing the Southern Hemisphere (Santiago, Chile; Buenos Aires, Argentina; and Cape Town, South Africa). Data in table 1.

shows the results of a 20-year moving summation tabulation. Here attention is invited to the fact that the sum of the annual temperature data for Philadephia for the 20 years ending with 1844 is 1047°, and for the 20 years ending with 1932 it is 1109°, a difference of 52°, or an average annual difference of 2.6°. If doubt exists as to the realness of this remarkable showing, comparison with similar graphs for other stations in different localities and even different countries, discussed later in this paper, is invited.

Figure 2 (data in table 1) shows, in a striking way, a very definite upward temperature trend for the Midwest and the eastern United States, from the records for St. Paul, Minn., and St. Louis, Mo., for the former, and Washington, D.C., for the latter. These curves indicate a nearly uninterrupted upward temperature swing since 1875, or for more than half a century. Moreover, the trend is marked, the summation for St. Paul for the 20 years ending with 1876 being lower by 52°, or an average of 2.6° a year, than for the 20 years ending with 1932. Attention is called also to the regularity and coincidence of the rise in the curves for the three records.

Figure 3 (data in table 1) contains the longest comparable records available—New Haven, Conn., 153 years; and Copenhagen, Denmark, 134 years. The rise in the latter part of both records, the former going back 57 years and the latter 75 years, is evident. That is, the general upward swing in temperature began in northern Europe, represented by the Copenhagen record, about 20 years earlier than in the United States. A previous

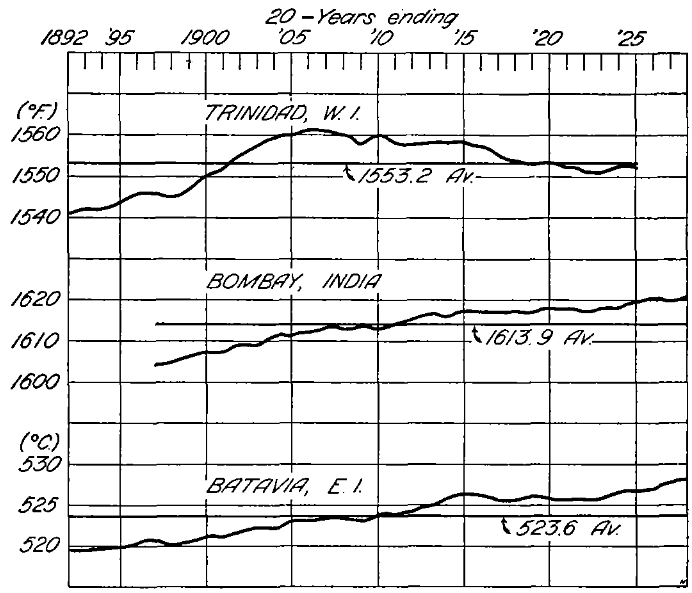

FIGURE 9.—20-year moving temperature summations, representing low latitudes (Trinidad, West Indies; Bombay, India; and Batavia, East Indies). Data in table 1.

major peak in the curve is shown for New Haven in 1810, or about 120 years ago, and for Copenhagen in 1835, nearly a century ago.

City influence on records.—It has been suggested that these tendencies to abnormally high-temperature records in recent years may be more apparent than real, in that data cited are nearly always from large cities where the thermometers may have been unduly affected by artificial influences that do not obtain in the open country. We have examined this phase of the matter and find that the suggestion is not well taken. It so happens that continuous, dependable cooperative records, made in the open country, or in small communities, are available for comparison with nearby city records. Among these are Dale Enterprise, Va., near Lynchburg, and Easton, Md., near Baltimore, which afford excellent comparisons between city and country exposures of instruments. The records from these points are presented in figure 4 (data in table 1) from which it is evident that, if anything, an even more pronounced upward trend exists in the cooperative data than in those for the nearby firstorder city station. These records cover a uniform period of 41 years from 1892 to 1932, inclusive. Corroborating this, figure 5 (data in table 1) contains a much longer cooperative record made at West Chester, Pa., near Philadelphia, covering 78 years from 1855 to 1932, compared with the same period for the latter city. Here again we find the cooperative record showing the same trend, and just as pronounced, as that for the Philadelphia station. These showings definitely dispose of the city-influence argument.

Figures 6 to 9 (data in table 1) are included to give, as nearly as we have been successful in finding, complete comparable records for a uniform period of 60 years for different parts of the world. Figure 6 represents a belt across northern North America, including Portland,

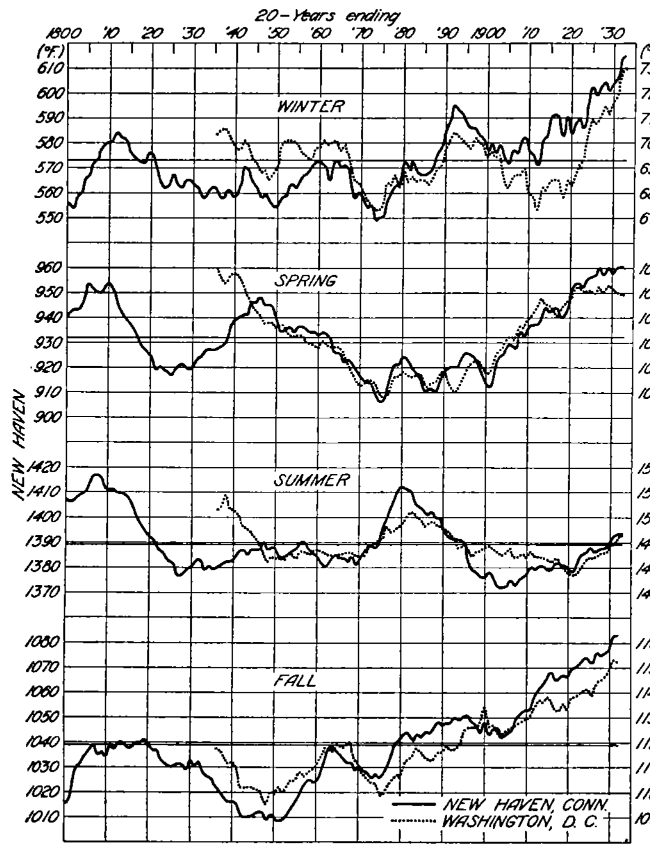

FIGURE 10.—20-year moving temperature summations of seasonal temperature data (winter, spring, summer and fall); New Haven, Conn., and Washington, D.C.; trend lines superimposed on a common base. Data in table 3.

Oreg., in the far West, and Winnipeg and Toronto, Canada, in intermediate and eastern locations, respectively. Three European stations, in addition to the Copenhagen data already discussed, are contained in figure 7, namely Paris, Vienna, and Greenwich. Figure 8 represents Southern Hemisphere stations in a belt along the 33°–34° south latitudinal zone, and extending in longitude from 71° W. to 18° E. The stations are Santiago, Chile; Buenos Aires, Argentina; and Cape Town, South Africa. Figure 9, represents a low latitude, or tropical belt, including Trinidad, W.I.; Bombay, India; and Batavia, D.E.I.

