

DECADE OF DISCONSOLATION

By Tom St. Martin

INTRODUCTION

An estimated 500 farmers, some armed, stormed the business district of England, Arkansas demanding food and threatening to take it forcefully. The business community appealed to the American Red Cross which responded by authorizing \$2.75 for each of the families involved. The farmers came from a rich agricultural region ravaged by drought.

Army engineers reported that the Mississippi River was an extremely low stage.

Water in the Mississippi River is at a lower level than at any time in the last seventy years.

More than 3,000 firefighters are now in the northern Minnesota woods area. Parched soil and dried out underbrush have created a fire hazard in every northern county according to A. F. Oppel, deputy state forester. Hundreds of small blazes reported. A thin pall of smoke hangs over the entire northern portion of the state. There is an impending threat of a roaring inferno.

Dust borne on northwest winds of high velocity shrouded the sun in Minnesota in neighboring states . It was the worst storm of its kind in recent years. It turned day into dusk and halted vehicular traffic. Office buildings and homes could not hold the dust out.

Grasshoppers, tiny but vigorous and with ravenous appetites invaded grain fields in the Argyle locality in great numbers and with a suddenness that caught the grasshopper fighting organizations unprepared. The drought has held back growth of vegetation in the hatching grounds and the hungry grasshoppers have moved into the fields and are devastating tender grass, leaving no signs of growth behind.

Open rebellion among Stevens County farmers on the progress of drought relief flamed up during the past week. Thirty five farmers presented their complaints to Governor Floyd B. Olson. The county is not getting the amount of drought relief that was promised. More than one thousand persons attended a mass meeting in Montevideo in the interest of obtaining more adequate relief for Minnesota drought areas.

Normal crop is believed impossible: many areas beyond the help of good rains. Secretary of Agriculture Wallace says drought will not cause a food shortage.

Budding bushes and trees and lawns were a verdant green this morning as a thirty minute rain late yesterday washed off the dust with which they have been laden the past few weeks.

Many area lakes are dry and others are five to six feet below normal levels. Subsoil water has receded from ten to twelve feet below the ground.

The drought has brought a calamity never before experienced in this county. Nearly all pastures are barren of grass and many farmers are without feed of any kind for their livestock except only that which they can obtain through drought relief. Cattle are dying of starvation. Other cattle are being made ill by the dust and dirt that coats every mouthful of grass.

As another heat wave headed into the northwest the federal Agricultural Adjustment Administration (AAA) officially classified 352 counties in eleven states as drought stricken. During the past months the severe dust storms have piled up so much dust in the ditches that drainage will be retarded. Ditches in places are filled to a depth of three feet. There has been no rain to speak of in Brown County since the forepart of April.

The foregoing excerpts --some of them paraphrased, most of them direct quotes -- are taken from various Minnesota newspapers during what, whether from a meteorological, economic or sociological standpoint, was indisputably one of the most disconsolate, miserable eras in the history of the United States, the Upper Midwest and the Plains states in particular. During the entire ten year period beginning in 1930 and ending in 1939, wide areas of the country were afflicted by extended periods of extreme drought, frequent dust storms and unprecedented summer heat waves. Tragically, this ten year siege of perverse weather was more or less coterminous with a prolonged economic depression which began with the Great Stock Market Crash of 29 October 1929 and which persisted, a few intervening but weak, short lived economic upturns notwithstanding, until the outbreak of World War II in the autumn of 1939. The result, of course, was widespread and intense human suffering, political turmoil and, in some instances at least, the threat, if not the reality, of mass violence.

The political, economic and sociological aspects of the latter -- of what is now called the Great Depression -- have, of course, been treated extensively in literature (e.g. Steinbeck's "Grapes of Wrath") and in numerous economic and political treatises. So far as I know, however, the meteorological/climatological dimension of the so-called "dirty thirties" has been neglected, seemingly even forgotten by a generation which, in many quarters, has become blindly caught up in controversies engendered by the worldwide warming trend which began in the 1980's, the causes and implications of which, at the time of this writing, are the focus of a lively debate involving climatologists, environmentalists, politicians and business interests. It is my hope, then (and a modest hope it is) that what follows will jog the memories of those who might read it, thereby helping them to see that "global warming" is neither a new nor a unique phenomenon. I would hasten to add, however, that this particular contemporary

concern is only one of several factors which prompted me to write a meteorological history of the 1930's. It is, rather, a secondary factor which, in my view at least, is a concern of little relative importance. Which is to say that the climatic anomalies of the 1930's even if they are now seen as little more than a backdrop for contemporary controversies --- are of intrinsic historical significance, having substantively influenced and even shaped many aspects of American life, not only in the years immediately preceding World War II but in the years beyond. Or, to put it differently, the dust storms, the droughts and the heat waves of the 1930's, although most certainly providing a perspective helpful in gauging the magnitude and extent of the changes taking place in today's global climate, warrant consideration in their own right, an episode not be forgotten or dismissed as something peripheral to the American experience.

With this in mind, I have attempted to compile an integrated but by no means exhaustive -- account of the meteorological events of the 1930's. What follows is, however, more than a mere compilation or aggregation of climatic statistics. Any account of the anomalous climatic events of the "dirty thirties" must, of course, include large amounts of quantitative data. My account, however, will, in addition to the indispensable numbers, include a large amount of qualitative material gleaned from newspapers and other sources material which will focus on the human dimension of the Dust Bowl years. I have, moreover, included a considerable amount of information pertaining to states other than Minnesota, information emphasizing an obvious fact, namely the fact that many other parts of the nation were afflicted by the 1930's drought and heat, some clearly experiencing adverse weather conditions worse than those experienced by Minnesota residents (e.g. Minnesota escaped the worst ravages of the massive drought which afflicted much of the southern, central and eastern parts of the United States in 1930).

As noted, much of the material contained in the ensuing account was obtained from various Minnesota newspapers, particularly those published in communities with reliable, complete 1930's weather records and/or published in communities whose records were assumed to be representative of weather conditions in a larger geographical area (e.g. the Moorhead and Argyle records were assumed to be representative of 1930's weather conditions in the Red River Valley region). Other sources include the Monthly Weather Review published by the United States Weather Bureau, then part of the United States department of agriculture (now the National Weather Service, United States department of commerce); Minnesota Monthly Climatological Data, vols. XXXVI through XLV, also published by the United States Weather Bureau; the daily local record (consisting of Weather Bureau forms 1001, 1032 and 1014) kept during the 1930's by observers at the Minneapolis Weather Bureau office; a book entitled "Dust Bowl: The Southern Plains in the 1930's" by Donald Worster (Oxford University Press, 1979); and "Climate and Man: Yearbook of Agriculture, 1941" published by the United States department of agriculture. With the exception of Worster's book, all of the foregoing source documents were provided courtesy of the Minnesota State Climatology Office, Minnesota Department of Natural Resources (DNR) and the Minnesota History Center (MHS).

Any attempt to gauge the extent and intensity of the climatic anomalies of the 1930's must, of course, entail comparison of specific monthly, yearly and/or decennary totals and averages with long term normals and trends. In all instances, the normal temperature and precipitation values cited herein are those established by the U.S. Weather Bureau for the period, 1891 (when the Weather Bureau was established) through the 1930's. So far as can be determined, all individual station normals are the simple averages of temperature and precipitation as recorded at each of approximately ninety sites during this period of record (or for a shorter period for stations which were established after 1891). Annual statewide averages, moreover, are a simple, aggregate average of the values recorded at the various individual station during any given month and/or year. And long term statewide normals, accordingly, are the simple average of the annual averages recorded during the years, 1891 through 1939. Regrettably, however, the 1891-1939 averages, whether for a particular station, for the state as a whole and/or for the entire period of record, differ in many important respects from the Minnesota climatological normals now used by the National Weather Service. First, the 1930's normals obviously do not reflect changes in temperature and precipitation trends which have occurred since the end of the 1930's (e.g. beginning in the late 1960's and continuing into the opening years of the twenty first century, Minnesota has experienced an almost unbroken series of wet years, the result of which has been a marked increase in "normal" precipitation values, both statewide and for most individual stations). Second, so far as can be determined, the 1891-1939 long term values, because they are simple (i.e. unweighted or unadjusted) averages, do not take into account the uneven geographical distribution of the approximately ninety established stations, data from which were used to compute 1930's normals. Accordingly, temperature and, more especially, precipitation normals would, *ceteris paribus*, be skewed in favor of densely distributed stations representing relatively small geographic areas. Third, use of simple averages failed to take into account differences in the times at which station self-registering maximum-minimum thermometers were read and re-set. So far as can be determined, some 1930's observers regularly took readings in the early morning, a practice which would yield relatively lower monthly averages (the result of the "double minima" effect) than those obtained from observations taken at midnight (the standard then used by regular Weather Bureau stations such as Minneapolis or Duluth). Conversely, readings taken by 1930's observers in the late afternoon or early evening (e.g. the 1600 hour observation time which, so far as can be determined, was standard at the Morris cooperative station during the 1930's) would tend to yield monthly averages higher (the result of the "double maxima" effect) than averages obtained from readings taken at other times of the day. The exact effect of an unadjusted "mix" of average temperatures derived from early morning, late afternoon, evening and midnight readings is, of course, difficult to determine. It is likely, however, that statewide average temperatures (whether monthly, annual or long term) as computed during the 1930's are probably significantly different than the averages which would have been obtained had all values been adjusted to the midnight-midnight standard (which is now used by climatologists to homogenize averages derived from morning, afternoon or evening readings).

Besides recurring episodes of drought and extreme heat, the 1930's featured several

notably anomalous winters, grasshopper infestations, forest fires, severe weather outbreaks, and, of course, economic distress resulting from heavy and recurring crop and livestock losses in a state that, in the 1930's, was predominantly rural and agricultural. Thus, in addition to a chronological overview of the meteorological events of the 1930's, the ensuing account includes sections specifically devoted to topics such as the fall and winter of 1935-1936; the winter of 1930-1931; the grasshopper war of 1932-1933; etc. I have also included an appendix containing the 1930-1939 precipitation and temperature records from twenty four Minnesota stations located in various regions of the state (south central, east central, north central, west central, northeastern, southeastern, northwestern and southwestern). Also included is a chart (appendix: figures 1 and 1A) showing statewide average precipitation and temperature for each month and year of the 1930's, comparing them with the U.S. Weather Bureau's 1891-1939 long term monthly and annual values. This table indicates, inter alia, that average annual precipitation during the 1930's as a whole was approximately 91 percent of the long term average, ranging from a low of 73 percent of normal in 1936 to 114 percent of normal in 1938 (a notably wet, warm year). It also indicates that precipitation deficits tended to be most pronounced during the early spring, summer and early autumn months (e.g. average July precipitation during the decade was approximately 22 percent below the then accepted July norm).

Yet, whatever their limitations and shortcomings, weather records kept during the 1930's unambiguously and often dramatically document a ten year siege of irascible and extreme weather, the like of which Minnesota had not experienced since European settlement of the Upper Midwest and which it has not experienced since. There have, to be sure, been other episodes of drought and/or heat: 1863-1864; 1889-1890; 1910; 1948; 1954-1955; 1976; 1987-1989. But none, at least up to the time of this writing, have been as prolonged and abnormal as the ten year period which ended in 1939, a decade which produced adverse weather almost beyond belief but which, in a more positive vein, featured a pastiche of interesting, sometimes even humorous, weather events (e.g. the great "toad" cloudburst at Morris, Minnesota in August 1935). It is these events, whether tragic, devastating and/or fascinating which I have attempted to document and which, I hope, will be widely read by anyone with an interest even a passing interest -- in weather history.

Thomas St. Martin
8965 Thomas Lane
Woodbury Mn 55125
15 August 2004

THE 1930'S: A CLIMATOLOGICAL OVERVIEW

To the extent that they have any impressions or memories of the Dust Bowl era, many people tend to think of it as a ten year period of uninterrupted, unremitting and universal heat and drought. But, although dry and hot they certainly were, the 1930's were not unrelentingly and uniformly dry and hot. The winter of 1935-1936, for example, was one of the coldest winters on record, not only in Minnesota but in much of the United States as well. Moreover, a pattern of persistently hot summers notwithstanding, only six years of the ten featured statewide average annual temperatures which exceeded the then accepted Minnesota annual average of 41.6 F. The warmest year of the decade (and the warmest recorded up to that time) was 1931 with a statewide average of 46.9 F. The coldest of the decade was 1936 (39.7F), a year of extremes, featuring a record hot July (77.1 F) and a record cold February (-5.5 F). Other notably warm years included 1930, 1934, 1938 and 1939, all with statewide averages ranging from 1.5 to 2.0 F above the 1891-1939 Minnesota normal.

There were also intervals in which some portions of the state, if not the state as a whole, received above normal sometimes even excessive amounts of precipitation. The winter of 1936-1937 was, for example, one of the wettest winters of record and May 1938 was the wettest May recorded by Minnesota observers during the entire period, 1891 through 1939. Moreover, each year of the decade (including 1936 which, overall, was the driest year of the lot) brought adequate to above normal precipitation to a few fortunate areas of the state. Some of the favored locations included the Pigeon River Bridge station (36.87; 36.86 and 39.27 inches of precipitation in 1930, 1932 and 1933, respectively); Grand Meadow (32.19 inches of precipitation in 1931); Red Wing (32.70 inches of precipitation in 1934); Winona (36.78 and 47.89 inches of precipitation in 1935 and 1938, respectively); Zumbrota (29.50 inches of precipitation in 1936); and Wheaton (31.02 inches of precipitation in 1937). Other Minnesota stations reporting thirty or more inches of moisture in any given year included New Ulm (1930 and 1932); Brainerd, Chaska and Maple Plain (1938); Duluth (1931); Orr (1932 and 1937); and Rochester (1930, 1931, 1935 and 1938).

In most instances, of course, above normal precipitation values such as these were atypical, reflecting in part the downpours produced by the isolated convection storms characteristic of drought years. When viewed from a statewide perspective, only three of ten years from 1930 through 1939 featured annual average precipitation values which approached or exceeded the then accepted statewide average of 25.1 inches. As noted, the wettest year of the ten was 1938 (statewide average of 28.5 inches), the greatest annual statewide average since 1911 (28.9 inches). In most other years, particularly those from 1930 through 1934, most areas of the state were, in fact, devastated by extended periods of extreme drought and extreme spring and summer heat, a reality which obviously has done much to shape perceptions of the decade as a whole. Moreover, many Minnesota stations regularly recorded less than twenty inches of precipitation, whether in any given year or in a succession of years and, in several extreme instances, annual precipitation totals dropped below ten inches (e.g. Moorhead observers recorded a mere 8.87 inches of precipitation in 1936, a total approximately 60 percent below the station's then accepted annual normal of 23.3 inches). Also, when averaged for the entire ten year period, 1930-1939, annual precipitation values for most Minnesota stations fell significantly below corresponding long term normals (e.g. annual precipitation during the 1930's averaged 23.4 inches at the Minneapolis Weather Bureau station, a value approximately 15 percent below that station's then accepted normal of 27.7 inches).

Although the drought of the 1930's was, arguably, the culmination of a trend which, at least in Minnesota, began in the 1920's, the extended heat waves which accompanied it were largely unprecedented. Summer temperatures above 100 F were, of course, not new to Minnesota: periods of hot summer weather (popularly termed heat waves) are a typical feature of Minnesota's continental climate. Moreover, in years such as 1830, 1850, 1856, 1863-64, 1868, 1894, 1901, 1910 and 1916, the state experienced prolonged sieges of midsummer heat and/or drought. The persistence and intensity of the heat of the 1930's was, however, without historical precedent. Temperatures soared to 111 F and 109 F at Beardsley Minnesota on 11 September 1931 and 25 June 1933, respectively; to 113 F at Milan Minnesota on 21 July 1934; to 112 F at Maple Plain on 31 May 1934; and to 114 F (originally recorded as 113.6 F) at Moorhead Minnesota during a devastating heat wave which raised temperatures above 100 F at most Minnesota stations every day from 6-16 July 1936. And, as noted, the heat was typically accompanied by extreme drought and drying winds. At the Redwood Falls, New London and Alexandria stations, for example, observers recorded only 3.02, 1.04, and 3.48 inches of precipitation, respectively, during the first five months of 1934. Even more extreme, precipitation at the Moorhead station totaled only 8.7 inches from 1 December 1935 through 30 November 1936, a meager 3.34 inches of which fell during the scorching 1936 growing season, 1 May through 30 September.

In what must be one of the more unfortunate coincidences of history, the drought and heat of the 1930's burst upon the nation during the first full year of the Great Depression, adding climatic calamity to economic calamity. In many respects, the first year of drought was the worst, both in its geographical extent and in its intensity, bringing unprecedented dryness to an area stretching across the mid-section of the country from Texas to the mid-Atlantic states (Maryland and Virginia especially). Although a significant portion of Minnesota

escaped the worst of this initial onslaught of drought and heat, the state as a whole was both considerably drier and warmer than normal: 1930 statewide precipitation averaged out at approximately 22.8 inches, a value greater than the corresponding value for 1929, but still about ten percent below the then accepted statewide normal of 25.1 inches. Although several months during 1930 (e.g. May, September, November) featured generally above normal precipitation, other months (August in particular) were abnormally dry. According to U.G. Purssell, Minneapolis Weather Bureau official, "several scattered areas over the state received heavy excess amounts [of precipitation] while the neighboring territory suffered from extreme dryness. However, from a material standpoint, the controlling feature of the year was...the dearth of rainfall during the critical growing months, July and August combined with the excessively high temperatures which prevailed at times during these months. The effect on crops was decidedly unfavorable, though it was not so disastrous as was the case in the states to the south and southwest. Oats ripened prematurely in localities while late planted spring wheat deteriorated badly...But the most serious damage was sustained by later crops, such as corn and potatoes, which were a total failure in some districts..."

The year's temperatures were similarly variable: an intensely cold January with heavy snowfall in the southern part of Minnesota was followed by a warm, generally snowy February (e.g. 29.2 inches of snow at Redby in Beltrami County). Except for a few favored areas, March and April 1930 were both warm and dry with statewide average precipitation values well below 50 percent of normal for the two months taken as a whole. Although temperatures averaged near normal during May 1930, severe and damaging frosts were recorded in many areas on 17-18 May. Rainfall was persistent and sometimes heavy during the first half of the month with generally dry conditions during the last half of the month. June temperatures were near normal and precipitation was spotty, some areas receiving nearly nine inches and many recording less than two inches. July 1930, like most of the Julys during the 1930's was generally dry and hot with temperatures rising to 108 F at Tracy and Fairmont during a scorching month end heat wave. August, as noted, was one of the warmest and driest ever recorded in Minnesota. Monthly maximum temperatures exceeded 100 F at most stations (with readings of 109 F, 108 F and 107 F, respectively, at Fairmont, Pipestone and New Ulm on 3 August). August 1930 precipitation, overall, was only about one third of the August normal. The hot, dry regime was temporarily broken at least in some locations by rains which began during the closing days of August, persisting through much of September 1930. The September rains, however, were largely limited to localities in the Minnesota River valley and southern Minnesota (with a monthly total of 10.74 inches at New Ulm and a 4.00 inch deluge at Albert Lea on 25-26 September). Conversely, the summer drought persisted in much of central and northern Minnesota, with monthly precipitation totals of less than one inch recorded at several stations (e.g. 0.20 inches at Fergus Falls). October 1930 was generally cold, temperatures falling to near zero degrees F at several locations during the last ten days of the month. Precipitation was again spotty, many stations receiving less than an inch (e.g. 0.55 inches at Montevideo and 0.14 inches at Gonvick). November 1930 was a notably schizophrenic month with alternating periods of cold and warmth and with a siege of extremely dry weather from 1-13 November. Frequent and sometimes heavy precipitation was recorded during the period, 15-26 November (with a total of 7.1 inches at the Pigeon River Bridge station). Many stations

recorded temperatures approaching or exceeding the 70's F while at the end of the month, areas of northern Minnesota experienced readings near -30 F. A major storm on 15-16 November brought varying amounts of rain, snow and ice to much of the state and, on 19 November, a severe ice storm caused considerable damage to telegraph lines in northwestern Minnesota.

Although, as noted previously, much of the nation experienced extreme drought in 1930, Minnesota's driest period began in December 1930, a moderately warm but extremely dry month, the beginning of one of the driest, warmest Minnesota winters ever. And the beginning of an exceptionally warm and dry period which, with only a few brief interludes, persisted until the autumn of 1934. For the state as a whole, December 1930 precipitation was about thirty percent of the then accepted average: snowfall averaged 2.3 inches, the lowest such value for any December since 1913. A record warm and near record dry January followed: statewide average precipitation (0.17 inches) was less than twenty percent of the long term January normal and the statewide average temperature (20.8 F) was the highest January average recorded during the entire period, 1891-1931. According to Minneapolis Weather Bureau officials "the month [January 1931] was excessively warm throughout, there being but two brief periods when temperatures were below the normal...Precipitation was below normal all over the state, and only in the southeast and the northern Lake Superior region were amounts at all comparable with previous records. The entire middle portion of the state from west to east was excessively dry, numerous stations there reporting but a trace of rainfall...." . Like December 1930, January 1931 produced little snow (the statewide average was a mere 2.1 inches) and, also as in December, most of the state was devoid of snow cover during all or most of the month. February 1931, although not as dry as January, was, on a statewide basis, the driest February since 1920. The month was also abnormally warm with a statewide average of 27.4 F, the highest statewide mean recorded during the entire period, 1891-1931. Snowfall was again light and with the exception of extreme northern locations, there was little snow cover during the month. And, at month's end, preparation for spring farm work was well underway in many parts of the state.

With the exception of March, precipitation during the spring months of 1931 was subnormal, thus intensifying the state's now well entrenched drought. Average statewide precipitation during April and May, respectively, was approximately 40 percent and 70 percent of normal. According to Minneapolis Weather Bureau officials, high winds during April stirred up the now extremely dry soil, causing some of the severest dust storms experienced by Minnesotans up to that time. Much blowing occurred on exposed slopes, requiring much reseeding of previously planted grain. With the exception of May, spring 1931 temperatures averaged above normal, thus intensifying the effects of the lack of moisture. Besides its distinction as 1931's only "cool" month, May brought above normal precipitation to some sections of the state, mostly to northern and central Minnesota (e.g. 5.25 inches at the Pine River Dam station in Crow Wing county). The month also featured a widely publicized tornado which, on 27 May, struck the Empire Builder, a famous express train then operated by the Great Northern Railway (which was later merged into what is now the Burlington Northern Railway). The train toppled from its rails, one passenger was killed and large number of others were injured.

The summer months of 1931 opened with a warm June, the warmest recorded in the state as whole since 1921. Although precipitation was generally below normal, some fortunate areas in the central portion of Minnesota received generous rainfalls (e.g. 8.04, 7.68, 6.47 and 6.36 inches, respectively, at Pine River Dam, Mora, Little Falls and Fergus Falls). A month end heat wave raised temperatures well above the 100 F mark at many stations, including 110 F at Canby, 108 F at Redwood Falls and 107 F at Montevideo and New Ulm. Predictably, small grains deteriorated rapidly during the heat wave and by the end of the month "pastures in many sections no longer afforded sufficient grazing for livestock..". July 1931, like June, was warmer than normal and, on a statewide basis, about thirty percent drier than normal. Consistent with the general pattern of 1930's summers, a few stations reported above normal July moisture while most others reported moderate to large deficiencies with some monthly totals of less than one inch (e.g. 0.57 inches recorded at the Farmington Minnesota station). The month began cool, bringing near freezing temperatures to some parts of the state, but soon turned hot. Once again the state was scorched by temperatures of more than 100 F, the highest of which was 112 F at Beardsley on 15 July. Other notable maxima included 110 F at Wheaton and 108 F at Tracy and Redwood Falls. The state's crop situation, of course, continued to deteriorate and, in many areas, burned out pastures no longer provided grazing for livestock. Although temperatures averaged near normal, August 1931 brought its share of heat and drought. Rainfall was again spotty with a scattering of stations reporting above normal amounts (e.g. 5.35 and 5.17 inches, respectively, at Fairmont and Zumbrota). An early August heat wave (really a continuation of a late July heat wave) produced temperatures of 100 F or higher at many stations while, at the end of the month an invasion of cold air brought freezing or near freezing temperatures to many parts of the state (e.g. 31 F, 30 F, 28 F, respectively at Morris, Milan and Big Falls on 30 August). The late August chill, in fact, reached far into the state, bringing minima as low as 33 F and 34 F, respectively, to Zumbrota and St. Peter, also on the morning of 30 August.

Apart from the exceptionally warm winter, the outstanding feature of 1931 weather was the heat wave which set new September records at virtually every station in Minnesota. The statewide average temperature for the month was 64.9 F, the highest September mean for any year since 1897. Seasonal temperatures prevailed during the opening days of the month but, beginning on 6 September, temperatures rose to 90 F or higher at many stations, the start of a period of unprecedented September warmth. Temperatures spiked to 111 F at Beardsley on 10 September, a reading which surpassed the previous statewide September record of 108 F set in 1895. Other record or near record maxima included 108 F at Milan and Wheaton; 106 F at Canby, Artichoke Lake, Morris, New Ulm, New London and St. Cloud; 105 F at Campbell, Fergus Falls, Little Falls, Moorhead, Mora and Willmar (all set on 10 September). Precipitation was again spotty, ranging from 7.34 inches at Grand Meadow to a meager 0.62 inches at Wheaton. Predictably, the month was notably sunny with a statewide mean of fifteen clear days and only six cloudy days. October 1931, although considerably warmer than usual was wetter than normal, a turn of events which must have brought a sigh of relief from many of Minnesota's drought weary residents. Precipitation was, however, again unevenly distributed: most stations recorded greater than normal amounts but some, mainly in the northern and southwestern parts of the state, remained relatively dry. The trend toward wetter than normal conditions persisted through

November 1931, featuring a statewide average which more than doubled the then accepted November normal. Precipitation was above normal at all but one of the state's then functioning weather stations. Monthly totals ranged from 5.80 inches at Grand Meadow to 0.73 inches at Milan; most stations, however, reported amounts in the two to four inch range. Heavy amounts of snow were recorded at some northern Minnesota locations with little snow at most locations in southern and central Minnesota. One of the most unusual meteorological features of the month was a tornado which struck the Maple Plain area at 2135 hours on 16 November, causing property damage estimated at \$10,000 to \$15,000 (1931 dollars). November 1931, like most of the other months in 1931, was abnormally warm (the warmest statewide since 1923) with monthly maxima in the 70's F at many stations and a reading of 81 F at the Canby station on 8 November. December 1931 was also warm, rounding out a record warm year. With the exception of a month end snowstorm which brought heavy snow to areas of southern Minnesota (e.g. 13.2 inches at New Ulm), December snowfall was generally light. Moreover, any snow that did fall was melted rapidly, leaving most of the state with little or no accumulated snow cover.

The warmth of 1931 was notably widespread. All Minnesota stations, including those in the far north, recorded above normal annual means and, at several southern and central locations, the annual average temperature exceeded 50 F, a rare occurrence for a state as far to the north as Minnesota (e.g. Winona, 52.8 F; Redwood Falls, 52.2 F; Faribault and Fairmont; 50.8 F; Waseca and Minneapolis, 50.8 F; and St. Paul, 50.6 F). As in 1930, statewide precipitation was about ten percent below normal, a few stations reporting above normal amounts but most reporting substantial precipitation deficits, the most extreme of which was recorded at Milan (13.40 inches, a value approaching one half of that station's normal annual total). According to Minneapolis Weather Bureau officials "distribution of rainfall was very uneven...with deficiencies which were quite marked over the upper Minnesota valley. From an economic standpoint...the deciding factor was the irregular distribution of moisture during the critical crop growing season, some areas being well watered with timely rains while others and by far the most extensive were unfortunate...Comparatively small wet districts enjoyed good average yields, but as a whole yields were extremely disappointing and in some localities in the southwestern quadrant where the shortage of water had been acute, crops were a total failure...". Predictably, 1931 snowfall was light, the lowest statewide average (21.7 inches) since 1895. The year was also sunny, another characteristic of drought years: according the Weather Bureau's statistics, 163 or 45 percent of the days of the year were classified as "clear" (compared to the 1891-1931 mean of 151 such days). The sunniest month was July 1931 with a statewide average of eighteen clear days.

Unlike the drought stricken, largely snowless winter of 1930-1931, the winter of 1931-1932 brought heavy snows to many parts of the state. Although December 1931 had been relatively dry, January 1932, in contrast, was somewhat wetter than normal, thus undoubtedly raising hopes for the coming growing season. January 1932 snowfall values varied widely, however: amounts as little as 2.5 inches were recorded at several northwestern Minnesota locations while, at many southeastern and some northeastern localities, monthly totals approached or exceeded thirty inches (e.g. Winona, 33.2 inches; Worthington, 24.8 inches; Albert Lea and Meadowlands, 28.0 inches; Grand Meadow, 27.5

inches; Farmington, 26.5 inches; and Pigeon River Bridge, 30.1 inches). January 1932 was also considerably warmer and much cloudier than usual (with a statewide average of sixteen cloudy days). Heavier than average snowfall persisted into February 1932 but was unevenly distributed, the heaviest amounts limited to northern sections (e.g. Mizpah, 24.8 inches). The western and central portions of the state were mostly dry (e.g. Alexandria, Milan and Artichoke Lake, 2.0, 1.5 and 0.5 inches, respectively). February 1932 was also somewhat warmer than normal, continuing a trend which, with few exceptions, had persisted through most of 1930 and 1931.

March 1932, in contrast, was coldest March recorded since 1923 and one of the coldest recorded in any year up to that time. Below normal temperatures prevailed from 4 - 24 March with sub-zero readings recorded at every station in the state during an Arctic outbreak, 5-10 March. Following a pattern characteristic of the early 1930's, March precipitation was irregularly distributed, some few areas receiving excess amounts while most areas remained locked in drought. Heaviest precipitation was limited to a few southern and northern stations (e.g. Worthington, Farmington, Fairmont and Tower, 29.2, 15.0, 23.2 and 14.8 inches of snowfall, respectively). In many areas of the state, livestock was reported as being undernourished and thin, the result of a combination of cold and a shortage of feed (in turn the result of the previous year's poor growing conditions). In contrast to March, April 1932 temperatures were near normal. April precipitation was, once again, unevenly distributed, some areas -- northwestern Minnesota especially -- receiving above normal amounts (with monthly snowfall totals exceeding ten inches at some northern stations). Most areas, however, remained dry. May 1932 was somewhat warmer than normal while rainfall, consistent with the now well established pattern, was erratically distributed. Precipitation was especially short in northwestern Minnesota, an area in which, according to Weather Bureau officials, "the persistent shortage of moisture had resulted in droughty conditions..". Many stations recorded temperatures in the low 30's F on 26-27 May with considerable damage to "tender" vegetation in many low lying areas.

The summer of 1932 was generally warm and dry. Weather during June was especially adverse, with an abnormal amount of sunshine and precipitation which, on a statewide basis, was approximately one-third less than the amount then considered normal. Although a few favored locations (e.g. Tracy, 6.56 inches) received generous amounts of rainfall, most of the state remained dry. The Weather Bureau reported, however, that "a lack of sufficient rainfall notwithstanding...crops made good advance, and were in good condition although there was considerable local deterioration in the excessively dry areas, especially on light soils...fortunately the fears of widespread damage from grasshoppers was not realized, the areas of infestation being small and confined to the northwestern counties..". Predictably, temperatures were also above normal, an early summer heat wave bringing temperatures as high as 101 F at Maple Plain on 6 June. Despite a few notably cool days at the beginning of the month, July 1932, like June was warmer and much sunnier than normal. A heat wave which persisted from 12 through 24 July brought temperatures of 100 F or higher to many localities, including readings of 106 F, 105 F and 104 F, respectively at Beardsley, Wheaton and Redwood Falls and New Ulm, Ada, Milan, Moorhead and Pipestone. Although a number of stations received substantial rainfall, precipitation was generally deficient, a pattern which, predictably, caused extensive crop damage, especially to plants growing in

light soils. The month also featured two tornado outbreaks which caused extensive damage in Brown and Meeker counties. Abnormally sunny, warm conditions persisted through the first part of August 1932, further damaging growing crops and pastures. Rains late in the month saved corn grown on heavy soils (while most corn grown on light soils was said to have been cut for silage). Most stations, however, reported above normal August precipitation, the result of often heavy and widespread rains which occurred during the last ten days of the month.

