sectors were examined. The isobars for these sectors were redrawn with extreme care (all available airway reports were used, making a rather close network of reporting stations). A geostrophic wind scale constructed from the well-known approximate formula, $G=\frac{\Delta P/\Delta S}{\rho.2\omega\sin\phi}$, where G is the geostrophic wind, $\frac{\Delta P}{\Delta S}$ the pressure gradient, $2\omega\sin\phi$ the apparent deflective force of the earth's rotation, and ρ the density of air. By applying the scale to the isobars, the theoretical geostrophic wind velocity may be read off directly in force Beaufort. A thorough check of these charts showed almost as definitely a critical velocity as the pilot balloon data. The velocity by this method was found to be half way in force 5 Beaufort, about 21 m. p. h., a value slightly higher than that determined by the balloon runs. It is probable that the explanation for the higher value is partly the method of determining the gradient wind from the balloon runs: If precision methods were employed, values about 2 m. p. h. higher would be obtained. It is true that the geostrophic wind scale would give too low values of gradient winds because of the usual slightly anticyclonic curvature of the isobars. It may be that at the higher elevation (about 300 m) of Atlanta, not as great a wind velocity is required to produce the stratus (because of additional cooling by lifting) as in the remainder of the area to the west where the wind scale was principally employed.

Little difficulty was encountered in forecasting, from the isobars, the areas over which the fog would form, except in about 10 of the seventy cases; in each of these cases, the pressure gradient changed during the night; a sufficient gradient was present on the 8 p. m. chart, but had diminished to below the minimum on the 8 a. m. chart, and as a result either no fog was formed or else it was much more broken than was indicated. A close check of these exceptions proved that it was a comparatively simple matter to draw the isallobars and apply Petterssen's kinematical methods (**7**) to the movement of isobars; since the extreme horizontal homogeneity in Tm air (**1**) demands parallel isobars, and since we are only interested in their relative movement, the computations are so simplified that they may in most cases be done by inspection. The appropriate formula is $h=h_0+(C_2-C_1)t$, where h_0 is the original distance between isobars, h is the distance after a time t, and C refers to the instantaneous velocity of isobars 1 and 2. The velocity of an isobar is $C_t=-Th$, where T is the three hour pressure tendency. With sufficient accuracy for our purposes, the unit distances may, in most cases, be considered equal for the neighboring isobars; this assumption permits a simple subtraction of pressure tendencies at the two isobars, which is then multiplied by 4 in order to obtain the spreading of the isobars between the two 12 hour charts.

It is interesting to note that in no case was there observed a condition where the gradient was insufficient on the 8 p. m. map to produce the stratus and had strengthened sufficiently during the night enough to produce it. The probable explanation lies in the time required for the actual height of the homogeneous layer to attain the theoretical height. Rossby and Montgomery state that such time is of short duration; nevertheless, mixing at the bounding surface is going on constantly and is, no doubt, sufficient to prevent the formation of the stratus.

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TEMPERATURE AND RAINFALL CHANGES IN THE UNITED STATES DURING THE PAST 40 YEARS

By LARRY F. PAGE

[Bureau of Agricultural Economics, Washington, D. C., December 1936]

About 3 years ago, Kincer (**1**) showed that the annual average temperature at a number of stations in the United States and elsewhere had been rising for a period of 20 to 30 years or more. For a few records, the four quarters of the year were separated, and the results indicated some differences in trends. A recent publication of the U. S. Geological Survey (**2**) includes an examination of precipitation trends at stations grouped in 15 sections of the United States, by three seasons, December to April, May to August, and September to November. Ten-year moving averages were used, and indicated upward trends in the fall, and declining trends in winter and summer precipitation [(**2**), p. 48]. The question naturally arises as to the similarity of trends among the months, within the seasons. Since the divisions of the year, as used in these studies, represent somewhat different types of weather influence, it might be reasonable to assume that the variations in trend were due to these differences. We might expect, at least, a shading from one average seasonal trend to the next for the same station or area.

To investigate this, State monthly average temperature and precipitation records were used, as published in *Climatological Data* by the U. S. Weather Bureau. In order to simplify calculation and comparison, only data for the years 1896 to 1935, inclusive, were used with the exception of California, where the published records begin with 1897. No indication is given, from this study, as to the future trend. Such changes as are shown might be due to fluctuations or periodicities of about 40 years *or longer*, or to more or less permanent changes in our climate. This 40-year period was divided into two series of 20 years each, 1896 to 1915 and 1916 to 1935. The mean value and standard deviation[1] for each of these series for each State were computed, and from the latter

[1] Standard deviations were computed by the formula $\sigma_{x_1}=\sqrt{\frac{(\Sigma x_1-\bar{x}_1)^2}{n_1}}$. Preference is often given to the formula using $n-1$ in place of n, but differences are small, and certain considerations indicated the use of the former. See (3), p. 51.

the standard errors of the differences between the means for the two series were obtained from the formulas (**3**):

$$\sigma_{M_1-M_2}=\sqrt{\sigma_{M_1}^2+\sigma_{M_2}^2}, \qquad \sigma_{M_1}=\frac{\sigma_{x_1}}{\sqrt{n_1}}$$

where M_1 and σ_{x_1} are the mean and standard deviation, respectively, of the series 1896–1915.

It must be kept clearly in mind that the comparisons given below are based on differences between averages over arbitrarily chosen periods. A longer or a shorter period might show a trend in the opposite direction; and variations of short duration may be obscured.

The reasons for adopting this method of analysis are its susceptibility to statistical test and its ease of calculation compared to fitting least square lines. If the data, exclusive of "random" fluctuations, lie on a straight line, calculation of the slope from means of the two halves of data will give approximately the same result as that obtained from a first degree regression against time. If the slope of the trend varies, so that a curve is necessary to represent it, the computation by least square methods presents an enormous problem. Although the use of long-time moving averages enables one to see changes of slope or direction, it is not readily adaptable to tests indicating the reliability of the results. Some such test is imperative, particularly in evaluating a large number of series.