The practically unanimous testimony of these graphs, not only establishes the realness of these upward temperature trends, but shows that they are operative on an extensive geographical scale.

It will be noted that the latter part of the Trinidad record shows a downward trend in opposition to the others. In this connection it may be stated that similar conditions are found to cover low latitudes from the West Indies eastward over northern Africa and the Mediterranean country. A number of stations in this region, such as Alexandria, Egypt, and Palma, Spain, show similar trends. The opposition appears to be confined to this particular region.

Seasonal trends.—In figure 10 (data in table 3) seasonal curves are presented for two long records in the eastern United States—New Haven, Conn., and Washington, D.C.—the former beginning with 1781, and the latter with 1817. These records cover well over a century of

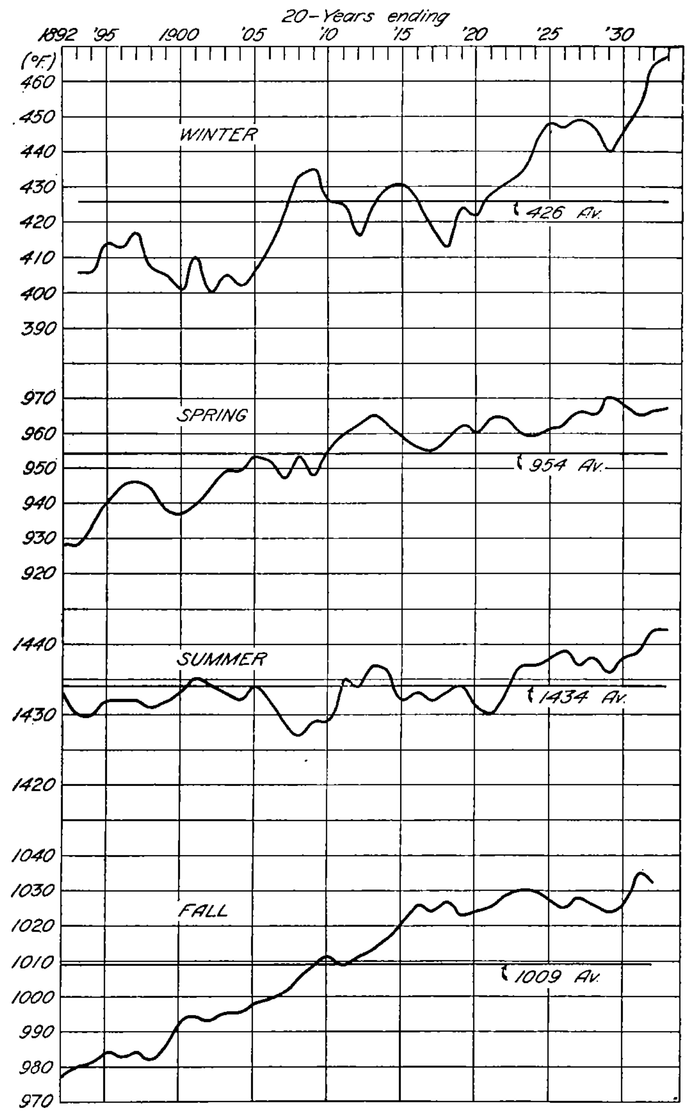

FIGURE 11.—20-year moving summations of seasonal temperature data, averages for all stations in the State of Iowa. Data in table 3.

time and must be credited with offering interesting and corroborative testimony. The four seasons—winter, spring, summer, and fall—are charted separately and, to facilitate comparisons, the lines for each season are superimposed on a common base. The similarity of these trends is remarkable, considering the very considerable distance between the stations. The results show not only that present tendencies to abnormally high temperatures are widespread, even on a seasonal basis, but also by trend concurrence that the fundamental observational data are trustworthy, and are of such character as to afford complete confidence in their integrity.

There is some disagreement for a few years after the beginning of the Washington record but, from about 1845 on, the similarity is striking. A minor winter divergence appears about 1915 to 1920, due to unusually cold weather in Washington being much less severe, relatively, in New England, such as the War winter of 1917–18. An outstanding coincidence is presented in the summer trends during the last 25 or 30 years, largely in opposition to those of other seasons.

Examining these graphs more critically, we find in the case of the New Haven winters very definite, comparatively short-period fluctuations, as follows:

	Years
Rising, 1801–12	12
Falling, 1813–49	37
Rising, 1850–64	15
Falling, 1865–73	9
Rising, 1874–92	19
Falling, 1893–1912	20
Rising, 1913–33	21

Disregarding these comparatively minor fluctuations, there is an outstanding recession in the curve from a maximum about 1812 to a minimum in 1873, a period of about 60 years; then a pronounced rise up to 1933, or for more than 70 years. The Washington winter curve closely follows that for New Haven for 100 years, except for a short period just prior to 1920, previously mentioned.

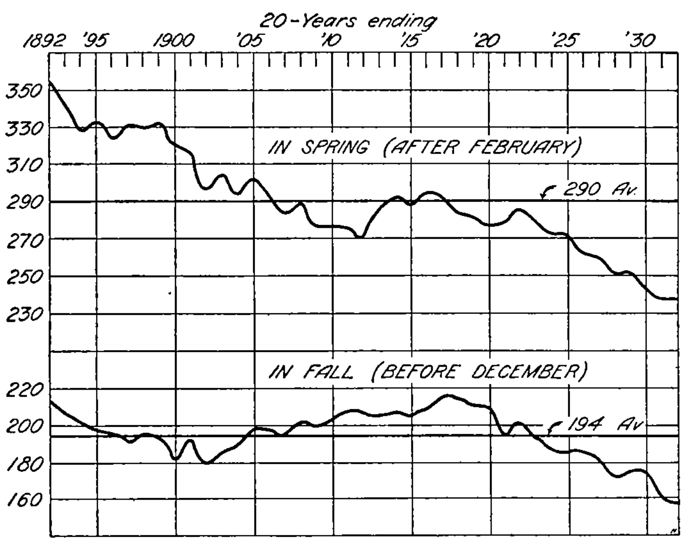

FIGURE 12.—20-year moving totals of days with freezing weather in fall and in spring, Washington, D.C. Data in table 2.

With these graphs before us, the question, in passing would seem pertinent, "What about granddad's old-fashioned winter?" The records for both stations show in the early seventies the winters for 20 years up to that time averaged 3° or more colder than for a like period ending with the winter of 1932–33. This is quite a difference in average winter temperature, comprising a span of 3 months, and for a period as long as 20 years.

The trends for the spring months for the two stations show close agreement since about 1845, actually for more than 100 years, because the records extend back 20 years beyond the respective points on the graph. In the case of New Haven there is a comparatively short down, then up trend, with maxima about 1810 and 1845, and minimum in 1825. From 1845 there is a pronounced recession, in both curves, to 1875, or about 30 years; then an even more prominent rise up to the present, or for more than half a century.