The autumn of 1932, unlike the summer which preceded it, was generally colder than normal. With the exception of November, precipitation was, however, generally deficient. On a statewide basis, the average precipitation during September 1932 was less than forty percent of the then accepted September normal and the least amount recorded in any September since 1898. The month was also extremely sunny with a statewide average of seventeen clear days, many individual stations reporting twenty or more days with little or no cloud cover (e.g. Winnebago and Alexandria, twenty five and twenty four clear days, respectively). October 1932 was a cloudy, cold month, some stations reporting as many as twenty five cloudy/overcast days. Most of the state remained dry: total monthly precipitation at many stations was less than one inch with above normal amounts limited to a few northwestern and northeastern localities (e.g. Pigeon River Bridge, 5.59 inches). Heavy snowfall was recorded at many northern Minnesota locations late in the month, Mizpah in Koochiching county reporting 19.4 inches. November, unlike most of the months of 1932 was somewhat wetter than normal. It was also considerably colder than normal with temperatures approaching -30 F at some northern stations on 26 November. Snowfall was also heavy at some locations, monthly totals reaching 28.5 inches and eighteen inches, respectively, at Warroad and Morris and Baudette. A sudden warm-up pushed temperatures into the 50's F during the closing days of the month, melting much of the state's snow cover and leaving the ground bare over much of the southern part of the state.

The last month of 1932, despite a few days of warmth at its beginning and at its end, was colder than normal, many stations recording minima of -30 F or lower. With a few exceptions, the month was also dry, continuing the droughty pattern which plagued much of Minnesota during most of the year. December snowfall was heavy in a few locations, St. Paul recording sixteen inches. Alexandria observers, in contrast, recorded only 0.2 inches. Freezing rain fell over much of southern Minnesota on 24 December. For the state as a whole, 1932 was slightly drier than either 1930 or 1931 with several stations (e.g. Collegeville and Alexandria) reporting annual totals thirty to forty percent below their respective station normals. According to U.S. Weather Bureau officials, "the annual [1932] precipitation was in general below the normal, only limited areas...receiving an excess. The precipitation was especially deficient in the extreme western and northwestern counties. From a crop standpoint...moisture was a deciding factor, temperature but secondary, though the unseasonable cold and frosts of May 26th and 27th did considerable damage and the frosts of September 29th definitely ended the growing season. The general shortage of rainfall during the critical month of June had a deleterious effect on growing vegetation, especially on light soils. Conditions during July were even more unfavorable with the excessive heat an added adverse factor to the prevailing scarcity of moisture...". Surprisingly, however, 1932 snowfall was generally above average, especially in northern

Minnesota. Stations with the greatest amounts included Pigeon River Bridge; 103.9 inches; Mizpah, 97.4 inches; Fairmont, 78.7 inches; Maple Plain, 75.5 inches; St. Paul, 72.0 inches; and Worthington, 66.7 inches.

The fourth year of the 1930's opened with an unusually warm but somewhat wetter than normal January. Snowfall was heavy at many stations (e.g. 29.7 inches, 22.8 inches, 21.0 inches, and 20.8 inches, respectively at Mizpah, Gnovik, Fosston and Brainerd and Moorhead. Precipitation, following the pattern of the past three years, was irregularly distributed, some areas in southwestern and west central Minnesota receiving virtually no moisture during the entire month. Above normal precipitation, in contrast, was recorded in much of eastern and southeastern Minnesota. Average snow depths ranged from about four inches in the southern part of the state to about fifteen inches in the north, the greatest depth (thirty inches) recorded at Mizpah.

February 1933 was a month of extremes, featuring an early month cold wave which, at least in Minnesota, rivaled the great cold wave of February 1899. Temperatures fell to -50 F or lower at many northern stations, the lowest (-55 F) recorded at Warroad on 8 February. Other notably low readings included -53 F at Big Falls; -51 F at Itasca State Park; -50 F at Leech Lake Dam, Orr, Pokegama Falls and Redby; and -49 F at Mizpah. Readings of -30 F or below were common at the Weather Bureau's western, central and southern Minnesota stations (e.g. -32 F at Zumbrota). Although temperatures warmed into the high 40's F and the low 50's F at many stations at the end of the month, February 1933 overall was one of the coldest Februaries recorded in the state since 1891. The month was also generally dry, approximately three-fourths of the state reporting less than normal amounts of precipitation. February was also a sunny month with a statewide average of twelve clear days and with 66 percent of possible sunshine recorded at the Minneapolis Weather Bureau station.

Weather during the spring of 1933 was erratic, a notably dry April sandwiched between a relatively wet March and a relatively wet May. Moisture, however, was unevenly distributed, many areas of the state remaining dry through most or all of the spring. March was especially erratic, featuring a long early month dry spell which, combined with high winds (reaching gale force at some locations), produced widespread dust storms. According to Minneapolis Weather Bureau officials, "much dust was carried into the atmosphere. This was particularly the case on the 8th...The amount of dust...at this period was so great as to cause considerable annoyance, as well as being the principal factor in a marked increase in physical ailments, particularly those of the respiratory organs...Aside from these effects the winds did no material damage so far as is known...". Droughty conditions were relieved temporarily -- at least in some areas -- by snow which fell during the latter part of the month. A combination of rain and heavy snow resulted in severe drifting and some local flooding over the southern part of the state on 18 March and on 24-25 March, heavy, wet snow fell over much of the state. As a result, most stations recorded above normal amounts of precipitation. Many northwestern and western stations, however, remained dry, recording less than an inch of moisture (e.g. Moorhead, 0.37 inches; Collegeville, 0.35 inches; Crookston, 0.47 inches; and Argyle, 0.24 inches). Greatest monthly snowfall was 25.5 inches at Grand Meadow in Mower county. April 1933, as noted, was a notably dry month: statewide average precipitation was approximately twenty five percent less than the then

accepted average with many stations recording less than one inch of moisture during the entire month (e.g. Canby, 0.76 inches; Argyle, 0.71 inches; St. Cloud, 0.76 inches). Agricultural field work was delayed at the beginning of the month due to wet snowfalls and wet soil conditions. Snowfall was, in fact, excessive in some areas (e.g. Pigeon River Bridge with an April snowfall totaling 30.5 inches and a snow cover of twenty eight inches on 5 April). Droughty conditions soon returned, however, becoming prevalent in many areas from 12-27 April and prompting U.S. Weather Bureau officials to note that "conditions...were rapidly becoming so unfavorable that fields could no longer be properly worked due to the dryness of the soil..". Moderate to heavy rainfall at the end of the month restored soil moisture in many localities, creating an aura of premature and unwarranted optimism concerning 1933 crop prospects. The late April rainfall persisted into May 1933, a month which, with the exception of a few locations, was marked by heavy, sometimes excessive precipitation. The greatest amounts of moisture were recorded in the east central, central and southern portions of the state: less favored locations included some northwestern and west central areas (e.g. Big Falls, 0.82 inches; Baudette, 0.44 inches; Canby, 1.64 inches; Hallock, 1.61 inches). Consistent with its general wetness, May 1933 produced a number of damaging hail and wind storms. One such storm hit the Princeton and Mille Lacs area on 22 May, causing local flooding and producing heavy hail. The most notable feature of the month, however, was the excessive rains which occurred in and around the Twin Cities area on 28-29 May. Rainfall totals on these dates included three to four inches in areas in and surrounding the Twin Cities and in some parts of Crow Wing county in north central Minnesota. May's generous rainfalls, of course, reinforced the aforementioned optimistic crop outlook, even leading many to think (hope?) that the drought was near an end (views which, incidentally, coincided with expectations of improved economic conditions, expectations roused by the actions of the Roosevelt administration during its first hundred days in office). Minneapolis Weather Bureau officials obviously shared such views, offering a rosy outlook in their summary of May 1933's rainfall: "The general heavy rainfall replenished subsoil moisture which in many portions of the state had been considerably depleted by long continued dryness while the warmth of the latter part of the month particularly the high night temperatures was decidedly favorable for the germination of corn, which at the close of the month had come up in fine condition. Wheat and oats also made good progress with stand and color both good".

Tragically, however, the spring's optimism soon evaporated under the burning sun of a summer which brought persistent and often record heat and little rainfall. June 1933, with temperatures more characteristic of a hot July than of a normal Minnesota June, was the warmest recorded in the state during the entire period, 1891-1933. It was also one of the driest Junes on record: for the state as a whole, precipitation was approximately half the amount then considered as normal. Many stations, moreover, recorded less than an inch of rain during the entire month, several of which (e.g. Albert Lea, 0.23 inches and Milaca, 0.29 inches) recorded amounts of less than one half inch. With the exception of several days in the middle of the month, June 1933 temperatures were consistently and markedly above normal, readings of 100 F or higher recorded even in the northern reaches of the state. The highest temperature recorded during the month, 109 F at Beardsley on 25 June, was the highest recorded in Minnesota in any June up to that time. Other monthly maxima included 106 F at Fairmont, Milan, Pipestone and Wheaton; and 105 F at Artichoke Lake and

Redwood Falls. The month, not surprisingly, was extremely sunny: the Minneapolis Weather Bureau station recorded 88 percent of possible sunshine and, on a statewide basis, nineteen days were classified as clear (with many individual stations reporting twenty or more clear days, including Faribault with twenty nine such days). This abrupt and probably unanticipated return of the drought, of course, spelled the end of the optimistic May crop outlook. In their June report, Minneapolis Weather Bureau officials noted an "almost total lack of rain over the state after the 18th.....The long continued heat wave and its unprecedented severity combined with an entirely inadequate rainfall had a most destructive effect upon growing crops, especially small grains. Spring wheat and oats were a total failure over large areas in the Minnesota valley and in parts of the southeast with fields either uncut or plowed under and sown to millet or forage crops. Even in other sections favored by moisture the small grains deteriorated badly, with crops heading out so short that on many fields binders could not be used...Heads, too, were not filled well and quality...was poor. Pastures suffered...and over wide areas no longer afforded grazing. Corn, however, fared much better than other crops and growth was exceptionally rapid, but the condition was not so good, and on sandy soils the crop was beginning to curl".

Weather conditions during July 1933, although not as extreme as those which prevailed in June, were still highly unfavorable. Precipitation, when averaged statewide, was approximately twenty five percent less than normal while temperatures averaged about three degrees above normal. And, like June, July was a notably sunny month, featuring a statewide average of sixteen clear days and 82 percent of possible sunshine at the Minneapolis and Moorhead stations. An intense heat wave during the last week of the month brought temperatures of 100 F or higher at many stations, the warmest occurring at Beardsley, continuing that station's tendency to break and set statewide heat records. Other maxima recorded during the same period included 109 F at Milan; 106 F at Morris; and 105 F at Montevideo and Wheaton. Unlike the month that preceded it, July 1933 did feature locally heavy rainfall (e.g. 5.89 inches at Waseca and 5.75 inches at St. Cloud). Most stations, however, recorded moderate to extreme rainfall deficits, especially those in the west central and north central portions of the state. One of the month's more notable meteorological events was a damaging storm which brought heavy rains to the St. Paul area on 10 July (1.9 inches officially recorded at the downtown St. Paul station), flooding low lying areas and damaging many city streets. The deterioration of Minnesota crops which was so pronounced during June, continued, of course, during July. Minneapolis Weather Bureau officials characterized conditions during the month as "decidedly unfavorable for growing crops. Only in limited areas where moisture was adequate did vegetation flourish. Especially damaging to corn were the hot dry winds that prevailed on the 28th, the crop firing so badly in some localities that it could be used only for fodder. Pastures were mostly dried up and provided little grazing".

August, although featuring generally normal temperatures, was, like the other summer months of 1933, dry and sunny. Average precipitation statewide was approximately one-half the then accepted August normal and, with a few exceptions, individual stations reported moderate to large moisture deficits, some stations (e.g. Campbell, 0.18 inches; Taylors Falls, 0.17 inches; Collegeville, 0.16 inches) recording less than a quarter inch of rain during the entire month. The Minneapolis and Moorhead stations, respectively, recorded 82 and 80

percent of possible sunshine and, on a statewide basis, fifteen days were classified as clear. Moreover, the first few days of the month, continuing the heat wave of late July, produced 100 F readings at several stations (Beardsley again recording the highest reading, 104 F on 6 August). Minneapolis Weather Bureau officials, in their monthly climatological summary, emphasized that the month was the third driest August in forty three years of record. They noted further that "precipitation was decidedly deficient at most stations and was very unevenly distributed through the month.....As during the preceding month, weather conditions were unfavorable for agricultural interests. Extended periods of very dry weather resulted in considerable deterioration to meadows, pastures and growing crops....rains that fell during the third decade [of the month] were generally too late for growing vegetation, threshing of small grains was completed earlier than usual; yields were generally disappointing....Corn fired badly over large areas, especially on light soils, and most of the corn crop was cut for feed. Pastures failed and extensive feeding of livestock was necessary at the close of the month....Fall plowing progressing very slowly because of dry ground".

The autumn months of 1933, September especially, brought some relief to drought and heat weary Minnesota residents. September, although notably warm, was wetter than normal, bringing excessive rains and local flooding to several counties in southwestern Minnesota. Worthington recorded 3.7 inches of rain on 1-2 September and at many stations in southwestern and southern Minnesota, monthly rainfall totals exceeded five inches, a no doubt welcome contrast to August's rainfall deficits. Although above normal rainfall also occurred at some northern and western Minnesota stations (e.g. 10.51 inches at Pigeon River Bridge), many localities, unfortunately, remained dry (e.g. Ada, 0.61 inches). According to the Minneapolis Weather Bureau's summary of September's weather, "it was unusually dry in the west central counties. [However] weather conditions were more favorable for agricultural interests than during the preceding month. Late potatoes and truck crops improved in many localities...fall plowing was mostly well advance, although there was much complaint of dry ground . Pastures varied from fair to poor in dry areas....". October 1933, in marked contrast to September, was cold and dry, with minima of zero F or lower recorded at several northern Minnesota stations on 28 October. Temperatures rebounded rapidly, however, bringing record or near record late season warmth during the closing days of the month (e.g. 83 F, 80 F and 76 F, respectively, at Farmington, Zumbrota and Winona and Rochester on 30-31 October). Although most stations particularly stations in the already parched areas of west central Minnesota -- recorded below normal amounts of precipitation, some areas in northern Minnesota received heavy and, in a few instances, record breaking October snowfalls (e.g. Duluth, 14.0 inches). For the state as a whole, October precipitation was approximately 75 percent of normal, ranging from 5.52 inches at Tower to a meager 0.05 inches at Pipestone. Late October's abnormal warmth persisted into the opening day of November 1933, pushing temperatures into the high 70's at many southern and central Minnesota stations. Some specific readings, all record or near record November maxima (and all recorded on 1 November) included 77 F at Minneapolis, St. Paul, Maple Plain, Albert Lea and Waseca; 78 F at Taylors Falls, Faribault, Beardsley and Zumbrota; and 80 F, a November rarity, at Farmington. In another of the meteorological turnarounds for which Minnesota is famous, temperatures dropped below zero F at most stations on 16 November, minima at several northern stations approaching -30 F. Several northern locations also received record or near record amounts of November

snowfall: 51.0 inches at Pigeon River Bridge; 28.5 inches at Grand Marais; 26.6 inches at Mizpah; and 23.0 at Baudette. The outstanding feature of the month, however, was not its erratic temperatures and its snowfall: it was, rather, a severe dust storm which swept over the state's dry southern and southwestern counties on 12 November, causing considerable damage. Clouds of dust were driven by high winds which swept across the state (with winds of 41 miles per hour at the Minneapolis Weather Bureau station) and which created blizzard conditions in the snow covered areas of northern Minnesota. The November dust storm was, of course, the first of many to plague the Middle West and the Plains States during the next several years, a harbinger of worst things to come. It also reflected the cumulative effects of a drought which, at the end of 1933, was well entrenched, having persisted with varying intensity since early 1930. During this three year period, inadequate rainfall and unprecedented summer heat had created large expanses of parched, exposed soil, both in Minnesota and in states to the south and west of Minnesota. As a result, many farmlands were subject to erosion, strong winds lifting dust particles high into the atmosphere and/or drifting them, like snow, in ditches, along fence lines and in creek beds and ravines. In addition to an increased incidence of blowing dust, the prolonged and deepening drought had significantly reduced water levels in the state's lakes and streams. And as noted by Weather Bureau officials in the November 1933 edition of Minnesota Climatological Data, the lack of moisture had lowered the state's water table, causing many farm wells to go dry (particularly in west central Minnesota where, at the end of 1933, drought conditions were the most severe).

The last month of 1933 was colder, wetter and much cloudier than normal, perhaps once again raising hopes (however faint and tentative) for some amelioration of the drought. A relatively mild regime at the beginning of the month soon gave way to extreme cold, especially during Christmas week. Readings in the -30's F were recorded at many northern stations, readings in the -20's F extending into southern and western portions of the state. The lowest temperatures during this period were recorded at Big Falls in Koochiching county, -50 F on 25 and 26 December and -51 F on 28 December. Following the November pattern, heavy snowfalls blanketed northern Minnesota with lighter, often sparse amounts recorded at many southern and western stations. Northern Minnesota snowfall totals included 29.7 inches at Orr; 29.6 inches at Park Rapids; 29.0 inches at Pigeon River Bridge; and 26.5 inches at Warroad. Locations such as New Ulm, Artichoke Lake and Montevideo, in contrast, recorded only one to two inches. December 1933, as noted, was unusually cloudy: the Minneapolis and Moorhead stations recorded 28 and 25 percent of possible sunshine, respectively. Overall, 1933 was a somewhat warmer but much drier than normal year. Precipitation for the state as a whole averaged about 20.6 inches, the lowest such average since 1923. Temperatures averaged 42.3 F, slightly less than one degree F above the then accepted statewide normal.

However perverse it may have been, Minnesota's 1933 weather -- when compared to the catastrophic weather conditions experienced during the year that followed -- was comparatively benign. With the possible exception of 1936, the fifth year of the 1930's was, at least in Minnesota, an unmitigated meteorological disaster. The year opened with a warm, dry and cloudy January (with 33 percent of possible sunshine recorded at the Minneapolis Weather Bureau station). With the exception of a few favored sites in northern Minnesota,

precipitation was below normal in all parts of the state, several stations recording less than one quarter inch of moisture (e.g. Tracy, 0.05 inches; Alexandria, 0.06 inches; Wadena, 0.07 inches; Pipestone, 0.25 inches). Snowfall was correspondingly light, averaging about one half the then accepted statewide normal. As a result, the ground lay bare in many parts of the state, exposing the dry soil to the high winds which, the records show, were frequent during the month (and, on occasion, reaching near gale force proportions). In many locations, dirt was blown off the exposed fields and deposited in drifts along roadsides and fence lines. Overall, January 1934 temperatures were approximately six degrees F above the statewide normal, many stations recording maxima in the 50's F during the closing days of the month.

But if January was bad, February 1934 was worse. Precipitation, when averaged on a statewide basis, was about one-third of normal, nearly all stations reporting moderate to large precipitation deficits. Individual station totals of less than one tenth inch were common and, in a number of localities (e.g. Alexandria, Campbell, Tracy, Waseca, Milan, Wheaton and Morris) the month was altogether devoid of measurable precipitation. The lack of moisture, together with a continued frequency of windy conditions, was conducive to continued soil erosion. According to Minneapolis Weather Bureau officials, "fields in southern counties were practically bare during most of the month and alternate freezing and thawing was unfavorable to small grains and grasses. High winds caused much soil drifting. Moisture was badly needed in southern and western counties where precipitation had been greatly deficient since last autumn. At the close of the month much livestock was looking thin and feed was rather scarce in many localities..".

March 1934, although generally colder than normal, was, with the exception of a few favored areas in southern Minnesota, another dry, unpleasant month. Precipitation at most stations was less than one inch and, in some locations, less than one tenth inch (e.g. Argyle, 0.06 inches; Mahanomen, 0.08 inches). Moderate to heavy snowfall near the close of the month brought some relief to droughty conditions in the southern half of the state, the resulting runoff replenishing the top soil moisture and benefitting pastures and winter grains. Windy, dusty and dry conditions, however, prevailed over much of the state, prompting Minneapolis Weather Bureau officials to note that "damage from drought...alternate freezing and thawing, and dust storms could not be determined because of the backwardness of the season, but it is believed to be serious. Much livestock is looking thin, with feed very scarce in many localities".

Yet, dry and disagreeable as it was, the winter and early spring of 1934 were but a prelude to the disaster that struck the state during April and May. April, like March, was somewhat cooler than normal. But, following a brief rainy/snowy period from 1-5 April, very little precipitation was recorded anywhere within the state during the entire month. Most stations recorded monthly totals of an inch or less with totals of less than one half inch at some stations (e.g. St. Cloud, 0.25 inches; New London, 0.18 inches; Willmar, 0.27 inches). Predictably, the month brought frequent and severe dust storms, storms stirred up by high winds blowing over bare, moisture starved fields. Another notable feature of the month was the heat which occurred at its close, pushing temperatures into the 90's F at many stations (including a statewide April record of 96 F at Maple Plain on 30 April). Interestingly, the

month end heat wave followed on the heels of a cold outbreak which brought abnormally low late season readings to many parts of the state on 27 April (e.g. the month's low of 19 F at Maple Plain was recorded on 27 April, just three days before that station's aforementioned record setting maximum).

Besides the discomfort and probable distress accompanying April's dry, dusty weather, there was, of course, tangible, extensive damage to vegetation and farm animals. According to Minneapolis Weather Bureau officials, "...the...weather was detrimental to the germination of seed in the ground and for growth of vegetation. High winds blowing over extremely dry, bare fields favored severe dust storms...Soil moisture was rapidly depleted, much new seeding blown out of the ground, soil drifted badly, and considerable damage to growing crops resulted. Some forest and brush fires were also reported. Pastures were very short and afforded little or no grazing. Livestock was mostly looking thin because of acute feed shortages in many localities.....Winter grains and grasses were showing serious damage from winter killing and other inclement weather conditions. Subsoil moisture was decidedly deficient, many wells were drying up, and lakes and streams were unusually low".

Disastrously dry conditions intensified and deepened during May 1934, one of the hottest, sunniest and driest spring months ever recorded in Minnesota. Temperatures statewide averaged nearly nine degrees F above the then accepted May normal and, at several individual stations, monthly average temperatures ranged from twelve to fourteen degrees F above normal (e.g. Pipestone, +13.9 F; Fairmont, +13.2 F; and Faribault, +12.8 F). Virtually all stations reported moderate to huge precipitation deficits and even the few isolated localities which received near normal rainfall recorded amounts of less than three inches (the state's greatest monthly May total was 2.82 inches at Mizpah, 2.38 inches of which fell on 2 May). Many stations, moreover, recorded less than a half inch of rainfall during the month, many even less than one quarter inch (e.g. Faribault, 0.18 inches; Farmington, 0.22 inches; Mankato, 0.17 inches; Maple Plain, 0.13 inches; Minneapolis, 0.21 inches; New London, 0.15 inches; and Waseca, 0.14 inches). When averaged statewide, precipitation was about thirty percent of the May normal, the lowest such value since May 1900. And, as noted, the month, like many 1930's drought stricken months was unusually sunny, the Minneapolis Weather Bureau, LaCrosse Wisconsin and Duluth stations recording 83, 86 and 77 percent of possible sunshine, respectively. For the state as a whole, seventeen days were classified as clear, some individual stations reporting twenty or more days with little or no cloud cover (e.g. Mora, 29 clear days; Waseca, 27 clear days; Albert Lea and New Ulm, 23 clear days).

May's heat made an early debut, some stations recording maxima above 90 F during the opening days of the month. The first really intense heat wave settled into the area on 8-9 May, pushing temperatures into the high 90's F at many locations and to 102 F at Beardsley on 8 May. A mostly dry but exceptionally strong cold front swept through the state on 9-10 May, stirring up what was indisputably the most intense and most widespread dust storm ever experienced in Minnesota. The dust, driven by gale force winds, turned day into night at many locations, destroyed newly seeded or emerging crops, disrupted traffic and sifted into homes and businesses, often damaging equipment, merchandise and furnishings. The storm was followed by a few days of cooler weather but, beginning on 16-17 May

temperatures were again on the rise, some stations recording maxima of 100 F or higher. The worst heat, however, came during the closing days of the month, spreading 100 F readings over all but the far northeastern part of the state. Highest readings, all recorded on 30-31 May, included the aforementioned May record of 112 F at Maple Plain and 108 F at Artichoke Lake, Campbell, Chaska, Fairmont, New Ulm and Pipestone.

In restrained language that understates the psychic, social and economic ravages of May's weather, Minneapolis Weather Bureau officials remarked that "...the drought and dust storms were decidedly unfavorable to agricultural interests. Growth of vegetation was retarded in all sections, with much seed lying in the dust ungerminated. Crops that were above the ground deteriorated considerably. With the exception of limited areas, small grains were severely fired, with much damaged beyond recovery. Meadows and pastures failed. Stock water was scarce. Cattle reached the point of starvation and it was necessary to utilize grain fields for grazing purposes. Many cattle were marketed prematurely or moved to more verdant pastures. Unusually low water was reported in lakes and streams and many wells were going dry. Weather conditions were ideal for forest, brush and peat fires which were numerous and caused considerable loss.....Rain was badly needed".

June 1934, although warmer, sunnier and somewhat drier than normal, brought timely rainfall which, in some areas at least, brought temporary drought relief, sending agricultural hopes soaring. Most of the month's rain fell during the first ten days with generally dry conditions prevailing thereafter (with spotted heavy showers at some locations, principally on 17, 20 and 25 June). Rainfalls of two to four inches were common during the period, 4-9 June, some specific amounts including 2.11 inches at Alexandria on 8 June; 2.42 inches at Beardsley on 7 June; 3.22 inches at Bird Island on 7-8 June; 3.45 inches at New Ulm on 8 June; 3.66 inches at Red Wing on 8-9 June; and 4.34 inches at Worthington on 7-8 June. Much to their disappointment, many Minnesota stations, in contrast, received less than three inches of rain during the entire month of June (e.g. Minneapolis, 2.30 inches; Farmington, 2.31 inches; Waseca, 2.37 inches; and Winona, 2.28 inches). Besides much needed rain, early June brought markedly cooler temperatures, a pattern which persisted until the last week of the month. At that time, the heat returned, once again raising temperatures to 100 F and higher at many stations. The warmest readings, most of them recorded on 27 June, included 108 F at New London; 106 F at Faribault and Maple Plain; 105 F at Rochester and Grand Meadow; 104 F at Minneapolis; and 103 F at St. Paul. The Minneapolis station also recorded 78 percent of possible sunshine, an unusually high value for a normally cloudy, rainy month such as June.

Minneapolis Weather Bureau officials, obviously sharing in the optimism generated by the early June rains, asserted "...that the general, timely rains that set in early in the month [June] terminated one of the most severe droughts ever experienced in the state. Further deterioration of vegetation was checked and pastures, meadows and late planted crops were benefitted materially". The report, however, concluded on a less sanguine note: "...the rains came too late for early sown small grains which were mostly damaged beyond recovery, except in the northern portion of the Red River Valley and in..areas in south central counties. Many poor grain fields were pastured or plowed under and reseeded to forage and other crops...Moisture was again badly needed in the southern third of the state".

Any hopes of an end to the drought, if not already dashed at the end of June, were surely dashed in July 1934, another very dry, very sunny and very warm month. The period from 18 through 24 July produced intense heat across much of the state, the three days from 21 to 24 July described by Weather Bureau officials as "probably the hottest three consecutive days ever experienced in southern Minnesota. Temperatures rose to 113 F at Milan on 21 July, a reading which fell just one degree F short of the then all time state record of 114 F (set at Beardsley in 1917). Other torrid readings included 109 F at Artichoke Lake and Redwood Falls; 111 F at Beardsley; 108 F at Morris and Milaca; and 107 F at Fergus Falls and Montevideo. Despite frequent, and sometimes relatively heavy rainfall at the beginning of the month, precipitation at most Minnesota stations fell significantly short of the then accepted July normals. A number of stations recorded July totals of less than one inch (e.g. Artichoke Lake, 0.51 inches; Morris, 0.99 inches; Beardsley, 0.39 inches; and Moorhead, 0.80 inches) and, when averaged statewide, July precipitation was about one-third less than normal. Heaviest rains (e.g. Grand Meadow, 5.45 inches) were in southern Minnesota where, according to the Minneapolis Weather Bureau office, "meadows, pastures and late sown crops were materially benefitted..". The Weather Bureau report further noted that "heat and drought during the latter half of the month caused considerable deterioration to growing crops. Small grains ripened prematurely...with disappointing yields in most sections of the state. Corn...was in fair to good condition at the end of July. Meadows and pastures were again short and turning brown in many localities....Rain was badly needed". On average, sixteen days during July were classified as clear with percent of possible sunshine values of 83 percent at Duluth, 80 percent at Minneapolis and 79 percent at Moorhead.

August 1934 was a schizoid month, marking a transition from heat and drought to cooler and wetter conditions. However, as in previous months, both precipitation and cloudiness were below normal (with 73 percent of possible sunshine recorded at the Minneapolis Weather Bureau station). Temperatures, in contrast, varied greatly: the first eighteen days of the month were hot, pushing temperatures to 100 F and above at many locations while the latter part of the month was decidedly cool, bringing early season frosts to many parts of the state. This abrupt change and abrupt it was was ushered in on 18 August by what the Weather Bureau called "one of the most severe electrical, wind and hailstorms ever experienced..". Damage to buildings and crops was extensive, three fatalities and eight injuries were reported and total damage (in 1934 dollars) was estimated at \$560,000. The cool weather which followed brought readings in the 30's F to most of Minnesota, including areas as far south as Worthington (38 F on 24 August), Zumbrota (37 F on 24 August), Milan (33 F on 28 August), and Rochester (33 F on 26 August). Predictably, many northern Minnesota stations recorded sub-freezing temperatures, the lowest of which was 25 F at Big Falls on 28 August. Although August was, as noted, a markedly dry month, timely rains, combined with cooler weather did bring some relief to the state's weather weary farmers. According to Minneapolis Weather Bureau officials, weather conditions were deemed to be "fairly favorable for agricultural interests." They went on say that, "heavy to excessive rains on the 8th checked further [drought] damage, and meadows, pastures and most growing crops were greatly benefitted. Cool weather during the last decade [of the month] retarded growth of vegetation. Some damage from frost, mostly in low places was reported. That and drought early in the month, caused considerable deterioration of corn, as did ear worms.

At the close of August ...plowing was progressing slowly because of dry ground....meadows and pastures were poor to fair, and late forage crops were looking well , except in drought areas in central and central western counties. Water in lakes and streams was unusually low, with some small rivers and creeks reported drying up".

With the exception of September, the autumn months of 1934 were much warmer than normal, featuring statewide departure of +4.0 F in October and +5.4 F in November. All three months, however, were wetter and generally cloudier than normal, signaling the beginning of a trend toward wetter conditions, a trend which, much to the relief of drought stricken areas of the state, persisted through the summer of 1935. The meteorological autumn opened with moderate to heavy rains in many areas (e.g. 2.60 inches on 2 September at New London, one of the worst drought stricken communities in the state). Moderate to heavy rains fell again during the middle of the month and at the end of the month (e.g. 3.84 inches at Cambridge on 24-25 September and 4.85 inches at Zumbrota on 25-26 September). As a result of the copious September rains, many stations reported monthly totals ranging from four to nine inches (e.g. Zumbrota, 9.05 inches). In some southeastern counties the heavy rains triggered local flooding, a vexation which was probably viewed as minor in comparison to the benefits gained. Unfortunately, however, the September rains missed areas of northern Minnesota, an area in which some stations recorded less than an inch of moisture (e.g. Argyle, 0.67 inches).

Consistent with the upturn in rainfall and the concomitant downturn in temperatures (the statewide September average temperature was about four degrees F below the then accepted normal), the Minneapolis Weather Bureau reported that "September conditions were favorable for agricultural interests in most areas of the state. Generous rains in southern counties delayed farmwork but resulted in material improvement to meadows, pastures and most late crops and put the soil in good condition for fall plowing. Pastures in many southern localities were reported as the best of the season. However, in northwestern counties where dry weather set in during the latter part of the growing season, moisture conditions failed to improve fields....Pastures are poor in that section...Killing frosts and a hard freeze on the 21st terminated the growing season over most of the state but damage was light to moderate..." .