The probability, by chance, of a mean difference twice the standard error of that difference is approximately 0.05; of one three times its standard error, about 0.005. These probabilities, of course, depend upon normal distribution of the data involved. Monthly State temperature records have been found to be nearly normally distributed, and probably never enough divergent to affect the conclusions which will be drawn. Furthermore, where distributions are not exactly normal, but tend toward normality, the distribution of the mean usually tends to normal [(**3**), p. 99]. Rainfall frequency distributions, however, vary considerably. Generalization may be made to the extent that where the State monthly average is less than twice its standard deviation, the distribution will be badly skewed. This is obvious since there cannot in this case be any negative values greater than twice the standard deviation. Generally speaking, as the average rainfall increases in terms of its standard deviation, the distribution becomes more symmetrical. Where the average monthly rainfall is more than twice its standard deviation, errors in interpretation due to non-normal distribution should be small and no doubt less than other unavoidable errors in the data itself.

Tables 1 and 2 show, for temperature and rainfall, respectively, the 1916–35 average minus the 1896–1915 average. Values more than twice their standard errors are in italics, and those more than three times their standard errors in bold face. Precipitation differences which appear to be significant, but where the distribution is clearly not normal, are shown in parentheses.

The values shown in tables 1 and 2 are plotted on figures 1 and 2, and on 3 and 4, respectively. The solid straight line is at zero change, and the dashed straight line is the average *annual* change from the 1896–1915 average to that for 1916–35. Where the dashed line is not shown, it was so close to zero that it could not be clearly plotted. The irregular lines indicate the annual march of temperature and precipitation *trends*. Monthly differences which are over twice their standard errors are marked o; those over three times their standard errors are marked x.

Different sections of the country appear to have characteristic patterns of changes in monthly temperature averages. In the South, Texas, Alabama, and Florida represent the changes, while Montana, Minnesota, and Michigan show the middle-western trends. Washington and Oregon are somewhat similar, but the two geographical extremes of California and New England have had only small changes.

Let us examine first by months, the maps of change in temperature: Annual temperatures have increased slightly throughout most of the country except in the Southwest and Pacific States; the most significant increases are in the eastern Gulf States; the apparent rise in Nevada may be ignored for reasons to be given later. January reflects the annual trend quite well, but here a larger area in the West shows a downward movement. February temperature changes show a very striking picture: In order to bring out the extent of these changes, figure 5 was drawn with the differences between averages for February shown; only Arizona, California, Oregon, and the western half of Washington had lower temperature averages for 1916–35 than during 1896–1915; 11 out of the 43 States or districts show differences between the means of over three times their standard errors; changes of over twice the standard error occurred in all the States east of the Rocky Mountains, except along the northern and northeastern boundaries; west of the Rockies, the trend tapered off and finally along the Pacific, the changes have been negative; the average increase for the United States for this month, weighted by State areas is 2.49°. March shows no significant trends, but there is a tendency toward increased temperatures in the Middlewest and Lake Region, and a small downward trend in the South.

In April, the entire West and Northwest has been somewhat cooler in the past 20 years than in the preceding period fo the same length. The South, from Texas east, has been warmer. The points for May indicate that there have been only small changes west of the Mississippi, but fairly large average decreases in the East, centered in the Carolinas. Small increases in temperature are shown over most of the country in June with the exception of the Pacific Coast region and the Southwest, including Texas. July is somewhat similar except that the increases here are much larger, and are over twice their standard errors in 10 States of the Middlewest and Rocky Mountain regions; east of the Mississippi they decline, reaching negative values along the entire Atlantic Coast. August is strikingly similar to June. In September the upward trends in the Mississippi Valley are less pronounced than in July and August; an area in the Southwest also shows positive changes in September. This upward trend is continued in October in the Southeast; October in the Central States is colder than previously, and in the South and Southeast is warmer. For November, the map shows the country divided diagonally from Montana to Mississippi; the Rocky Mountain area, especially, has a downward movement of temperature during the period. In December, the northern third of the United States was colder in the past 20 years than in the 20-year period preceding 1916; the greatest upward changes were in the Gulf and South Atlantic States.

The indications of temperature trends shown point out two facts which should be investigated further, probably from a synoptic approach: (1) Different regions of the United States do not show the same secular changes in temperature; (2) these changes are not always even in the same direction in a given locality for different months in