For the summer, the highest points for the New Haven curve appear for the 20 years ending with 1807 and that ending with 1881, the maxima being about 75 years apart The Washington record does not go back to the first New Haven peak, but the second crest of the latter coincides with a similar maximum for Washington in the early eighties. An interesting feature of these curves is the recent comparatively cool summers. In other words, following 1880, while the winters, springs, and falls were becoming definitely warmer, the summers were getting cooler. More recently they, too, show a recovery in the trend lines corresponding with the other seasons.

The fall months show the most remarkable trends in this series of graphs. Beginning with Washington for 1848, and New Haven for 1850, disregarding minor fluctuations, there is shown a very definite upward trend in the temperature curves to 1932; in other words, the falls in the eastern United States unquestionably have been getting definitely warmer for the last 100 years when the long-time temperature trend is considered. Figure 11 (data in table 3) shows confirmatory seasonal trends for the State of Iowa, based on the average temperature for all stations within the State for a period of 61 years from 1873 to 1933. The reader is again reminded that, in considering these curves, each successive point thereon represents data for the 20 years preceding the date of entry.

In concluding this study, other weather features directly related to general temperature conditions were examined such as the occurrence of frost in the fall and spring, the number of days in winter with certain low temperatures, the occurrence of freezing weather in the fall and spring seasons, the length of the winters, as indicated by the first frost in fall and the last in spring, etc. All of these confirm the general statement that we are in the midst of a period of abnormal warmth, which has come on more or less gradually for many years. An example of this auxiliary evidence is shown in figure 12, in which the general trend of the number of days with freezing weather in fall and in spring at Washington, D.C., is charted for a period of 60 years (data in table 2). It will be noted that for the 20 years ending with 1892 there was for the spring months (after February) a total of 354 days with minimum temperature 32° or lower, and for the 20 years, ending with 1933, this had dropped to 237 days, a reduction of one third from the early total, or an average difference of 6 days a year.

The following additional supporting evidence from the records of Washington, D.C., may be cited. The average number of days with freezing weather (minimum temperature 32° or lower) for the 3 winter months, December to February, for the 20 winters up to 1911–12 was 66 and for a like period, up to 1932–33, 57 days. Again, for the same periods, the average number of days with temperatures continuously below freezing (maximum 32°, or lower) was 15 and 10, respectively. That is, the average number of days with temperature continuously below freezing for the earlier 20-year period was 50 percent greater than for the latter. Also, the average length of the frost-free season (number of days from the last killing frost in spring to the first in fall) for the 20 years ending with 1906 was 188 days and for a similar period ending with 1932 it had increased to 199 days.

TABLE 1.—*Mean annual temperature*

Year	Philadelphia, Pa. °F.[1]	St. Paul, Minn. °F.[2]	St. Louis, Mo. °F.[3]	Washington, D.C. °F.[2]	New Haven, Conn. °F.[3]	Copenhagen, Denmark °F.[3]	West Chester, Pa. °F.[4]
1780	----	----	----	----	49.7	----	----
1781	----	----	----	----	50.4	----	----
1782	----	----	----	----	49.1	----	----
1783	----	----	----	----	48.4	----	----
1784	----	----	----	----	47.3	----	----
1785	----	----	----	----	47.7	----	----
1786	----	----	----	----	48.5	----	----
1787	----	----	----	----	48.5	----	----
1788	----	----	----	----	49.7	----	----
1789	----	----	----	----	49.5	----	----
1790	----	----	----	----	49.5	----	----
1791	----	----	----	----	49.5	----	----
1792	----	----	----	----	48.2	----	----
1793	----	----	----	----	50.4	----	----
1794	----	----	----	----	50.2		----
1795	----	----	----	----	49.6	----	----
1796	----	----	----	----	48.4	----	----
1797	----	----	----	----	48.1	----	----
1798	----	----	----	----	49.3	49.1	----
1799	----	----	----	----	48.4	43.9	----
1800	----	----	----	----	50.2	46.4	----
1801	----	----	----	----	51.0	49.3	----
1802	----	----	----	----	51.3	45.7	----
1803	----	----	----	----	50.8	44.1	----
1804	----	----	----	----	49.8	45.3	----
1805	----	----	----	----	51.7	43.7	----
1806	----	----	----	----	49.7	46.9	----
1807	----	----	----	----	49.2	46.8	----
1808	----	----	----	----	50.3	46.0	----
1809	----	----	----	----	49.2	45.5	----
1810	----	----	----	----	50.0	45.3	----
1811	----	----	----	----	49.7	47.8	----
1812	----	----	----	----	46.9	43.9	----
1813	----	----	----	----	49.0	46.4	----
1814	----	----	----	----	48.6	43.5	----
1815	----	----	----	----	47.3	45.9	----
1816	----	----	----	----	46.6	44.2	----
1817	----	----	----	----	46.4	46.2	----
1818	----	----	----	----	46.8	47.1	----
1819	----	----	----	----	49.0	48.0	----
1820	----	----	----	----	47.9	44.4	----
1821	----	----	----	----	47.6	45.9	----
1822	----	----	----	----	49.7	48.6	----
1823	----	----	----	----	48.1	45.7	----
1824	----	----	----	----	49.9	47.7	----
1825	52.9	----	----	----	50.8	47.1	----
1826	53.3	----	----	----	49.7	48.4	----
1827	51.5	----	----	----	48.9	46.4	----
1828	55.1	----	----	----	51.8	46.6	----
1829	52.0	----	----	----	48.7	42.6	----
1830	54.3	----	----	----	50.8	44.6	----
1831	53.1	----	----	----	49.2	46.9	----
1832	53.3	----	----	----	47.7	46.4	----
1833	53.1	----	----	----	48.3	45.9	----
1834	54.0	----	----	----	48.9	48.2	----
1835	53.0	----	----	----	46.6	45.9	----
1836	49.0	43.0	53.2	51.4	45.2	44.8	----
1837	50.1	44.1	54.6	53.7	46.4	44.2	----
1838	50.7	41.8	53.3	53.7	48.2	41.5	----
1839	51.8	47.2	55.3	53.6	49.2	43.3	----
1840	52.2	44.8	55.6	53.6	49.0	41.2	----
1841	51.5	43.8	55.5	52.9	49.5	44.2	----
1842	52.5	43.4	56.1	54.6	49.9	46.6	----
1843	51.3	39.8	53.6	53.5	47.4	45.9	----
1844	52.7	42.6	56.6	54.0	50.2	43.7	----
1845	53.2	45.7	56.3	54.9	50.2	43.3	----
1846	53.8	48.2	56.6	56.8	50.1	47.5	----
1847	53.2	41.8	53.8	55.2	49.4	45.1	----
1848	53.4	42.5	54.2	55.4	49.2	45.5	----
1849	52.5	42.2	53.7	55.8	48.3	44.4	----
1850	53.4	43.6	55.0	57.1	48.8	44.6	----
1851	53.4	46.6	55.2	56.8	49.0	45.5	----
1852	53.2	43.7	54.7	54.5	48.8	46.6	----
1853	54.3	42.2	54.9	56.0	49.6	44.2	----
1854	54.1	44.7	57.3	55.6	49.3	45.3	----
1855	53.0	43.6	54.1	54.4	49.0	42.8	52.3
1856	51.4	42.8	52.4	51.7	47.0	44.2	49.9
1857	52.2	41.5	53.0	52.0	47.5	46.9	51.0
1858	53.7	43.9	56.3	54.8	48.3	45.9	51.9
1859	53.6	40.8	54.4	55.0	48.0	47.1	51.5
1860	53.5	43.1	56.5	54.0	48.6	44.2	51.7
1861	54.1	42.2	56.6	54.6	50.1	45.5	52.3
1862	53.6	40.7	55.6	54.1	49.5	44.8	51.2
1863	53.9	42.7	54.4	53.6	50.0	47.3	51.7
1864	54.2	42.6	54.8	54.2	49.9	43.7	52.0
1865	54.9	43.6	56.4	55.0	49.0	45.1	52.5
1866	54.1	40.4	55.2	54.4	48.0	46.0	51.7
1867	53.3	40.1	55.3	53.0	48.0	43.0	51.8
1868	52.6	41.7	54.3	52.4	47.0	47.1	50.4
1869	54.1	42.4	54.1	53.6	47.0	45.7	51.9
1870	56.2	46.1	55.9	55.1	49.0	43.7	53.7
1871	53.0	43.6	57.5	54.8	48.0	42.8	52.3
1872	52.0	41.3	54.1	54.8	48.0	47.7	51.7
1873	51.5	40.6	53.7	54.8	47.9	46.4	51.4
1874	53.0	42.8	56.5	56.0	49.3	46.2	50.6
1875	50.0	39.0	52.8	52.2	48.3	44.6	48.6
1876	52.7	42.3	55.7	54.3	50.8	45.1	50.2
1877	54.3	46.8	56.7	55.5	52.5	44.6	51.6
1878	54.9	48.9	57.4	56.0	52.7	46.9	52.0
1879	53.7	44.8	56.4	55.1	50.8	43.3	50.7
1880	54.9	44.8	56.3	55.6	51.7	45.7	51.6
1881	54.5	46.1	56.9	55.9	49.9	43.7	51.9
1882	54.8	46.3	56.7	54.9	48.8	47.1	50.5

