Source Materials for the Study of Oklahoma's Climate[1]

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The purpose of this paper is to call to the attention of Oklahoma geographers and other interested persons the most important statistical materials, maps, and general analytical writings which contribute to an understanding of the climate of our state. Since it appears to be both impractical and undesirable to consider Oklahoma in isolation — indeed, one wonders just what kind of climate Oklahoma would have were there no external influences involved — most of the materials mentioned are of regional, national, or even international scope.

The concept of periodic fluctuations in the climate of Oklahoma is well authenticated by numerous studies of prehistoric vegetation, animal life, and Indian settlements. Statistical data of any kind for more precise studies of climatic means and climatic variability are available only for a little more than a century, and many of the most reliable station records are shorter in length than a half century.

As early as May, 1814, hospital surgeons at military posts in the United States were ordered to keep a regular diary of the weather conditions. In July, 1818, the Surgeon-General, Dr. Joseph Lovell, distributed to the various military posts instructions for taking the observations. Unfortunately, the hours at which observations were to be taken were not kept constant, and uncertainties as to the local standard of time employed are such as to lessen considerably the comparability of data for the first several decades of observations. From these early observations of Army medical officers, however, there resulted a series of four "Meteorological Registers," providing much valuable information on maximum, minimum, and mean temperatures, wind direction, precipitation, and other weather conditions. In 1860 the Surgeon-General published a comprehensive work covering the observations of medical officers over a period of forty years. The meteorological organization of the Army Medical Corps was abandoned in 1874, and in June of that year the post surgeons began sending their weather reports to the Army Signal Service. All weather records and reports since July 1, 1891, have been sent to the U.S. Weather Bureau, which until 1939 was part of the Department of Agriculture and since 1940 has been in the Department of Commerce. A useful summary of the status of weather observation in the United States up to 1935 is included in the introduction to the United States section of the Köppen-Geiger *Handbuch* (Ward and Brooks, 1936).

In 1847 a young, semi-independent agency in Washington, the Smithsonian Institution, began collecting and analyzing weather data under the encouragement of its first Secretary, Professor Joseph Henry. By the end of 1849 the Smithsonian Institution was receiving reports from 150 regular daily observers, and by 1861 this number had increased to 616. Standard barometers and thermometers were imported from Europe as a check on accuracy, and sets of instruments were supplied to cooperating observers over the country. A system of daily telegraphic reports was instituted as early as 1849, and shortly thereafter the Smithsonian was displaying for the public a regular daily weather map. In February, 1874, the routine weather work of the Smithsonian Institution was turned over to the Army Signal Corps, but the Smithsonian has maintained an

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interest in meteorology and has published a number of valuable research studies. Dr. Arnold Guyot, the Swiss scholar who served for many years at Princeton as a Professor of Physical Geography, prepared a significant compilation of meteorological tables for publication by the Smithsonian in 1852. Five years later, in 1857, the J. B. Lippincott Company of Philadelphia published Blodget's *Climatology of the United States* (1857), based on the records of 583 stations in the United States, including five in Indian Territory. These station reports included monthly and annual mean temperatures for Fort Gibson based on a 27-year record, for Fort Towson based on a 20-year record, for Fort Washita based on a 12-year record, and for Fort Arbuckle based on a 5-year record.

Fifty years after the appearance of Blodget's (1857) *Climatology,* at the time of admission to statehood, Oklahoma had about seventy reporting stations, although the records of precipitation and twice-daily temperature observations from many of these stations, then being reported in the *Annual Report of the Chief of the Weather Bureau,* were fragmentary and unreliable. Climatological data for reporting stations scattered over the United States were published in bulletins under various titles for the first twenty years or so of the Weather Bureau, then starting in 1910 were reported in the Bureau's *Monthly Weather Review,* and since January, 1914, in a series entitled *Climatological Data for the United States by Sections.* A massive compilation under this title for the period of record through 1920 was published in 48 sections by the Weather Bureau, and in addition to precipitation and mean temperature data it included for a number of stations information on temperature extremes, mean maximum and mean minimum temperatures, prevailing wind directions, average wind velocity, average number of days with 0.01 inch or more of precipitation, average monthly and annual snowfall, average dates of the first and last killing frost, average percent of relative humidity, and average percent of possible sunshine. Only the Oklahoma City station at that time was reporting wind velocity, relative humidity, and sky conditions.

Another edition of *Climatological Data for the United States by Sections,* generally known as Bulletin W, was issued during the 1930's carrying the summaries of individual station data through the year 1930. Since that time there has been one major *Supplement to the Climatic Summary of the United States* (Bulletin W, 1930 edition) covering the years 1931 through 1952. For the years since 1952 the Oklahoma weather record is reported in a series of annual and monthly summaries entitled *Climatological Data: Oklahoma,* our state being one of the 43 sections into which the country is now divided for this purpose.