Drought breaking precipitation continued into October 1934, all but a few Minnesota stations receiving normal or above normal amounts of rainfall. Significant rainfalls were recorded at many stations on 3-6 October with many localities, especially in northern Minnesota receiving amounts of more than an inch. Another, and generally heavier, round of precipitation fell over much of the state during the period 15-21 October. Amounts in many instances were heavy to excessive, including 2.18 inches at Angus on 16 October; 2.32 inches at Argyle on 16 October; 2.60 inches at Fosston on 20 October; 2.50 inches at Gonvick on 20 October; 2.50 inches at Warroad on 16 October; 3.10 inches at New Ulm on 20 October; 3.95 inches at Chaska on 20 October; and 5.39 inches at the Minneapolis Weather Bureau station on 19-20 October. The month was also warm, generally sunny and virtually free of snow. Maxima of 88 F were record at a number of stations (e.g. Artichoke Lake, Milan, Pipestone and Worthington) on 11 and 12 October. Predictably, October's weather was, to use the words of Minneapolis Weather Bureau meteorologists "....very favorable for harvesting of late crops and for plowing and seeding in most

sections.....Heavy to excessive, timely rains during the [month] terminated the dry weather over the state.....especially in northwestern counties where moisture was badly needed....Most livestock improved and a considerable saving of winter feed was affected by late grazing...Subsoil moisture conditions improved over most areas..".

Although many stations recorded less than an inch of moisture during the entire month, November 1934 precipitation was, overall, above normal, the result of especially heavy precipitation in the southeastern part of the state. Some station totals in that section included 5.07 inches at Zumbrota; 4.31 inches at Albert Lea; 4.93 inches at Winona; and 4.45 inches at Grand Meadow. A heavy snowstorm in the southeastern counties on 30 November, caused considerable drifting, seriously impeding traffic in some areas. From a statewide perspective, however, November snowfall was well below normal, reflecting the general dearth of moisture over much of northwestern, west central and central Minnesota. The month's general warmth was reflected in numerous 70 degree F readings, the highest of which was 79 F at Montevideo on 6 November. Also, no station reported a sub zero reading, the lowest recorded being 4 F at Grand Rapids on 19 November. The warmth, moreover, was accompanied by a great deal of cloudiness and fog, the Minneapolis Weather Bureau station recording a mere 37 percent of possible sunshine.

December 1934 was a notably snowy, cloudy and cold month, featuring a cold wave which, during the last week of the month brought minima of -30 F or lower to many northern and north central stations (the lowest of which was -40 F at Warroad on 26 December). The heaviest amounts of snow were recorded in the northern and southeastern areas of the state, the drought stricken west central and southwestern sections generally receiving lighter, mostly less than normal amounts. Stations with the greatest snowfalls included Reads (Wabasha county), 30.2 inches; Grand Marais, 33.0 inches; Two Harbors, 30.0 inches; and Hastings, 27.0 inches. The smallest amounts included 2.4 inches at Artichoke Lake; 3.0 inches at New London; 3.2 inches at Wheaton; and 4.5 inches at Milan and Montevideo. Overall, seventeen days during the month were classified as cloudy, some individual stations reporting as many as twenty five overcast or largely overcast days. And at the Minneapolis Weather Bureau station, observers recorded only 32 percent of possible sunshine, a value even lower than that recorded during the grey days of November.

At the obvious risk of redundancy, it is necessary to stress the adversity experienced by Minnesota residents during 1934. The year was an unprecedented climatological disaster, combining extreme drought and desert like spring and summer heat: as a whole it was an extremely dry year, the driest, in fact, recorded statewide since 1923. And it proved disastrous from an agricultural point of view, especially in west central and central Minnesota where, according to Weather Bureau officials, there was "practically a complete crop failure" and where "cattle reached the point of starvation". Hopes were, however, raised by autumn rains, no doubt raising expectations for the new year expectations which, at least in part, were fulfilled.

The opening month of 1935 was (by January standards) extremely wet, bringing more beneficial moisture to a water starved state. It was, however, an adverse month, marked by long periods of extreme cold, snow blocked roads, underfed and cold stressed livestock and

much cloudy, foggy, gloomy weather. The cold, which continued late December's frigid regime, persisted for what must have been perceived as several interminable weeks, relenting finally on the last several days of the month. Monthly minima of -30 F and lower were recorded at most stations, the most extreme of which included -51 F at Pine River Dam; -50 F at Pokegama Falls; -48 F at Meadowlands; -46 F at Taylors Falls; -42 F at Cambridge; and -40 F at Chaska and Farmington. On a statewide basis, it was the coldest January since 1930, ending a four year streak of abnormally warm Januaries. Snowfall was twice the then accepted long term statewide average, the heaviest amounts (as in December) recorded in the northern and southeastern portions of the state. Snowfall totals of twenty inches or more were common in southern Minnesota (e.g. 22.1 inches at Red Wing and 21.9 inches at Maple Plain). Heaviest amounts, however, were recorded in northeastern Minnesota, the Lake Superior snow belt especially (e.g. 50.0 inches at Pigeon River Bridge; 47.0 inches at Two Harbors; 42.0 inches at Grand Marais; and 33.7 inches at Duluth). In contrast, accumulations of less than ten inches were recorded at many west central and southwestern stations (e.g. 4.5 inches at Artichoke Lake; 5.3 inches at Wheaton; 5.5 inches at Worthington; and 6.4 inches at Pipestone).

In one of the great, and usually surprising turnarounds for which Minnesota weather is famous, February 1935 was extremely warm (the warmest since 1931) and extremely dry (with the exception of 1934, the driest since 1912). Precipitation was deficient at virtually all stations, several of which (all in northern Minnesota) received only a trace (T) of moisture during the entire month. Snowfall was correspondingly short, averaging about one-third of the statewide February normal. The month, although it probably raised specters of another year of drought, was "very favorable for winter agricultural operations.... Winter grains and grasses were mostly well protected [by snow cover built up during January] and are believed to be in good condition. Livestock wintered fairly well, although much [is] looking thin. The mild weather in February resulted in a material saving of feed which was scarce and in some counties practically exhausted...".

The spring of 1935, in marked contrast to the spring of 1934, was generally cool and, in many localities, quite wet. March, however, was a relatively warm month while both April and May were significantly cooler than normal (the statewide May maxima of 83 F was the lowest recorded since 1905). In many localities, cool and rainy weather, although replenishing much needed subsoil moisture, seriously delayed spring farm work. April was particularly backward, featuring frequent rains (with heavy to excessive rains at many stations during the period, 23-29 April) and persistent cold. Temperatures dropped below zero F at several northern sites on 3 April and on 15 April several stations recorded notably low late season temperatures (e.g. 15 F at Milaca and Mora, 18 F at Minneapolis). Many stations in the west central and northern parts of the state also recorded heavy April snowfall (e.g. 12.0 inches at Wheaton; 12.3 inches at Fergus Falls; 12.4 inches at Beardsley; 14.5 inches at Bemidji and 14.8 inches at Park Rapids). Generally, and fortuitously, the heaviest spring precipitation fell in the areas that needed it most, west central Minnesota especially. May 1935, although somewhat drier than normal was generally favorable to agricultural interests: growth of meadows and pastures was spurred by the late April rains and the cool weather, providing verdant pasturage for much of the state's livestock.

However, despite several months of adequate to above normal precipitation, vestiges of the 1934 drought lingered into March. At that time, subsoil moisture was still greatly deficient in parts of the state, western areas especially. In addition, thick, blowing dust was observed at the Artichoke Lake, Milan and Big Falls stations on 18 March and at Moorhead, Baudette, Virginia and Duluth on 22 March. Light dust was also reported at several stations at various times during March and April (but not during May). The spring of 1935 also featured several notable storms, the first of which was a destructive sleet and glaze storm in the Duluth area on 3-5 March. Electric light, telephone and telegraph wires broke under the weight of the accumulating ice, leaving Duluth isolated from the outside world (other than by way of a few short wave amateur radio stations). Storm damage was estimated at one half million 1934 dollars. A much more widespread sleet, snow, glaze and windstorm swept through much of the state of 1-2 May 1935, bringing record to near record late season accumulations of snow to many stations. Heaviest amounts of snow were recorded in west central, central and east central Minnesota, the greatest amounts recorded at such stations as Wheaton (11.0 inches); Beardsley (8.5 inches); Fergus Falls (7.9 inches); Campbell (5.5 inches); and Wadena (5.0 inches). The Minneapolis Weather Bureau station record 3.0 inches, the greatest May snowfall at that location since 20 May 1892.

The summer of 1935, unlike the summers of the previous five years, was wetter than normal. For the state as a whole, June was the wettest June since 1925; July was the wettest July since 1928; and August was the wettest August since 1928. In relative terms, August 1935 was the wettest of the three months, statewide precipitation averaging about forty percent above the 1891-1935 normal (as then calculated). Heavy to excessive rains were common in many areas throughout the summer, including 4.58 inches at Maple Plain, 15-16 June; 4.09 inches at Beardsley, 15-16 June; 4.63 inches at Mankato, 17-19 June; 2.90 inches at Albert Lea, 24 July; 5.78 inches at Artichoke lake, 18 August; 4.34 inches at Morris, 18 August; 4.94 inches at Collegeville, 18-20 August; 4.22 inches at Waseca, 6 August; 5.14 inches at Chaska, 17-20 August; and 7.20 inches at New London, 17-20 August. Temperatures during the summer varied greatly: June was the coolest recorded in the state as whole since 1928 but July, in contrast, was the warmest July since 1916. August was also warm, the warmest August since 1930. July and August were both notably sunny months with a statewide average of sixteen and fifteen clear days, respectively. Consistent with the general lack of cloud cover, the Minneapolis Weather Bureau station recorded 85 and 75 percent of possible sunshine, respectively, in July and August. Maximum temperatures during July and early August reached or exceeded 100 F at many stations, the highest of which was 108 F at New Ulm on 27 July.

Although 1935's summer weather was, on the whole, a boon to Minnesota's drought distressed agricultural community, conditions in some areas were far from ideal. Some crops were damaged by excessive rainfall and by wind and hailstorms. The July heat also damaged crops in some areas, particularly in those areas of western and southwestern Minnesota which missed the otherwise generally generous July rainfalls. In its June report, the Minneapolis Weather Bureau claimed that "weather conditions were ideal for small grains, pastures and meadows, but too cool for corn, potatoes and truck. Cutting and haying were delayed, showers being too frequent for proper cutting of hay and some was damaged...some replanting of corn was necessary". Further exceptions to a generally

optimistic outlook were expressed in the Weather Bureau's July report: "Numerous rains early in the month with high temperatures spurred rapid growth of vegetation, although some grain was lodged, hay damaged and some washing of crops occurred.....warm, moist weather was conducive to rust development on small grains, especially spring wheat which was sown late and was more susceptible at its critical stage. Black stem rust spread rapidly ...and caused severe damage to spring wheat.....extreme heat during the third decade caused considerable deterioration in some places. At the close of the month. Pastures, meadows and other outstanding crops was mostly looking well, but needed rain in many localities....". The Bureau's August report, although generally positive, was still qualified, stating that "weather conditions were mostly favorable for agricultural interests. Heavy rains early in the month over much of the state were very beneficial for growing crops. However, the hot weather that followed caused considerable deterioration in many localities, mainly in central and extreme western counties. General, heavy to excessive, timely rains during the last half of the second decade [of the month] terminated the extended period of high temperatures and also relieved the dry conditions that persisted in many localities....Meadows, pastures, corn...were mostly good to excellent. The ground was in good condition for fall plowing..."

Unfortunately, however, the state's year long return to normal or above normal precipitation was not destined to last. The autumn months of 1935 were extremely dry in many parts of the state, signaling a return to another round of drought, a drought which reached its climax during the summer and autumn of 1936. The first month of the autumn of 1935 was somewhat cooler and much drier than normal, many stations especially those in the west central and northwestern parts of the state recording less than an inch of moisture. Many localities, moreover, received almost no precipitation during the period, 6-24 September and only light amounts during a brief rainy period, 25-26 September. Average precipitation for the state as a whole was less than one half the then accepted normal, the lowest September value (with the exception of 1930) recorded since 1918. Some implications of the September drought, as summarized by Minneapolis Weather Bureau officials, included conditions that were "mostly favorable for the completion of threshing, haying and maturing of late crops but too dry for pastures, plowing, fall sown grains and grass. It was unusually dry in the west central counties..Pastures were becoming short in many localities and rain was badly needed".

October 1935, like the month that preceded it, was cool and dry but, with the notable exception of the west central and northwestern portions of the state, was somewhat wetter than normal. Many stations in the east central, southeastern and northeastern counties recorded two to more than four inches of precipitation during the month (e.g. Cambridge, 4.72 inches; Maple Plain, 4.24 inches; Rochester, 3.17 inches), while other areas experienced a continuation of September's drought, receiving less than an inch of moisture (or, in some instances, less than one-tenth inch). Some of the driest locations included Campbell, 0.07 inches; Alexandria, 0.18 inches; Argyle, 0.10 inches; Marshall, 0.27 inches; Morris, 0.03 inches; and Milan, 0.15 inches). November 1935 was much colder than normal, providing Minnesota residents with a foretaste of the winter to come. Although precipitation and snowfall averages for the state as a whole were somewhat greater than normal, large pockets of drought remained, particularly in the west central and southwestern

areas of the state (e.g. Alexandria, 0.16 inches; Morris, 0.12 inches; Campbell, 0.43 inches; and Milan, 0.63 inches). Except in the northwestern counties, the month was also extremely cloudy and foggy, the Minneapolis and Duluth Weather Bureau stations recording 32 and 24 percent of possible sunshine, respectively. Overall, the month was deemed unfavorable for agricultural interests. There was "much feeding of livestock and moisture was needed generally, especially in western counties where subsoil moisture is greatly deficient".

Both precipitation and temperature during December 1935 were near the 1891-1935 statewide average. Precipitation was slightly to moderately above normal at most stations but some locations, chiefly those in the northern part of the state, reported significant deficiencies. Cold weather from 18-28 December was followed by a month end warm-up, a change which probably was taken by many as indicating a mild winter. The only climatologically distinguishing characteristic of the month was an unusual number of cloudy and foggy days, the statewide average of eighteen cloudy/overcast days being the greatest such value for any December in the 1891-1935 record. Possible sunshine values were correspondingly low: 25 percent at both Minneapolis and Duluth and 26 percent at Moorhead. When considered as a whole, 1935 was a wetter than normal year, the wettest recorded on a statewide basis since 1919. As in the previous years of the decade, moisture was, however, unevenly distributed, some areas receiving heavy to excessive amounts while others, particularly in the northwestern and western areas of the state, remained dry (e.g. Roseau, 14.91 inches; Crookston, 18.12 inches; Tracy, 19.09 inches). Weather related monetary losses from wind, heavy rains, sleet and glaze was estimated at about 1.8 million in 1935 dollars.

For most Minnesotans, 1935's weather was probably seen as signaling a return to more normal, less droughty and less extreme conditions. Any such expectations were soon dashed, however: 1936 turned out to be Minnesota's driest year since 1910; January and February were the coldest winter months recorded since the Little Ice Age of the 1880's (and, in some respects, perhaps the most adverse since the infamous winter of 1874-75); and the summer, July especially, was one of the hottest on record. Overall, the extremes in temperature were probably the greatest to occur in any single year (with the possible exception of 1838) since 1819 (when records were first kept at the Ft. Snelling post hospital station). It all began early in January, a month which opened with relatively mild weather but which soon turned bitterly cold. Below zero temperatures prevailed throughout the state during most of the month, reaching a near record state minimum of -55 F at Warroad on 23 January. At Moorhead, no temperatures above zero F were recorded between 15 January and 21 February. Monthly minima of -30 F or lower were recorded at virtually all Minnesota stations, even those in the southernmost portions of the state (e.g. Zumbrota, -33 F; Waseca, Rochester and Winnebago, -32 F). Other notably low minima were recorded at Minneapolis, -34 F; St. Cloud, -37 F; Taylors Falls, -42 F; Alexandria, -38 F; New London, -40 F; Fosston, -44 F; Big Falls, -52 F; Roseau, -49 F; and Campbell, -40 F.

January precipitation was frequent in occurrence but generally light in total. Snowfall, however, was somewhat above average, many stations reporting monthly totals of ten inches or more. Given the month's persistent and extreme cold, there was very little thawing,

allowing snow cover to accumulate to a considerable depth in most areas of the state. The heavy blanket of snow was, of course, subject to drifting, blocking many secondary roads and seriously hampering, even stopping, the marketing of farm products. The snow did, however, provide much needed protection for winter grains and grasses (which might otherwise have been seriously injured by the extreme cold). High winds and bitterly cold temperatures created blizzard conditions in many areas of the state on 22 January, disrupting traffic and causing several weather related deaths.

Adverse as it may have been, January 1936 was but a prelude to a bitterly cold, blizzard ravaged February. Sub zero readings were recorded at virtually all Minnesota stations on virtually every day of the month, the only exceptions limited to a few moderately warm days at the end of the month. Record or near record minima were observed at many stations during an intense mid-month cold wave which pushed bitterly cold Canadian air into much of the United States. The lowest temperatures were generally recorded on the mornings of 15 and 16 February 1936, some of which, at Minnesota stations, included -53 F at Ada; -51 F at Crookston; -47 F at Taylor Falls; -41 F at Morris; -42 F at Fergus Falls and Milan; -46 F at Little Falls; -37 F at Chaska; -40 F at New London; and -34 F at Maple Plain. Moreover, temperatures at most Minnesota stations averaged below zero during February (the lowest of which was a monthly average of -14.4 F at Hallock in northwestern Minnesota). At the Minneapolis Weather Bureau station (with a monthly average of 0.0 F), February 1936 was the coldest February since 1875.

The hardships caused by the month's persistent and extreme cold were, tragically, compounded by heavy snowfall and recurring blizzards. Blizzard or near blizzard conditions prevailed over all or parts of the state on 4, 8-9, 13, 17-18 and 26-27 February, snarling and often completely curtailing railroad, automobile and air transportation. Many secondary roads were impassable during most or all of the month, making it difficult for rural area residents to obtain food, fuel, medical care and other necessities. In extreme southern Minnesota, where the snowfall was the heaviest, some communities were isolated for extended periods of time. Statewide average snowfall was more than double the then accepted February average with many individual stations recording twenty inches or more. Some representative monthly snowfall totals included 36.0 inches at Winona; 30.7 inches at Zumbrota; 32.5 inches at Albert Lea; 30.0 inches at Faribault; 28.8 inches at Marshall; 33.0 inches at Grand Marais; 31.0 inches at New Ulm; 28.0 inches at Redwood Falls; and 25.0 inches at Milan. Disastrous as it was, however, February's record setting weather did improve the spring moisture outlook, especially in the drought afflicted western counties of the state.

Despite a few unseasonably cold days at the beginning of the month, temperatures during March 1936 were near normal, a marked and probably unexpected reversal of February's extreme cold. The month, however, was considerably wetter and snowier than average, the snowiest March overall since March 1917. Snowfall was far from evenly distributed, some stations recording twenty to thirty inches (e.g. Taylors Falls, 24.7 inches; St. Paul, 22.0 inches; Virginia, 23.3 inches) while others remained virtually snowless (e.g. Alexandria, 0.2 inches; Wadena, 1.9 inches; Wheaton, 1.8 inches; Artichoke Lake, 0.5 inches). Warmer temperatures during the last week of the month triggered a rapid snow melt which, in the southern areas of the state, resulted in extensive but local flooding. Moisture from the

melting snow cover was, however, generally beneficial, providing encouragement for farmers looking forward to the 1936 growing season. In this regard, Minneapolis Weather Bureau officials noted that "the soil is generally well saturated and subsoil moisture conditions fairly good, except in the western and northwestern counties..." .

April 1936 was, unlike March, cool and dry, featuring record or near record low temperatures at a number of stations on 7 April (e.g. -3 F at Wadena; 2 F at St. Cloud; -2 F at Alexandria and Morris). The lowest temperature of the month, -18 F-- the lowest April temperature recorded at a Minnesota station since 1896 -- was recorded at Warroad on 1 April. Precipitation was again unevenly distributed, many stations, especially those in the northern section of the state, recording monthly totals of less than an inch while several localized areas, in contrast, received excessive rainfall. Stations in the latter group received most of their precipitation during storms which deposited two to more than three inches of rain in the Willmar, New London and Collegeville areas on 30 April. Heavy, damaging rains were also reported in the Winona area on the same date. A tornado which touched down in Martin and Fillmore counties on 30 April took three lives, injured about forty people and caused property damage estimated at \$850,000 (1936 dollars).

Hopes for a moderate and continued wet regime dimmed rapidly during May and June 1936. Consistent with earlier patterns, adequate amounts of moisture fell in some local areas, especially in the southern and northeastern parts of the state while other areas remained dry. The favored areas included Winona, 6.34 inches in May, 3.83 inches of which was recorded on 1 May; Winnebago, 4.88 inches in May; Cloquet, 5.40 inches in May; and Itasca State Park, 4.11 inches in June. Other areas in contrast -- particularly those in the already dry areas of the state -- received less than an inch of moisture in either one or both of the two months (e.g. Argyle, 0.16 inches in May; Alexandria, and Moorhead, 0.62 inches and 0.48 inches, respectively, in June). On a statewide basis, precipitation for the two months, May-June, was about forty percent short of the then accepted normal. May's spotty rainfall was accompanied by persistently warm and sunny weather. June, in contrast, was relatively cool but, giving an indication of things to come, featured a short heat wave with maxima of 105 F and 103 F recorded at Canby and Artichoke Lake, respectively, on 25 June.

Despite the late spring drift toward drier conditions, the impending threat to the state's agricultural interests was not fully recognized until June. In its May report, the Minneapolis Weather Bureau reported that pastures and meadows had made good growth and that livestock had "improved considerably." It was also noted that "corn planting was practically completed, with much up and looking well. Early small grains were showing good stand and color....". Cutworm damage was noted as occurring in some localities and, in a concluding, more sobering statement, the Weather Bureau report emphasized the need for generally heavy rains, "especially in northwestern counties where the drought was becoming serious". The Bureau's June report was much less sanguine. Although it began by stating that growing crops "were greatly benefitted, especially in extreme northwestern counties by general, timely soaking rains early in the month...and extended period of dry weather that followed....caused considerable deterioration....rains during the later half of the third decade [of the month] were beneficial in northern and some southwestern counties...were far too late for material improvement to small grains which were reported as almost a complete failure in middle western counties and portions of the Red River of the North Valley. At the

close of June, spring wheat, oats and barley were mostly in fair condition but not doing well....pastures were turning brown in many localities.....rain was badly needed in many localities".

But if rain was badly needed at the end of June it was desperately needed during July 1936, a month which brought a devastating combination of intense heat and record setting drought to virtually every portion of Minnesota. For the state as a whole, average precipitation fell about seventy five percent short of the 1891-1936 normal; temperatures averaged about seven degrees above the long term July normals; and twenty one days were classified as clear (with only one day classified as cloudy/overcast). The percent of possible sunshine rose to record heights: 90 percent at the Minneapolis Weather Bureau station; 85 percent at Duluth; and 86 percent at Moorhead. Daily maxima of 100 F or higher were recorded at a number of stations every day from 6-16 July. Not surprisingly, daily overnight minima at many of the same locations offered little relief from the burning heat, often remaining in the high 70's and low 80's F. Precipitation was almost totally lacking at many stations, a number of which recorded only about one tenth inch or less during the entire month (e.g. Minneapolis, 0.11 inches; St. Paul, 0.06 inches; Fergus Falls, 0.05 inches; Milan, 0.08 inches; Cambridge, 0.01 inches; Maple Plain, 0.09 inches; and Little Falls, a trace [T]).

With the exception of several lake cooled North Shore sites, every Minnesota station recorded temperatures well above 100 F, the highest of which (114 F at Moorhead on 6 July) equaled the state's previously highest temperature (114 F at Beardsley in 1917). Other notable monthly maxima included 111 F at far northern Ada; 110 F at Fosston, Farmington and Maple Plain; 109 F at Hallock, Cambridge, Zumbrota and Chaska; 110 F at Red Lake Falls; 112 F at Beardsley and Wadena; 111 F at Campbell, Canby and New Ulm; and 113 F at Wheaton. Most of these readings, of course, approached and often surpassed previous record maxima at the stations involved. Moreover, an all time Twin Cities record was set on 14 July when the mercury rose to 108 F at the Minneapolis Weather Bureau station. For the month as a whole, temperatures at the Minneapolis station averaged 81.4 F, surpassing the previous July record of approximately 80 F set at the Ft. Snelling post hospital station in 1830.

Needless to say, the Minneapolis Weather Bureau's summary of July 1936 weather painted a very grim picture: "The period from the 5th to the 18th.....was the hottest period os such duration ever experienced in Minnesota. The extreme heat resulted in innumerable heat prostrations, many...fatally. A large news gathering agency estimated the number of deaths in the state at 759, attributed directly or indirectly to the heat wave. There was much suffering to livestock, with attendant losses. In streams tributary to Lake Superior and in the southeastern part of the state, severe losses to game fish occurred, particularly in the trout streams, when surface water temperature rose to as high as 85 degrees. There were more forest fires started during the period of extreme heat than in any like period since the organization of the state forestry and fire prevention service in 1911. Lake and stream levels were affected considerably by the excessive evaporation. There was some damage to highways....Rainfall was greatly deficient at all stations....Droughty conditions that set in over sections of the state near the close of the first decade in June, continued throughout July, becoming more extensive and severe. Weather conditions were decidedly unfavorable

to agricultural interests. The...drought....had a most destructive effect on growing crops. Small grains ripened prematurely on very short straw with heads poorly filled. On many fields, binders could not be used for harvesting grain and mowers were necessary. Yields ranged from good locally in some southeastern counties to very poor in extreme western counties where small grains were cut for feed in many localities. Meadows and pastures dried up in most of the state and by the close of the month feeding of livestock was becoming rather general. Corn, potatoes and other crops deteriorated badly, with much damaged beyond recovery. Unusually low water was reported in lakes and streams and navigation was suspended on the upper Mississippi river...".

July's drought continued unabated through the first half of August 1936 when, after another round of record breaking heat, moderate to heavy rains fell in many portions of the state. Maxima exceeded 100 F at many stations, chiefly those in central and southern areas. The highest readings in most areas occurred during the period, 8-15 August but, at some locations, chiefly in southwestern Minnesota, the monthly peak was reached on 24 August. The warmest temperature recorded in the entire state during the month was 108 F, recorded at the St. Paul armory station on 15 August (and the highest temperature recorded in any August since 1930). Other monthly maxima included 107 F at Pipestone and Worthington on 24 August; 106 F at Maple Plain and New Ulm on 15 August; and 105 F at Beardsley, Canby, Tracy Wheaton, Faribault, Farmington, St. Cloud and Zumbrota. Although precipitation for the state as a whole remained below normal, many locations recorded above normal to excessive amounts of rainfall. Some of the most significant amounts included 4.45 inches at New London on 20-21 August; 3.07 inches at St. Peter on 28 August; and 3.21 inches at Zumbrota on 28 August. A number of stations, most of them in the northern part of the state, however, missed most of the late August rains, recording less than an inch of precipitation during the month, values about two inches below their respective August averages. Any beneficial effects of the month's tardy rains notwithstanding, August's weather was generally unfavorable, whether for agricultural interests or for the state's environment in general. According to Minneapolis Weather Bureau officials, the "lack of rain combined with high temperatures during the first half of the month caused considerable deterioration to growing crops. Meadows and pastures dried up and yard feeding of livestock was general. There were reports of trees and game fish dying because of drought. Fall plowing was delayed because of dry soil. The forest fire situation became acute. General rains which set in on the 14th and continued more or less to the 28th, terminated one of the most severe droughts ever experienced in the state. Forest, brush and peat fires that had been prevalent in northern and eastern counties since July were checked. Vegetation began to revive, and by the close of the month meadows and pastures were showing material improvement...the ground was in good condition for plowing and seeding in extreme southern counties but elsewhere more rain was needed..".

The autumn of 1936 began with a hot September which, consistent with a pattern often associated with dry years, was followed by a cold October-November. All three months, however, were drier than normal, October especially (with a statewide precipitation value approximately one third of the then accepted October average). With a few exceptions, chiefly in southeastern Minnesota, September's drought was widespread, some stations reporting monthly amounts of less than an inch (e.g. Moorhead, 0.26 inches; Canby, 0.70

inches; Redwood Falls, 0.73 inches; Collegeville, 0.76 inches; and Minneapolis, 0.78 inches). The month also brought record or near record late season warmth (e.g. Moorhead, Ada, Wheaton, Beardsley, 101 F on 22 September). October, in contrast, set a new statewide record October minimum, -16 F at Roseau on 16 October. Most stations recorded less than an inch of precipitation during the month, some receiving less than one tenth inch (e.g. Redby, 0.08 inches; Alexandria, 0.05 inches; Pipestone, 0.06 inches; and Gonvick, a mere trace [T]). October snowfall was, however, above normal, especially in northern and central Minnesota (e.g. Cloquet, 8.7 inches; Detroit Lakes, 7.2 inches; St. Cloud, 6.3 inches; and Mora, 6.7 inches). Predictably, October brought a return of the 1930's dust storms with thick dust at several locations on 9, 30 October and light dust on 9, 29, 30 and 31 October. According to the Minneapolis Weather Bureau's October report, dusty conditions were prevalent in "extreme western counties where much soil blowing was reported". November 1936 opened with abnormally cold weather, bringing sub zero readings to stations as far south as Waseca (-2 F on 8 November). Moreover, in an unusual departure from the normal November pattern, the month's lowest reading (-20 F at Redby) was recorded on 7 November. Although November precipitation was below normal at about two thirds of the state's weather stations, snowfall was above average, exceptionally heavy snows falling at several far western locations, mostly during the opening days of the month. The greatest monthly snowfall (26.0 inches) was recorded at Wheaton in Traverse county. Other amounts in the same region of the state included 17.4 inches at Campbell; 18.0 inches at Fergus Falls and 17.2 inches at Beardsley. Heavy snowfall was also recorded at many northeastern Minnesota stations. Seemingly, however, mild weather late in the month melted the snow cover in many parts of the state, creating conditions favorable for what Weather Bureau officials termed a "severe" dust storm on 20 November.

The last month of 1936 brought the beginning of the end of an extended eight month drought. The month was warmer, wetter, snowier and much cloudier than normal, featuring an unusual period of warm weather during the 1936 holiday season. Temperatures approaching 60 F were recorded at several southern Minnesota stations on Christmas Day and St. Stephen's Day and, even at stations in far northern Minnesota, holiday week maxima reached into the 40's F. All but ten reporting stations recorded above normal precipitation, much of it falling during the last days of the month (as heavy snowfall in the north and as rain in areas of the southern Minnesota). Predictably, snowfall was heaviest in northern and northeastern Minnesota, exceeding twenty inches at many stations in those areas (e.g. 29.7 inches at Pokegama Falls; 28.2 inches at Orr; 28.4 inches at Virginia; and 26.5 inches at Grand Rapids). Heavy snowfall also occurred in other parts of the state, bringing much needed moisture to drought stricken areas such as Willmar (19.2 inches), Bird Island (21.5 inches), Marshall (14.5 inches) and Collegeville (23.1 inches). December's general wetness notwithstanding, a severe dust storm was reported in some North Dakota-Minnesota border communities on 19 December (driven by winds which reached velocities of 35 miles per hour at Moorhead). Overall, December's weather was deemed favorable for agricultural activities. According to the Minneapolis Weather Bureau, "melting snows with little if any runoff, followed by slow rains improved the moisture situation. There were some reports of winter grains and grass turning green prematurely in extreme southern and western counties near the close of the month, because of unusual warmth...".