[1] Figure 1. [2] Figure 2. [3] Figure 3. [4] Figure 5.

TABLE 1.—*Mean annual temperature*—Continued

Year	Philadelphia, Pa. °F.[1]	St. Paul, Minn. °F.[2]	St. Louis, Mo. °F.[3]	Washington, D.C. °F.[2]	New Haven, Conn. °F.[3]	Copenhagen, Denmark °F.[3]	West Chester, Pa. °F.[4]
1883	54.1	41.3	54.7	54.0	47.6	45.9	49.5
1884	54.2	44.2	56.2	55.1	48.9	46.8	50.7
1885	51.9	43.1	55.2	53.0	47.4	45.1	49.2
1886	53.8	42.8	56.7	53.4	48.3	45.7	50.2
1887	54.4	42.2	57.6	54.8	48.7	45.1	50.8
1888	52.8	41.2	54.6	53.6	47.2	43.5	49.9
1889	54.8	45.0	56.0	55.1	50.2	45.7	52.4
1890	55.0	43.5	56.8	56.3	49.3	45.9	52.8
1891	55.1	44.0	56.2	55.4	50.0	45.5	53.0
1892	53.5	42.8	55.0	54.0	48.6	45.0	51.5
1893	52.9	41.3	55.2	53.7	47.6	45.1	50.9
1894	55.0	46.1	57.6	56.4	49.7	46.9	53.0
1895	53.6	43.6	55.1	54.2	48.9	45.1	51.8
1896	54.5	44.0	57.9	55.5	48.9	47.1	52.8
1897	54.6	43.7	57.4	54.9	49.5	46.4	52.5
1898	55.6	45.4	57.1	56.1	50.3	46.8	53.7
1899	54.5	44.2	56.6	54.4	49.2	47.1	52.5
1900	56.0	46.5	58.3	56.5	50.7	46.0	54.1
1901	53.8	45.6	57.4	54.1	48.7	46.2	52.0
1902	54.2	45.0	56.6	54.8	49.4	43.9	52.6
1903	54.2	43.5	56.0	54.3	49.2	46.2	52.7
1904	51.8	42.6	54.4	52.2	46.7	46.0	49.9
1905	53.9	44.2	54.9	54.1	48.8	45.9	52.3
1906	55.3	45.1	55.6	55.9	50.4	47.3	53.7
1907	53.1	42.5	55.3	53.5	48.3	45.5	50.9
1908	55.5	46.0	57.4	55.4	50.9	46.0	53.4
1909	55.1	43.7	56.0	55.2	50.1	44.4	52.6
1910	55.0	46.1	55.5	55.2	50.3	47.5	52.4
1911	55.4	44.8	57.5	56.4	50.5	48.0	53.3
1912	54.2	43.2	54.4	54.5	49.9	45.7	52.0
1913	57.0	45.6	57.8	57.3	52.3	47.5	55.0
1914	54.3	44.9	57.4	54.9	49.4	48.2	51.7
1915	55.4	44.8	56.3	55.6	51.1	45.0	53.4
1916	54.3	42.7	56.6	55.0	49.4	46.4	52.3
1917	52.8	40.4	54.0	53.0	47.9	45.5	50.6
1918	54.8	45.0	56.8	55.6	49.8	46.6	53.4
1919	55.7	44.2	57.2	56.4	50.9	45.1	53.4
1920	54.4	44.5	56.0	54.7	49.3	47.1	52.4
1921	57.0	47.5	60.1	58.0	51.9	47.7	54.8
1922	55.7	45.6	58.2	56.4	50.8	44.1	52.8
1923	55.3	45.0	56.7	56.1	49.6	44.6	53.1
1924	53.8	42.1	54.5	54.1	49.3	44.8	51.6
1925	55.9	44.6	57.2	56.1	50.6	46.9	53.3
1926	53.6	43.4	55.8	54.5	48.4	46.9	50.4
1927	55.5	43.3	57.0	56.3	50.7	45.9	53.1
1928	55.4	45.0	56.5	56.0	50.9	45.9	52.6
1929	55.9	42.2	55.2	56.5	50.6	45.0	53.3
1930	56.7	46.3	57.9	57.5	57.5	47.7	54.3
1931	58.1	50.6	59.9	58.2	52.7	45.3	55.3
1932	57.1	44.9	57.4	57.0	52.2	----	54.3