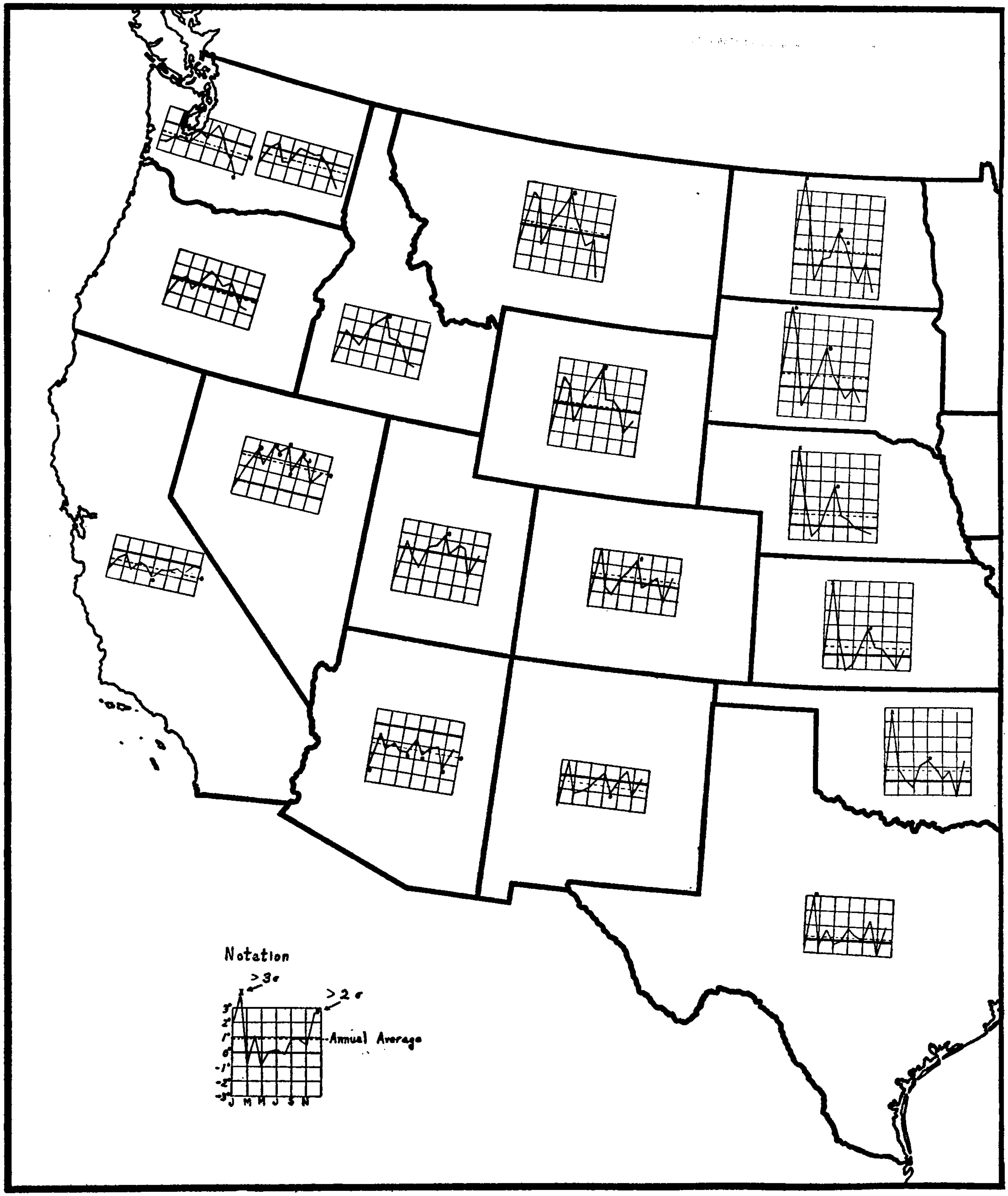

FIGURE 1.—The 1916–35 average of mean monthly State temperatures minus the 1896–1915 average.

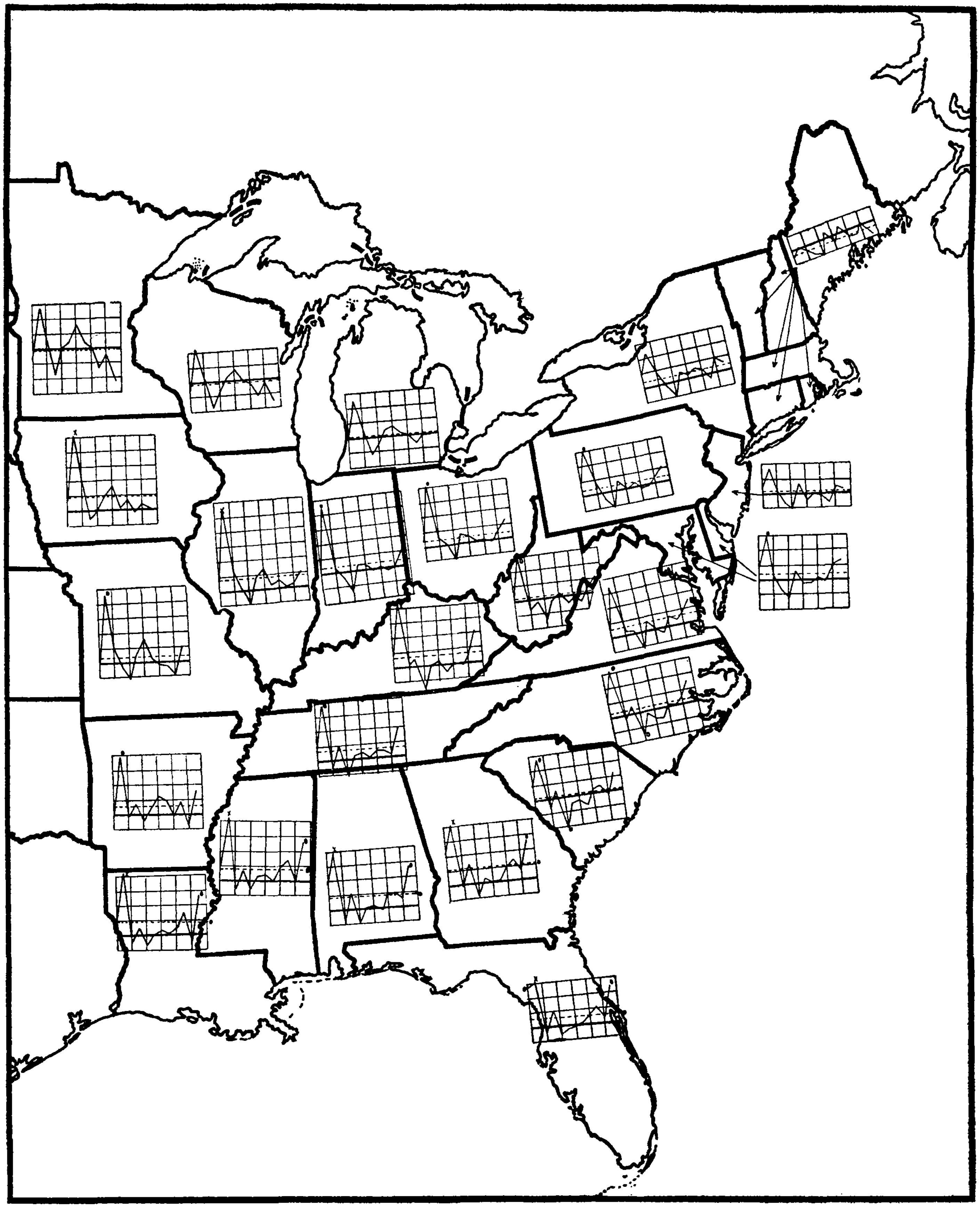

FIGURE 2.—The 1916–35 average of mean monthly State temperatures minus the 1896–1915 average.