Despite its benign ending, 1936 was, without question, one of the worst years in Minnesota climatological history. As noted previously, total annual precipitation fell below ten inches at several northwestern Minnesota stations (e.g. 8.87 inches at Moorhead; 7.81 inches at Angus; 9.72 inches at Argyle; and 9.99 inches at Crookston). Moreover, a wet winter notwithstanding, precipitation at most other stations was far below normal with many localities recording annual totals of about fifteen inches or less (e.g. Pine River Dam, 14.81 inches; Red Lake Falls, 11.03 inches; Alexandria, 10.46 inches; Artichoke Lake, 12.02 inches; Beardsley, 11.59 inches; Campbell, 14.38 inches; Wadena, 14.92 inches; and Hastings, 15.10 inches). Snowfall, however, was well above the 1891-1936 statewide average with annual amounts approaching or exceeding 100 inches at some northern stations (e.g. 136.5 inches at Pigeon River Bridge; 106.1 inches at Virginia; 109.3 inches at Grand Marais; and 96.0 inches at Duluth). In addition, even areas of central and southern Minnesota experienced record or near record snowfall, most of it deposited in January and February (e.g. annual totals of 93.7 inches at Bird Island; at Duluth; 85.1 inches at Redwood Falls; 84.1 inches at Collegeville; and 86.7 inches at Maple Plain; and 81.2 inches at Marshall). The lowest annual total reported was 26.7 inches at Angus in far northwestern Minnesota. Predictably, 1936 was an unusually cloudless year with a statewide average of 148 clear days and 62 and 64 percent of possible sunshine, respectively, at the Minneapolis and Moorhead stations. Also, as previously noted, the year's statewide temperature range (-55 F to +114 F) was probably the greatest in any year during the entire period, 1891-1936 (and perhaps the greatest ever since the beginning of the American presence in Minnesota). All of which was summed up aptly by Minneapolis Weather Bureau officials when they stated that "the year, 1936, will go down in the climatic history of the state as one of great extremes in temperature and precipitation. It was unparalleled for prolonged periods of sub zero weather in January and February and abnormally high temperatures in July....Severe cold with unusually heavy snows caused much suffering, demoralized traffic and resulted in local fuel and food shortages. Much damage to highways occurred and there was a great economic loss. Extremely high temperatures in July caused innumerable heat prostrations.... Forest fires were unusually numerous. It was the second driest year since the beginning of statewide records in 1891....The crop season was one of the most unfavorable ever experienced in Minnesota. As compared with 1934, the drought was more extensive and of greater severity, although the livestock situation was not so critical. Moisture conditions at the beginning of the season were encouraging....Crop prospects looked good when an extended period of drought set in about the tenth of June, intensified by extreme heat in July.....".

For the many who may have thought that drought and heat had become a permanent part of life in Minnesota were undoubtedly pleasantly surprised by the weather of 1937. Although not totally drought free, the year's precipitation returned to generally normal levels, particularly in some of the worst drought stricken parts of the state. Moreover, and more importantly, the year marked the beginning of a steady, but certainly not uninterrupted, trend toward less harsh and wetter climatic conditions. The opening months of the year, however, were far from normal, bringing cold which, although not as severe as that experienced in 1936, was more extended. More importantly, January and February 1937 laid down a heavy blanket of snow which, when it melted in the spring, raised lake and stream levels and improved 1937 crop outlooks. January 1937 was the wettest, snowiest January

recorded statewide since 1916, bringing heavy snowfall to most areas of the state, the drought parched west central counties especially. Monthly totals approached or exceeded twenty inches at most stations, reaching levels near fifty inches in some localities. Some of the more significant monthly values, many of them recorded in areas which had suffered the worst of the 1936 drought, included 47.1 inches at Campbell; 19.7 inches at Ada; 27.3 inches at Moorhead; 19.0 inches at Detroit Lakes; 18.0 inches at Alexandria; 24.3 inches at Beardsley; 26.5 inches at Bird Island; 22.5 inches at Morris; 30.1 inches at Wheaton; and 20.5 inches at Willmar. The heavy snowfall was accompanied by persistent cold, some stations recording minima of zero F or lower every day of the month. The lowest temperature recorded was -47 F at Pokegama Falls on 19 January. Whatever its eventual benefit, January's excessive snowfall was not without its drawbacks. As in the winter of 1936, traffic was seriously delayed, many secondary roads were blocked during the entire month and "farmers experienced much difficulty in caring for livestock because of the deep snow" .

February 1937, like the month that preceded it, was cold and snowy. Snowfall, however, was not as uniformly distributed as it was in January, with heavy snowfall in the northern part of the state and generally lighter amounts in southern areas (e.g. Windom, 4.0 inches; Worthington, 3.5 inches; and St. Peter, 6.0 inches). Of special note were the exceptionally heavy snowfall values recorded at several west central stations, locations which had experienced heavy snowfall in January. Some more notable two month combined totals included 73.6 inches at Campbell; 52.4 inches at Wheaton; 39.5 inches at Morris; 44.0 inches at Bird Island; and 43.0 inches at Moorhead. Predictably, the February snowfall, especially when piled on top of January's snow cover, snarled traffic and interfered with agricultural work. In its monthly report, however, the Minneapolis Weather Bureau stressed the advantages of the winter snow cover, stating that "the moisture situation over the state was favorable, especially in the dry western counties where the winter snowfall was unusually heavy...".

The spring of 1937 was, on the whole, cooler and wetter than normal. March, however, was a dry, sunny month, no doubt raising the specter of another dry year. With the exception of several isolated locations, snowfall was light and many stations, particularly those in the northern half of the state, recorded less than one quarter inch of precipitation (e.g. Campbell, 0.06 inches; Fergus Falls, 0.11 inches; Little Falls, 0.24 inches; Tracy, 0.19 inches; and Detroit Lakes, the driest of all, only a trace [T]). Above normal precipitation was limited to a few stations in southern and southwestern Minnesota (e.g. the Bird Island station recorded 24.9 inches of snow, bringing its January-March total to 68.9 inches). Other significant snowfall totals were recorded by observers at Marshall(23.7 inches); New Ulm and Redwood Falls (19.0 inches); and Albert Lea (16.5 inches). Yet, the January-February snowfall notwithstanding, the Minneapolis Weather Bureau reported that subsoil moisture was still "greatly deficient over much of the state".

March dryness persisted into the first several weeks of April but, fortunately for Minnesota's drought weary residents, the month closed with heavy, soaking rains in virtually every area of the state. April 1937 was the wettest April recorded on a statewide basis since 1896, a ranking mostly attributable to generous, recurrent rains which fell in all sections of the state during the last ten days of the month. The heaviest rains, moreover, tended to favor areas

which had suffered the worst from the 1936 drought, many of which recorded four to six inches of moisture during the month (e.g. Wheaton, 6.33 inches; Beardsley, 6.06 inches; Milan, 5.19 inches; Little Falls, 5.25 inches; Alexandria, 4.94 inches; Ada, 4.52 inches; Marshall, 4.83 inches; Detroit Lakes, 5.00 inches; Crookston, 4.26 inches; Hallock, 5.63 inches; and Moorhead, 4.69 inches). Northern and western sections of the state also recorded heavy April snowfall, the greatest amount (17.0 inches) recorded at Beardsley. Much of the snow was deposited during a sleet and snowstorm which, accompanied by high winds, did considerable damage in the western counties of the state on 25 April. April's precipitation was also accompanied by an abnormal amount of cloudiness with a statewide average of fifteen predominately overcast days and only 45 percent of possible sunshine at the Minneapolis Weather Bureau station.

Wetter than normal conditions persisted in May 1937, a warmer and sunnier than normal month. Above normal amounts of moisture fell at about two thirds of the stations then reporting, some of the greatest monthly values again recorded in the driest areas of the state (e.g. Detroit Lakes, 6.45 inches; Crookston, 4.13 inches; Alexandria, 4.43 inches; Tracy, 5.54 inches; Worthington, 4.49 inches; and St. Cloud, 5.72 inches). The greatest monthly total (8.55 inches) was, however, recorded at the Chaska station where, on 29 May, a four inch downpour triggered local flooding, causing damage estimated at \$145,500 (1937 dollars).

The summer of 1937 was, as a whole, somewhat warmer and slightly wetter than normal. June was relatively cool, July was warm and August was hot, the warmest August recorded on a statewide basis since 1900 (and at the Minneapolis Weather Bureau station, one of the warmest recorded since Twin Cities record keeping began in 1819). June was very dry in the northern portions and wet at many locations in the central and southern portions of the state. Representative monthly rainfall totals included 1.34 inches and 1.41 inches, respectively, at Crookston and Moorhead and 7.98 inches, 7.15 inches and 7.45 inches, respectively at New Ulm, Mankato and Grand Meadow. Moreover, daily rainfall amounts of four inches or more were reported at several southern locations on 12-13 June (including 4.55 inches at New Ulm, 4.36 inches at Springfield and 4.38 inches at Mankato). Killing frosts occurred in some areas as late as 27 June and, as a reminder of the recent drought, light dust was observed at various stations on 18, 22, 24 and 25 June. Overall, June weather conditions were said to have been "mostly favorable for agricultural interests. Unseasonably cool weather during the first decade [of the month] retarded growth of corn but small grains and grass did well...Pastures were reported as the best in years....At the close of the month, small grains were good to excellent, although there were scattered reports of black stem rust on spring wheat.....Insects were numerous. Rain was badly needed in northwestern counties, and locally in eastern counties".

July 1937 was a moderately warm month with many stations reporting maxima of 100 F or higher (e.g. 101 F at Ada; 103 F at Canby; 104 F at Chaska; and 105 F at Beardsley). Precipitation patterns were, however, decidedly different from those experienced in June: July's heaviest rainfalls generally fell in the northern parts of the state with lighter amounts in southern and central areas. Some localities were, in fact, very dry, recording less than one inch of precipitation during the entire month (e.g. Bird Island, 0.52 inches; New Ulm, 0.85

inches; Pipestone, 0.46 inches; Faribault, 0.18 inches; Waseca, 0.42 inches; Winona, 0.13 inches; and Mankato, 0.21 inches). Several northern stations, in contrast, were excessively wet. Baudette in Lake of the Woods county, the state's northernmost county, recorded 12.50 inches of precipitation. Of that total, 8.07 inches fell in a three day period, 14-16 July, 5.00 inches of which was recorded on one day (15 July). Other northern stations reporting heavy July precipitation included Warroad, 8.33 inches; Ahgwahching, 8.82 inches; Hallock, 7.23 inches; and Gull Lake Dam, 7.42 inches. July was also unusually sunny with a statewide average of seventeen clear days and 81 percent of possible sunshine at the Minneapolis Weather Bureau station. The extremely dry weather experienced in some locations caused considerable deterioration to crops growing on light soils. Overall, however, crop yields were said to be "mostly good to excellent" but "meadows and pastures were short in many localities".

August 1937, as noted, was much warmer than normal. Temperatures above 100 F were recorded at many stations in the central part of the state, the highest 108 F at Beardsley on 15 August. Other notably high readings included 107 F at Canby and Pipestone; and 104 F at Milan. Fortunately, however, the heat was tempered by above normal rainfall, many stations reporting monthly totals in excess of six inches (e.g. Redby, 9.84 inches; Two Harbors, 6.77 inches; Long Prairie, 7.75 inches; Montevideo, 7.96 inches; Collegeville, 6.48 inches; Milaca, 8.79 inches; and Little Falls, 6.48 inches). Heavy rains at the beginning of the month, added to July's extreme wetness, triggered extensive flooding in portions of Lake of the Woods, Beltrami, Pennington, Roseau, Marshall, Red Lake and Clearwater counties with losses estimated at \$2 million (1937 dollars). Above normal precipitation notwithstanding, the Minneapolis Weather Bureau's August report pointed out that "in several extreme southern counties, heat and dryness caused much deterioration [of crops], particularly on light soils. Corn and potatoes matured too rapidly for best results. Grasshoppers caused damage in Hennepin and adjacent counties estimated at \$200,000. Heavy rains at the beginning of the month....improved...pastures and late crops...Heavy rains during the closing days of the month were beneficial and put the ground in good condition for plowing".

With the exception of September, a somewhat warmer than normal month, the remaining months of 1937 were colder than normal. All four, moreover, were drier than normal. September's rainfall was unevenly distributed with some northern stations reporting amounts in excess of six inches while others recorded less than an inch (e.g. Crookston, 0.37 inches; Red Lake Falls, 0.45 inches; and Alexandria, 0.61 inches). The general dryness was also accompanied by record late September heat: temperatures of 101 F, 100 F, 99 F were recorded at Wheaton, Zumbrota and New Ulm, respectively on 21 September. Nor was the unusual late season warmth limited to a few stations: with the exception of most far northern sites, most localities recorded maxima in the high or mid 90's F, also on 21 September. September's dryness persisted into October, all but a few stations reporting moderate to large precipitation deficits. The driest areas were in northern and central Minnesota, some areas experiencing an October almost totally lacking in moisture (e.g. Ada and Crookston, 0.08 inches; Fosston, 0.05 inches; Gonvick, 0.03 inches; Moorhead, 0.11 inches; and Roseau, 0.07 inches). With a few exceptions (e.g. Bird Island, 10.0 inches; Worthington, 6.5 inches), the month was also largely devoid of snow, leaving fields and pastures dry and

barren in many parts of the state. Not surprisingly, light dust was reported in various localities on several days during the month. Although generally cooler than normal, October finished with several unusually warm days with temperatures above 80 F recorded at several southwestern Minnesota stations on 29 October. On a statewide basis, November 1937 was the driest November recorded since 1929. Precipitation shortfalls were recorded at all but six of the state's then functioning official stations: with a few exceptions, monthly totals were less than one inch with many areas receiving less than one quarter or even less than one tenth of an inch of moisture. According to Minneapolis Weather Bureau officials, November was "too dry for pastures, winter grains, grass and fall plowing which was abandoned at about the middle of the month.....Fields were practically bare during the last week of the month and alternate thawing and freezing was somewhat detrimental to winter grains and grasses.....At the end of November, the ground was frozen to a considerable depth with surface and subsoil moisture greatly deficient over much of the state".

Drier than normal conditions persisted through the last month of 1937. December snowfall was generally light in the southern part of the state and generally heavier in the northern and central areas. The greatest monthly totals exceeded thirty inches (e.g. Pigeon River Bridge, 36.5 inches; and Grand Marais, 35.9 inches). In contrast, stations such as Alexandria, Chaska and Faribault recorded three inches or less. Although 1937's year end dryness no doubt caused much anxiety, especially in the rural areas of the state, the year as a whole, as noted previously, marked a turning point in Minnesota's climatological history, the beginning of the end of the prolonged drought which had persisted in many areas of Minnesota since the 1920's. At some stations, especially those in the parched western regions of the state, 1937 was the wettest year of the decade (e.g. Wheaton, 31.02 inches, an annual total nearly double that recorded in the previous year and approximately four inches greater than the annual totals recorded during any other year of the 1930's). It was also the wettest year of the decade at Morris and, at many other stations, 1937's annual precipitation was greater than that recorded during 1931, 1933, 1934 and 1936.

Drier than normal conditions persisted through January 1938, the fifth consecutive month in which precipitation was generally deficient. January, although much warmer than the preceding two Januaries, was nevertheless colder than normal, the fourth in a series of cold Januaries. Snowfall was generally light to moderate, all stations reporting amounts of less than twenty inches (with some recording less than four inches). Weather patterns, however, began to change in February 1938, a month which, in contrast to the months immediately preceding, was cloudier, warmer and slightly wetter than average. And, although February snowfall was light to moderate, the greatest amounts, propitiously, fell in some of the driest areas of the state (e.g. Pipestone, 14.2 inches; Springfield, 17.8 inches; Tracy, 14.5 inches; Worthington, 13.9 inches; Argyle, 10.2 inches; Crookston, 10.8 inches). Many stations recorded frigid temperatures on the first day of the month (e.g. -42 F at Meadowlands and Pokegama Falls) but generally mild weather prevailed during the remainder of the month (with Meadowlands recording +53 F on 27 February, a value 95 F higher than that station's 1 February minimum).

The trend toward wetter conditions accelerated in March 1938, the first month of what would be one of the wettest springs in the state's history. Moderate to light amounts of

precipitation fell over southern and central Minnesota on 4-5 March and over the entire state during the last three days of the month. While most stations ended the month with above normal amounts of moisture, a few areas, the extreme northwestern corner of the state especially, remained dry, reporting monthly totals of one-half inch or less (e.g. Crookston, 0.37 inches; Argyle, 0.47 inches; Mahanomen, 0.30 inches; and Moorhead, 0.46 inches). March was also unusually warm, the warmest recorded on a statewide basis during the entire period, 1891-1938. Temperatures on 21 March rose into the 70's F at most stations, including several in northern Minnesota. March's above average precipitation did not, however, banish all effects of the previous year's autumn drought: in its summary of the month's weather, the Minneapolis Weather Bureau noted "that there was little run off from melting of winter snows and much moisture was absorbed by the dry ground.....Seeding of spring wheat was reported as the earliest in years....Moderate to heavy precipitation from the 29th to the 31st was very beneficial, as the ground was getting dry, resulting in some soil blowing from the fields.....Topsoil moisture is sufficient for present needs, but subsoil moisture is deficient, particularly in west central counties".

April 1938 started dry and ended wet, featuring moderate to heavy rainfall in all areas of the state during the two week period, 14-28 April. For the state as a whole, April precipitation was about fifty percent greater than the then accepted normal, making it the wettest April recorded on a statewide basis since 1896. Total monthly precipitation exceeded two inches at all but a few stations while many stations, mostly in southern Minnesota recorded amounts of four to five inches. Weather conditions during the month were not, however, unqualifiedly congenial: cold, dry weather during the first part of the month retarded field work and the growth of vegetation. And, according to Minneapolis Weather Bureau officials, "some soil blowing was reported in northwestern counties where rain was badly needed." "Warm weather with frequent light to heavy rains during the second week were favorable for growth, although farm work was delayed.....At the close of April, spring sown grains were up and looking well; winter grains, pastures and meadows were in good condition....." .

Any lingering thoughts of drought were banished at least temporarily in May 1938, a month which brought excessive and persistent rainfall, flooding and much cloudy, dreary weather. It was the wettest May recorded on a statewide basis during the entire period, 1891-1938 and, with the exception of Hallock in northwestern Minnesota, all of the state's stations reported above normal rainfall. Notable monthly precipitation values included 10.95 inches at Hastings; 10.43 inches at Gull Lake Dam; 9.19 inches at Cambridge; 9.28 inches at Farmington; 9.20 inches at Red Wing; 9.39 inches at Taylors Falls; 8.71 inches at Brainerd; and 8.45 inches at Collegeville. Moreover, many other stations recorded monthly amounts ranging from five to eight inches. In addition, precipitation was unusually frequent: several stations reported measurable amounts (0.01 inches or more) on twenty four days during the month with a statewide average of seventeen such days, another May record. Predictably, the month's heavy and persistent rains raised river and lake levels, triggering widespread flooding in many areas, the upper Mississippi river basin especially. The Mississippi river at Aitkin reached flood stage on 6 May, cresting at a level about four feet above flood stage on 12 May, returning to its normal level on 28 May. Similarly, the Fort Ripley station experienced flood conditions from 9-19 May with the crest reached on 11

May. At Minneapolis and St. Paul, however, the river approached, but did not exceed flood stage. Apart from flooding, damage from excessive rainfall was extensive: e.g. downpours in the Jordan-Hastings area on 17-18 May caused damage estimated at about \$160,000 (1938 dollars). According to Minneapolis Weather Bureau officials, the month's floods and rains resulted in losses exceeding \$1 million (1938 dollars), much of which was the result of damage to highways and roadways adjacent to swollen rivers and streams. The Bureau's May report also noted that "farm work was seriously delayed by frequent rains, but subsoil moisture which was greatly deficient, was replenished. Growth of vegetation was retarded by cool weather. However, small grains stood well and grass made good growth....At the close of the month, meadows, pastures and small grains were good to excellent, although some yellowed or drowned out in low places....".

June 1938, unlike the excessively wet month which preceded it, was somewhat drier than normal. Precipitation, however, was unevenly distributed: many stations in the southern and central regions of the state reported above normal rainfall while many stations in northern areas reported substantial deficits. The driest locations included Moorhead (1.04 inches); Crookston (1.20 inches); and Fergus Falls (1.39 inches). Most stations in the southern part of the state, in contrast, recorded four to seven inches of rain during the month. Excessive rains caused damage in the Chaska and Fairmont areas on 24 June and, on 29-30 June, rains of cloudburst proportions occurred at Worthington (5.88 inches); Wheaton (3.98 inches); and Pipestone (3.95 inches). Overall, weather conditions during the month were reported as "mostly favorable for agricultural interests. Cool, dry weather retarded growth of corn...Higher temperatures that set in during the latter half of the second decade favored rapid growth of vegetation, but the topsoil was becoming rather dry, especially in extreme southwestern counties. Pastures were good to excellent.....At the close of the month, all crops...were in good condition. Rain was needed in the northern two thirds of state, although cool weather prevented much deterioration. Grasshoppers were numerous in extreme western counties...." .

July 1938 was relatively cool, the coolest recorded on a statewide basis since 1928. Although precipitation, when averaged for the state as a whole, was near normal, most individual stations reported below normal amounts. The heaviest monthly totals were recorded in southeastern Minnesota (e.g. Rochester, 9.66 inches; Winona, 7.57 inches; and Spring Grove, 6.45 inches). Frequent, but isolated, thunderstorms accounted for much of the month's precipitation, including 4.27 inches at Rochester on 30-31 July; and 3.35 inches at Redby on 27 July). Damage from these storms, some of which produced tornadoes and hail, was estimated at more than \$1 million (1938 dollars). The last summer month of 1938 was considerably warmer and drier than normal with approximately three fourths of the state's weather stations reporting below average precipitation. Although most localities received at least two inches of rain during the month, several southwestern and west central stations reported much lesser amounts (e.g. Wheaton, 1.20 inches; Mankato, 0.82 inches; Artichoke Lake, 0.97 inches; and Tracy, 0.99 inches). Many west central stations also recorded notably high August maxima (e.g. Wheaton, 106 F; Campbell, 105 F; and Beardsley, 104 F). August was also a sunny month with a statewide average of seventeen clear days and 75 and 81 percent of possible sunshine, respectively, at Minneapolis and Moorhead. Overall, however, the summer of 1938 was considered as favorable for

agricultural interests: crop production was reportedly better than average. Yet, at the end of August, droughty conditions had returned to many parts of the state and, according to Minneapolis Weather Bureau officials, "pastures were brown in places and fall plowing was hindered by dry ground." It was further noted that "Rain was badly needed in many localities, especially in extreme southwestern counties".

September 1938 was a schizoid month, featuring a brief period of copious, sometimes excessive, rainfall in southern Minnesota but leaving many northern sections tinder dry. Most of the month's precipitation, moreover, fell during the period, 5-15 September, the latter date marking the beginning of one of the many autumn droughts so characteristic of the 1930's. Heavy rains during the wet portion of the month included 4.41 and 4.22 inches, respectively, at Worthington and Windom on 8 September; 5.88 inches at Taylors Falls, 8-10 September; 4.55 inches at Farmington on 10 September; 5.39 inches at Hinckley, 6-10 September; 5.37 inches at Isle, 7-9 September. Monthly totals at many southern stations exceeded eight inches (e.g. Worthington, 11.16 inches; Albert Lea, 8.96 inches; Winona, 8.38 inches; and Fairmont, 9.62 inches) while, in stark contrast, several northern stations recorded less than one half inch (e.g. Ada, 0.37 inches; Fosston, 0.30 inches; Crookston, 0.43 inches; Warroad, 0.29 inches; Baudette, 0.11 inches; and Big Falls, 0.10 inches). Predictably, the northern Minnesota drought was conducive to forest fires, creating a situation which, by month's end, had become critical. Thick smoke, presumably from fires which had already erupted, was reported at several locations on 26, 27, 28, 29 and 30 September.

The autumn drought intensified during October 1938, a month which on a statewide basis, was the driest October since 1895. The month was also unusually warm, the warmest October since 1924. Monthly maxima in the 90's F were recorded at many stations, including 95 F at Milan; 94 F at Canby and Wheaton; and 93 F at Artichoke Lake, Beardsley, Marshall and Montevideo. The warmth persisted into mid-month, setting late season records at several stations, including Minneapolis (86 F on 16 October). Precipitation was greatly deficient at virtually all Minnesota stations, many of which recorded less than one quarter inch of moisture during the entire month (e.g. Moorhead, 0.15 inches; Canby, 0.04 inches; Marshall, 0.15 inches; Milan and Windom, 0.05 inches; Morris, 0.18 inches; Collegeville, 0.22 inches; Albert Lea, 0.18 inches; and Fort Ripley and Little Falls, each a trace [T]). The forest fire situation, which had become critical at the end of September, culminated with extensive blazes along the Minnesota-Canadian border on 10 October. According to the Minneapolis Weather Bureau's month end report, the fires killed twenty one people and caused extensive damage to timber, farm crops, homes and buildings generally. Fortunately, light rains during the period, 15-18 October checked the spread of the conflagration, allowing fire fighters to bring it under control.

November 1938, unlike the month that preceded it, was colder and wetter than normal. Its general coldness notwithstanding, the month featured several days of unusually high temperatures, the warmest of which, 83 F at Artichoke Lake on 1 November, was the highest November temperature recorded in the state during the entire period, 1891-1938. The autumn drought was alleviated by generous rains which fell over much of the state

during the first days of the month, some locations receiving three to four inches of moisture (e.g. Grand Rapids, 4.15 inches, and Pokegama Falls, 3.35 inches, 2-3 November). Unfortunately, however, November precipitation was light in areas of the drought stricken Red River Valley, stations such as Hallock, Moorhead and Crookston recording less than an inch of moisture during the month. November snowfall was very light over much of southern and central Minnesota with heavier amounts in northern sections (e.g. 27.3 inches at Orr; 25.8 inches at Mizpah; and 17.5 inches at Bemidji). A small tornado, an unusual November weather event in Minnesota, touched down near Nashwauk on 2 November, causing one personal injury and some loss of livestock and poultry. December 1938 was a meteorologically undistinguished drier and warmer than normal month, featuring much cloudy, foggy weather. Cloudy days averaged fifteen for the state as a whole, some stations reporting as many as twenty four cloudy December days. And at Moorhead, Weather Bureau observers recorded a scant eighteen percent of possible sunshine. Snowfall was generally moderate, much of it deposited during a storm on 26 December, a storm accompanied by high winds in many sections of the state (with a maximum sustained velocity of 50 miles per hour at Duluth).

Despite its relatively dry ending, 1938 was notably wetter than any other year in the 1930's. As noted previously it was, for the state as a whole, the wettest year of the decade (as well as the wettest year since 1911). The year's precipitation exceeded thirty five inches at many stations in southern Minnesota, some of them recording forty or more inches (e.g. Rochester, 43.69 inches; Spring Grove, 41.97 inches; Reads, 45.35 inches; Worthington, 40.50 inches; and Winona, as previously noted, 47.89 inches). Regrettably, 1938's drought breaking precipitation did not reach into all areas of the state: annual precipitation totals at several northern and west central stations were comparable to those of the worst drought years (e.g. Moorhead, 16.21 inches; Angus, 15.06 inches; Argyle, 14.94 inches; Milan, 20.11 inches; Roseau, 17.16 inches; and Hallock, 12.13 inches). The year as a whole was also notably warm, featuring a statewide average temperature approximately two degrees F above the then accepted state normal (41.6 F). With the exception of 1931, it was the warmest year of the decade.

Warmer than normal conditions persisted into January 1939 which, on a statewide basis, was the warmest January since 1931. The month was also wetter, cloudier and foggier than normal (with a statewide average of sixteen cloudy days). Interestingly, much of the month's precipitation fell as rain or freezing rain with the heaviest amounts recorded on 9 January (e.g. 1.54 inches at Wheaton and 1.34 inches at Beardsley). The rains, however, were not altogether beneficial, resulting in some "smothering of winter grains and grass in central counties because of an ice sheet on fields". Also, as in so many months during the 1930's, January's precipitation was unevenly distributed: although approximately three fourths of the state's weather stations reported above average precipitation, some received only scant amounts (e.g. Worthington, 0.34 inches). Similarly, most stations recorded above normal January snowfall while some, mostly in southern and central Minnesota, recorded subnormal amounts. In some southern areas, snow cover was said to have been insufficient to protect winter grains and grasses.

February 1939, unlike January, was a much colder than normal month, the coldest February

recorded on a statewide basis since 1936 (and apart from 1936, the coldest since 1917). Minimum temperatures of zero F or lower were recorded at many stations on most days of the month (including a near February record of nineteen sub zero days at the Minneapolis Airport station). Temperatures at many northern and central Minnesota locations dropped below -30 F, the lowest of which was a frigid -51 F at Meadowlands in St. Louis county on 21 February. Other notable monthly minima included -49 F at Sandy Lake Dam and Warroad; -48 F at Pokegama Falls; -47 F at Pine river Dam, Bemidji, Itasca State Park and Redby; -36 F at Long Prairie and Wadena; -35 F at Campbell; -34 F at Little Falls; and -30 F at far southern Zumbrota. February was also wetter than normal, featuring heavy snowfall at all but a few stations. Monthly snowfall totals included 51.0 inches at Pigeon River Bridge; 49.2 inches at Grand Marais; 45.5 inches at Two Harbors; 38.8 inches at Cloquet; 30.7 inches at Moose Lake; 25.0 inches at Collegeville; and 22.9 inches at Fairmont. Many other stations recorded snowfalls of fifteen to twenty inches and, for the state as a whole, snowfall was more than double the then accepted February average.

With the exception of May, the spring months of 1939 were colder than normal. All, however, were drier than normal, threatening a return to the droughty conditions of the earlier years of the decade. Precipitation during March was approximately one half of the 1891-1939 normal with many stations recording less than a half inch of precipitation (e.g. Alexandria, 0.12 inches; Hallock and Long Prairie, 0.10 inches; Fosston and St. Cloud, 0.27 inches; Windom, 0.06 inches; New London and Winona, 0.35 inches; Willmar, 0.29 inches; and Roseau, a mere trace [T]). March snowfall was correspondingly light, most stations recording monthly totals of less than ten inches. Also, sub zero temperatures were recorded on many days during the first half of the month, the lowest of which (-41 F) occurred at Mizpah on 18 March. April 1939, although proportionally not as dry as March, brought little relief from the spring drought. Despite several rainy interludes (16-18 April especially), many northwestern and west central stations received less than an inch of moisture (e.g. Crookston, 0.66 inches; Roseau, 0.70 inches; Alexandria, 0.73 inches; Fergus Falls, 0.47 inches; and Ahgwahching, 0.02 inches). Temperatures during the first part of April were generally chilly, giving way to a warmer regime which began at the end of the month and persisted through May. Many stations recorded maxima near to, or above, the 100 F mark on 30 May, the highest of which was 107 F at Ada. Other stations recording highs of 100 F or higher on that date included Moorhead and Crookston (101 F) and Angus, Redby and Bemidji (100 F). May rainfall was very unevenly distributed, some stations receiving four to six inches while others, especially those in the already dry areas of the state, recorded less than an inch (e.g. Ada, 0.46 inches; Crookston, 0.69 inches; and Detroit Lakes, 0.87 inches). In their May end report, Minneapolis Weather Bureau officials emphasized the seriousness of the drought while, at the same time, noting that extreme dryness was limited largely to the western and northwestern areas of the state: "It was unusually dry in the Red River of the North Valley...Where moisture was sufficient, vegetation advanced rapidly during the first decade [of the month]. Dry weather that followed retarded growth especially in western counties where the drought became serious.....At the close of the month, meadows, pastures and spring crops were looking well, except in dry western areas..". Predictably, 1939's spring dryness raised the specter of the decade's earlier dust storms with "light" dust noted at various stations on nine days during the month.

Fortunately, however, the drought was temporarily broken by heavy rains which soaked many areas during the last week in May, rains which persisted through June and into early July. On a statewide basis, June precipitation was approximately thirty percent greater than the then accepted June average. More importantly, however, June rainfall was average to above average in areas which had suffered the worst of the spring drought. Monthly totals included 5.09 inches at Ada; 3.92 inches at Moorhead; 7.45 inches at Beardsley; 6.60 inches at Fergus Falls; 6.28 inches at Alexandria; 6.31 inches at Morris; 7.86 inches at Wheaton; 6.69 inches at Collegeville; and 5.97 inches at Pipestone. The greatest monthly amounts were recorded at Chaska (9.00 inches) and Maple Plain (8.29 inches). June's rainfall did not, however, put an immediate end to the dusty conditions which had become endemic during May. Light dust was reported in some areas of the state on 4, 7, 8 and 18 June: "thick" dust on 4 June.