Year	Lynchburg, Va. °F[5]	Dale Enterprise, Va. °F[5]	Baltimore, Md. °F[5]	Easton, Md. °F[5]	Portland, Oreg. °F[6]	Winnipeg, Canada °F[6]	Toronto, Canada °F[6]	Paris, France °C[7]	Vienna, Austria °F[7]	Greenwich, England °F[7]
1873	----	----	----	----	52.8	32.8	42.3	----	50.2	49.3
1874	----	----	----	----	53.4	31.0	43.8	10.3	48.7	49.7
1875	----	----	----	----	53.2	30.3	40.6	10.2	47.3	49.8
1876	----	----	----	----	53.0	30.7	43.9	10.6	48.2	50.6
1877	----	----	----	----	53.2	36.1	46.0	10.4	48.9	49.9
1878	----	----	----	----	53.0	40.4	47.1	10.0	49.3	49.7
1879	----	----	----	----	52.4	32.3	43.9	8.2	46.6	46.3
1880	----	----	----	----	50.9	31.4	45.4	10.6	49.1	49.5
1881	----	----	----	----	52.9	34.1	46.1	9.8	46.9	48.8
1882	----	----	----	----	52.7	33.7	45.4	10.1	50.0	49.8
1883	----	----	----	----	52.9	29.0	41.5	10.0	48.0	49.4
1884	----	----	----	----	52.6	30.9	43.4	10.6	48.9	50.7
1885	----	----	----	----	55.6	31.6	40.8	9.8	48.7	48.7
1886	----	----	----	----	53.6	33.5	43.4	10.3	48.7	48.8
1887	----	----	----	----	52.3	31.0	43.9	8.8	47.3	47.9
1888	----	----	----	----	53.8	32.1	42.7	9.0	46.9	47.8
1889	----	----	----	----	54.8	36.4	45.5	9.5	47.7	48.8
1890	----	----	----	----	52.2	33.3	45.1	9.3	48.0	48.7
1891	----	----	----	----	53.7	34.8	45.8	9.5	47.5	48.4
1892	56.3	53.3	54.1	54.5	52.9	32.8	44.6	10.2	48.0	48.1
1893	55.9	52.3	53.6	54.3	50.1	30.3	43.5	10.8	48.4	51.0
1894	58.2	53.6	55.9	57.5	51.9	36.5	46.7	10.4	49.1	50.0
1895	56.1	50.4	54.2	54.5	52.0	33.9	44.2	9.8	47.3	49.3
1896	57.6	52.6	55.8	55.0	52.6	33.4	45.5	9.8	47.7	50.2
1897	57.3	52.5	55.2	54.3	53.1	34.7	46.4	10.6	48.7	50.4
1898	57.5	52.2	56.3	55.5	52.6	35.2	47.8	10.7	50.2	51.4
1899	56.5	52.0	55.1	54.2	51.9	34.3	46.4	10.8	48.4	50.7
1900	58.4	53.8	57.0	56.4	53.5	36.9	47.3	11.1	49.5	50.5
1901	55.7	51.3	54.4	53.9	52.6	36.3	46.0	10.0	48.6	49.3
1902	56.8	52.8	55.2	55.3	52.6	37.6	46.0	9.9	46.8	49.1
1903	56.4	52.1	55.0	54.9	52.9	35.1	46.0	10.3	49.1	50.2
1904	54.8	50.7	52.6	52.3	54.3	34.1	42.6	10.4	49.3	49.8
1905	56.1	52.1	54.7	54.0	53.3	36.1	45.0	9.9	48.9	49.7
1906	57.5	53.8	56.0	55.6	54.4	37.2	46.2	10.5	49.1	50.5
1907	56.0	51.8	53.6	53.4	53.6	33.8	44.4	10.1	48.6	49.4
1908	56.8	52.7	56.2	55.3	52.9	37.4	46.7	9.8	47.7	49.8
1909	56.9	52.9	55.8	54.7	51.8	35.3	46.1	9.5	47.7	48.6
1910	56.5	52.1	55.7	54.5	53.3	38.0	46.4	10.3	49.3	49.7
1911	58.0	53.9	56.6	55.9	52.2	36.2	47.7	11.2	49.8	51.5
1912	56.5	52.1	55.0	54.8	53.4	36.1	44.8	10.5	47.7	50.2
1913	58.0	55.2	57.9	57.2	52.8	36.3	47.7	10.9	48.7	50.5
1914	56.9	52.8	55.4	54.7	54.5	37.9	46.0	10.5	48.0	50.8
1915	57.2	52.5	55.9	55.5	54.8	38.4	46.8	10.4	48.6	49.3

[5] Figure 4. [6] Figure 6. [7] Figure 7.

TABLE 1.—*Mean annual temperature*—Continued

Year	Lynchburg, Va. °F	Dale Enterprise, Va. °F	Baltimore, Md. °F	Easton, Md. °F	Portland, Oreg. °F	Winnipeg, Canada °F	Toronto, Canada °F	Paris, France °C	Vienna, Austria °F	Greenwich, England °F
1916	57.0	52.2	55.2	55.1	51.5	34.2	46.4	10.4	50.4	49.5
1917	54.8	51.2	53.4	53.3	54.0	33.5	43.2	9.3	48.2	48.4
1918	56.7	52.4	55.7	55.5	54.8	37.0	46.0	10.5	49.5	50.1
1919	57.8	54.7	56.6	56.4	52.7	36.4	48.3	9.8	47.8	48.4
1920	55.9	52.9	55.2	54.7	52.9	37.4	45.8	10.6	49.3	50.4
1921	59.4	56.5	58.2	58.2	53.8	38.4	49.8	11.5	50.5	52.2
1922	58.1	55.0	56.9	56.2	52.2	38.7	46.3	10.0	47.7	49.0
1923	57.7	54.2	56.6	56.6	54.5	37.8	45.6	10.7	49.5	49.7
1924	55.6	52.1	54.7	54.7	53.7	35.2	44.6	10.3	47.7	49.7
1925	58.0	54.2	56.5	56.4	55.3	36.6	45.9	10.2	49.3	49.7
1926	57.0	52.7	54.7	54.2	56.8	36.2	43.8	11.0	50.2	50.5
1927	58.2	54.4	56.6	55.7	53.8	36.0	46.8	10.5	49.6	49.5
1928	57.3	53.4	56.5	55.1	54.1	38.9	46.6	11.4		50.6
1929	57.5	53.9	56.8	55.1	53.2	35.0	46.0	10.5		49.5
1930	58.9	54.5	58.1	56.2	53.2	37.9	47.4	11.2		50.6
1931	59.2	56.0	59.2	57.4	55.2	41.3	49.4			49.3
1932	58.9	54.5	57.9	56.4	54.2	35.9	47.8			