In the latest annual summary, that for 1958, some weather statistics are reported for each of 250 stations, the two newest of which, at the sites of Keystone Dam and Eufala Dam, had been in operation for only one year. The records of nearly one hundred stations, well distributed over the state, are sufficiently complete for a period of 35 years or longer so that analyses can now be made of the weather conditions in Oklahoma during a complete Brückner cycle. Data for these stations have been put on punch cards for machine handling, and the first M.A. thesis on Oklahoma climate using modern computer techniques is now in process at the University of Oklahoma.

A recent Weather Bureau publication entitled *Substation History, Oklahoma,* provides a summary of information on all of the weather station locations which had been used in the state through the year 1955, with facts concerning the elevations, exposures, instrumentation, periods of record, and even the names of local observers insofar as they could be determined. Detailed descriptive analyses of the weather at approximately 270 stations in the United States, including Oklahoma City and Tulsa, are

available in a Weather Bureau seriel entitled *Local Climatological Data,* Monthly, Monthly Supplement and Annual Summary. This publication supersedes former publications entitled *Local Climatological Summary* and *Station Meteorological Summary.* A valuable pamphlet series on the climate of the individual states under the general title *Supplements to Climatic Summary of the United States Containing Data from 1931 through 1952* is being published by the Bureau, although at the time of writing (December, 1959) the Oklahoma number in the series had not yet appeared. Much raw material for climatic research is also available in the *Daily Weather Map* and the *Weekly Weather* and *Crop Bulletin* series.

The United States Weather Bureau has made and is making available a wealth of statistical material on the weather and climate of Oklahoma, although most of the facts presented have not been subjected to detailed study. The Bureau's *Monthly Weather Review* has been appearing regularly since 1872, publishing many articles of a descriptive or analytical nature, some of them bearing directly on the climate of this state. Many longer monographs on storm types, periodic weather means and extremes, unusual precipitation conditions, and other special phenomena have appeared in the *Monthly Weather Review* Supplement series, started in 1914, and more recently in a new series entitled U.S. Weather Bureau *Technical Bulletins.*

Maps showing various climatic distributions in Oklahoma have been published from time to time in the *Climatological Data* (by sections) series and for the period preceding 1940 in the Oklahoma section of *Climate and Man,* the 1941 Yearbook of the U.S. Department of Agriculture. Most of the cartographic representation available, however, covers the entire country or the continent. The early United States maps of A. J. Henry, published around the turn of the century, have been refined in several subsequent compilations, among the most important of which are those of J. B. Kincer published between 1917 and 1928 for the *Atlas of American Agriculture,* the maps of Robert DeCourcey Ward published in 1925 in his still useful book, *The Climates of the United States;* the series of *Climatic Maps of North America,* prepared by C. F. Brooks, A. J. Conner, and others, published as separate sheets by the Harvard University Press in 1936 and in smaller format in Volume II of the Köppen and Geiger, *Handbuch der Klimatologie;* C. Warren Thornthwaite's *Atlas of Climatic Types in the United States,* 1900-1939, published in 1941 as Miscellaneous Publication No. 421 of the U.S. Soil Conservation Service; and, finally, S. S. Visher's *Climatic Atlas of the United States,* issued by the Harvard University Press in 1954.

The problem of climatic classification in the United States, approached in a tentative way more than 50 years ago by A. W. Greely, A. J. Henry, and W. G. Reed, was also confronted by European scholars, particularly Alexander Woeikof, Julius Hann, Alexander Supan, Wladimir Köppen, A. J. Herbertson, and Emmanuel DeMartonne, all of whom devised world-wide schemes of climatic types . Among modern geographers the classifications of Köppen, with refinements by R. J. Russell, Glenn T. Trewartha, and others, and those of Thornthwaite, formerly a staff member of the Department of Geography of the University of Oklahoma, have been most used. For educational purposes it has proved particularly difficult to find one that is complex enough to recognize all important regional differences and simple enough to be mastered by highschool or college students.

For those persons interested in correlating the climatic record with astronomical phenomena, major world air mases, surface sea temperatures, upper and surface wind and pressure conditions, special frontal situations, crop results, and other physical or cultural circumstances, the challenges are obvious. The climate of Oklahoma, envisioned already in its broad

outlines more than a century ago by Lorin Blodget and his contemporaries, still needs much careful observation and analysis. The statistical and cartographic raw materials are now reasonably available, but many of us when confronted by such a seemingly simple question as "Is our climate changing?" prefer such a simple answer as, "Well, the weather certainly is. As for the climate, let's wait and see."

LITERATURE CITED

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