According to the Minneapolis Weather Bureau, storm damage during June was unusually large, aggregating to several million 1939 dollars. Severe storms raked much of the state on 7 June, accompanied by high winds and extensive hail. In Rock county in southern Minnesota, the hailstones purportedly reached grapefruit size, killing a large number of hogs and chickens. The outstanding meteorological event of the month, however, was the tornado which struck the northwestern portion of Hennepin county and the southern portion of Anoka county between 1500 and 1600 hours on 18 June. Nine persons were killed and several hundred injured as the tornado swept along a twenty five mile path extending from the town of Corcoran in Hennepin county to Cedar in Anoka county. Portions of the communities of Anoka and Champlin were devastated by winds so strong that, according to people who saw the funnel as it crossed the Mississippi river, the water was lifted up and the wind velocities were so great as to prevent the return flow of the river until the tornado again reached land.

July 1939, like so many of the Julys of the 1930's was warm and dry. Temperatures of 100 F or higher were recorded at many stations during the month, the highest of which was 106 F at Pipestone on 12 July. And, although a few favored locations received ample precipitation, most stations reported large to moderate moisture deficits. Isolated thunderstorms brought excessive rainfall to several areas, including Morris (3.88 inches on 4 July) and Tracy (3.85 inches on 27 July). The far southwestern community of Worthington, moreover, recorded its wettest July since 1903. And, although the greatest precipitation deficits were recorded at stations in northern and central Minnesota, several southern stations also experienced extreme dryness. Some of the lowest monthly totals were recorded at Moorhead, 0.43 inches; Roseau, 0.51 inches; Detroit Lakes, 0.40 inches; Faribault, 0.94 inches; Hallock, 0.82 inches; and Zumbrota, 1.15 inches. Predictably, July's weather had a detrimental effect on crops and pastures: according the Minneapolis Weather Bureau's end of July report, "heat and dryness over most of the state caused considerable deterioration to meadows pastures and late crops, especially in northwestern counties. Extremely high temperatures on the 12th in extreme western counties were injurious to small grains which ripened too fast....". August 1939 brought heavy to excessive rains to many areas of the state, the northeastern and southern areas especially. Some notably heavy amounts included 6.50 inches at Two Harbors on 8-9 August; 4.11 inches at Virginia on 8-9 August; 3.22 inches at Duluth on 8 August; 3.20 inches at Ahgwahching on 8 August; and

3.14 inches at Taylors Falls on 20-21 August. The greatest monthly total was 10.86 inches at Two Harbors. Unfortunately, however, the August rains failed to improve crop prospects in many areas, the Red River Valley area especially (where, according to Weather Bureau officials much of the potato and sugar beet crop was damaged beyond recovery).

Drought returned in earnest during the autumn of 1939, bringing a succession of three drier than normal months, the driest such period recorded for the state as a whole since 1892. The first month of the three was abnormally warm and dry. September precipitation was approximately fifty percent below the then accepted statewide average while temperatures rivaled those experienced during the record warm September of 1931. Temperatures of 100 F or higher were recorded at many stations on 14 September, the highest of which was 103 F at Redwood Falls. With the exception of a few isolated localities, all sections of the state were dry with many stations recording less than an inch of precipitation (e.g. Wadena, 0.30 inches; Tracy, 0.44 inches; Albert Lea and Austin, 0.51 inches; and Little Falls, 0.46 inches). October, unlike September was somewhat cooler than normal. Precipitation, however, was generally deficient, especially in the southwestern and southeastern areas of the state. Also, with the exception of a few northern locations, very little snow fell during the month.

The dry conditions which prevailed during the first two months of the fall of 1939 were, however, but a prelude to a siege of extreme drought which prevailed during much of November and December. For the state as a whole, November was the driest November recorded during the entire period, 1891-1939. Monthly precipitation totaled less than one tenth of an inch at most Minnesota stations, several of which (Faribault, Mankato and Waseca) recorded no precipitation whatsoever during the entire month. Numerous other stations (e.g. Angus, Campbell, Alexandria, New Ulm, St. Paul, Maple Plain, Pipestone, Wheaton, Windom and Collegeville) recorded only a trace [T] and at only one station (Mahnomon) did November's precipitation exceed one-half inch. Snowfall, of course, was largely absent, most stations recording only a trace [T] during the entire month. Predictably, November was abnormally cloudless, featuring a record statewide average of eighteen clear days, the greatest number of such days recorded in any November during the period, 1891-1939. Seventy two percent of possible sunshine was recorded at the Minneapolis Weather Bureau station, an extremely high value for November, a normally dreary, cloudy month. The drought was accompanied by much higher than normal November temperatures: readings in the 70's F were common at mid-month and, with a few exceptions, unseasonable warmth persisted throughout the entire month. According to Minneapolis Weather Bureau officials, November's "lack of moisture was detrimental to fall sown grains and grasses. Plowing was difficult. The ground was bare and lakes and streams were unfrozen most of the month...Numerous forest, brush and peat fires were reported....Moisture was badly needed".

The last month of 1939 and the last of 120 months of mostly adverse weather was extraordinarily warm, the warmest December recorded in the state up to that time. The first ten days of the month brought temperatures in the 60's F to many stations and, at a few west central stations readings topped 70 F on 6 December (e.g. Wheaton, 74 F; Marshall, Milan and Beardsley, 73 F; and Montevideo, 72 F). The Wheaton reading, in fact, was the highest December temperature recorded in Minnesota during the entire period, 1891-1939. The

December warmth was accompanied by continued dry conditions, most stations recording less than one half inch of moisture and little snowfall. The driest locations included Argyle (T); Grand Marais and Tracy (0.06 inches); Hallock (0.04 inches); Willmar (0.08 inches); and St. Cloud (0.08 inches). No Minnesota station recorded more than ten inches of snowfall during December and, in many places, monthly snowfall totaled less than one inch. In its end of December report, the Minneapolis Weather Bureau emphasized the positive aspects of the December drought, noting that "weather conditions were very favorable for outdoor work, marketing and for livestock. Lake Minnetonka in Pope county was frozen over on the 21st, the latest of record for that lake. The grazing season was extended and resulted in much saving of feed. There was a report of oat threshing near Chaska on the 14th, which is the latest date of threshing grain in this vicinity. The ground was bare over practically the entire state until near the close of the second decade [of the month] when rains and heavy, moist snows relieved the drought in western, east central and extreme southeastern counties. Grass fires and soil blowing were checked....". Overall, 1939 was one of the driest and warmest years of the 1930's: average annual precipitation for the state as a whole was 21.9 inches, a value more than six inches below the comparable value for 1938 and little more than an inch above the annual averages recorded in the extremely dry years of 1933 and 1934.

December's warmth was followed, surprisingly, by a persistently cold (but dry) January, the first month of a new decade, a decade which, unlike the ten years from 1930-1939 kept Minnesota green, restoring lake and river levels, abetting the production of bumper crops. Most importantly, normal rainfall returned to the Great Plains Dust Bowl, putting an end to the suffocating dust storms which plagued much of the central United States during the 1930's. The 1940's, however, remained warm: although temperatures were generally not as extreme as those experienced during the previous ten years, the decade as a whole was, at least in some locations, warmer than the decade which preceded it. The end of the 1930's, moreover, marked the end of the Great Depression and a return to prosperity. And the return of an optimism which, although often facile and often dampened by the decade's seemingly unremitting warfare (whether hot or cold) was nonetheless preferable to the gloom and the sense of futility which prevailed in so many quarters during much of the 1930's.

THE 1930'S

THE DISASTROUS NATIONWIDE DROUGHT OF 1930

With the exception of a sharp recession which followed in the wake of World War I, the decade which ended in 1929 was, for the most part, a decade of prosperity. It was also a decade which featured above average precipitation in most of the agricultural areas of the United States. More specifically, states such as Oklahoma, Kansas, Nebraska, Missouri, Iowa, North and South Dakota, Montana, Wyoming, Colorado, Texas, Illinois and Indiana, on average, experienced a wetter than normal decade. According to the United States Department of Agriculture's 1941 yearbook, "Climate and Man," precipitation during the decade averaged 104 percent of the then accepted normal in both Dakotas; 105 percent of normal in Ohio, Indiana, Illinois and Kansas; 107 percent of normal in Colorado; 108 percent of normal in Missouri and Wyoming; and 110 percent of normal in Oklahoma. Moreover, many other states, Minnesota excepted, enjoyed average to slightly above average precipitation (e.g. Iowa and Nebraska, 101 percent of normal; Montana 103 percent of normal). The 1920's above average precipitation was not, however, an unmixed blessing. It was, for example, a factor in the severe flooding experienced in the Mississippi Valley in 1927. More importantly, however, it favored agricultural production, contributing to a burgeoning agricultural surplus which, in turn, depressed the prices of many commodities, preventing much of the agricultural sector from sharing in the general prosperity of the decade.

The era of prosperity, of course, came to an end with the Stock Market Crash of October 1929, the beginning of the Great Depression, an event (or series of events) which has left a deep impression on the American consciousness, an impression so deep that many still fear (even anticipate) a future economic collapse as bad or worse as that experienced in the 1930's. And then came the Great Drought of 1930, an event which certainly contributed to and probably even accelerated the nation's slide into economic chaos. Beginning in February 1930, the entire nation (with the exception of a few western, northeastern and southeastern states) plunged into drought, a drought which extended from Texas, Oklahoma, Arkansas through much of the west central, central and mid-Atlantic regions of the United States. According to the September 1930 edition of the U.S. Weather Bureau's Monthly Weather Review (pp. 353-355), only nineteen states out of forty two experienced subnormal

precipitation in January 1930. However, in February (a much warmer than normal winter month), twenty nine states recorded precipitation deficits, several of which were of unprecedented magnitude. According to the Weather Bureau statistics, February precipitation for the nation as a whole was 77 percent of normal and only 27 percent of normal in Kansas, the center of the American winter wheat belt. The drought deepened in March 1930, thirty six of the Weather Bureau's forty two geographical units reporting subnormal precipitation, one of which (North Dakota) received a mere eleven percent of its normal March moisture. Many other states reported significant deficits, ranging from an eighty percent deficit in Kansas to deficits of about fifty percent or greater in Missouri, Illinois, Arkansas, Minnesota, South Dakota, Oklahoma, Indiana and Kentucky. The drought persisted into April 1930, shifting from the north central to the southern and mid-Atlantic regions of the country (e.g. Arkansas, Louisiana, Mississippi, Alabama, Kentucky, Tennessee, Missouri, North Carolina with 29, 29, 23, 34, 33, 37, 53 and 59 percent of normal precipitation, respectively). For the country as a whole, however, April (72 percent of normal precipitation)was proportionately drier than either February or March. May 1930, in contrast, was wetter than average (with 110 percent of what was then considered as normal May precipitation for the United States as a whole). Several previously dry states (e.g. Mississippi and Arkansas) received approximately twice the normal amount of moisture while others, Minnesota included, received amounts ranging from 130 to 150 percent of normal. Ominously, however, severe drought persisted several east central and mid-Atlantic states with Illinois, Indiana and Ohio recording precipitation deficits of 50 percent or more.

May's relative wetness, moreover, was short lived. Widespread drought returned in June with thirty three states reporting precipitation deficits, six of which (Arkansas, Kentucky, Louisiana, Mississippi, West Virginia and Tennessee) experienced record shortfalls. For the country as a whole, June rainfall (according to U.S. Weather Bureau calculations) was approximately thirty percent below normal. Conditions worsened in July 1930, a month which combined large precipitation deficits with record or near record heat. Thirty six of the Weather Bureau's forty two "states", recorded significant precipitation deficits, nine of which (Virginia, Maryland, West Virginia, Kentucky, Ohio, Illinois, Missouri, Florida and Arkansas) suffered through a record setting July drought. Nationwide, July precipitation was only about two thirds of the then accepted July normal. In addition, every state reported maximum temperatures of 100 F or higher with record setting highs recorded in several mid-Atlantic and southern states. According to meteorologist Alfred J. Henry (writing in the September 1930 edition of the Monthly Weather Review), daily maxima in Washington D.C. passed the 90 F mark on eighteen days in July, culminating in a record setting maximum of 106 F on 20 July. He then went to point out that "these extraordinary temperatures were not peculiar to the eastern seaboard but prevailed over a very considerable part of the country from the eastern foothills of the Rocky Mountains to the eastern seaboard states of Maryland and from North Dakota to northern Louisiana...". August 1930 brought little relief, thirty five states reporting rainfall deficits, several of which (including Minnesota) set new August drought records. The first half of the month was also abnormally warm: temperatures of 100 F or higher were recorded in every state and in the District of Columbia (Washington D.C., temperatures rose to 102 F on 4 and 5 August and again on 9 August). Although precipitation for the nation as a whole was above normal during September 1930, twenty four states reported less than the normal amount of September rainfall. Moreover,

when considered as a whole, the 1930 growing season (April-September) was abnormally dry especially in the mid-Atlantic and Ohio Valley states. It was, in fact, the driest such period ever recorded in West Virginia, Maryland, Virginia, Kentucky, Pennsylvania and Tennessee. In Ohio and Michigan it was the driest growing season since 1895 and in Missouri, the driest since 1901. And in Washington D.C. only 2.6 inches of precipitation were recorded during the 115 days from 16 July through 31 October 1930, a value more than eighty percent below the then accepted normal for that portion of the year. Moreover, the Weather Bureau's analysis indicated that only eight states, most of them in the western part of the United States, received above normal precipitation during the first nine months of 1930. For the nation as a whole, precipitation during this longer interval was 87 percent of the then accepted nationwide average. Individual state values (expressed as a percentage of normal) included Kentucky, 63 percent; Maryland-Delaware, 58 percent; Virginia, 56 percent; West Virginia, 59 percent; Michigan, 77 percent; Iowa, 79 percent; North Dakota, 76 percent; South Dakota, 80 percent; Wisconsin, 88 percent; Texas, 78 percent; Kansas, 90 percent; and Minnesota, 87 percent.

Although, as noted previously, Minnesota escaped the worst of the 1930 drought, the state's agricultural and business interests felt its effects, whether directly or indirectly. Predictably, then, the state's newspapers featured a large number of local and national drought stories, most of them accurate, others of which were basically accurate but probably exaggerated and others of which, in contrast, sometimes tended to downplay the seriousness of the situation (perhaps, from time to time, even indulging in wishful thinking). Minnesota newspaper accounts, moreover, were typically anecdotal and impressionistic, sometimes even inconsistent, thus often failing to provide readers with a comprehensive portrayal of the drought, its extent and its effects. As an example, the 2 July 1930 edition of the Minneapolis Star optimistically reported that "fairly liberal rains" had bettered the crop outlook throughout much of the northwest. This was followed by a story in the Star's 4 July edition asserting that weather conditions during the past week had been ideal for crops, a view distilled from Cargill Corporation's weekly crop bulletin. Scattered showers, it was said, had fallen in practically every sector of the northwest and that the area's "extremely" hot weather had greatly aided in development of the prospective corn crop. Yet, a few days later (9 July), the Star, in a less sanguine vein, reported that Minneapolis and the northwest "continued to swelter [under] a moisture laden blanket of heat." One heat related death was reported in Minneapolis and the city's mail carriers, because of the excessive heat, had been allowed to finish their daily work one hour earlier than usual. And on the following day (10 July), another Star story noted that it was so hot that farmers in the Smith City, Kansas area were forced to harvest at night, daytime temperatures ranging between 105 F and 190 F. More bad news followed on 11 July: temperatures of 111 F and 110 F were reported, respectively, at Norfolk, Nebraska and Aberdeen, South Dakota and, more importantly, that corn and wheat fields throughout the Midwest were "suffering under the sizzling sun and it is feared that damage will be serious unless rains come within twenty four hours...".

More bad news followed. In its 12 July edition, the Star noted that seventeen heat related deaths had occurred in the Twin Cities during the past week, eight of them within the last twenty four hours. For the Midwest as a whole the "parching weather" was said to have caused (or at least contributed to) 100 deaths. It was also noted that temperatures as high

as 122 F had been recorded in Missouri. In Minnesota, the early July heat wave pushed temperatures into the high 90's F and low 100's F at many stations during the period, 7-11 July (e.g. 105 F at Tracy; 104 F at New Ulm; 103 F at Pipestone; 102 F at Fairmont; 99 F at Montevideo; and 98 F in Minneapolis). The early July heat was followed by a brief period of cooler weather (with maxima in the 70's F in many Minnesota locations), bringing what the 14 July edition of the Star termed "urgently needed relief to almost the entire country". Deaths from heat prostration were said, at that point in time, to have reached a nationwide total of 173. The heat soon returned, however, persisting through much of the remainder of the month. On 19 July edition, the Star took note of the renewed high temperatures, featuring a headline stating that "scores perish as heat wave strikes again." The heat was said to have blanketed every section of the United States, causing at least twenty heat related deaths. Maxima of 113 F and 110 F were reported, respectively, at Phillipsburg, Kansas and Beatrice, Nebraska. In another report on the same day, the Star stated that the drought news had boosted wheat prices two cents per bushel.

On 21 July 1930 the Star noted that light showers had fallen in various parts of the northwest on Sunday and Sunday night [20 July]. And, on the following day, it was optimistically reported that needed rain had checked the heat throughout the nation, stating that the moisture had brought relief from "one of the most disastrous droughts in the nation's history". In a less positive vein, however, the Star further reported that, on 21 July, the heat had claimed 114 lives nationwide and that Minnesota crops were "badly in need of moisture", with only 66 percent of normal precipitation recorded statewide since May. "Widespread crop damage" was also said to have occurred in many sections of the United States. Memphis, Tennessee, in the heart of the drought belt reportedly had received only two percent of its normal rainfall during the past nine weeks. Nor did conditions improve during the remainder of the summer. On 23 July, the Star noted that heat and drought had seriously damaged the Minnesota wheat crop but that southeastern Minnesota "remained one of the few bright spots in the country as regarding the corn crop". On 25 July, the same source indicated that the long hot spell had raised the potential value of the corn crop in Minnesota, South Dakota, Iowa and Nebraska. And on 26 July, the Star emphasized the severity of the drought, pointing out that the entire country remained in the grip of heat wave that had "continued with little break for three weeks". It was also noted that rain had fallen in several northwest cities on Friday [25 July] "but was not sufficient to cause much reduction in temperature". On 28 July, four more heat related deaths were reported in the Twin Cities area. There were, moreover, continued reports of extensive crop damage in Minnesota. Rainfall was, however, general over much of Minnesota during the period, 25-28 July, but few locations received amounts sufficient to break the drought (e.g. Minneapolis received only 0.18 inches of rain, the three day total produced by what the newspaper called a few "tantalizing" showers).

On 29 July the Star reported, prematurely as it turned out, that the heat wave had been broken but that farmers were praying for rain which, it was stated, was direly needed throughout the nation's food producing regions. A similar report on 30 July noted that oppressive heat combined with a lack of moisture had caused further deterioration of crops throughout the northwest during the past week, "damaging corn as well as wheat and flax". Touching on another aspect of the drought, the Star also revealed that several lakes north

of the Twin Cities had been "tapped by the government to provide a six foot depth in the Upper Mississippi River". This action, it was said, was necessary to maintain a water level sufficient to allow grain boats to navigate the river above Minneapolis. On 31 July, the Star emphasized that the corn crop in the states bordering Minnesota had been "seriously affected" by the long drought and that Cargill Corporation, in a recently released report, anticipated poor crop yields in Kansas, Missouri, Illinois and Oklahoma. In Minnesota, however, the "bulk" of the corn crop was reportedly "still in good condition" (an assessment seemingly inconsistent with some earlier reports regarding the state of Minnesota crops).

July's excessive heat persisted into August 1930, many Minnesota stations, as noted previously, reporting maxima above 100 F during the first five days of the month (e.g. Beardsley, New London and Montevideo, 101 F; Tracy, 104 F; New Ulm, 107 F; and 109 F at Fairmont). Even worse, July's drought continued into August, some areas (Minnesota especially) experiencing intensified dryness. In its 1 August edition, the Minneapolis Star noted that except for a few scattered showers and a "downpour" in New Orleans, the nation remained "bone dry". And on 2 August, the Star noted that water in the Mississippi River was at a level lower than any recorded in the past seventy years. What was described as "an all night drizzle" and "the heaviest rainfall in a month", deposited a mere 0.19 inches of moisture at the Minneapolis station on 1 August (a station which recorded only 1.64 inches of rainfall during July and August combined). According to the Star, the rain "soaked into parched lawns and gardens almost as fast as it fell". One new heat prostration death was also reported. On 4 August, the Star belabored the obvious by telling its readers that Minneapolis and the nation were still sweltering, evidence of which included a 113 F reading at Emporia, Kansas. Some of the economic implications of the drought were highlighted on 5-6 August: one Star story quoted W. C. Coffey, then dean of the University of Minnesota's school of agriculture, as predicting an increase in commodity prices "out of proportion" to the reduction of grain yields attributable to the drought. In another article, the Star noted that wheat prices on the Minneapolis market had "jumped" six cents per bushel during the past two trading days. More of the same followed on 6 August: Star headlines on that date emphasized "soaring" wheat and corn prices, the cause of which was a yet "unbroken" drought. Corn prices it was said had reached the \$1 mark, an increase of eight cents per bushel. The Star's report stated further that crop reports from all sections of the northwest wheat belt "indicated an increasingly serious condition as the hot, dry weather continues." Additionally, the heat of the past two weeks was said to have reduced estimated corn yield by nearly 500 million bushels. On 7 August, another Star article reported that "nine states and probably eighteen, including Minnesota, will probably remember July as the driest month in forty years". The newspaper then elaborated, quoting a U.S. Weather Bureau report that the states of Virginia, Maryland, West Virginia, Tennessee, Kentucky, Ohio and Indiana, among others, had suffered through record setting July drought. The same report indicated that the states of Minnesota, North Dakota, South Dakota and Missouri, respectively, had received 52, 46, 63 and 12 percent of their normal July precipitation.

Another aspect of the drought was brought to the attention of Star readers on 11 August 1930 when John Payne, chairman of the American Red Cross stated that unemployment and disease were complicating "a situation already made critical...". More ominously, he said that "in some cases actual starvation" had become a real threat. Yet, in what may have been

an example of wishful thinking, a source identified only as David Lawrence (perhaps David Lawrence, the founder of U.S. News and World Report) contended that the drought situation may have been "overemphasized". He was quoted as saying that "from a national point of view, the ill effects will be spotty with little influence on agriculture as a whole or the food supply". "Disaster is likely to be confined to local areas." Other more or less optimistic reports followed: the 12 August edition of the Minneapolis Star stated that lower temperatures and increased humidity "appeared today to have checked crop destruction in the corn belt". And, on 18 August, Star readers were told that the "\$750,000,000 drought of 1930" had been "effectively broken" in all but a few areas "by widespread soaking rains" which, it was expected, would significantly reduce crop damage. In another optimistic report (21 August), the Star quoted Dan Wallace, then editor of the Farmer magazine, to the effect that Minnesota crop conditions were "much improved," a view which, it was said, was shared by Cargill Corporation in its August crop report. The August rains, however, were deemed insufficient to appreciably raise water levels in the Mississippi river (which remained at its lowest level in years). In the Quincy, Illinois area, for example, the river was described as a "dawdling" stream, having fallen to a level just 1.7 feet short of its official low water mark at that point.

Yet, whatever their effect on 1930 crop prospects, the August rains did not alleviate the human suffering associated with the drought. The 15 August edition of the Star, as an example, stated that a "vast relief organization" was in the process of formation, its stated purpose being provision of autumn and winter aid to an estimated 270,000 drought distressed farm families. President Herbert Hoover, the Star emphasized, had promised speedy and timely aid after meeting with the governors or other representatives of twelve drought stricken states. And, on 16 August, the Star reported that, despite the "cheer" which accompanied recent rains in the nation's "great agricultural regions", the President's drought relief program touted as a federal, state and local cooperative effort had been expanded to include sixteen states.

Drought news, of course, made headlines in many Minnesota newspapers other than those published in the Twin Cities. The 18 July 1930 edition of the Brown County Journal (New Ulm), as an example, reported that crop prospects in that area of the state were only "fair". However, although damage in some fields was said to have been as high as 40 percent, the Brown county agricultural extension agent gave a more sanguine report, stating that losses were generally "over estimated". In this instance, an optimistic assessment was probably warranted: the New Ulm area was one of a few areas spared the worst of the 1930 drought, receiving more than 34 inches of rainfall during the year. Summer precipitation, although somewhat below normal was at least adequate (4.92 inches in May, 3.84 inches in June, 2.95 inches in July and 1.78 inches in August). Moreover, New Ulm, as noted previously, received excessive rainfall during September 1930. The first of September's rains, welcome as it might have been, was, however, accompanied by heavy winds which caused much damage to area trees, toppling broken limbs onto telephone wires, disrupting operations of the New Ulm Telephone Company (Brown County Journal, 5 September 1930). Another wind and rain storm occurred on 25-26 September, once again causing considerable damage to area telephone lines. This event, which soaked New Ulm with a 3.1 inch downpour, began with slight showers during the afternoon of 25 September "but early in the evening

heavy precipitation began and continued until...Friday morning...The rain was accompanied by a heavy wind...The storm assumed tornadic proportions in parts of Iowa..". (Brown County Journal 3 October 1930).

Inevitably, of course, the adverse effects of the 1930 drought extended well beyond agriculture and commerce: the drought also had wide ranging ecological effects, creating conditions favorable for widespread forest fires and endangering fish and wildlife. The 22 August 1930 edition of the Brown County Journal, in a syndicated story, pointed out, for example, that drought and forest fires had taken an enormous toll on wild life and fish throughout the United States. In a report attributed to the American Game Protective Association, the Journal stated that forest fires had destroyed "countless numbers" of wild animals and that ashes and burned timber falling into lakes, streams and swamps had formed a deadly poisonous lye, threatening aquatic life. Many fish, it was also said, had been killed by rising water temperatures, lowered water levels and, in some instances, by the complete drying up of ponds, streams and lakes. In Minnesota, the forest fire danger reached the critical point in August, the 19 August edition of the Minneapolis Star noting that crews consisting of approximately 1,200 men were then fighting one hundred forest fires in northern Minnesota. Three days later (22 August), the Star reported that more than 3,000 fire fighters were battling fires in the north woods area. The same article also stated that, according to A. F. Oppel, deputy state forester, parched soil and dried out underbrush had created a fire hazard in every northern county, creating the "impending threat of a roaring inferno". Hundreds of small blazes, it was said, had already broken out, creating a thin pall of smoke which hung over the entire northern portion of the state. High winds near the end of month created an even more dangerous situation: headlines in the 27 August edition of the Star told readers that "forest fires spread as wind rises." The story that followed stated that flames had burst through fire lines in several areas of northern Minnesota, forcing fifty farm families to flee from their homes. One fire which it was thought had been set by an arsonist, reportedly swept through 1,400 acres of timber before being brought under control.

Causes of the sudden onset and dogged persistence of the abnormally hot, dry conditions that came to be known as the Great Drought of 1930 are difficult to determine. This is true, of course, because changes in the earth's atmosphere are characteristically erratic, involving as they do complex and often elusive interactions of cause and effect, effect and cause. Moreover, the science of the 1930's lacked much of the upper air data that, in recent years, has become an essential part of meteorological science. The drought was, nevertheless, characterized by several features which, at the least, partially explain and describe the atmospheric dynamics involved. Maps prepared by the U.S. Weather Bureau in the 1930's indicate the presence of a persistent high pressure (anti-cyclonic) system which was centered over the south central part of the United States and which, accordingly, effectively blocked the northerly flow of Gulf moisture while simultaneously sustaining a circulation pattern which brought desert heat to much of the midwestern, central and eastern United States. Also, in a detailed article appearing in the September 1930 edition of the Monthly Weather Review, Weather Bureau meteorologist Alfred J. Henry discussed what he called the "pronounced abnormalities of the weather in distant regions that may or may not (emphasis added) have contributed to the drought in continental North America." His

remarks, which are of both scientific and historical interest, were as follows:

"....attention is first directed to a persistent and rather pronounced depression of the barometer over the northeastern Atlantic Ocean, that prevailed from October 1929 to February 1930, as illustrated by the readings at Lerwick, Shetland Islands, and the west coast of Ireland, as at Valencia.

"Considering now the pressure distribution over the northeastern North Pacific for the same month it is to be noted that while the reverse pressure conditions prevailed over the first half of the month, the high pressure gave way to very low pressure, 28.76 inches at Dutch Harbor on the 27th and 28.82 at Kodiak on the 28th. The Aleutian low in January 1930 was displaced far to the south southwest and high pressure prevailed over the northeastern north Pacific and costal Alaska, Kodiak 0.56 inches above normal and Juneau 0.45, a complete reversal from conditions in January.

The high pressure over [the] northeastern Pacific doubtless was directly related to the development of a large number of anticyclones over the western Canadian provinces and their subsequent movement southeastward over the United States and likewise the development and movement of a group of cyclones from British Columbia and the state of Washington southeastward to various points west of the Mississippi, thence northeastward to the Great Lakes and down the St. Lawrence valley.

When cyclones recurve to the northeast, east of the Mississippi generous precipitation is assured to Atlantic coast districts but cyclonic storms passing down the St. Lawrence valley may or may not yield generous rains to the piedmont section of Atlantic seaboard states. In January 1930, there was more or less failure of the rains from the Carolinas northward to New England; thus in a rather devious path we relate the failure of the rains in the beginning of the drought to the course and character of the cyclonic storms which passed across the country.

The change in pressure from January to February 1930 was exceptionally large: whereas high pressure prevailed in January it gave way remarkably to low pressure in February and with the low pressure an unusually large crop of cyclonic storms, most of which entered the continent north of 50 degrees north latitude and moved eastward at or north of the Canadian boundary. As a result, the warmest February, perhaps in a century, was experienced in the United States. With the exceptional heat there was much dryness and it is perhaps not far from the truth to ascribe the beginning of the drought to the disturbed conditions of general circulation that set in in that month. The succeeding months, March to June, were not especially dry except in small areas; North Dakota, for example, had but eleven percent of normal rainfall in March. The most noticeable phenomenon was the breaking down of the cyclonic part of the secondary circulation and perhaps in one or two months the intensification of

the circulation induced by anticyclones. The latter was especially noticeable in the piedmont sections of the states south of the Pennsylvania line. In these states it was doubtless the largest single factor contributing to the failure of the rains.

Anticyclones mostly from the Hudson Bay region drifted southward and settled over the Carolinas, Virginia and Maryland thus insuring to those states at least a week of uninterrupted sunshine before the high pressure would pass away; moreover, the presence of high pressure over the Atlantic off the Carolina coast with the wedge shaped front extending westward across the Appalachians doubtless diverted the paths of cyclonic storms approaching from the west into a more northerly course, thus withholding from the Virginia-Maryland region the rains that were received by states farther westward. Still another condition the reason for which is not known persisted, viz, cyclonic storms moving northward along and a short distance offshore failed to give rain in costal states until the New Jersey coast was reached.

In September, the weather control was mostly anticyclonic with no cyclones of importance, except, possibly on two occasions, the 23d and 26th; on the first named a cyclonic storm with circular isobars and central pressure down to 29.10 inches moved north-northeast from Montana to Manitoba with a further fall of pressure...A secondary from this cyclone developed in Colorado and moved thence to central Wisconsin, pressure falling to 29.16 inches. This storm was attended by considerable precipitation in the Lake region and Ohio..but the center of the cyclone continued to move forward to Hudson Bay in the ensuing twenty four hours with rain in the Carolinas and thence to southern New England. High pressure followed closely in the wake of the cyclone.

The secondary circulation, especially that branch which is associated with air movement about cyclonic systems became weak and disorganized during the spring and early summer months of 1930. By midsummer a blanket of warm surface air had developed over the great river valleys extending from the Gulf of Mexico to the Canadian border in which the normal temperature change with latitude had been destroyed.

Beginning with the turn of the season in September, when the transfer of polar air equatorward normally sets in, the chief weather control as between cyclones and anticyclones passed definitely to the anticyclonic. September 1930 anticyclones from the Hudson Bay region moved south-southeast and merged with permanent high pressure over the Atlantic somewhere east of the Carolina coast. In that position they served as a buffer to prevent cyclonic systems from moving into the Ohio valley and spreading across the Appalachians into Atlantic coast states. The effect of this [was] to augment the tendency of the dry weather to maintain the status quo in the piedmont sections of Atlantic states where drought still endures".