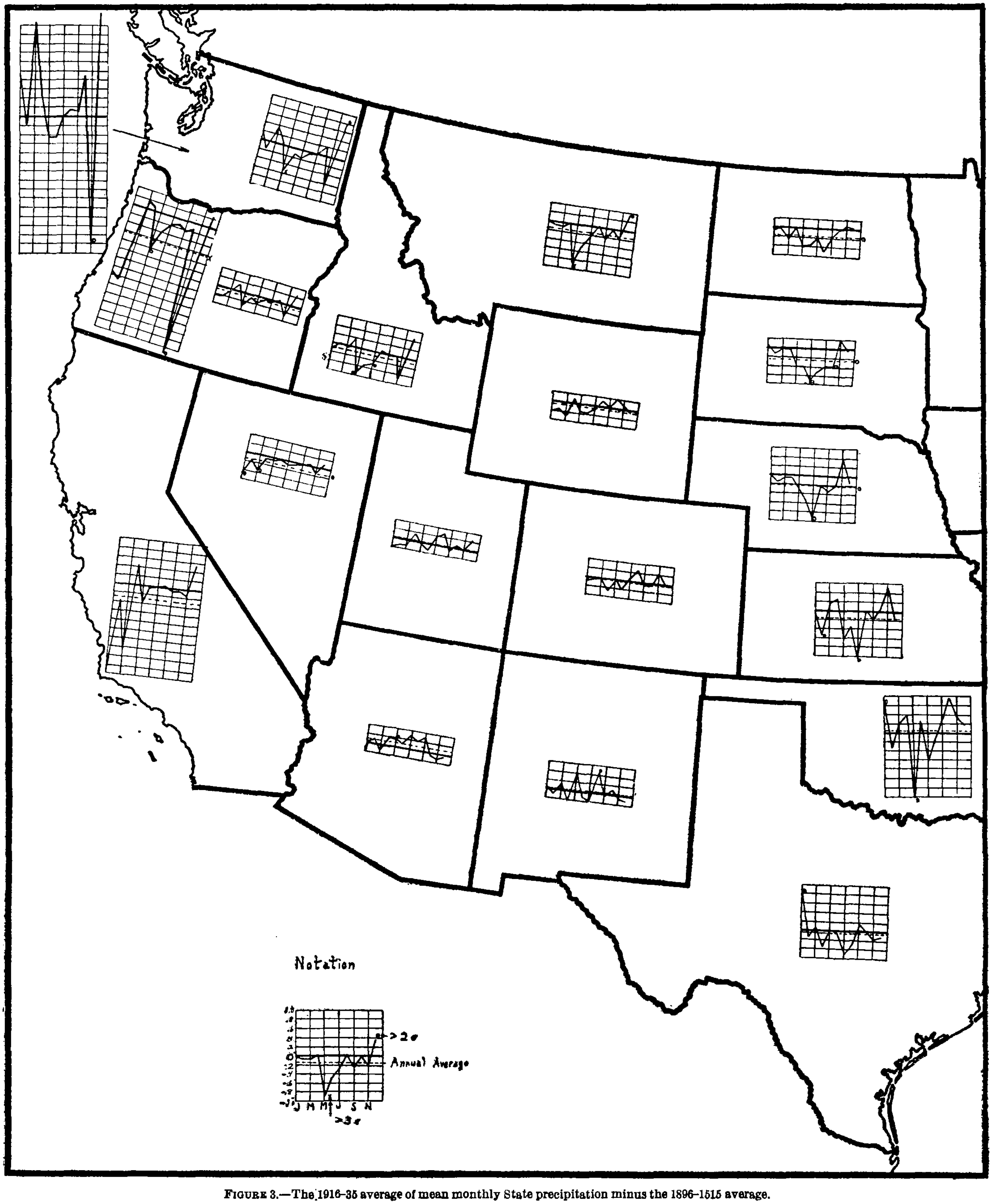

FIGURE 3.—The 1916–35 average of mean monthly State precipitation minus the 1896–1515 average.