Year	Santiago, Chile, °C.[8]	Buenos Aires, Argentina, °C.[8]	Cape Town, South Africa, °F.[8]	Trinidad, West Indies, °F.[9]	Bombay, India, °F.[9]	Batavia, East Indies, °C.[9]
1873	13.4	16.2	63.3	77.1	80.7	25.9
1874	13.0	15.1	61.9	76.5	79.4	25.6
1875	13.1	15.7	62.1	76.4	80.4	25.9
1876	14.2	16.0	61.7	76.9	80.9	25.9
1877	14.8	16.6	62.5	78.1	79.9	26.3
1878	14.1	15.8	61.2	78.5	79.5	26.6
1879	14.4	16.0	60.9	76.6	79.5	25.8
1880	14.2	15.8	61.6	75.2	79.8	25.6
1881	13.6	16.6	62.4	76.6	80.1	26.1
1882	13.6	15.8	63.1	75.8	79.5	25.8
1883	13.0	16.2	62.4	76.1	81.0	25.9
1884	13.2	16.3	62.1	75.7	80.5	25.8
1885	12.9	15.6	63.1	77.6	80.1	26.0
1886	13.4	15.9	62.9	76.8	80.3	26.1
1887	13.5	16.0	62.8	77.3	80.5	25.7
1888	13.9	16.4	62.2	78.3	79.7	26.2
1889	12.6	15.6	61.9	79.3	80.4	26.4
1890	13.4	15.8	61.8	76.7	80.4	25.8
1891	14.0	16.0	62.1	78.5	81.4	26.2
1892	13.2	15.8	60.7	77.4	80.3	26.0
1893	13.2	15.8	62.0	77.6	81.2	25.7
1894	13.6	15.7	62.2	77.1	80.8	25.9
1895	13.6	16.3	61.6	78.1	80.9	26.0
1896	14.5	17.0	62.7	78.3	80.9	26.4
1897	13.9	16.6	62.3	78.2	82.1	26.6
1898	13.0	15.4	61.6	77.6	79.9	26.1
1899	13.8	16.4	62.2	78.8	81.1	26.0
1900	14.0	17.1	62.6	78.5	80.3	26.4
1901	14.2	16.5	62.5	78.5	80.4	26.2
1902	14.0	16.6	62.5	78.9	81.2	26.4
1903	13.7	16.5	60.6	78.6	80.4	26.3
1904	14.2	16.3	61.6	77.2	80.2	25.8
1905	14.0	16.0	62.2	78.2	80.5	26.5
1906	14.0	16.6	61.1	77.7	81.1	26.5
1907	13.5	15.8	61.8	77.5	81.5	26.0
1908	14.0	16.1	61.5	77.3	80.6	26.2
1909	13.6	15.6	63.0	77.5	81.3	26.2
1910	13.0	15.8	63.0	78.0	81.3	26.2
1911	13.2	15.3	63.0	77.4	80.9	26.3
1912	14.0	16.2	63.0	77.1	80.1	26.5
1913	14.4	17.1	62.9	77.2	81.1	26.4
1914	14.0	16.7	62.4	77.6	80.9	26.6
1915	14.2	16.1	63.0	78.0	81.7	26.7
1916	13.7	15.9	62.6	77.0	81.2	26.2
1917	13.8	16.0	62.9	76.3	81.0	26.0
1918	14.0	16.2	63.5	77.1	81.1	26.1
1919	14.3	16.7	63.1	77.8	81.4	26.4
1920	14.0	16.5	63.2	77.7	81.6	26.1
1921	13.7	16.0	62.6	77.7	81.2	26.2
1922	13.5	16.4	62.5	78.2	80.4	26.4
1923	13.2	16.2	62.9	78.1	81.0	26.4
1924	14.0	15.6	62.6	78.7		26.6
1925	14.3	16.6	63.4	78.5		26.6
1926	14.5	17.0	62.6			26.9
1927	14.2	16.7	64.2			26.6
1928	13.8		63.0			26.6
1929	14.0		63.1			
1930	14.8		63.7			

[8] Figure 8.

[9] Figure 9.

TABLE 2.—*Number of days with freezing weather*

Year	Washington, D.C.[10] Spring	Washington, D.C.[10] Fall	Year	Washington, D.C.[10] Spring	Washington, D.C.[10] Fall
1873		18	1904	19	14
1874	21	14	1905	14	13
1875	27	15	1906	21	8
1876	21	8	1907	17	9
1877	17	10	1908	11	14
1878	4	7	1909	15	6
1879	16	14	1910	6	11
1880	17	17	1911	18	16
1881	21	8	1912	17	11
1882	11	13	1913	9	8
1883	26	9	1914	24	11
1884	11	10	1915	20	9
1885	25	5	1916	21	9
1886	12	9	1917	15	14
1887	26	11	1918	9	9
1888	21	7	1919	7	8
1889	9	8	1920	15	5
1890	20	8	1921	5	4
1891	17	11	1922	9	7
1892	18	12	1923	14	6
1893	14	10	1924	12	9
1894	9	8	1925	7	11
1895	13	11	1926	20	8
1896	25	6	1927	7	5
1897	9	7	1928	10	4
1898	11	10	1929	6	9
1899	15	12	1930	8	12
1900	18	6	1931	8	1
1901	8	18	1932	11	8
1902	9	1	1933	9	
1903	6	15			

[10] Figure 12.

TABLE 3.—*Mean seasonal temperatures*

Year	New Haven, Conn.[11]				Washington, D.C.[11]				Iowa State[12]			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
1781	32.9	47.1	70.8	50.9								
1782	27.4	48.0	70.7	46.9								
1783	29.5	46.9	70.3	47.3								
1784	23.5	44.0	70.3	51.5								
1785	26.5	43.0	70.3	50.3								
1786	28.2	47.5	69.5	50.6								
1787	27.0	47.3	68.1	49.7								
1788	27.3	47.7	70.7	55.8								
1789	26.9	46.2	71.9	51.2								
1790	32.6	46.4	70.9	52.2								
1791	25.1	50.4	69.6	50.0								
1792	26.1	48.3	68.2	50.7								
1793	29.3	49.4	70.7	51.4								
1794	28.8	48.9	69.3	51.2								
1795	30.5	46.7	69.5	52.0								
1796	28.7	46.1	69.7	50.9								
1797	27.1	46.4	70.9	48.2								
1798	25.6	48.6	72.1	51.4								
1799	24.8	43.5	71.6	51.6								
1800	28.2	48.0	71.7	51.5								
1801	30.5	49.7	69.8	53.6								
1802	32.5	47.9	71.7	54.4								
1803	30.4	46.8	71.9	52.3								
1804	30.2	48.2	70.7	53.2								
1805	27.3	50.3	72.4	53.0								
1806	33.8	45.1	73.2	53.0								
1807	28.2	45.3	70.3	51.0								
1808	31.9	48.2	69.7	52.4								
1809	28.2	47.4	68.3	52.3								
1810	32.4	49.0	69.5	50.8								
1811	28.5	47.5	69.5	53.7								
1812	27.1	42.9	67.5	49.9								
1813	27.0	45.2	70.9	53.3								
1814	28.2	47.3	68.5	51.0								
1815	25.6	44.8	68.2	50.3								
1816	26.6	43.0	65.2	51.0								
1817	25.0	43.7	66.4	50.6	37.0	55.8	74.4	56.4				
1818	25.4	43.7	69.0	50.7	34.5	51.8	73.0	55.8				
1819	29.1	43.4	69.3	52.7	37.4	52.6	77.2	56.8				
1820	27.8	44.9	69.5	50.4	35.9	54.9	75.0	53.4				

[11] Figure 10.