However dry it might have been at times during 1930, Minnesota, as noted previously , did not experience drought of a severity comparable to that which, as Henry's analysis emphasized, plagued the mid-Atlantic states (as well as other parts of the country). It is probable, in fact, that Minnesota was benefitted, albeit modestly, by a jet stream which, although it must have been far to the north of its normal position, may sometimes have dipped enough to steer moisture bearing systems into portions of the state. Severe drought did, however, become entrenched in Minnesota beginning with a warm and exceedingly dry December. Precipitation during the month consisted largely of light snowfalls and/or snow flurries with several stations (e.g. Albert Lea, Campbell, Cloquet, Milan, New Ulm and Worthington) recording only a trace [T] of precipitation during the entire month. Moreover, and more importantly, December 1930 marked the beginning of another of the many notable features of the 1930's, namely the extraordinarily warm, dry winter of 1930-1931, the subject of the next chapter in the saga of the "dirty thirties".

THE 1930'S THE WINTER THAT WASN'T: 1930-1931

Straw hats appeared, farmers started preparations for spring seeding and boys played marbles yesterday as a touch of spring struck the northwest. In Minneapolis, bees are swarming. At Fairmont several farmers dragged their fields preparing them for spring seeding. Winona's eight inch snowfall vanished under a warm sun. At Fargo a man appeared

on the street in a Panama hat. Such was the Minneapolis Journal's 25 January 1931 account of the previous day, a day which produced maxima of 49 F, 54 F, 52 F, 58 F, 53 F, 55 F, respectively, at Minneapolis, Bird Island and Fairmont, Beardsley, Canby, New London and New Ulm. More of the same followed. On 28 January, the Journal humorously commented that "despite discouragement on the part of Ulysses Grant Purssell, U.S. meteorologist, the mercury was climbing steadily into the summer heat region today and a few optimists started searching the fields for daffodils and dandelions as a gentle spring rain [0.09 inches] fell on the city. On the following day, a day when temperatures rose to a springlike 60 F at Canby, 58 F at Pipestone, 59 F at St. Peter and 49 F again in Minneapolis, the Journal reported that Purssell, " apparently unabashed by the havoc his January weather has wrought to the state's reputation as a cold country, stubbornly held out for more warm weather today". This bit of light hearted editorializing was followed by a list of remarkable mid-winter phenomena: "the Mississippi river, usually frozen tight from now to spring has been open and flowing every day except four this winter. At Longfellow Gardens, tropical animals were let outside to bask in the warm sun yesterday. This is the first time they have been outdoors in January since the zoo was established. All over the city, children were playing marbles and baseball and an iceman appeared wearing a straw hat. There were hundreds of golfers on the city's links. Dandelions bloomed in Iowa and geese and ducks were flying north along the Mississippi river....Peach trees bloomed in several sections of Missouri....". And on 30 January, the Journal noted that "the weatherman continued to shoot the myth of Minnesota's cold weather today. There was only one city in the northwest reporting a temperature below freezing today. It was Thief River Falls".

Given the recent incidence of warm Minnesota winters, the Journal's almost incredulous description of 1931's mid-winter weather may now seem extravagant, even exaggerated. However, for most people living in the early 1930's, the winter of 1930-1931 was truly extraordinary, the warmest in memory. It was, in fact, the warmest recorded in Minnesota since the statewide climatological service was established in 1891. Moreover, at St. Paul, a location with reliable records stretching back to 1859, it was the warmest winter since 1877-1878, even surpassing the notably warm winter of 1881-1882. Unfortunately, however, the period, December 1930 through February 1931, was extremely dry, intensifying the moderate, endemic drought which had prevailed over much of Minnesota during 1930. On a statewide basis, precipitation during December 1930 and January 1931 was only about 25 percent of the then accepted normal. And February 1931, although somewhat wetter, was still about 50 percent drier than normal. Precipitation at most Minnesota stations was less than an inch during the entire three month period, December-February, falling below one half inch at several locations (e.g. Worthington, 0.12 inches; Tracy, 0.18 inches; Pipestone, 0.24 inches; Redwood Falls, 0.27 inches; Alexandria, 0.37 inches; Crookston, 0.31 inches; Argyle and Moorhead, 0.47 inches; and Wheaton, 0.43 inches). Snowfall was corresponding light, leaving much of the state without snow cover during most of the winter. Lack of snow cover, although it facilitated outdoor agricultural work and favored winter commerce, left fields vulnerable to wind erosion and set the stage for the spring and summer drought that followed. With the exception of a few stations, most of them in northern Minnesota, December-February snowfall totals were generally less than twenty inches and, in some instances, five inches or less (e.g. New London, 5.0 inches; Wheaton, 4.8 inches; Tracy, 4.2 inches; New Ulm, 3.9 inches; and Worthington, a mere 1.7

inches). Snow cover of one inch or more was recorded by St. Paul observers on twenty seven days during December 1930, six days in February, eight days in March and on no days in January, the latter a highly unusual occurrence at an east central Minnesota station. Another indication of the dearth of winter moisture was the number of stations (e.g. Morris, New Ulm, Waseca, Collegeville and Fergus Falls) reporting a complete lack of snow cover on 31 January 1931. And at Moorhead, maximum January snow cover was recorded as 0.7 inches, only a, only a trace [T] remaining on the ground at the end of the month. The station's February snow cover, in contrast, peaked at 1.9 inches but dwindled to 0.1 inches at month end. By the end of February, however, snow had accumulated in some localities (e.g. Collegeville and Fergus Falls with month end snow depths of eight inches and 3.5 inches, respectively). Yet, the ground remained bare or nearly bare in much of the state, stations such as New Ulm and Waseca reporting a total absence of snow cover on 28 February 1931.

One of the casualties of 1931's warm, snowless winter was the Minneapolis winter sports program. The 16 January 1931 edition of the Minneapolis Journal defiantly predicted that the Winter Sports Play Week sponsored by the Minneapolis park board "will open tomorrow, snow or not" but conceded that lack of snow might mean cancellation of the annual dog derby. On the following day (17 January) the Journal noted that "with clear, mild weather and no snow on the ground or in prospect, thousands of Minneapolis boys and girls ushered in Winter Sports Week: lack of snow and cold weather made it necessary to postpone the dog derby scheduled for Saturday....the complete absence of snow meant that toboggans had to be left home...". On 18 January, Journal readers were told that a golf and tennis tournament was to be played during the week "as part of the park board's annual winter sports play week. With bare hills and soft ice facing opening of the winter program yesterday, the plans for tobogganing and snow modeling went glimmering." And on 19 January, the Journal, as if to emphasize an earlier point, once again stated that Winter Sports Week directors were planning golf and tennis tournaments, displacing some of the city's usual winter sports events. The same report indicated, however, that two to ten inches (Austin reporting the latter amount) of snow had blanketed southern Minnesota, northern Iowa and Wisconsin and that snow was falling in North and South Dakota. This, of course, raised the prospects of snow in the Twin Cities, suggesting that Winter Sports officials might be forced to reverse direction, cancelling the planned tennis and golf events. A few flakes of snow did fall: the 20 January edition of the Journal reported that snow had "held up plans for golf and tennis tournaments" but had "raised hopes of those in charge of the winter sports program that they may be able to stage their dog derby." The Journal also told its readers that a robin had been spotted by John T. Arthur at 4644 Vincent Avenue South in Minneapolis. Unfortunately, any snow that did fall soon melted, forcing winter sports officials to postpone ski run contests and to once again put off running of the much anticipated dog derby (Minneapolis Journal 23 January 1931).

Other of the state's newspapers also took note of the warm weather's effects on winter sports. The 6 February 1931 edition of the Morris Tribune noted, for example, that the oldest of west central Minnesota's old timers couldn't remember a warmer January. Tribune writers then went on to point out that "the unusual weather thus far has made golf one of the pleasant diversions of the winter for some fans. Some field work has been reported by

several farmers..". Similarly, the 19 January 1931 edition of the St. Paul Daily News, one of the sponsors of the vaunted dog derby, announced that "lack of snow may cause postponement [of this event] until later in the winter. Many of the young mushers have been disheartened by the shortage of snow. The Minneapolis park board combed ravines and gullies to find enough snow to enable running of the park board ski jump. Golf foursomes competed with ski jumpers on the municipal course in Minneapolis." A few days later (25 January), the Daily News, apparently echoing what turned out to be a bad Weather Bureau forecast, wrote that "Old Man Winter is due to bring a new mantle of snow today to replace the one that melted Saturday as the mercury soared to above the forty degree mark. The mild weather Saturday (24 January) sent rivulets from every small snow bank left after the previous mild weather and drew thousands out into the open". And on 29 January, a Daily News headline announced: "city [of St. Paul] has snow removal fund and nothing to spend it on." The newspaper also pointed out that the [Mississippi] river is now open over its entire width. A year ago on this date there were fourteen inches of ice in the river". Moreover, on 11 January 1931, the St. Paul Pioneer Press stated that, according to M.R. Hovde, chief of the U.S. Weather Bureau's St. Paul station, temperatures had averaged 27.2 F during the seventy one day period ending 10 January, the third warmest such period in the then 112 year old St. Paul-Ft. Snelling climatological record. Interestingly, also, the 15 January 1931 Pioneer Press told its readers that the world's weather had become a "bit giddy," bringing snow to Mexico City, below zero weather in parts of the Spain and "one of the most chilly storms in years" to Morocco.

In a similar report, the St. Paul Dispatch (31 January 1931) stated that "St. Paul's warmest January in fifty one years ended today with prospects of moderate weather continuing." The Dispatch further reported that the winter's mildness had caused buds to break out on apple trees at the University of Minnesota's experimental farms in St. Paul and "had endangered winter crops with the possibility of premature growth, kept the Mississippi river open and saved enormous amounts in costs of city snow removal. St. Paul spent only \$3,922 for street cleaning and cindering during January. Lack of snow combined with abnormally high temperatures is endangering winter crops, shrubs and perennial plants." And on 4 February, the Dispatch noted that "a daring butterfly was captured in St. Paul Tuesday after a brief flight in the February sunshine."

A subsequent, and less lighthearted, Dispatch article (11 February 1931) emphasized the seriousness of the winter drought, quoting statistics compiled by U.S. Weather Bureau official, J.B. Kincer. According to this report, low rainfall records were established in eight states between 1 October 1930 and 31 January 1931, ten other states reporting deficient precipitation during the same period. Especially dry states included Kentucky (44 percent of its normal October-January precipitation); Ohio and Indiana (47 percent); Pennsylvania (49 percent); West Virginia (51 percent); Maryland (53 percent); Michigan (63 percent) and New York (67 percent). Surprisingly, however, October-January rainfall was said to have been above normal in both North Dakota and South Dakota.

February 1931, although unusually warm, was as previously noted, not as dry as December and January. Exceptionally warm temperatures (e.g. 60 F at St. Peter; 58 F at Faribault; 57 F at New Ulm; 54 F in Minneapolis; 52 F in St. Paul) on 1 February were followed a few

days later by the first significant precipitation in two months. The 2 February edition of the Minneapolis Tribune commented on the first phenomenon by noting that "Sunday [1 February] was the warmest day of the winter in Minneapolis and also the warmest early February day in the forty years of history of the Weather Bureau..". The second event made news on 7 February, the Tribune announcing, somewhat grandiloquently, that "snow and rain falling with timorousness of a stranger" were moving eastward over the nation on 6 February. "The precipitation, it was said, came to Minneapolis during the night as snow: "the flakes were light and came slowly, melting when they struck sidewalks and streets but finally accumulating." The same report struck a hopeful chord, noting that the U.S. Weather Bureau's Chicago office "predicted Friday night that the long drought which began in the summer and has carried over into the winter may be at least partially broken. Murky weather supplanted sunshine in the drought afflicted states of Texas, Oklahoma, Kansas, Missouri and Nebraska during Friday. The rain began falling as a low pressure area moved northeast out of Texas...". On the following day, the Tribune reported that two inches of "slushy" snow had fallen in Minneapolis and that although a "large area of the Midwest lay under a blanket of snow Saturday night [7 February] many sections where moisture was most needed the skies offered little hope for additional moisture." In Kansas, the rain that did fall was said to have fallen too far to the east to benefit that state's winter wheat growing regions. And in Wisconsin, rivers, lakes and farm wells remained at their "lowest levels in years". Yet, in areas in which the snow did fall, it was "regarded as having arrived in time to at least temporarily save winter crops." In a similar vein, the Minneapolis Journal (6 February 1931) stated that "a snowstorm sweeping toward Minneapolis from Western Canada today promised relief to winter crops." According to the Journal, the storm was "raging" on a two thousand mile front extending from Edmonton, Alberta to Amarillo, Texas: "winter crops now exposed and at the mercy of any sudden freeze will benefit greatly from snow cover." On the following day (7 February), Journal headlines reinforced the earlier story, stating that "snow, general in the northwest, brings relief to drought states: protective blanket laid over winter crops on wide front."

The snow which fell in the Twin Cities was, however, seen as a mixed blessing, the 8 February edition of the Minneapolis Tribune pointing out that "for skaters the snow was hardly welcome since it added to the conditions that permanently closed rinks and natural lakes. The unseasonably warm weather has weakened ice on the lakes to the point of making it unsafe even if there is a new cold wave." On the same day, the Minneapolis Journal noted that the snow had made city streets "glazed and dangerous." Presumably, however, the 6-7 February snowfall soon melted: warm, dry weather prevailed during much of the remainder of the month. Beginning on 15-16 February, temperatures once again rose into the 50's F at many stations, marking the onset of a springlike trend which persisted into the closing days of the month. Readings of 60 F were also recorded at several stations on 24 February, the highest of which was 63 F at Farmington. Needless to say, the long awaited dog derby was again postponed. According to the 21 February 1931 edition of the Minneapolis Tribune, the park board had attempted to avoid further delay, proposing that the derby be run on Powderhorn Lake, rather than in the snowless city parks; unfortunately, however, this option was ruled out because the warm weather had "softened" the ice on the lake to such an extent as to make it unsafe for the children and their dogsleds. Happily, however, the long delayed race (described by the Tribune as the "annual juvenile speed classic") was

run on 28 February following a precipitation event which brought heavy snows to many parts of Minnesota, the Twin Cities included. According to the Minneapolis Tribune, the "novelty of snow was offered Thursday night [26 February] when a soft, heavy downfall, melting almost as it fell, disrupted the springlike weather that has prevailed for the past two weeks. The fall began shortly after 7 p.m. and continued at intervals until midnight." The St. Paul Dispatch (27 February 1931), quoting Andrew Boss, a University Farm agricultural expert, further noted that "because of the defrosted condition of the ground in Minnesota, the snowfall of early today will do inestimable good to crops. The snow will act as a blanket for winter wheat, rye and grass..". The same report also pointed out that the 26-27 February snowfall "was the first of any consequence" in St. Paul since 24 November 1930 (when 5.5 inches fell). The snow, which was said to have ranged from about an inch at Albert Lea to 11.5 inches at St. Cloud, was described as "soggy", requiring the St. Paul public works department to hire snow removal crews consisting of "nearly" two hundred temporary workers.

February's snowfall, however, provided but a brief respite from the drought. Minnesota's drought, in fact, intensified: below normal precipitation and abnormally warm temperatures combined to make 1931 one of the state's most unpleasant years in a decade of mostly unpleasant years. If press accounts are to be believed, however, rainfall in some other parts of the nation was greater during 1931 than during 1930. Evidence of this change in fortune includes a report issued by the U.S. Weather Bureau on 19 February 1931 (and summarized in the 19 February 1931 edition of the St. Paul Dispatch). According to J. B. Kincer, an agricultural meteorologist and apparent author of the report, "the long stagnant atmospheres which brought drought to the country have stirred. That apparently is why it is raining once more". Kincer then went on to state that "science has found no cause for the almost complete lack of motion of the upper air, to which it [science] attributed the drought that had devastated wide stretches of farming land. Furthermore, there is no way of knowing...whether the resumption of currents is permanent or will again lapse. A readjustment of air pressure conditions in early February permitted the air to flow from high to low pressure areas in normal fashion. The low pressure areas swung across the country and in recent days have been attended by substantial and sometimes heavy rains over much of the hitherto persistently dry areas. Before that time a high pressure area, hovering intolerably long over the Rocky Mountain areas, blocked off the rains which should have come to the interior of the continent out of the west. Since the first of February, rainfall has totaled an inch or more in nearly all of the southern states and over a wide belt extended from extreme southern New York, Pennsylvania, and West Virginia southwest and west to Oklahoma and eastern Kansas. In general, the totals have come near normal or somewhat above in Ohio, Indiana, the southern half of Illinois, and in Tennessee. Rains have been above normal generally in West Virginia, Kentucky, Arkansas, Oklahoma, Texas and much of Missouri. In all there was a great deficiency to be made up. In Maryland, Virginia and the Carolinas, rain has remained moderate and generally below normal. In the Plains states north of Kansas and also in the Upper Mississippi valley from northern Missouri northward there has been little rain or snow as yet. The heaviest rainfall has occurred in Kentucky, Tennessee, Arkansas, southern Missouri, the northern parts of Mississippi and Louisiana and eastern Texas. These were the state of the most severe drought areas. In West Virginia, Ohio, Indiana and the southern half of Illinois, also hard hit, rains have been mostly from one

inch to two inches." Further indication of some modest (but transient) easing of the drought was provided by a 6 March 1931 Minneapolis Tribune account of "heavy blizzards" in Wyoming and Montana and heavy snow which was said to have "brought welcome moisture" to parts of Nebraska. Earlier, on 9 February, the St. Paul Dispatch sounded a similar theme, noting that "hope was revived today for this year's crop in the drought ravaged sections of the south. Rain fell throughout the parched areas. Arkansas, where more than half a million sufferers are being fed by the Red Cross received the greatest share of the rainfall. More than three inches fell at Ft. Smith in western Arkansas. The rainfall belt extended generally from southeast Illinois down the western side of the Mississippi to southern Louisiana." On 15 February, the Dispatch noted that more heavy rains had been reported in drought stricken areas of Missouri, Kansas, eastern Oklahoma, Arkansas and parts of Texas. Similarly, on 17 February "heavy to light" rains were said to have fallen in the Ohio river valley, Kansas, Iowa, Nebraska and the Dakotas (but, it was emphasized, not in Minnesota).

Yet, although precipitation nationwide may have been more plentiful in 1931 than in 1930, the effects of the Great Drought continued to make news in the new year. The 4 February 1931 edition of the Minneapolis Journal, for example, reported that the Red Cross was then providing aid to approximately 400,000 "drought sufferers" in twenty one states and 381 counties. It further reported that several Kentucky cities continued to "feel the pinch of water shortages resulting from drought now in its twelfth month." And, on 4 January 1931, the St. Paul Pioneer Press reported that 500 farmers "from a rich agricultural region ravaged by drought", some armed, had stormed the business section of England, Arkansas, demanding food for their hungry families, threatening to take it forcefully, if necessary. The Red Cross, it was reported, responded by authorizing a food allowance of \$2.75 per family. The extent of the distress was further emphasized in a St. Paul Dispatch story on 23 January 1931 stating that nearly a million people were expected to receive Red Cross relief aid by 1 February. Of these, an estimated 550,000 were on the Red Cross relief rolls in Arkansas alone. And, on 19 February 1931, the Minneapolis Tribune reported that a local Red Cross fund raising drive was "making an effort" to meet its \$90,000 drought relief quota. Relief funds, it was stated, was being distributed to drought victims in a "wide range of the United States, stretching from Texas to Virginia and extending north to southern Illinois, Indiana and Ohio" and into parts of Montana.

Nor was the Red Cross the only source of relief available to the drought ravaged areas of the country. The St. Paul Dispatch (10 January 1931) reported that the Red Cross had asked President Herbert Hoover for \$10 million in federal drought relief aid, an appeal which, it seems, was not fruitless. According to the 15 February edition of the Minneapolis Tribune, Hoover had recently signed a bill providing \$20 million in drought relief loans, thus ending a "long dispute" between the U.S. Senate and the administration regarding the type and scope of the federal government's response to the drought crisis. Aid was also provided through various private initiatives, an instance of which involved St. Paul's school children. According to the 4 February 1931 St. Paul Dispatch, the children were asked to send Valentines to school children in the "drought stricken south." Contents of the Valentines, presumably consisting of monetary donations, were to be turned over to the Red Cross for the "benefit of children whose families had been left destitute by the drought." Similarly, the

9 February 1931 edition of the Minneapolis Tribune reported that creamery operators in Wright county had offered one thousand pounds of cheese to be sent to distressed families in Arkansas.

Although many Minnesotans, city dwellers especially, undoubtedly welcomed lower heating bills and the lack of cold, snowy and icy weather, the warm, dry weather during the winter of 1930-1931, was, on balance, more harmful than beneficial. As noted previously, the period from December 1930-February 1931 brought little moisture to the state's already dry farmlands, setting the stage for the severe summer drought that was to follow. Less seriously, outdoor agricultural activities were "impeded at times by the soft conditions on non-paved roads". Some of the state's main highways were also adversely effected: the 6 February 1931 edition of the St. Paul Dispatch reported, for example, that the mild weather had "left some stretches of Minnesota's trunk highways soft or rough. According to the weekly road report issued by the state highway department, frost heaves had appeared in many places. Poor stretches are mainly on recently constructed routes." More importantly, however, the winter's dry, open weather hastened the decline in Minnesota lake and river levels, raising the prospects of water shortages and exacerbating disputes involving the diversion and control of waters in the Mississippi river watershed.

Predictably, declining water levels and the concomitant threat of widespread drought made news during the winter of 1930-1931. In a statement published in the 9 February 1931 edition of the Minneapolis Journal, W. C. Coffey, dean of the University of Minnesota's school of agriculture stated that the "most serious danger from the lack of precipitation here is that lake and river levels will be extremely low next summer." He added, however, that northwest crops had not yet been affected by the lack of moisture. Winter precipitation, he claimed, was "of no great value to crops. If we receive plenty of rain in April and May when the ground has thawed, we will have nothing to fear from drought." A similar view was expressed in the 31 January 1931 St. Paul Daily News by Andrew Boss, identified as the University Farm's vice president: Minnesota's mild January and the accompanying lack of snow, he said, had not endangered the crop outlook. Then, in an even more reassuring vein, he went on to say that the record of the last month [January] should give no cause for alarm. The "popular idea that deep snow covering helps the farmer" was dismissed with the statement that "deep snow all runs off the surface into creeks and rivers: it is the April showers that the crops must have, not winter blizzards."

Although they may have reflected the sincere opinions of early 1930's agricultural specialists, such statements appear, in retrospect, as overly optimistic -- as presenting a partially accurate, reassuring outlook which, unfortunately, seems to have been filtered through rose colored glasses. Less sanguine, more forthright, views were, however, expressed by other officials, including M.R. Hovde, chief of the U.S. Weather Bureau's St. Paul office. In an article published in the 19 January 1931 edition of the St. Paul Dispatch, he pointed out that the Mississippi river at St. Paul was then at its lowest stage since river level readings were first taken in the drought year of 1864. On 17 January, he said, the stage of water in the river stood at three feet, seven tenths inches below 1864's low water mark. And although the water level had risen 0.4 feet in the last two days, Hovde, nonetheless feared that the river might drop to a level four feet below its previous low mark, a level that

would place it below the markings on the existing St. Paul river gauge. He was, accordingly, planning to install a new gauge with lower markings. Also, on 19 January, the U.S. Army Corps of Engineers reported that the Mississippi river was at an "extremely low stage," and that the possibilities of spring floods was "almost nil". This view was reinforced by a 23 February 1931 St. Paul Dispatch story quoting the Minnesota game and fish department as saying that "Minnesota's 10,000 lakes are solely in need of a drink". Lakes in the southern part of the state, it was said, were more in need of precipitation than those in northern sections where, according to the department, significant autumn rains had helped to maintain "fairly normal" water levels. It was also pointed out that the warm weather had kept many southern Minnesota lakes partially or wholly ice free, thus increasing evaporation, further lowering water levels. In addition, water was being withdrawn from many lakes by farmers who, because their wells had run dry, had no other source of water for their livestock. And on 27 January, Leonard Thompson, the superintendent of the St. Paul city water department, warned that continuation of the present drought through March would seriously affect St. Paul's municipal water supply. Like Hovde, he reminded St. Paul residents that the Mississippi river was at its lowest stage in history. Flowage was said to have been approximately 1800 cubic feet per second, 432 cubic feet of which was being withdrawn from "reservoir lakes" in the headwaters of the Mississippi. Moreover, although the amount of water taken from this source was "approximately normal for this time of year," the levels of the headwaters lakes themselves was low, partly because of heavy withdrawals and partly because of sustained drought.

Although he avoided mentioning it specifically, Thompson's comments touched directly on a controversy which roiled Minnesota water politics during much of the 1930's. The controversy arose specifically because many northern Minnesota residents wished to establish and maintain minimum water levels on the so-called reservoir lakes in the Mississippi river headwaters. This, of course, put them at odds with southern interests, the Twin Cities especially, who sought to maintain water levels sufficient for navigation and/or for proper treatment of the effluent from the Twin Cities sewerage system. In addition, the controversy focused attention on the need for a nine foot channel and a series of locks and dams on the Mississippi river, an undertaking which, although costly, promised to resolve the conflicting interests of those who wished to protect the northern lakes and those who demanded an adequate level of water in the then drought shrunken Mississippi river. Predictably, the controversy spilled over into the news and editorial pages of 1930's newspapers. The 22 January 1931 edition of the St. Paul Pioneer Press, for example, reported that a group of about one hundred Brainerd area citizens concerned about excessive withdrawals from northern reservoir lakes had "voiced unanimous support for establishment of minimum water levels on a number of Minnesota lakes". Two days later the Pioneer Press stated that construction of dams to pool the Mississippi river would remove the need for drawing lake water to maintain adequate mid-summer water levels. The same article then went on to argue that dredging of a nine foot channel "appears to be the only way to protect the six big reservoir lakes from excessive diversion." This, it was said, was the view of Minnesota senator Thomas D. Schall who, it was added, saw no reason for enactment of any legislation establishing minimum water levels in the northern reservoir lakes. And, according to the 21 January 1931 edition of the St. Paul Dispatch, the St. Paul Association's board of directors expressed a different view, adopting a resolutions in favor

of establishing minimum water levels in the Mississippi river reservoir lakes. The board did, however, state that the "best and most permanent method of assuring protection of the northern lakes is by speedy construction of a nine foot channel and a series of locks and dams on the upper Mississippi".

Because the U.S. Army Corps of Engineers was ultimately responsible for control of water levels on the Mississippi river, the reservoir lakes issue soon shifted to Washington D.C. The 12 February 1931 St. Paul Dispatch reported that a bill had been introduced in Congress "to establish maximum and minimum levels for northern Minnesota lakes, restraining withdrawals of water." According to the Dispatch, the bill provided that aggregate June 1931 withdrawals from Leech, Winnibigoshish, Sandy, Pine River, Gull, Pokegama and several other lakes would be limited to 2,500 cubic feet per second. And on 13 February 1931, the Dispatch reported that Patrick J. Hurley, secretary of war had approved "modification" of the maximum and minimum water levels in the reservoir lakes in the Mississippi headwaters area. So far as can be determined, this decision attempted to mollify northern interests who argued that withdrawals during the summer of the 1930 had harmed northern Minnesota's resort industry and threatened fish populations. Conversely, however, it was noted that a reduction of the flow of water in the Mississippi river would create "intolerable" conditions downstream from the Minneapolis and St. Paul sewage treatment plants. The Dispatch further noted that Hurley's move had abolished forty year old regulations governing previous withdrawals of water from the reservoir lakes. Apparently, however, the Corps did agree to allow enough water to be withdrawn to prevent "septic conditions" in the Mississippi river at the Twin Cities.

Secretary Hurley's action, although apparently controversial, did, however, forestall consideration of proposed legislation which, as noted, would have given Congress the power to establish maximum and minimum water levels on the lakes involved. In this regard, the 25 February 1931 edition of the Minneapolis Tribune reported that "prospect of legislation to control the levels of northern Minnesota lakes, which are drawn upon to accelerate the flow of water in the Mississippi, disappeared today in the face of a letter from Secretary of War Patrick J. Hurley, opposing the proposed enactment. The letter was addressed to Senator Hiram Johnson of California, chairman of the committee on commerce, which has control of the bill. Secretary Hurley has already issued an order dealing with the matter and says the essential purposes of the act can be secured under existing law.

"Secretary Hurley points out that construction of the dam and lock below St. Paul, gradually will render unnecessary reliance upon the lake reservoirs. To stop the flow now, he says, would work irreparable damage upon the cities of Minneapolis and St. Paul. Under the circumstances, Secretary Johnson sees no chance of getting through any legislation dealing with the matter in the closing days of the session. [Minnesota] Senator [Henrik] Shipstead today secured printing in the Congressional Record an address by Col. George C. Lambert of St. Paul showing the benefits to agriculture accruing from navigation on the upper Mississippi river.

"Secretary Hurley's letter follows: Dear Senator Johnson: Reference is made to your letter of January 19 requesting a report on senate bill no.5637 to regulate the discharge of water

from certain reservoirs in the headwaters of the upper Mississippi river. These reservoirs have been constructed by the United States for the purpose of improving navigation on the upper Mississippi river. They are operated in accordance with regulations prescribed by the secretary of war under authority conferred by Congress in the rivers and harbors act of August 11, 1888..The operation of the reservoirs under these regulations has resulted in increasing the stage of the Mississippi river at St. Paul as much as three feet during dry years. Without increased flow afforded by these reservoirs, navigation to St. Paul and Minneapolis would have been impossible during the low stages of the past year. The United States has just completed and is about to put into operation a lock and dam below St. Paul which will remove the need for the present drafts from the reservoirs in the interests of navigation.

"The shores of these reservoirs have become extensively utilized for summer resort purposes. The draft of water from the reservoirs during such a dry year as has just past has drawn them down to such low levels as to greatly impair their utility for such purposes. Because of the completion of the lock and dam referred to, it now appears possible to build up gradually the levels of the reservoirs so that they can be maintained above the minimum levels generally proposed in the bill and regulations to that end are in process of formulation. To shut off the outflow as proposed in the act until these levels were established would, however, do irreparable damage to the cities of St. Paul and Minneapolis since a substantial outflow from the reservoirs during the summer months is necessary to prevent intolerable conditions in the Mississippi river below the sewage out falls of those cities. It would do besides great damage to industries, large and small, dependent upon the river flow. I must therefore recommend that the bill not be enacted....".

Hurley's position was echoed by General Lyttle Brown, chief of the Army Corps of Engineers on 26 February 1931. According to the St. Paul Dispatch, Gen. Brown emphatically stated that the Army engineers would "never recommend" any legislation that would preclude "responsible emergency withdrawals of water to meet the sanitary needs of the Twin Cities." "Hard and fast" restrictions, it was said, "might cause a health menace to St. Paul and Minneapolis which use large quantities of water for sewage disposal and domestic purposes....".

Although some subsequent newspaper articles suggest that it did not fully resolve the conflict of interests involved in the reservoir lakes dispute, Hurley's action, at the least, seems to have muted the controversy. The debate, moreover, appears to have been eventually and essentially resolved by construction of the long delayed and long anticipated nine foot channel project. According to the 29 July 1933 edition of the Minneapolis Star, President Franklin Roosevelt had recently authorized/ordered construction of the nine foot channel with its complex network of locks, dams and controls. The work, which was scheduled for completion within a two to three year period at a cost of approximately \$3.3 billion, was expected to provide work for 40,000 workers, many of whom may have been unemployed at the time. The channel was to extend from the Twin Cities to St. Louis and, in the expansive words of the Star, it promised "tremendous development," opening a "vast land locked empire, rich in natural resources and industrial potential but throttled by lack of cheap transportation...".

Yet, despite its warmth, its drought, its controversies and its phenological curiosities, the winter of 1930-1931 was, as noted previously, little more than a prelude to a remarkable year: a year of record and sustained warmth and a year in which Minnesota experienced its first really "deep" drought of the 1930's. The full story of the winter of 1930-1931, then, can only be told in the context of the abnormal year that followed.