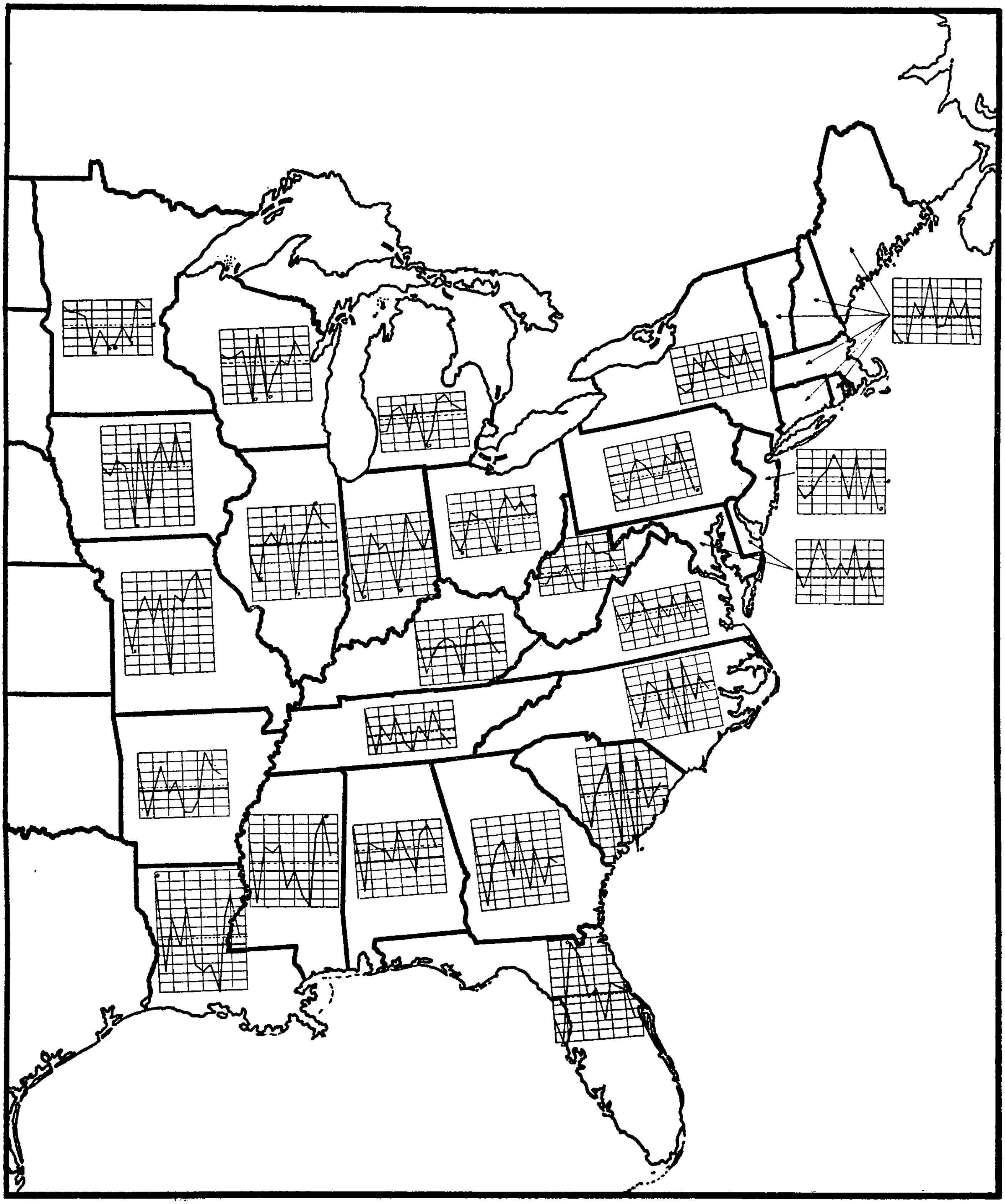

FIGURE 4.—The 1916–35 average of mean monthly State precipitation minus the 1896–1915 average.

the same meteorological season. It has been suggested that apparent increases in temperature over long periods are due to artificial factors—the growth of cities, a change in the hours of observation or, where sectional values are used, to a difference in the location of stations. Any explanation on the basis of general changes such as these is in general invalidated when adjoining months have different trends.

What effect do these trends have upon the average annual march of temperature? Figure 7 shows monthly

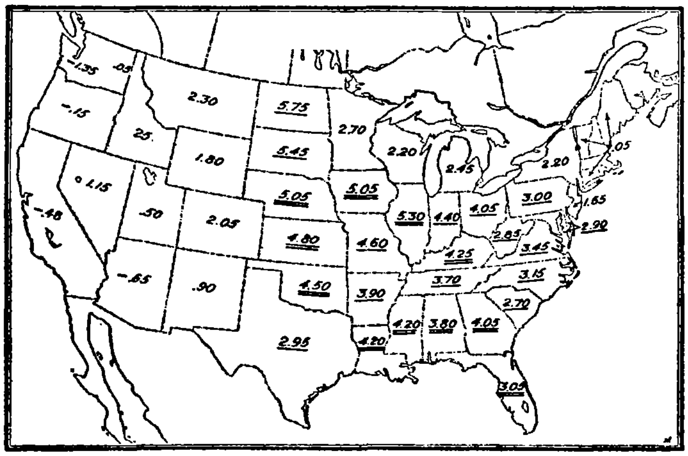

FIGURE 5.—The 1916–35 average of February State temperatures minus the 1896–1915 average. The doubly underlined values are those given in bold face in table 1; the singly underlined, those in italics.

average temperatures for three States, Ohio, Nebraska, and Georgia, for both 20-year periods. In Nebraska and Ohio the shape of the curve is changed somewhat, but in Georgia the averages for the winter months are raised consistently. Since neither of the two sets of averages can be said to represent the normal temperatures, the conclusion may be reached that often so-called normal

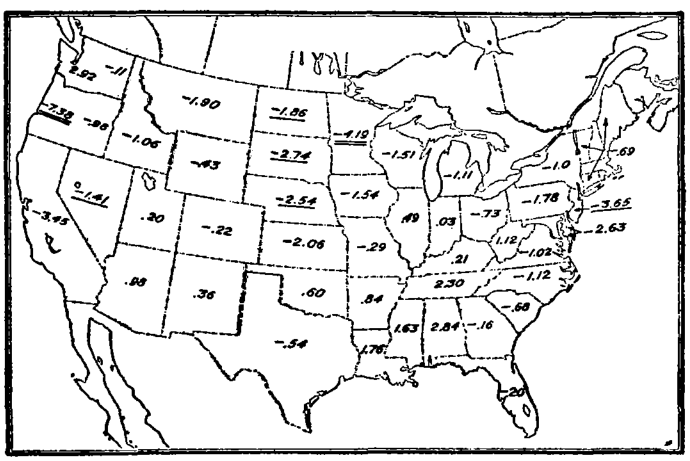

FIGURE 6.—The 1916–35 average of annual State precipitation minus the 1896–1915 average. The values shown are 12 times those given in table 2. The doubly underlined values correspond to those given in bold face; the singly underlined, to those in italics.

values are taken too seriously, without due regard to their instability.

As mentioned above, the temperature values for Nevada do not appear to be reliable. In each month, the trend in Nevada has a higher positive or lower negative value than that for the surrounding States. In attempting to find an explanation for this, it was discovered that the average altitude of the stations reporting in 1900 was 5,250 feet; in 1935, it was 4,925 feet, or an average decrease in altitude of 325 feet (about 100 meters). The average surface temperature in mountains decreases approximately at the rate of 1° C. for each 180 meters increase in altitude (4), so this reduction in altitude would account for about 1° F. increase in temperature. An adjustment on this basis would bring the Nevada averages more nearly in line with those of surrounding States. Another factor which may have some influence is the latitude of the station. Several of the later stations are located in the southeastern point of the State, which was represented in the early records by only one station.