[12] Figure 11.

TABLE 3.—*Mean seasonal temperatures*—Continued

Year	New Haven, Conn.				Washington, D.C.				Iowa State			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
1821	25.9	44.3	68.9	51.1	32.9	50.9	74.4	55.7	------	------	------	------
1822	26.4	48.8	68.5	54.2	33.6	59.2	78.1	61.0	------	------	------	------
1823	26.9	46.0	70.0	48.8	38.4	58.5	75.7	54.2	------	------	------	------
1824	31.5	47.3	68.0	51.5	37.4	53.7	74.9	55.6	------	------	------	------
1825	31.9	49.1	71.7	52.2	37.9	56.3	76.5	57.1	------	------	------	------
1826	29.4	47.0	69.6	52.4	37.4	58.2	76.1	58.6	------	------	------	------
1827	27.6	47.4	67.7	51.8	36.1	57.4	76.9	57.5	------	------	------	------
1828	34.7	47.3	72.0	52.6	41.9	53.6	77.4	56.8	------	------	------	------
1829	28.3	46.3	69.2	50.1	33.7	53.9	74.1	53.9	------	------	------	------
1830	29.9	50.2	70.2	54.3	37.0	55.5	76.9	59.8	------	------	------	------
1831	27.2	50.6	72.6	52.3	30.9	54.6	73.9	54.8	------	------	------	------
1832	23.8	44.2	67.2	50.6	32.7	54.4	75.2	59.0	------	------	------	------
1833	29.3	47.4	67.3	49.4	37.1	56.2	73.8	55.0	------	------	------	------
1834	30.0	47.9	69.0	49.5	36.6	54.9	76.1	54.2	------	------	------	------
1835	25.7	44.2	68.0	50.0	31.6	53.0	75.7	56.8	------	------	------	------
1836	21.9	44.1	66.1	47.2	32.3	50.3	71.0	52.3	------	------	------	------
1837	24.8	44.8	67.0	48.4	33.4	51.8	73.3	55.4	------	------	------	------
1838	29.1	45.7	70.7	48.3	35.0	51.1	78.0	52.8	------	------	------	------
1839	27.3	48.1	68.8	50.6	33.1	55.3	71.1	54.3	------	------	------	------
1840	27.6	48.0	70.5	50.7	32.6	55.2	73.9	54.0	------	------	------	------
1841	29.0	45.7	71.6	50.3	31.7	50.1	74.1	53.6	------	------	------	------
1842	34.4	49.6	69.4	48.5	38.1	55.0	73.1	53.4	------	------	------	------
1843	25.9	46.2	68.5	48.9	34.6	46.5	75.4	55.4	------	------	------	------
1844	26.5	52.3	69.9	51.9	33.7	55.8	74.1	53.1	------	------	------	------
1845	29.4	48.7	71.4	52.7	36.2	54.1	74.9	55.7	------	------	------	------
1846	26.0	49.0	69.9	54.2	33.3	57.2	74.6	58.7	------	------	------	------
1847	28.2	45.1	70.6	51.4	36.7	53.9	73.6	56.3	------	------	------	------
1848	31.3	46.7	69.4	49.5	37.5	54.9	74.3	53.4	------	------	------	------
1849	26.9	45.6	69.8	52.6	36.8	54.5	76.1	59.1	------	------	------	------
1850	30.8	43.5	69.5	51.9	38.8	52.6	76.3	58.7	------	------	------	------
1851	29.7	47.1	68.4	52.0	40.6	56.5	74.9	57.9	------	------	------	------
1852	25.5	45.2	68.2	51.3	33.6	52.4	74.1	55.3	------	------	------	------
1853	33.1	48.0	68.3	51.5	38.0	54.5	75.7	57.1	------	------	------	------
1854	29.1	46.8	70.3	52.5	36.2	55.1	76.1	56.7	------	------	------	------
1855	27.2	46.0	68.5	51.8	31.3	53.4	74.4	57.1	------	------	------	------
1856	25.2	44.4	69.1	51.3	28.3	50.3	74.7	55.1	------	------	------	------
1857	25.9	43.2	67.0	51.3	31.6	48.1	72.7	54.6	------	------	------	------
1858	31.3	44.9	68.0	50.2	35.1	51.6	75.8	55.1	------	------	------	------
1859	29.3	47.8	66.6	49.8	38.3	55.1	73.3	55.3	------	------	------	------
1860	26.8	47.2	68.6	51.8	33.1	54.4	73.8	54.9	------	------	------	------
1861	28.3	47.0	69.4	53.4	34.8	52.5	73.1	56.9	------	------	------	------
1862	28.6	46.9	69.1	53.7	36.0	51.8	71.7	57.1	------	------	------	------
1863	31.4	45.8	70.8	52.9	36.2	50.1	73.8	54.8	------	------	------	------
1864	29.0	47.2	72.2	51.0	34.9	52.1	75.2	54.6	------	------	------	------
1865	26.4	48.6	70.4	52.4	31.9	54.9	74.8	57.6	------	------	------	------
1866	27.0	45.3	69.7	51.3	34.7	53.3	73.7	57.7	------	------	------	------
1867	25.3	45.7	69.0	50.3	32.2	50.4	73.0	57.0	------	------	------	------
1868	21.3	43.7	70.7	49.0	29.4	50.7	75.1	54.4	------	------	------	------
1869	28.7	43.7	67.3	49.7	35.8	50.7	73.9	51.9	------	------	------	------
1870	29.0	42.3	71.3	52.3	37.0	51.6	75.9	57.0	------	------	------	------
1871	25.7	44.0	71.0	51.7	34.2	56.7	74.7	54.6	------	------	------	------
1872	26.7	45.0	70.3	50.3	32.5	52.9	78.5	55.7	------	------	------	------
1873	26.5	44.7	69.7	49.5	32.0	52.8	76.6	54.6	------	44.6	74.7	47.1
1874	30.5	43.8	69.5	53.1	39.3	52.0	76.4	56.9	21.1	45.9	74.5	49.0
1875	27.0	44.6	71.2	50.9	32.5	50.2	73.9	53.1	11.8	43.5	69.7	46.2
1876	32.2	47.2	74.2	52.2	38.1	51.8	77.2	53.7	26.3	45.5	71.7	46.2
1877	29.0	48.6	72.5	55.4	31.8	51.9	76.0	57.2	19.9	45.0	70.9	49.4