THE 1930'S 1931: WARM, WARM AND WARMER

With the exception of May, every month of 1931 featured above normal temperatures. January and February, to repeat, were extremely warm with statewide averages exceeding the then accepted normals by approximately 11 F and 15 F, respectively. March and April were more temperate, each with statewide averages about 2 F above normal. Abnormal warmth returned in June, a month which produced the highest temperature (110 F at Canby on 29 June) officially recorded in Minnesota during any June for the period, 1891-1931. Overall, June temperatures averaged about 5 F above the statewide June normal, a temperature anomaly accompanied by a low incidence of cloudiness and a concomitant plentitude of sunshine (with 68 percent of possible sunshine recorded at the U.S. Weather Bureau's St. Paul station). July and August, although hot, were, like March and April, more temperate, statewide temperatures during August exceeding the long term average by only 0.5 F. Both July and August, however, were unusually sunny months, July featuring a statewide average of eighteen clear days and, at the St. Paul station, 79 percent of possible sunshine. September, in turn, was unusually warm, the statewide average exceeding the then accepted normal by approximately 6 F. October and November were similarly warm, each featuring statewide averages approximately 5 F to 6 F above normal. And, consistent with the pattern that had prevailed since late 1930, December 1931 temperatures averaged about 9 F above normal.

Besides its sustained string of above normal months, 1931, as noted previously, was characterized by repeated summer heat waves, temperatures exceeding 100 F on several days at most stations during June, July, August and September. The hottest days occurred on 28-29 June, 15-16 July, 4 August and 9-10 September, dates on which temperatures soared well above 100 F at many stations, including such far northern stations as Big Falls (105 F on 29 June). Other stations (e.g. Morris, Minneapolis, St. Paul, New London, Collegeville) recorded 100 F plus maxima in June, again in July and again in September. At Moorhead in northwestern Minnesota, maxima of 100 F or higher were recorded on eight days during the summer while Tracy in southwestern Minnesota suffered through thirteen days with such readings. Moreover, with the exception of June (which brought adequate rainfall to some areas of the state) the growing season months (May-September 1931) were notably dry, thus compounding the effects of the heat on state's already depressed economy. Most of the heaviest rains of the summer (and, in many locations, the only heavy

rains of the summer) fell in early and mid-June, some stations recording amounts in excess of three inches on 10-12 June (e.g. 3.62 inches at Gull Lake Dam; 4.40 inches at Grand Rapids; 3.35 inches at Fergus Falls; and 3.93 inches at Sandy Lake Dam). A few stations also received heavy to excessive rainfall late in the month (e.g. Faribault, 5.03 inches on 20-21 June; Tower, 4.62 inches on 17 June; and St. Peter, 3.80 inches on 20 June). In Minneapolis, heavy thundershowers (1.02 inches at the city's Weather Bureau station) flooded streets and basements and dislodged paving blocks on 3 June (Minneapolis Tribune 4 June 1931). This storm, which brought temporary relief from the day's ninety degree heat was accompanied by high winds and a half hour downpour. According the Tribune, another heavy thunderstorm passed through the city on 11 June, producing lightning which "twice threatened to disrupt the city's electrical power". Within a week, however, it was oppressive heat, not rainstorms, which attracted journalistic attention. A "torrid heat wave" which was "scorching" the entire northwest made banner headlines in the 18 June 1931 edition of the Minneapolis Tribune. The heat, it was said, was accompanied by high humidity which "accentuated the effects of the sun". The Tribune further noted that extremely high temperatures had been recorded in Montana and the Dakotas (e.g. 104 F at Minot, North Dakota) on 16 June, spreading eastward into Minnesota on 17 June, "sending the mercury rocketing". In Minneapolis, a reading of 90 F was said to have been recorded at the Minneapolis municipal airport at 1900 hours on 17 June while, at the same time, the official Weather Bureau reading was 87 F. Unofficial readings as high as 95 F were reported in various parts of the city (the official maximum for the day was 89 F). Also, in what may have been an unduly optimistic report, the Tribune stated that northwest crops were reported as "holding up well despite the heat".

The weather merited another Tribune banner headline on 19 June, the day after the city's official maximum had reached 94.4 F. According to the story that followed, "a blistering sun beat down...unmercifully...and sent the mercury soaring to a high that shattered all records for this year". The same report also noted that a fifty mile per hour wind had hit the Little Falls area, blowing down twenty five tents in the National Guard encampment at Ft. Ripley. And on 21 June, the Tribune emphasized the severity of the drought, asserting that "not since 1922 has the northwest enjoyed normal precipitation in any form for any twelve month period. The result is that the subsoil contains little or no reserve moisture". Both the drought and heat intensified in late June, with little rainfall recorded anywhere in the state between 20 June and early July. In Minneapolis, as in most other areas, the heat continued to build, maxima at the Minneapolis Weather Bureau station reaching 99 F, 97 F, 102 F, 102 F, 100 F, respectively, on 26, 27, 28, 29 and 30 June.

Similar patterns prevailed elsewhere in the state, particularly in west central counties which, in 1931, as well as during much of the remainder of the 1930's, experienced unprecedented episodes of drought and heat. At Morris, where temperatures reached 104 F, 102 F and 102 F, respectively, on 28, 29 and 30 June, crops were badly damaged, both by the heat and, ironically, by heavy thunderstorms. The 26 June 1931 edition of the Morris Tribune noted, for example, that temperatures in the 90's F on 17-19 June had been followed by "heavy storms" which brought 1.35 inches of precipitation (19-22 June) and "a combination of wind, hail and lightning doing thousands of dollars of damage." On 3 July, the Tribune noted further that small grains had been damaged to "some extent" by the June heat wave. Wheat

and barley, it was reported, had suffered the worst effects of the hot, dry weather. It was also pointed out that "small grains on light soils were very nearly destroyed. Searing winds virtually burned up the crops." And on 17 July, the Tribune stated that the heat had hastened the 1931 grain harvest, adding that "most small grains suffered to some extent from the burning sun and wind of two weeks ago." The flax crop, however, was said to have been in good condition, the corn crop in "excellent" condition. By the end of July, however, any earlier optimism had given way before the reality of a deepening drought: on 31 July, the Morris Tribune noted that 1931 had been "marked by an unusual shortage of moisture. The county [Stevens] has gone through two exceptionally severe heat waves this summer. Small grain yields are spotty. Some fields will probably not be threshed. Grasshoppers have begun ravaging the corn and the flax." The Tribune story further noted that a new temperature record had been established on 26 July "when a blazing sun sent the mercury to 104.5 [F]", the culmination of a heat wave which, with but a few brief breaks, had scorched the Morris area since 14 July. A light rain (0.24 inches) on 27 July ushered in a welcome, but transient, return to a more normal temperature regime, a rain event which, according to the Tribune, brought relief from the "sweltering weather...just in time to save many fields of corn." Many cornfields, nonetheless, "showed burning and shriveling".

Widespread rains in early August brought additional relief from 1931's prolonged and intense summer drought. Rainfall amounts ranging from a few tenths of one inch at some stations to 3.27 inches at Rochester were recorded on 1 August and, on 6-9 August, many stations received one to three inches of additional, and desperately needed moisture. The Morris area, of course, benefitted greatly from the August rains, a point emphasized by the Morris Tribune (7 August 1931): "A general rain on Thursday morning [6 August] was welcomed for the benefit it will bring to the corn and the late potatoes." Yet, much damage had already been done, the same edition of the Tribune noting grimly that "some areas report almost negligible crops yields." Unfortunately, also, the rains apparently did little to alleviate the grasshopper infestation which, according to the Tribune, was continuing to menace Morris area cornfields. The late August cold was followed by another round of heavy thunderstorms, especially in east central and southern Minnesota. Fairmont recorded 3.08 inches of rain on 31 August and, in the Twin Cities, the rains were at first heavy, flooding streets and basements, later tapering off to a "slow drizzle" which continued throughout the day (Minneapolis Tribune, 1 September 1931). The 31 August rainfall totaled 0.91 inches and 1.30 inches, respectively, at the Minneapolis and St. Paul Weather Bureau stations.

One of the most noteworthy climatic events of the summer of 1931 did not, however, occur during the meteorological summer (June-August). It occurred, rather, during the transitional month of September, producing unprecedented late summer (early autumn?) heat. Although, as noted previously, September 1931 was the warmest September recorded on a statewide basis since 1895, the month's torrid heat was preceded, surprisingly, by autumnal temperatures which, during the closing days of August, brought freezing or near freezing temperatures to many parts of the state (e.g. 33 F at Argyle, Crookston, New Ulm, Rochester and Zumbrota ; 34 F at Faribault, Fergus Falls and Grand Meadow; 37 F at Maple Plain; 35 F at Chaska; and 31 F at Wheaton). At Morris, where a minimum of 31 F was recorded on 29 August, frost was said to have caused "spotted damage" in many

Stevens county cornfields (Morris Tribune, 4 September 1931). The September heat wave that followed began on 5 September, persisting until 12-13 September. Daily maxima at most Minnesota stations exceeded 100 F on several days during the peak of the heat wave, reaching a then record September high of 111 F at Beardsley on 11 September. Other extreme readings included 100 F at far northern Ada on 11 September; 105 F at Alexandria on 10 September; 106 F at Artichoke Lake on 10 September; 103 F at Bemidji on 8 September; 104 F at Bird Island on 10 September; 105 F at Campbell on 11 September; 104 F at Chaska on 10 September; 105 F at Fergus Falls on 10 September; 103 F at Ft. Ripley on 10 September; 105 F at Little Falls on 10 September; 108 F at Milan on 10 September; 105 F at Montevideo on 10 September; 101 F at Moorhead on 7 September; 106 F at New London on 10 September; 106 F at New Ulm on 10 September; 106 F at St. Cloud on 10 September; 105 F at Tracy on 10 September; 108 F at Wheaton on 10 September; 105 F at Willmar on 10 September; and 100 F at Winnibigoshish on 8 September. Temperatures of 100 F or higher were also common the Dakotas, reaching 107 F at Aberdeen, South Dakota on 10 September and 104 F at Bismarck, North Dakota on 7 September. Temperatures of 100 F were also reported in parts of southern Canada.

In east central Minnesota, temperatures of 101 F and 104 F, respectively, were recorded at the St. Paul and Minneapolis Weather Bureau stations on 10 September. The heat reportedly disrupted many Twin Cities area community activities, forcing several temporary school closings and sending thousands flocking to Twin Cities parks and beaches, many of which, although previously closed for the season, were reopened to accommodate heat weary residents. The heat moved eastward out of the Dakotas, settling into east central Minnesota on 8 September, pushing temperatures to 98 F and 99 F, respectively, in St. Paul and Minneapolis and inducing five cases of heat prostration at the Minnesota state fair. On the same date (i.e. 8 September), Twin Cities newspapers reported several heat related deaths in Wisconsin, including three at Milwaukee. The heat, it was said, was accompanied by hot, brisk southwest winds which were accompanied by overnight minima in the 70's F and, at least on several days, by high humidity, factors adding to the discomfort of heat stressed Twin Cities residents.

Similar conditions prevailed in west central Minnesota, an area which, as noted, experienced temperatures even higher than those recorded in east central and southern Minnesota. The 11 September 1931 edition of the Morris Tribune, for example, focused on the extreme heat, particularly the 100 F which had been recorded on 8 September and the record setting 105.5 F recorded on 10 September. The heat it was said had been preceded by "freakish winds:" "on Monday night [7 September] and early Tuesday [8 September]...many folks were awakened during the night by heavy gusts and arose to find the wind feeling as though it were blowing from a huge furnace". "The year 1931", the Tribune added, "has proven to be an unusual one all the way, beginning with an extremely mild winter." Interestingly, the September heat wave seems to have been somewhat limited in geographical extent: according to the 10 September 1931 edition of the Minneapolis Tribune, "Montana was having cool weather while Minnesota, North Dakota and South Dakota were sweltering....".

Montana's cooler more seasonal weather reached Minnesota and the Upper Midwest beginning on 11 September, bringing with it rain and severe storms. Hail with heavy rain

was reported at Fargo, North Dakota on 11 September and, on 12 September, Minneapolis observers noted that a light afternoon shower was accompanied by a thirteen degree drop in temperature. The Minneapolis station also reported northwest winds of 26 miles per hour on the same date (Minneapolis Tribune, 13 September 1931). Light to moderate (and sometimes heavy) rainfall was reported in many areas of the state. But at Fergus Falls, where little rain fell, brisk winds accompanying the incoming cold front triggered one of the many dust storms which were to afflict Minnesota during the next several years.

One of the most noteworthy and tragic events spawned by 1931's combination of drought and heat (September's heat especially) afflicted the Baudette-Grygla region of northern Minnesota. On 11 September, several fires erupted in the desiccated peat bogs and forests in that area and, fanned by high winds, spread rapidly over approximately 500 square miles of woodlands, brush and peat. Although some portions of the area involved received light to moderate rains during September (e.g. Baudette, 2.79 inches), the moisture was generally insufficient to check the spread of the fires. According to the 12 September 1931 edition of the Duluth Herald, five persons were unaccounted for and three "burned slightly as brush and grass fires driven by strong winds swept parts of northern Minnesota".

Quoting A. F. Oppel, deputy state forestry commissioner, the Herald emphasized the role of "unusual drought, heat and wind" in the rapid spread of the fires which, at that point, were said to have destroyed fifty homes in Pennington and Lake of the Woods counties. The fires in Lake of the Woods counties was reported to have been "particularly bad" in the East Rapid river and Hay creek regions while a fire that had threatened homes near Eveleth was reported as "under control". According to the Herald, the "fires in the main were caused by smouldering peat bogs which have been burning all summer." The same article also noted that "forest ranger Jim Gannaway of Baudette was given authority to draft every able bodied man to fight fires along the Minnesota-Canadian border". The fires, it was further reported, had destroyed telephone lines and many bridges, especially those bridges which had been built in what had become highly flammable peat bogs. Brush fires, moreover, had burned a bridge on the Minnesota and International railroad near Margle Minnesota, tying up all freight and passenger traffic in an out of International Falls. Even the highways, it was claimed, were burning in some areas near Grygla. And in the country east of Grygla, forty miles from Thief River Falls, "bad brush fires" had reportedly spread over an area approximately 25 by 30 miles, filling the air with smoke so dense as to preclude automobile travel on roads in the fire zone.

Two days later (14 September) the Herald reported that the fires had been brought "under control" but cautioned that strong winds could again "make them menacing." Three hundred persons living in the fire area had been driven from their homes and were now being cared for by local relief committees. Approximately ninety homes were said to have been burned and three persons were known to have died as a result of the fires. The Herald also noted that a crew had been put to work in the Baudette area burying animals that had been burned to death in the fires, carcasses which, according to the newspaper, "threatened to become a health hazard if left unburied." Finally, on 15 September, the Herald announced that "favorable weather conditions had aided relief workers in the fire stricken areas of northwestern Minnesota. Unfortunately, however, the fire danger remained, a consideration which prompted forestry officials to request that people (farmers especially) in fire prone

areas create a safety zone by clearing all high weeds, loose wood and other flammable materials found within ten feet of any exposed building. The Herald further stated that "a partial check" revealed that losses in the forest district "would approximate \$1.2 million" [1931 dollars], \$1 million of which was attributable to loss of standing timber in the Baudette area alone. In another story, the Herald stated that, in the Grygla area, potatoes had been "baked in the ground" and that one man's shoes had been burned off as he tried to escape encroaching flames. All refugees from the fires, it was said, were being fed and clothed by the Red Cross.

Despite its generally dry summer weather, 1931 was not without episodes of severe weather, two of which involved noteworthy tornadoes. As noted previously, one such storm struck near Maple Plain at about 2135 hours on 16 November, passing about three-fourths of a mile southeast of that station. According to U.S. Weather Bureau reports, "the area affected was limited, the path of the tornado being but a few hundred feet wide and about five miles long, with a direction from the southwest to the northeast. Some farm buildings were totally demolished or badly damaged, while telegraph poles along the line of the Great Northern railway were leveled for a distance of about half a mile..". The Maple Plain event, although unique because of the time of year at which it occurred, was dwarfed by the tornado which snaked through the Moorhead area (Clay county) during the late afternoon of 27 May 1931. This tornado, of course, was noteworthy not because of the month in which it occurred (late May being well within Minnesota's normal tornado season): it was especially noteworthy, rather, because it hit and derailed the Great Northern's Empire Builder, killing one passenger and injuring scores of others. According to the Moorhead Daily News (28 May 1931), the train, which left the Fargo, North Dakota station at 1615 hours on 27 May with 170-175 passengers on board, was struck broadside by the tornado and tipped off the rails at about 1630 hours at a point eight miles southeast of Moorhead. The first news of the disaster reached Moorhead a few minutes later by way of motorists who, when traveling north on state highway 64, saw the train crash on its side (and who, themselves, may have had a close encounter with the tornado). Predictably, the 28 May edition of the Daily News was filled with accounts of the event as told by various of the train's passengers. In one such story, Miss Pauline Smith of Seattle, Washington, described "dark, swirling clouds, a terrific wind roaring outside, a slightly swaying coach, swinging ever more wildly every minute, a sudden screeching, lurching plunge then oblivion." Another passenger told the Daily News that "four of us were sitting in a drawing room car playing bridge when it happened. We noticed dark clouds as we left Moorhead but paid little attention. Suddenly, the car began to rock slightly. In a few minutes we felt it begin to swerve from side to side. A second later it seemed as though an unseen hand lifted our car up in the air and tossed it aside." Still another passenger who remembered the afternoon as being hot, stated that "looking out the window of the observation car, I saw something that looked like a water spout...then a great crash came, the windows caved in like nobody's business. The train rocked and before I knew what happened, we were all tumbled in a heap..".

In addition to the stories told by the Empire Builder's unfortunate and shaken passengers, the Daily News, in a bit of drama of its own, stated that the train, "the finest in the Great Northern system", steamed directly into the path of the funnel cloud "that took the

thousands of tons of steel into the air like a toy and sent all coaches crashing onto the prairie...only the engine was left standing." The passenger who was killed, it was reported, was thrown out of a window and crushed under one of the cars of train as it toppled onto the railroad right of way. The newspaper's coverage of the event also pointed out that the "death dealing funnel", besides wrecking the Empire Builder, raised havoc with farm buildings and other structures as "it swept through Clay county in a northeasterly direction, accompanied by terrific winds..". More than fifty farm homes, barns and other buildings were said to have been damaged or destroyed and, according to the 29 May edition of the Daily News, "farmers and animals were "thrown about by the freakish funnel: buildings were lifted up like matchsticks...cattle and other animals were tossed about on the prairies....".

Although they were unusually warm, the last three months of 1931 were, as a whole, relatively wet. Heavy rains fell at many locations at various locations during October and November (e.g. 2.90 inches, 2.75 inches and 3.50 inches, respectively at Zumbrota, Waseca and Mankato on 7 October; 2.27 inches at Pigeon River Bridge on 27 October; 2.35 inches at Maple Plain on 16-17 November; and 2.60 inches at Redwood Falls on 17 November). The late autumn rains, however, were insufficient to break the year's entrenched drought. Nor were they sufficient to eliminate another drought related menace, namely the growing threat posed by the proliferation and spread of grasshopper populations. Although grasshoppers had caused some crop losses in western Minnesota in 1931 (ref: Morris Tribune, 7 August 1931), it was not until 1932 that the grasshopper problem became widespread and serious enough to attract the attention of the state's major news media. Newspaper accounts suggest, in fact, that the grasshopper infestation was the cause celebre of the summer of 1932, the center of a political debate that reached to the halls of Congress and the source of fears which shook the state's agriculture and agribusiness communities. It is appropriate, then, to think of the summer of 1932 as the Grasshopper Summer, the summer in which Minnesota and other Midwestern states declared war, not on a foreign nation, but on the hardy insects which, along with the drought, seriously threatened the well being of farmers and townspeople alike.

THE 1930'S THE SUMMER OF 1932: THE GRASSHOPPER SUMMER

How serious was the grasshopper infestation that is said to have accompanied (caused by) the drought of the 1930's? If one believes what Minneapolis Weather Bureau officials said in June 1932, it affected only a small portion of the state: as noted previously, the Weather Bureau dismissed the matter, stating that "fears of widespread damage from grasshoppers were not realized, the areas of infestation being small and confined to northwestern counties". But if this assessment of the grasshopper menace is true, Minnesota newspapers published during the summer of 1932 could be seen as alarmist, engaging in exaggerated and/or uniformed reporting or, worse, guilty of unconscionable exploitation of the fears of Minnesota's economically and climatically stressed population. For, in stark contrast, to the Weather Bureau's view, the newspapers published photographs of grasshopper ravaged fields and carried stories in which they reported that a "number of fields of grain have been destroyed [by grasshoppers] and some pastures have been eaten bare.." (Minneapolis Tribune 14 June 1932).

On balance, however, extant evidence suggests that the newspaper stories were more accurate than the Weather Bureau's optimistic, dismissive report. Or, alternatively, that both assessments were correct in part: that the war waged against the grasshopper invasions was so successful that damage, ultimately, was limited to small portions of the state. But, whatever the actual extent of the damage, there is no doubt that the threat was real and that Minnesota farmers and others waged a valiant perhaps even desperate -- battle to stop, or at least contain the grasshopper threat -- a threat which, it is clear, endangered crops, pastures and gardens during the early summer of 1932 (and, to a lesser extent, during most of the summers of the 1930's).

The battle began in early June 1932 when, according to the 4 June edition of the Minneapolis Tribune, "millions of grasshoppers" in Ward county North Dakota were "destined to perish during the coming week" as authorities armed with poison bait (consisting of a mixture of arsenic and molasses) mounted an "offensive" against the insects (which were said to be hatching in "great numbers"). On the following day (5 June), the Tribune reported that "a renewed grasshopper threat more dangerous than ever before came to the northwest Saturday [4 June] as skyrocketing temperatures hatched thousands of eggs." The Tribune's account stated further that the "hordes of newly hatched grasshoppers would increase over the weekend...hundred of acres of growing grain have already been destroyed by the insects in the Red River valley and the danger is also appearing in Kanabec

and Chippewa counties." In an effort to counteract the growing menace, the state executive board, it was reported, had appropriated \$50,000 to buy poisoned grasshopper bait (molasses-arsenic mixed in bran). Although heavy rains on 10 June in parts of North Dakota (up to four inches in the Glen Ulin area) and Montana (where local flooding was reported) were expected by some to aid in the fight against the grasshoppers, the danger persisted, apparently unabated. The 12 June 1932 edition of the Minneapolis Tribune reported, for example, that abundant rains had chased away the "bogie man of drought" but that grasshoppers, rain notwithstanding, were doing "great damage up and down the Red River valley."

In reality, however, the "abundant" rains did little to banish the drought. And, as noted, the rains did little to reduce the grasshopper threat, evidence of which was provided in the Tribune's 14 June 1932 edition. In an article which emphasized the need for prompt and effective action, the Tribune story claimed that, in addition to \$300,000 (\$200,000 in federal funds and \$100,000 in state funds) already available for grasshopper control, another \$1,250,000 from the federal government was "desperately" needed "to save area crops". A grim scenario followed: "two or three weeks ago the ground along the Missouri river in parts of South Dakota was covered with young grasshoppers". Moreover, A. G. Ruggles, Minnesota state entomologist, fresh from an inspection tour of the Red River valley was quoted as saying that the grasshopper situation from Wheaton to the Canadian border was "extremely and increasingly serious." A number of fields, it was said, had been destroyed and some pastures had been eaten bare. For the most part, however, the insects were reportedly eating vegetation along the edge of the fields and in sloughs and pastures. This, according to Ruggles, meant that it was yet not too late to prevent the grasshoppers from entering fields of growing grain. In addition to the infestation in the Red River valley, "serious conditions" were reported in Murray and Itasca counties. And, as if to remind farmers and others of the consequences of an unchecked grasshopper invasion, it was pointed out that in 1931, the ravenous insects, together with drought, had ruined millions of bushels of the grain required to feed cattle, hogs, horses and sheep.

Yet, despite the gravity and extent of the menace, Minnesotans, although perhaps somewhat discouraged, were obviously determined to carry on the battle against the invaders. As of mid-June, three hundred to four hundred tons of poison mash had already been distributed, yielding what Ruggles called "wonderful results." In addition, another 1,500 tons of bait, paid for by two \$50,000 grants authorized by the state executive council, were being rushed to twenty three counties and, in other instances, bait was being procured with funds contributed by local communities and by Minnesota businesses. The Minnesota Highway Department (now the Department of Transportation) also joined in the fight, spreading poison bait along roadsides and in ditches. On 15 June, the Tribune again emphasized the need for more federal assistance, its headlines announcing that "pressure continues for federal appropriation of \$1,250,000 in grasshopper fight." Tribune writers then went on to stress the need for prompt action, pointing out that wetter weather alone would, again as noted, have little effect on the grasshopper population: grasshopper eggs while in the soil were said to be waterproof. Moreover, according to the Tribune, the young insects remained "immune from death by climatic causes....during the sixty day May-June hatching and molting period, an interval in which "nothing short of a week's rain will

exterminate or even materially reduce their numbers". And the poison bait itself at that time the only effective insecticide available in the fight against the grasshoppers was of limited, even little, value unless applied during the forty to sixty day period before the newly hatched insects developed wings and the concomitant ability to migrate (or to swarm). On 16 June, the Tribune noted that the grasshoppers were "taking a heavy toll" in Mahnomen and Pennington counties and that the insects were "in great abundance all the way from Manitoba [Canada] to Traverse county. Many pastures and fields have been stripped bare or destroyed by the grasshoppers". And in a ruling that must have disappointed farmers and others in need of the resources necessary to successfully combat the menace, Minnesota's attorney general, it was reported, had ruled that township voters had no power under existing law to appropriate money for grasshopper control.

On 17 June the Tribune reported that, according to state officials, Minnesota could provide the funds necessary to fight the grasshopper menace in its own borders, in effect dropping its demand for a portion of the \$1,250,000 grasshopper control appropriation being debated in Congress. It was pointed out, however, that federal assistance was still required by states such as Montana and North Dakota, states in which the infestation was deemed to be more serious than in Minnesota. The Minnesota situation, nonetheless, remained serious: on 18 June, the Tribune stated that sixty tons of poison mash had been distributed in Douglas county and that "millions of grasshoppers" had invaded the Ortonville area in far west central Minnesota. And, although rains were said to have temporarily slowed the progress of the grasshopper infestation in parts of the Red River valley, the threat had spread eastward into St. Louis, Carleton, Aitkin and Pine counties. More alarming news followed: on 19 June, Alex Hansen, field manager of the Minnesota Livestock Breeders Association was quoted as saying that the grasshopper situation had become "so critical" as to require "wholehearted" cooperation of business and agricultural interests. He also appealed to any individuals (presumably townspeople and farmers and others from areas not immediately threatened by grasshoppers) who may be "in a position to help" to join in the fight to "prevent widespread damage if not outright destruction of the 1932 grain crop." On the same date, the Tribune warned that once grasshoppers "wing out" they can be expected to spread rapidly from infected areas to uninfected areas. The most severely infested counties, at that point, were the far west central counties of Douglas, Wilkin, Clay and Traverse.

Nor did the situation improve as June waned into July. Headlines in the 21 June 1932 edition of the Minneapolis Tribune told readers that the "hopper peril" had grown worse and that the situation in the Red River valley and western Minnesota had become "increasingly alarming." Whole fields, it was claimed, had been stripped bare. On the following day (22 June), the Tribune reported that the grasshoppers had "stripped clean" a 320 acre stand of flax near Breckenridge. On the same date, the U.S. House of Representatives voted against the proposed \$1,250,000 grasshopper control appropriation, an appropriation which had been recommended by Arthur Hyde, then U.S. secretary of agriculture and approved by the U.S. Senate. So far as can be determined, the majority of the House members thought that any appropriation made in late June would be of little help to farmers in the grasshopper infested areas, the damage presumably already having been done.

Yet, whatever the perceptions of the majority in the U.S. House, the grasshopper threat

seems to have continued unabated. In its 23 June 1932 edition the Minneapolis Tribune quoted Cargill Corporation's monthly crop bulletin, stating that the "grasshopper menace is great and growing, with prospects of a fine grain crop being ruined". It was also noted that cut worms and other "pests" had joined the grasshoppers in their attack on Upper Midwest crops and that crops in the Arrowhead region of Minnesota were now threatened, several farms near Floodwood said to have been attacked by foraging grasshoppers. On a lighter note, the Tribune reported that many farmers were catching grasshoppers "by the bushel," drying them and using them as chicken feed.

The situation took yet another turn on 24 June when Minnesota Governor Floyd B. Olson announced the appointment of Frank T. Heffelfinger, Minneapolis grain executive and civic leader to serve as a liaison "between field experts at the University of Minnesota and Twin Cities businessmen in coordinating the fight against the grasshoppers." It was also reported that a Twin Cities businessmen's committee had made arrangements with area millers "under which the latter will pool their bran output and deliver it directly to the state authorities, thus preventing speculators from raising bran prices." And, in response to reports that grasshoppers were "starting to move in growing numbers," the state executive council voted to appropriate an additional \$150,000 for the purchase, preparation and distribution of poison bait (Minneapolis Tribune, 24 June 1932). Still another warning was issued on 25 June, the Minneapolis Tribune noting that the grasshoppers were "rapidly reaching a stage of development at which they will be able to fly." On 27 June, the Tribune reported further that 3,000 farmers in Clay county, one of the "hardest hit" of the state's counties, had organized a "disciplined group" to scatter poison in an effort to stop the spread of the grasshopper menace. And on 29 June, the Tribune noted that the grasshopper threat had spread to Lincoln, Pine and Redwood counties and that, in an attempt to hinder grasshopper migration, the highway department had halted cutting of weeds and grass adjacent to state roadways.

The end of June did not, however, bring an end to the grasshopper wars. On 4 July, the Tribune noted that the "welcome rains" that had fallen in many parts of the state were "not cold enough to be of any great advantage in the fight against the grasshoppers". The same report stated that the grasshoppers had caused "considerable damage" to fields of barley near Hadley, Lake Wilson and Chandler, Minnesota. On 6 July, the Tribune announced the end of any hopes for immediate federal help for the grasshopper plagued farmlands of the Upper Midwest. The U.S. House of Representatives, it was said, had ended the matter by refusing, once again, to provide funds to assist local authorities in their battle against the grasshopper invasion. Representatives from the farm states were quoted as saying that no further effort would be made to obtain assistance from the federal government while others asserted that, because the summer was already half over, any money spent on grasshopper control would be ineffective (or, as the newspaper put it, money thrown away). This news, however disappointing as it may have been, was followed by an optimistic report: Minnesota "crop experts," it was stated, believed that eighty to ninety percent of the state's 1932 grain crop could now be saved. The poison bait, concentrated at key points had been "highly effective". Moreover, birds and various natural parasites were said to have helped to diminish the grasshopper population. Moreover, and perhaps more importantly, a grasshopper destroying fungus had appeared in some places, particularly in Polk county.

Reports further indicated that, as of early July, the worst, most serious, grasshopper infestations were confined to Marshall, Red Lake, Norman, Wilkin and Clay counties in Minnesota (and in many areas of North and South Dakota). Finally, the 5 July 1932 edition of the St. Paul Dispatch quoted T. L. Aamodt, assistant state entomologist, as declaring a successful end to the "campaign to save crops in grasshopper infested areas of the state." According to Aamodt, the campaign was "virtually over," the shipment of poison bait to affected counties having been discontinued. His statement also tended to corroborate the view of Minneapolis Weather Bureau officials, who, as noted previously, thought that 1932's grasshopper damage was significantly less than more alarmist reports would suggest. Specifically, Aamodt noted that, although Kittson county farmers sustained serious losses, grasshopper damage was expected to be comparatively light in counties such as Marshall (an estimated eight percent loss) and Norman (an estimated ten to fifteen percent loss). Aamodt did note, however, that grain fields in northwest Minnesota, Nebraska and North Dakota were "suffering from an invasion of wheat stem maggots which," he explained, "eat grain stems just above the top joint."