The Arizona averages indicate uniformly lower temperatures than 20 to 40 years ago. The average altitude of the stations has changed but little. The five counties of

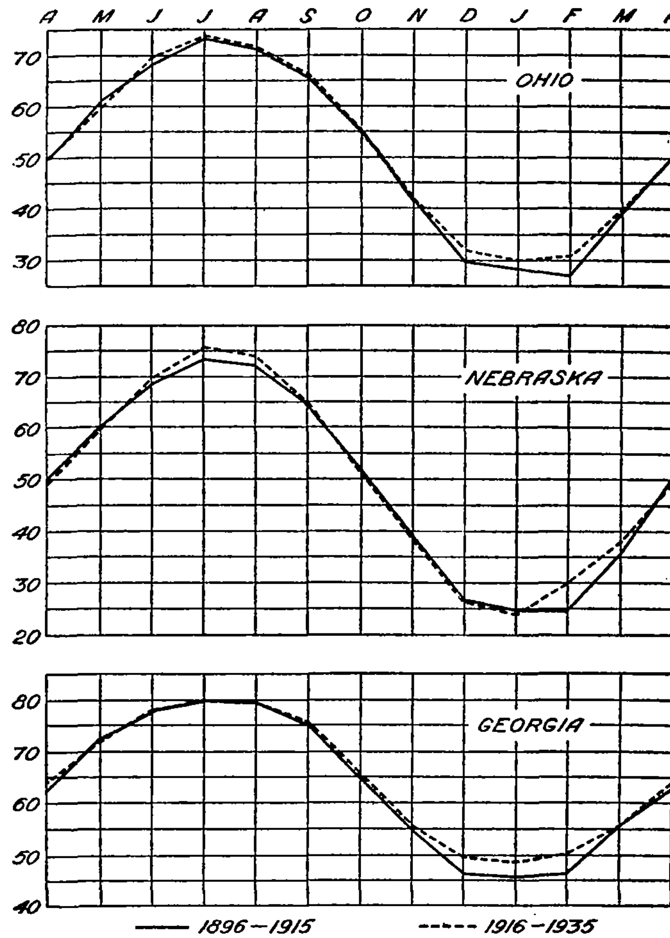

FIGURE 7.—Annual variation of temperature by months for Ohio, Nebraska, and Georgia.

Mojave, Coconino, Yavapai, Navajo, and Apache cover approximately the northern half of the State. In 1897, 26 percent of the stations were in these counties, but in 1935, 40 percent of the observations were in the northern half. This may account for the trend toward lower annual averages, but, of course, has no bearing on the differences between monthly trends.

Turning now to figures 3 and 4, we may investigate the changes in rainfall for the 20 years 1916–35 compared with the next previous period of the same length. Taking the year as a whole (the position of the dotted straight line refers to 1/12th the annual average difference), most of the country has had less rain in the period just passed through with the exception of a few southern states. The North Central States, particularly west of the Mississippi, have been hardest hit, with the possible exception of California and the western half of Oregon. A very interesting feature of this map, which will be mentioned again later, is the increase in rainfall in western Washington in contrast to the large falling off to the south.

In January, the South, from Texas eastward, except Florida, shows increasing rainfall, while western Oregon and California have decidedly decreased; the change in Oregon is not extremely large compared with its average of 8.40 inches for this month for the 40-year period, but the California average has dropped from 5.84 inches for the period, 1896–1915, to 3.84 inches for 1916–35; looking at the records of individual years, we find four with large precipitation: 1909 with 16.17 inches; 1911, 13.20 inches; 1914, 13.09 inches; 1916, 15.61 inches; the next highest January State rainfall in California was 6.79 inches in 1921. Such wide variations, however, indicate that even the large average difference of 2.00 inches is lacking in statistical significance. This indication is, of course, supported by comparison with the standard error of 1.18. Comparatively small changes are recorded in February for the western half of the United States, but significant reduction in precipitation in Missouri, Illinois, Indiana, and Ohio; the changes shown for these States are quite large compared with their averages for the entire period for this month, of from 2.00 inches in Missouri to 2.58 inches in Ohio. Although milder winters are often associated with heavier precipitation, almost every State has had less precipitation with higher temperatures in the past 20 years in February. The March and April data have nothing of particular note, except perhaps the increase in western Washington and the decrease in California in March.

In May, the Southeast has had increasing rainfall, while that in the west North Central and Northwest has decreased. The June points show a milder decrease in the latter areas together with slight decreases in precipitation in the South. The Missouri, Mississippi, and Ohio Valleys have had less rainfall in July than formerly, significant departures occurring in many States, particularly in the Corn Belt, where July rainfall is an important factor in the production of crops. August and September continue with lowered moisture in Minnesota, the Dakotas, Nebraska, and parts of the South, which is not statistically significant. October rainfall in the Ohio and lower Mississippi valleys has been somewhat more plentiful, but the opposite is true in Minnesota and South Dakota. Apparently the rainy season in Washington and Oregon has been starting later during the past 20 years, since the western portions of both of these states have been much drier in November, but show some increase in December. The Mississippi Valley rainfall has increased in November, especially in the South. December shows the most consistent changes in New England and the Middle Atlantic States, where some significant decreases are indicated.

Returning to the annual figures, which are plotted separately as figure 6, some questions arise. The yearly rainfall along the Pacific coast is determined almost entirely by that during the winter. Why has average precipitation in California and western Oregon decreased while it has increased in Washington? This precipitation is largely due to warm, humid winds from the Pacific. It seems that there has been a secular change in the forces which determine this movement. What is the cause behind this? Is it associated with the distributions of air masses which explain the lack of rainfall in the past few years in the Middle West, or are these more closely related to the increases in precipitation in the South? The answers to these questions would make a good beginning toward an understanding of long-time trends in our weather.