TABLE 3.—*Mean seasonal temperatures*—Continued

Year	New Haven, Conn.				Washington, D.C.				Iowa State			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
1878	34.3	51.6	71.2	55.2	38.4	56.7	74.8	57.1	32.2	50.9	72.5	50.5
1879	29.1	48.2	70.7	54.4	31.9	53.5	75.1	57.3	18.3	50.1	72.5	51.3
1880	36.1	49.9	71.7	51.9	41.3	55.9	75.3	54.3	25.2	49.3	72.4	44.7
1881	25.3	46.2	68.2	56.4	29.8	52.5	74.9	62.5	14.2	45.4	74.3	50.3
1882	32.0	44.0	69.4	52.7	38.4	51.4	74.6	57.6	30.2	46.5	69.6	51.8
1883	26.8	43.6	69.1	50.6	33.7	50.7	74.4	56.4	15.6	45.0	69.9	47.5
1884	28.2	44.9	68.1	53.7	35.7	52.5	73.6	58.7	18.8	46.1	69.9	52.1
1885	26.0	42.7	68.6	51.8	31.9	50.0	74.1	55.4	12.7	45.4	69.8	48.3
1886	28.3	46.5	67.3	53.1	32.8	53.2	72.3	57.7	18.0	47.8	73.2	50.0
1887	27.4	45.5	69.5	50.6	34.2	52.7	75.3	55.1	13.4	49.7	73.3	47.9
1888	26.9	42.9	68.7	50.2	34.0	51.0	74.1	54.9	15.3	43.7	71.9	48.2
1889	30.6	48.5	68.0	51.7	35.9	54.1	73.0	54.8	22.7	49.7	70.2	47.1
1890	36.5	45.5	67.5	51.6	44.3	52.9	74.5	57.4	26.3	45.3	71.8	49.2
1891	29.8	46.1	67.5	52.3	37.7	51.8	72.7	56.2	24.6	45.2	68.9	49.3
1892	32.4	44.8	69.8	51.1	37.3	51.0	76.1	55.1	25.2	43.8	71.2	50.8
1893	24.8	44.7	68.7	51.4	31.0	52.2	74.7	55.4	14.7	44.6	71.9	50.4
1894	29.1	48.3	69.4	51.7	37.1	55.9	75.2	57.8	20.3	51.3	74.7	49.8
1895	23.7	45.9	69.0	52.5	31.7	52.7	74.9	57.0	20.0	50.1	71.2	49.0
1896	29.6	46.5	69.0	52.7	36.3	54.6	74.6	57.5	25.4	50.3	71.5	45.3
1897	29.0	47.4	67.7	52.4	34.4	53.8	73.3	57.4	24.2	46.1	71.2	50.7
1898	31.4	47.4	69.8	53.5	36.6	54.7	76.4	57.6	21.9	48.4	72.0	48.3
1899	27.7	46.1	69.5	52.5	32.1	53.5	75.2	56.5	16.7	44.0	72.7	54.4
1900	31.1	45.8	70.7	55.8	35.0	52.5	76.8	61.5	21.0	48.7	73.5	52.4
1901	28.1	45.4	70.5	51.3	33.6	52.7	76.1	54.5	22.7	48.3	76.2	51.1
1902	28.5	48.6	67.2	54.1	32.1	55.0	73.8	58.6	20.2	50.4	69.1	51.3
1903	29.8	50.6	65.5	51.6	35.1	56.1	71.6	55.2	21.0	50.1	68.9	49.1
1904	23.7	46.2	67.9	50.0	29.4	52.3	72.6	54.9	16.1	46.2	68.9	52.7
1905	23.9	46.7	68.4	52.8	29.0	54.7	73.9	56.5	15.8	49.1	71.6	51.1
1906	33.2	46.1	70.3	54.0	37.2	52.5	74.8	59.2	25.1	46.8	71.0	51.0
1907	26.5	44.4	67.8	52.5	34.8	52.1	71.4	55.3	23.2	45.2	70.4	50.0
1908	30.7	48.6	70.5	54.6	34.4	56.4	74.3	56.9	26.0	49.3	70.0	52.8
1909	32.7	46.5	68.9	53.2	38.7	53.6	73.7	56.8	24.9	44.7	72.5	51.5
1910	29.9	49.9	69.3	53.3	33.4	56.8	73.7	57.5	17.0	52.3	72.0	50.6
1911	28.8	47.1	69.9	52.4	35.2	54.1	76.1	56.8	23.6	50.4	74.3	48.1
1912	28.6	46.9	69.1	54.9	32.3	53.9	73.2	58.9	16.7	45.8	70.6	51.5
1913	34.7	49.3	70.2	54.9	40.1	56.3	74.9	58.0	23.4	47.2	74.4	52.6
1914	30.1	47.1	68.5	54.3	36.4	53.3	75.4	57.2	25.5	48.5	74.2	53.8
1915	32.3	47.7	68.3	55.7	35.7	53.6	73.6	58.6	20.8	47.5	66.8	52.8
1916	30.1	44.9	68.7	53.9	36.4	52.7	74.2	56.5	20.6	47.4	72.7	50.2
1917	29.5	44.6	70.6	50.0	34.4	52.4	75.0	52.9	17.0	45.1	69.9	48.7
1918	23.3	49.2	69.2	53.5	29.5	57.1	74.3	57.0	15.4	50.9	73.3	51.2
1919	34.3	48.8	69.3	54.1	39.0	54.9	74.9	59.8	28.1	48.0	73.6	50.6
1920	24.9	48.5	69.0	55.0	31.3	52.7	73.8	58.6	18.6	46.6	70.8	53.2
1921	32.6	51.8	69.9	54.8	38.3	59.0	75.4	59.6	28.6	52.8	74.9	51.8
1922	29.4	49.4	69.7	54.4	36.2	55.9	74.7	59.1	23.9	50.5	72.5	55.1
1923	26.9	48.8	69.1	53.7	35.7	54.1	75.2	56.9	23.6	45.8	72.3	50.9
1924	32.3	49.4	68.9	52.3	38.1	51.5	73.7	55.9	24.4	45.5	69.6	52.0
1925	31.0	49.2	70.4	51.3	37.4	54.6	75.7	56.4	21.1	51.1	72.3	48.4
1926	30.3	44.7	68.9	52.8	35.8	52.1	74.1	57.1	25.0	47.6	71.5	48.9
1927	29.7	47.2	68.2	56.6	36.6	54.5	71.7	60.5	24.7	49.1	69.1	53.5
1928	32.4	46.1	71.3	53.9	37.5	53.0	75.4	58.1	24.2	48.6	70.4	51.1
1929	30.2	49.4	69.8	53.8	36.4	57.4	74.6	57.8	17.6	49.3	71.2	48.8
1930	32.3	48.2	71.5	54.8	38.6	55.2	77.4	59.6	23.6	49.9	73.8	52.8
1931	31.1	48.7	72.0	58.6	37.4	53.5	76.2	63.1	30.3	47.8	74.9	57.2
1932	36.7	47.3	70.8	54.3	44.6	52.3	76.1	57.7	28.5	46.9	73.3	48.3
1933	35.2	48.5	68.7	------	40.2	55.3	75.6	------	25.6	48.4	74.8	-----