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TABLE 1.—*Temperature*

[1916–35 average minus 1896–1915 average]

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Alabama	1.80	3.80	−0.85	1.10	−0.95	0.05	0.20	−0.10	0.95	1.00	0.55	2.70	0.90
Arizona	−3.20	−.65	−1.60	−1.25	−1.60	−1.60	−.65	−1.65	−1.15	−.90	−2.40	−.90	−1.40
Arkansas	−.20	3.90	−.20	.65	−.45	.45	1.20	.95	−.15	.80	−.85	1.50	.60
California [1]	−1.48	−.48	−.13	−1.04	−.53	−.68	−1.42	−.73	−.69	−.43	−.63	.02	−.69
Colorado	−1.55	2.05	−.55	−1.00	.05	.70	1.50	−.30	.10	.50	−1.20	.60	.30
Florida	2.70	3.05	−.45	.90	−.60	−.30	−.15	.10	.55	1.05	.40	2.40	.60
Georgia	2.15	4.05	−.15	1.35	−.85	.35	.05	.10	1.00	1.40	.65	2.65	1.05
Idaho	−2.05	.25	−.15	−.65	.70	1.30	1.80	.40	.30	−.10	−1.05	−1.20	.00
Illinois	.70	5.30	1.35	.10	−.95	.80	1.35	.25	.50	.05	.25	1.10	.80
Indiana	.20	4.40	.30	−.35	−1.40	.40	.40	−.05	.15	−.15	.00	1.05	.40
Iowa	.75	5.05	2.05	−.55	−.05	1.00	1.55	.15	.70	−.15	.35	.05	.90
Kansas	−.20	4.80	1.35	−1.10	−.70	.60	1.80	.50	.45	−.10	−.85	.40	.55
Kentucky	.85	4.25	.15	.55	−1.55	.05	.25	−.40	.05	−.05	.40	2.05	.65
Louisiana	1.05	4.20	−.50	.50	−.65	.05	.35	.10	.50	1.50	−.45	2.60	.90
Maryland and Delaware	.80	2.90	.35	−.65	−1.25	.60	−.30	−.25	.15	−.10	1.05	1.35	.40
Michigan	.05	2.45	.55	−1.20	−.50	.45	.70	.20	.00	−.55	−.05	.00	.05
Minnesota	−.75	2.70	.55	−1.65	.05	.45	1.55	.45	.05	−1.35	−.45	−2.25	−.05
Mississippi	1.10	4.20	−.60	.70	−.55	.30	.35	.00	.90	1.35	.00	2.55	.85
Missouri	.05	4.60	.95	−.25	−1.15	.50	1.45	.15	−.20	−.30	−.85	1.00	.35
Montana	−1.45	2.30	1.90	−1.20	.45	1.30	2.55	1.10	.35	−.75	−.25	−2.75	.30
Nebraska	−.40	5.05	1.70	−.80	−.25	1.05	2.70	.70	.50	−.10	−.25	−.45	.75
Nevada	−.50	1.15	2.35	1.40	2.80	2.55	3.05	1.40	2.60	2.30	1.00	1.75	1.80
New England	−.65	.05	−.30	−.80	−.95	.45	−.45	.45	−.45	−.50	.15	−.85	−.35
New Jersey	.35	1.65	.25	−.65	−1.05	.65	−.45	.00	−.15	−.65	.50	.30	.15
New Mexico	−2.10	.90	−1.25	−1.05	−.75	−.05	.40	−.90	.10	.75	−.95	.30	−.45
New York	1.00	2.20	.85	−.30	−1.00	.50	.35	.60	.45	−.30	1.00	.60	.40
North Carolina	1.15	3.15	−.30	.50	−1.45	−.10	−.60	−.65	.15	.05	.45	1.50	.30
North Dakota	1.20	5.75	3.20	−1.15	.40	.60	2.35	1.55	.20	−.95	.50	−1.55	1.10
Ohio	.60	4.05	.55	.05	−1.05	.70	.45	.10	.10	−.10	.55	1.30	.40
Oklahoma	−.30	4.50	.85	.00	−.40	1.10	1.40	.90	.10	.70	−1.00	1.35	.75
Oregon	−1.35	−.15	.35	−.40	.25	1.15	.85	.40	.75	.05	−.60	−.75	−.05
Pennsylvania	.65	3.00	.80	−.45	−1.10	.65	.05	.30	−.15	−.10	.50	1.10	.40
South Carolina	1.00	2.70	−.65	.50	−2.10	−.40	−.30	−.75	.30	.50	−.20	1.20	.15
South Dakota	.55	5.45	2.95	−1.25	−.15	.90	2.90	1.10	.45	−.55	.25	−.75	.90
Tennessee	.65	3.70	−.50	.95	−1.15	.20	.45	.05	.50	.50	.20	1.90	.65
Texas	−.75	2.95	−.45	.70	−.25	.00	.85	.30	.10	1.40	−.95	1.15	.25
Utah	−2.45	.50	−.50	−1.15	.35	.55	1.40	.10	.75	.65	−1.25	.30	.00
Virginia	1.00	3.45	.30	.20	−1.15	.65	.00	−.35	.70	.35	.80	1.55	.60
Washington:													
Eastern	−1.35	.05	.50	−.75	−.70	.45	.30	.20	.40	−.20	−.80	−1.60	−.45
Western	−1.45	−1.35	−.85	−.80	−.90	−.05	−.35	.70	.10	−.80	−1.30	−2.10	−.75
West Virginia	.15	2.85	−.70	−.25	−1.40	−.15	.20	−.40	−.15	−.45	.40	1.10	.15
Wisconsin	−.55	2.20	.15	−1.75	−.65	.20	.75	.05	−.30	−1.05	−.25	−1.45	−.15
Wyoming	−2.45	1.80	1.15	−1.25	.45	1.45	2.75	.60	.65	.05	−1.40	−.65	.10

[1] California record, 1897–1935.

TABLE 2.—*Precipitation*

[1916–35 average minus 1896–1915 average]

	January	February	March	April	May	June	July	August	September	October	November	December	Annual ÷12
Alabama	0.78	−0.65	0.42	0.28	0.22	−0.06	0.60	0.09	−0.28	0.52	0.71	0.18	0.24
Arizona	.02	.10	−.09	.18	(*.16*)	.08	.30	.18	.31	−.05	−.10	−.05	.08
Arkansas	.54	−.56	−.00	.51	−.07	.18	−.50	−.51	−.21	.79	.42	.28	.07
California [1]	−2.00	−.36	−1.43	.45	−.39	−.02	.00	.03	−.07	−.06	−.16	.56	−.29
Colorado	−.08	−.04	−.01	−.26	−.02	−.22	.07	.24	−.06	−.06	.22	−.00	−.02
Florida	−.51	−*.98*	.16	(*1.13*)	.86	−.08	.10	−.60	.22	.10	.04	−.60	−.02
Georgia	1.84	−.90	−.13	.30	.50	−.34	.68	−.64	.24	−.58	−.00	−.12	−.01
Idaho	−.14	.02	−.01	.18	−*.56*	−.36	(−*.29*)	.06	−.02	.00	−.40	.44	−.09
Illinois	−.20	−.76	−.00	.26	−.02	.46	−1.10	.02	.31	*.79*	.44	.28	.04
Indiana	−.14	−*.88*	−.36	.45	.10	.20	−*.84*	−.08	.82	.36	.00	.38	.00
Iowa	−.08	−.27	.06	−.08	−*1.35*	.42	−1.05	.02	.44	−.18	.62	−.08	−.13
Kansas	−.06	(−*.56*)	.17	.24	−.62	−.33	−*1.06*	−.00	−.18	.04	.52	−.20	−.17
Kentucky	.40	−.54	−.13	.11	.20	.10	−.64	.34	.36	.49	.04	−.25	.02
Louisianna	*1.48*	−.54	.56	−.01	.82	−.46	−.54	−.44	−1.02	.62	1.08	.15	.15
Maryland and Delaware	−.07	−.44	.06	.58	.18	−.24	.11	−.14	.53	−.30	.15	−.66	−.22
Michigan	−.36	−.34	.08	.18	−.36	.21	−*.76*	−.42	.24	.35	.14	.05	−.09
Minnesota	.10	−.03	−.05	−.14	−*.91*	−.46	−*.82*	−*.78*	−.38	−.72	.20	.06	−.35
Mississippi	.65	−.72	.52	.40	.56	−.40	−.02	−.55	−.78	.80	*1.14*	.28	.14
Missouri	−.06	−.89	−.04	.28	−.28	.28	−1.42	.26	.12	.55	.76	.18	−.02
Montana	−.02	−.07	−.08	.02	−.88	−.48	−.26	.02	−.23	−.02	−.20	(*.34*)	−.16
Nebraska	.00	−.14	−.06	−.04	−.30	−.54	−*.94*	−.20	−.35	−.22	.41	−.14	−*.21*
Nevada	(−*.48*)	−.15	(−*.34*)	−.04	−.06	−.00	−.09	−.04	−.02	.04	−.11	.10	−*.12*
New England	−.32	−.54	−.61	.28	−.08	.82	−.25	−.20	.40	−.02	.34	−.48	−.06
New Jersey	−.42	−.66	−.50	−.19	−.04	.30	−.03	−.68	.30	−.72	−.02	−*.90*	−*.30*
New Mexico	.04	−.09	.14	−.22	.39	−.10	−.18	*.46*	−.04	.11	−.05	−.11	.03
New York	−.19	−.38	−.32	.34	.03	.44	−.10	−.26	.32	.02	.38	−.44	−.01
North Carolina	.44	−.74	−.26	.26	.02	−.66	.41	−1.00	.54	−.34	.14	−.16	−.09
North Dakota	.00	−.02	−.24	.00	−.42	−.38	−.22	−.51	−.20	−.01	.07	.04	−*.16*
Ohio	−.16	−*.65*	−.36	.18	.02	−.03	−.77	.16	.47	.12	.30	−.04	−.06
Oklahoma	(*.64*)	−.36	.22	.38	−*1.42*	.26	−.62	−.14	.29	.76	.34	.16	.05
Oregon:													
Western	−1.52	−1.65	.20	.10	−*.82*	−.40	−.16	−.11	−.21	−.14	−*2.92*	.24	−.62
Eastern	−.22	−.20	−.05	.15	−.31	−.08	−.17	−.04	−.04	.04	−.27	.22	−.08
Pennsylvania	−.40	−.58	−.58	−.02	.23	.08	−.24	−.26	.18	−.01	.46	−*.69*	−.15
South Carolina	.46	−.74	−.04	.30	.62	−*1.19*	.98	−*1.34*	.72	−.46	−.12	.08	−.06
South Dakota	.04	−.12	−.02	−.04	−.38	−.38	−*.70*	−.51	−.38	−*.40*	.20	−.04	−*.23*
Tennessee	.74	−.18	.38	.04	.54	.00	−.22	.32	.02	.63	.12	−.16	.19
Texas	(*.82*)	−.12	.08	−.36	.02	−.03	−.50	−.32	.14	.00	−.15	−.12	−.04
Utah	−.20	−.14	−.12	.17	−.03	−.14	.18	.26	−.06	.05	−.00	.22	.02
Virginia	.20	−.37	−.19	.40	.04	−.63	.08	−.24	.20	−.42	.22	−.28	−.08
Washington:													
Eastern	.18	−.18	.36	.09	−.54	−.13	−.18	−.04	.00	.18	−.66	*.78*	−.01
Western	.96	−.18	2.08	.46	−.47	−.45	−.00	.16	.11	.90	−*2.74*	2.08	.24
West Virginia	−.12	−.15	.08	.04	.22	−.32	−.40	.66	.38	.39	.32	−.04	.09
Wisconsin	.08	−.03	.04	.14	−*.94*	.48	−*.88*	−.40	−.08	−.21	.30	.01	−.13
Wyoming	−.21	−.14	−.26	.12	−.15	−.19	−.06	.14	.02	.20	.08	−.04	−.04

[1] California record 1897–1935.