Yet, newsworthy as they may have been, the 1932 grasshopper wars did not end with the summer of 1932. The grasshopper problem, in fact, persisted through the remaining years of the decade, sometimes affecting relatively small, isolated areas and sometimes spreading over large areas of the Upper Midwest, the Dakotas especially. Any adequate documentation of the extent and significance of the grasshopper outbreaks during the period, 1933-1939 would, however, require several hundred additional pages: what follows, then, are several select, but representative, accounts of the grasshopper threat as it was seen and reported during the last seven years of the 1930's. And, surprisingly, the first year of the seven (i.e. 1933), saw a marked decline in grasshopper populations, a decline which may be attributable in part to preventive measures taken by area farmers and/or to weather conditions during the spring of 1933. The preventive measures, which were encouraged and widely publicized by entomologists and agricultural specialists, involved tillage practices which, by loosening and stirring the topsoil, bringing the grasshopper eggs to the surface, thereby exposing them to the lethal effects of heat, cold, sun and drying winds. In addition, relatively cool, wet conditions in May 1933 were thought to have inhibited the hatching and growth of grasshopper populations. Most important of all, however, was the aggressive 1932 grasshopper eradication program, featuring as it did extensive and purportedly "highly successful" use of poisoned bait.

The likelihood of decreased grasshopper activity in 1933 was suggested as early as March 1933 by A. G. Ruggles, state entomologist. According to the 2 March 1933 edition of the Marshall County Banner (Argyle), he pointed out that "soil tests have revealed a startling under production of grasshopper eggs". In the Red River valley, the site of last summer's heaviest infestations, soil samples indicated a "very low" egg count, one egg for every ten eggs found during 1932. This decrease, according to Ruggles, indicated that the grasshopper "control campaign started last summer was productive and that the danger from a heavy infestation this year [1933] is light." Similar views were expressed by the Marshall Messenger on 5 May 1933. Ruggles was again quoted as saying that the grasshopper plague in Minnesota was almost totally obliterated: "the plague that scourged the northwest last year, destroying crops and grains will be reduced by ninety percent this summer. The

organized poison war that farmers waged last year is the direct cause of the drop." Ruggles did concede, however, that a recurrence of the grasshopper menace threatened other northwest states, the Dakotas among others. At the same time, the Marshall County (Argyle) Banner (4 May 1933) indicated that officials in the Red River Valley, Ruggles optimistic views notwithstanding, were taking no chances: "although the menace will not reach the proportions of 1932, plans are already in place to control and exterminate the [grasshopper] pests as far as possible." Ruggles himself was also less optimistic, stating that the heavy rains at the end of May 1933 had killed only a "small percentage" of the grasshopper population (Minneapolis Star, 29 May 1933). The two to three percent of the insects that had hatched would probably be harmed to a "great extent" but the rains would have little effect on the "bulk" of the hatch which, he explained, would not take place for another ten days.

But whether or not the infestations were as bad as those experienced in 1932, the summer of 1933 was not without its share of grasshoppers. The 8 June 1933 edition of the Argyle Banner noted, for example, that "grasshoppers have already made their appearance in large numbers in sections of [this] locality." The Banner also noted that the insects had seriously damaged gardens and that some flax fields had been seriously infested, prompting the shipment of three and one half tons of poison bait to be used by Marshall county farmers in combating the threatened outbreak. The area's efforts to contain the grasshoppers was, however, temporarily aided by cool weather in mid-June (36 F at Argyle on 14 June), weather which was said to have held the invading insects in check, keeping them from "moving so rapidly into fields and gardens (Banner, 15 June 1933). The situation soon worsened, however: on 29 June, the Banner noted that the "grasshopper menace continues to grow, as haying progresses the hoppers are moving to the fields from their breeding grounds in the meadows." If newspaper reports are to be believed, there was little consensus as to the extent and seriousness of the 1933 grasshopper infestations, whether for particular areas or for the state as a whole. In this regard, the 20 June 1933 edition of the Minneapolis Star asserted that "huge damage" from the twin scourge of heat and grasshoppers was reported in Minnesota, South Dakota and North Dakota. A few days later, however, the Star (7 July 1933) quoted state entomologist Ruggles as stating that "while grasshoppers in Minnesota are one hundred percent hatched, no significant reports of damage have been received." Consistent with his earlier statements, he maintained that "the infestation is about ten percent that of 1932." Ruggles further noted that the locus of the grasshopper infestations had shifted to the north and east, the "peak" occurring in Lake, St. Louis, Carlton, Pine, Chisago, Kanabec, Benton, Stearns, Morrison, Mille Lacs, Crow Wing, Aitkin, Cass, Itasca and Koochiching counties. Meanwhile farmers in Goodhue, Anoka, Mille Lacs and Washington counties were said to be fighting cinch bugs, an insect pest which, according to Ruggles, had already done "considerable" damage to the corn crop in other states.

Yet, whatever differences of opinion there may have been regarding the seriousness of the grasshopper infestation in 1933, there can be little doubt as to its prominence during the drought stricken spring and summer of 1934. As early as 30 March 1934, the Milan Standard warned its readers that grasshoppers were "still a menace in Minnesota." Farmers, it was said, were being urged to destroy the eggs by "plowing, raking and harrowing" their

fields, a practice which, according to agricultural experts, would "break up the waterproof egg masses and bring the eggs to the surface of the soil where they will be exposed to the drying wind and sun." Any such precautionary measures notwithstanding, the grasshopper menace soon became serious, partly as a result of an extreme May drought which destroyed much natural vegetation, driving the insects into pastures and crop lands. On 29 May 1934, the Minneapolis Tribune noted that grasshopper and cinch bug warnings had been issued in six Upper Midwest states. And on 31 May, the St. Paul Dispatch reported that a horde of grasshoppers had blown into Vermillion, South Dakota on a southeasterly wind, filling the air with "swarms of thousands." Also, on 31 May, a number of Minnesota newspapers announced that the state entomologist (Ruggles) had requested a state appropriation of \$50,000 "to combat the grasshopper menace," a menace which he emphasized had been created largely by the month's dry weather.

So far as can be determined, the northwestern region of the state suffered most from the 1934 infestation. The 31 May 1934 edition of the Marshall County (Argyle) Banner reported, for example, that "grasshoppers, tiny but vigorous and with ravenous appetites invaded grain fields in [this] locality Monday [28 May] in great numbers and with a suddenness that caught the hopper fighters unprepared." The Banner then went on to explain that the heat wave which began on Sunday 27 May had "apparently" brought the insects to life. The drought, it was said, had held back the growth of vegetation in the hatching grounds, forcing the "hungry hoppers" to move into the fields, devouring tender grains and "leaving no signs of growth behind them: the crops have had great odds against them this spring, drought, high winds and frost have done great damage and now the grasshopper menace threatens to clean the fields." June, however, brought some relief from the infestation. The 7 June edition of the Banner stated that the "grasshopper menace has not yet been relieved" but, the 14 June edition, noting a general improvement in crop conditions, announced that wetter, cooler weather had "been a check on the grasshopper hordes," their activities "almost at a standstill this week." The Banner also noted, somewhat enigmatically, that the carload of poison bait which had arrived in the Argyle area on 9 June "would have been of little effect in checking the hoppers had they been on a rampage." In its next edition (21 June), the Banner maintained that while the grasshoppers continued to menace crops, the poison bait was being spread "to hold them in check". By 12 July, however, the Banner was able to report that, although the grasshoppers continued to be "troublesome in some areas," the poison bait was deemed "sufficient to keep them in check." Little additional damage to crops was also reported, the apparent result of improved weather conditions and the effectiveness of the arsenic bait.

Yet, although they were a prominent feature of 1934's disastrous growing season, grasshoppers as such did not make news to the extent that they had in 1932. This lack of attention to what was undoubtedly a serious problem is probably attributable to a surfeit of other weather news (dust storms, starving livestock, low water levels, etc.), news which probably crowded out the now shopworn grasshopper stories. More importantly, however, the grasshopper menace was checked by what the state entomologist (as quoted in the 12 December 1934 edition of the Brown County Journal) called Minnesota's "now nationally famous" grasshopper control program. He asserted (perhaps with some degree of unwarranted pride and overconfidence) that the grasshoppers had received a "big setback"

in 1934, noting that the state's efforts, now in their third year, had been highly successful in reducing infestations. He further stated that, as a result of past efforts, less poison bait would be needed in 1935 than in previous years, except "for a half dozen northwestern counties."

The grasshopper threat was further reduced in 1935, the probable result of a cool, wet spring. The 1 March 1935 edition of the *Milan Standard* did, however, quote A. G. Ruggles, state entomologist as saying that although grasshoppers would probably be "plentiful" in the northwest corner of the state during the upcoming growing season, farmers are "organized" and have sufficient bait to "hold the pests in check". And, on 3 May 1935, the *Standard* reported that a total of \$464,500 had been spent to control the grasshopper infestation in Minnesota during the preceding four years, 1931-1934. This expenditure, according to the Minnesota department of agriculture, "saved" \$28 million in crops. Poison bait, it was added, was the "only form in which grasshopper funds were received by farmers". Ironically, also, 1935's wet, cool spring and warm summer -- while inimical to major grasshopper infestations -- favored the spread of black stem rust, a disease which is said to have attacked much of the state's 1935 wheat crop. According to Ruggles (as quoted in the 16 August 1935 edition of the *Brown County [New Ulm] Journal*), "the sultry and rainy weather responsible for the ravages of the black stem rust was the factor that eliminated the grasshoppers and cinch bug plagues. Little damage from either [i.e. cinch bugs or grasshoppers] is expected...this year is the first year in Minnesota's five year battle with grasshoppers that the weather has favored the farmer." "Heat [an apparent reference to the year's extremely hot July] and excessive moisture this year created unfavorable conditions for the hatching of millions of eggs laid by grasshoppers that came into Minnesota and North Dakota from Manitoba [Canada] last fall..".

Although they appear to have been plentiful during the extraordinarily hot, dry year that followed 1935, grasshoppers, surprisingly, were rarely mentioned in the numerous drought stories which made headlines in Minnesota newspapers during the spring and summer of 1936. The reasons for this apparent oversight are twofold: first, the worst of the 1936 grasshopper infestations appear to have been concentrated in the Great Plains states, not in Minnesota; and second, journalistic attention was centered on the summer's intense drought and heat, a focus which undoubtedly overshadowed the less compelling grasshopper stories. There are, nonetheless, several significant reports relating to the 1936 grasshopper menace, one of which appeared in the 22 June 1936 edition of the *Moorhead Daily News*: "another devastating drought with grasshoppers as an added hazard impended throughout large sections of the northwest today. Hot, dry winds have seared badly almost all of North Dakota and the plains of northern Minnesota. Grasshoppers, larger and hungrier than ever experienced...were reportedly working havoc in twenty eight South Dakota counties". On 25 June, the *Daily News* noted that "few grasshoppers have yet been seen [in the Moorhead area]. In parts of Nebraska, in contrast, grasshoppers were said to have been "massed so densely that their numbers obscured the sun: the grasshopper hordes carry the threat of destructive powers which could strip the earth of all vegetation if large numbers alight in a concentrated area." In the Red River valley, however, it was not hordes of grasshoppers but "droves" of webworms (or sugar beet worms) that threatened to destroy the vegetation. In the Glyndon, Minnesota area, the worms were said to have attacked sugar beets,

potatoes, corn, sweet clover and even gardens. And by early July, the Daily News (9 July 1936), noted that grasshoppers were "again becoming numerous in many vicinities," presumably adding to the woes of the Red River valley's pest and drought besieged farmers. In another story that emphasized both the severity of the 1936 grasshopper infestation and the 1936 drought, the 10 July 1936 edition of the Minneapolis Star stated that in Aberdeen, South Dakota, grasshoppers, in an effort to get to the artificial green grass in downtown window displays (the only grass in sight), had "battered" themselves to death, hitting plate glass store windows with lethal force. And, in still another believe or not story, the 14 July 1936 edition of the St. Paul Dispatch reported that grasshoppers were eating wash hanging on outdoor clothes lines as well as paint from buildings in Gettysburg, South Dakota.

Nor did the Upper Midwest's grasshopper problem end in 1936, the last of the 1930's extreme drought years. Newspaper accounts and other sources indicate, rather, that the grasshopper threat, although apparently diminished, persisted during the generally wetter regime that began in 1937 and continued through much of 1938 and 1939. As noted previously, grasshoppers caused extensive damage in Hennepin county during the summer of 1937. And on 30 July 1937, the Morris Tribune noted that, although the grasshopper infestation in Stevens county was "not bad this year," there are "still enough grasshoppers to cause a bad infection if conditions are right for their development next year." "The use of poison bait this year will do much to assure against a heavy infection next year." Other west central counties, however, reported "heavier" infestations: according to the Tribune, Big Stone and Wilkin counties had taken one and two carloads of poison bait, respectively. Further anxiety regarding the grasshopper situation was expressed several weeks later (13 August 1937) in a Tribune article stating that "state authorities fear a general outbreak of grasshoppers in 1938." The Tribune further noted that "due to the heavy demand for grasshopper bait from a number of counties in the state, Stevens county did not receive the promised supply last week." But, it added reassuringly, a shipment is expected within a week. The shipment did, in fact, soon arrive, the 27 August 1937 edition of the Tribune announcing that free grasshopper bait was now available to Stevens county farmers. Farmers were also reminded that the "heavy egg laying season for grasshoppers here will be the first week of September, so there is yet time to prevent a heavy infestation." "Farmers in areas where grasshoppers are numerous," it was added, "are urged to get together and plan spreading bait on a community basis." The same edition of the Tribune also reported that T. L. Aamodt, assistant state entomologist, had pointed out that "the species of grasshoppers which is becoming numerous here did not show up in Minnesota until the last three years." "This, Aamodt said, "is the sargent or differential grasshopper which is causing such great havoc in the Dakotas."

Aamodt's comments, of course, reinforced previous warnings issued by state officials who feared large scale grasshopper infestations during the summer of 1938. Newspapers and other sources indicate that no such outbreak actually occurred, probably because of timely preventive measures and/or because of the cool, wet conditions which prevailed during much of the spring and early summer of 1938. The threat was nonetheless real, evidence of which was provided in the 6 May 1938 edition of the Morris Tribune. According to the Tribune story, "an examination of fields in various parts of the county [Stevens] made last week by county agent S. C. Martensen and a representative from the state division of

entomology revealed that the stage is set for a grasshopper epidemic in 1938. Alfalfa fields and other favorable breeding grounds in the northern and western portions of the county were sampled [and found to] contain fifty to one hundred grasshopper eggs per square foot....A countywide meeting is scheduled for May 11 to discuss the problem....Material for making poison bait is stored in Morris where a central mixing station can be set up...". This was followed on 20 May 1938 by a lengthy admonition from Aamodt: "with large areas of Minnesota heavily seeded with grasshopper eggs, farmers have two ways to escape severe crop destruction in 1938.....One way is merely a gambler's chance that the weather at hatching time might be cold and wet enough to kill the hoppers. The other way is the sure way ofhaving poison bait ready and spreading it before the hoppers scatter from their hatching grounds to the fields....In the northern half of Minnesota, especially in the Red River valley where hoppers struck hard seven years ago, farmers didn't depend on weather. They have proved that poison bait is a positive control for a grasshopper outbreak.....Minnesota's biggest test this year will be in the newly infested area, including the five southern tier of counties.....county agents in this territory are working hard to organize farmers and familiarize them with methods and procedures necessary to insure results. The federal government is arranging to provide the poison bait material and has set up an office in Minneapolis to handle distribution of these supplies to twenty three states...Egg surveys made last year definitely forecast severe outbreaks, not only in Minnesota but in many other states....There is no excuse to allow grasshoppers to destroy crops this coming season..". This advice, it was said, was being taken seriously by Stevens county farmers, the Tribune noting that each township chairman had been appointed as an "insect officer" for his township. "If a big hatch of grasshoppers appear and survive until the weather cannot control them," the township officer will order a general bait spreading program.

Finally, in the summer's last noteworthy grasshopper story, the Tribune (24 June 1938) reported that "field inspections made in various parts of the county this week revealed that a considerable number of grasshoppers have been hatched and destroyed by the weather....However, a number of places were found where the hoppers are so numerous that bait must be used to avoid damage to the crops. Requests for bait have been received from several communities which indicates that farmers are aware of the situation and want the grasshopper population from becoming too big.....Arrangements have been made to supply ready mixed wet bait at the county fair grounds to farmers who want it. If larger amounts must be hauled out, the highway department is ready with their trucks to bring it to local centers for distribution to farmers and bait scattering crews at designated times. Sacks must be furnished by those who receive the bait.

"The following instructions...will be valuable to those who use the bait. Endgate seeders and homemade spreaders can be used for spreading the bait over large areas. The rate of application should be twenty pounds of wet mash per acre per application. If properly spread there should be only a few flakes per square foot. If the grasshoppers are not controlled, make another application in about five days. Bait should be spread on hatching grounds after most of the eggs have hatched but before hoppers begin to migrate into the crops. To get the most good out of one application delay spreading as long as possible but do not wait until the dangerous migrations take place. Ordinarily, hoppers do not leave the

hatching grounds until about half grown. It is important to poison the grasshoppers when they are in this small area rather than later after they have developed wings and are scattered over the whole farm.....It is necessary to cover only the hatching areas of the egg infested areas. When trying to locate egg beds and young hoppers early in the spring, remember where most of the grasshoppers concentrated in the fall and late summer. The early hoppers are usually found in pastures, borders of fields, along fences, in alfalfa fields, hay meadows, weedy places, wastelands, roadsides, ditch banks, railroad grades and in general on strips of land 50 to 100 feet wide bordering on or near fields which the previous year were in flax, corn, small grains and other preferred crops and legumes.

"Grasshoppers start feeding soon after sunrise...and continue until 10 or 11 o'clock in the morning. They do not feed a great deal when the temperature is below 68 degrees F or above 85 degrees F. The best time to spread bait then is when feeding is at its height. The best results are obtained when the bait is fresh and moist. Grasshoppers do not die until six to 48 hours after eating the poison. Sometimes they are hard to find after they die of poisoning. In estimating the kill, the area must be examined very closely.....Arsenic is a deadly poison. If the bait is scattered in flakes at the rate of twenty pounds per acre, there is no danger to livestock or birds....Arsenic and other left over bait containers and other similar materials should be burned and the ashes spread very thinly over a large area of ground or buried deeply.....Following the 1932 control campaign in Minnesota, when bait was used over approximately five million acres....farmers and county agents were asked....[if] livestock poisoning was due to carelessness.....Every one of the fifty five counties involved reported that any livestock poisoning was due to carelessness."

Other evidence of the apparently successful attempt to control the 1938 grasshopper threat was highlighted by the Minneapolis Star (15 June 1938): "with grasshoppers in the Brooklyn area of Hennepin county seventy five percent hatched, the poison bait mixing plant at Osseo was in full operation today supplying the bait to farmers. Plants in other sections of the county will open as soon as the grasshoppers in those sections begin hatching..". Yet, however successful it may have been, the 1938 grasshopper control program did not completely remove the threat of a 1939 outbreak. According to the Morris Tribune (16 June 1939), assistant state entomologist Aamodt warned that "in some sections of Minnesota there will be a three-cornered race this summer between farmers, binders and grasshoppers. The farmers and the binders have the edge on the grasshoppers, however, if they start their fight immediately." On 3 June 1939, the Minneapolis Tribune stated that recent rains and cool weather were "expected to aid materially in the battle against grasshoppers." However, on 5 June 1939, the Tribune noted that Hennepin county extension agent K.A. Kirkpatrick had recently announced "plans for fighting the threatened grasshopper menace in this area". A survey conducted by the state entomologist, it was said, indicated that grasshopper conditions in the county [Hennepin] were "spotted with some areas hatching thirty five to forty insects per square yard." In an effort to prevent or at least ameliorate the threatened outbreak, poison bait was being distributed to farmers free of charge by the state-federal grasshopper control commission. In other parts of the northwest, the Tribune added, the "return of warmer weather again is stimulating growth of grasshoppers."

Several noteworthy grasshopper stories followed. On 6 June, the Tribune reported that

"Minnesota farmers are waging a successful war against threatening hordes of crop destroying grasshoppers". T. L. Aamodt, assistant state entomologist was quoted as pointing out that "in spite of heavy grasshopper infestations, especially in the Red River valley, control operations have held crop losses to a minimum". "Weather conditions," he added, "have favored the farmers who are cooperating with state and federal authorities in spreading poison bait in areas where the pests are hatching by the millions." The same (6 June) edition of the Tribune, however, brought bad news, announcing the "threatened abandonment of federal aid to the grasshopper control campaign", effective 10 June 1939. The prospect of losing federal aid, the result of depletion of funding, was said to have "brought a storm of protest from all parts of the northwest as desperate efforts were begun to secure an additional \$5 million to complete the fight." And on 29 June, the Tribune alarmingly reported that "the northwest's fight against grasshoppers faced a new crisis today. Exhaustion of funds in North Dakota forced closing of all WPA [Works Project Administration] bait mixing stations, leading to the fear that unless some method of operating the stations is found, farmers will be deprived of needed bait. This would permit grasshoppers to develop unhampered and might result in migration to Minnesota and other states." The WPA bait mixing program, it was explained, was started last spring with an allocation of \$90,000, a sum that had since been exhausted. W. E. Dove, Minneapolis, director of the northwest grasshopper control campaign, it was reported, had asked for additional WPA funds. But, probably knowing that additional funding was unlikely, Dove suggested an alternative, specifically that the U.S. Bureau of Entomology assign foremen to the North Dakota stations and that farmers, under supervision, could then mix their own bait. On the following day (30 June), the Tribune reported that Dove had approved a plan "whereby 125 to 150 foremen would supervise [the] stations," thus making it possible for farmers to prepare their own bait.

Funding problems and the anxiety felt by many at the beginning of the growing season notwithstanding, grasshopper damage during 1939 appears to have been minimal, again the result of successful control measures and wetter weather (especially during the month of June). The 12 June 1939 edition of the Minneapolis Star reported, for example, that weekend rains had brought "generous" precipitation to "practically all of the entire northwest." The rains, while benefitting crops, also "helped in combating the grasshopper invasion." Similarly, the 21 June 1939 Star hailed "general rains and cool temperatures" which, it was said were a "boon to crops and especially beneficial in combating grasshoppers." This view was reinforced by A. G. Ruggles, state entomologist who stated that the cool, wet weather had held grasshopper activity to a "minimum" throughout the northwest. "Hoppers, he said, do not feed under these conditions: the weather has delayed grasshopper development and given us more time for spreading bait." He further noted that there had been no reports of any "real" grasshopper damage in Minnesota during the first several months of the 1939 growing season. Similar views were expressed by the Minneapolis Tribune (16 July 1939): although its report indicated that grasshoppers had caused damage in some scattered areas and "heavy" losses in a few areas, the Tribune predicted that extensive damage to wheat and other small grains was deemed "unlikely". The threat, however, was expected to rise as the insects reached maturity and began to fly in greater numbers. But despite increased migration, the grasshopper threat was said to be minimal, countered first by the "effective distribution" of poison bait and second because

grain crops had matured rapidly, making them less susceptible to extensive grasshopper damage. The same edition of the Tribune also quoted J. A. Munro, University of Minnesota entomologist, as saying that the 1939 grasshopper epidemic was largely confined to two sections of North Dakota, the northern end of the Red River valley and some sections along the Missouri river. "Mass flights of grasshoppers," he added, "are less likely this year than in 1938."

Yet, however worrisome or threatening they may have been, none of the grasshopper outbreaks of the 1930's appear to have been more devastating and widespread than those which plagued the Upper Midwest residents during the summer of 1932. That summer, however, appears to have been the first summer in which arsenic laced bait was used extensively and systematically in an effort to control, if not eliminate the grasshopper menace. In addition, the summer of 1932, although notably dry and warm, was somewhat less extreme than the summer which preceded it (1931) and the two summers (1933, 1934) which followed it. Evidence that marginally improved growing conditions prevailed during 1932 is provided by several newspaper accounts, the first of which appeared in the 14 July 1932 edition of the St. Paul Dispatch. In that report, the Dispatch quoted the state and federal crop reporting service as saying that "all of Minnesota's principal crops except flax and winter wheat promise substantially larger yields this year than last, the corn crop leading the parade with an indicated increase of fifty percent over 1931". It was pointed out, however, that hopes for a bumper crop, a bumper wheat crop especially, had been "somewhat dimmed" by reports of "heavy winds" at the end of June, by joint worm infestations and, of course, by reports of grasshopper damage. Similar reports appeared in the 22 and 31 July editions of the Minneapolis Tribune. The first of the two quoted H. L. Webster, dean of agriculture at the North Dakota Agricultural College as contending that the summer's heat toll on North Dakota crops was "light" and "spotted" and that reports of crop losses had been "highly exaggerated". The second of the two stories stated that "optimistic reports continue to trickle in from all sections of the northwest as harvest continues. Crop reports from the Northfield area are unusually bright. Some flax is being cut while somewhat green to keep it from being further damaged by grasshoppers...". And, on 12 July 1932, the Tribune reported that the United States Department of Agriculture (USDA) had predicted a bumper U.S. corn crop (438,850,000 bushels greater than in 1931) while anticipating wheat yields lower than those harvested in 1931. Finally, on 30 December 1932, the Brown County [New Ulm] Journal summed up the 1932 crop situation, stating that "the 1932 season resulted in a total production of principal crops approximately 34 percent larger than the low production of 1931. Except for the dry area in north central Minnesota, comprising about eight counties, practically all sections of the state have a very ample supply of feed. This is in contrast to last year's situation when practically all sections experienced a feed shortage".

But even if it was somewhat less extreme than other summers of the 1930's, the summer of 1932 produced several episodes of abnormally hot weather and extended periods of rain free, cloudless weather (e.g. eighty percent of possible sunshine recorded at the St. Paul Weather Bureau station during July 1932). The first notably dry period of the season occurred in mid-April, some stations (e.g. Minneapolis and St. Paul) recording little or no precipitation during the period, 7-22 April. Rains returned at the end of April and persisted

through much of May with totals of three inches common during the period, 23 April-9 May. Although scattered showers were common during the closing days of May and throughout June, most Minnesota stations recorded less than normal amounts of late spring and early summer precipitation. Locally heavy rains fell during early July (e.g. 2.57 inches at Maple Plain on 3 July), prompting the 4 July 1932 edition of the Minneapolis Tribune to note that "farmers welcomed the rains that fell in many parts of the state. Crops were generally in good condition before the rain, but added rain insured sufficient moisture to make up deficiencies in most areas. Pastures in some sections were drying out and rain will bring them back to life and benefit corn and potato crops". July, however, remained relatively dry, the lack of moisture exacerbated by a heat wave which, according to newspaper accounts "engulfed much of the nation" from 12-21 July. On 16 July, the St. Paul Dispatch reported, for example, that nearly fifty deaths had been attributed to the nationwide heat wave. And, as early as 13 July, the Minneapolis Tribune reported, prematurely as it turned out, that July's first heat wave which had caused five heat prostrations in the city -- had been broken by light rains (0.01 inches at the Minneapolis Weather Bureau station). A week long series of bad news followed: on 15 July, the Tribune reported two heat related deaths, noting that the heat had set "new high marks in the northwest"; on 16 July, it reported forty heat related deaths nationwide; on 18 July, Tribune headlines told readers that the "heat wave blanketed the entire northwest," a "scorching" sun keeping the mercury up in the 90's; on 19 July, the newspaper promised relief from the heat while noting that the "whole northwest continued to swelter," the mercury reaching 105 F at Aberdeen, South Dakota. And, on 20 July -- the hottest day (101 F at Minneapolis) of the heat wave and the end of a nine day period with Minneapolis station maxima of 90 F or higher -- the Tribune reported four more local heat related deaths. It was further noted that thundershowers had "failed to materialize" and that the "haze of light clouds which hung over the city most of the day on Tuesday [19 July] were no obstacle to the sun's rays".

Heat and drought notwithstanding, July 1932 spawned several severe weather events, the most notable of which was a tornado outbreak on 27 July. According the 28 July 1932 edition of the Minneapolis Tribune, one tornado "devastated a fifteen mile stretch" near Dassel, Minnesota, killing one person and injuring at least twenty seven others. The storm, which was accompanied by hail, developed at about 1800 hours, producing a funnel which remained on the ground for about one-half hour. Witnesses described the storm "as a dark cloud hanging low in the sky". A second tornado touched down in Brown and Watonwan counties on the same afternoon, injuring several persons and causing property damage in the amount of about \$500,000.

Earlier, on 10 July 1932, the Tribune reported another severe weather outbreak which, like the 27 July outbreak, produced several tornadoes. This storm was said to have followed a day of high humidity, sweeping through sections of the northwest late Saturday afternoon [9 July], "bringing heavy downpours of rain and killing one person". The Minneapolis Weather Bureau station recorded 1.43 inches of rain on 9 July, an amount sufficient to wash paving blocks out of the streets in portions of Minneapolis. The worst damage, however, occurred when a tornado touched down in the Sioux Falls, South Dakota area, killing one person and injuring twenty two others. A tornado was also reported near Comfrey in Brown county Minnesota. Interestingly, also, the 10 July edition of the Tribune reported one of

the earliest harvests on record, stating that farmers in the Minneapolis vicinity had begun threshing their small grain crop seven to ten days earlier than usual. The crop, it was said (perhaps with some exaggeration), was "one of the finest in Minnesota history". And, on 21 July, a Tribune banner headline announced that wind and rains had broken July's oppressive nine day heat wave. "High winds resulting from high pressure pushing into low pressure" had produced scattered rains (e.g. 1.87 inches at Grand Rapids; 1.30 inches at Bird Island but only 0.21 inches in Minneapolis). According to the Tribune account, the rain was preceded by "black clouds which gathered rapidly" and by high winds which "swept open places". Temperatures, it was approvingly reported, had fallen sixteen degrees in an hour.

Although much of August 1932 was dry, general rains at the beginning and again at the end of the month were sufficient to boost precipitation values to a level near the then accepted statewide August normal. The last ten days of the month, in fact, brought heavy to excessive rains in some areas (e.g. 3.00 inches at Mankato on 25 August; 6.55 inches at Taylors Falls, 24-26 August; 2.88 inches at Crookston, 24 August; 3.45 inches at Grand Rapids, 24-26 August; and 3.70 inches at Pokegama Falls, 23-26 August). A few favored locations also recorded heavy rains at mid-month (e.g. Faribault, 2.45 inches on 16 August). With the exception of November, the autumn months of 1932 were, as noted previously, cool and dry. Heavy to excessive precipitation was recorded in some areas in early November (e.g. 3.88 inches at Two Harbors, 8-9 November; 5.29 inches at Pine River Dam, 8-10 November; and 2.90 inches at Reeds, 8-9 November). The six weeks from mid-November until the end of the year were, in contrast, notably dry, marking the beginning of a trend which, with a few breaks, persisted until late in the summer of 1934. Early December, also as previously noted, was extremely cold with temperatures of -20 F or lower common at most Minnesota stations during the period, 7-16 December. Some of the lowest minima recorded during this period included -22 F at Morris on 15 December; -22 F at Zumbrota on 16 December; -23 F at St. Peter on 16 December; -25 F at Farmington on 16 December; -25 F at Cambridge on 26 December; -24 F at Maple Plain on 16 December; and, the coldest of the month, -38 F at Big Falls on 8 December. And, at New Ulm where the month's low was a comparatively moderate -16 F, the Brown County Journal (23 December) noted that "last week was one of the coldest December weeks on record". The Journal also welcomed the more moderate weather which prevailed over much of the state during the last two weeks of December, commenting that the "frigid blast which blew over the northwest last week dissipated Saturday [17 December] when the mercury showed signs of thawing out".

Finally, it is important to recall that, in addition to its generally unfavorable weather and its hordes of grasshoppers, 1932 was, on the whole, the most economically depressed year in a series of depressed years which prevailed from 1930 until 1939. Gloomy weather stories, consequently, were typically accompanied by gloomy economic reports which focused public attention on topics such as high unemployment, relief efforts and economic malaise generally (e.g. the 24 July 1932 edition of the Minneapolis Tribune noted that a federal relief grant of approximately \$3.4 million had made it possible to provide "road jobs" for an additional 7,000 Minnesota workers, raising the total number of men employed in such work to 21,500. The relief bill which provided work for the additional workers had been signed

by President Herbert Hoover on 21 July). And, although the inauguration of Franklin D. Roosevelt on 20 March 1933 marked the beginning of a halting and anemic economic recovery of sorts, the United States, as in 1932, remained economically distressed throughout much of 1933. Moreover, a few brief periods of wet weather notwithstanding, Upper Midwest drought conditions intensified, dashing any hopes for a timely return to normal weather conditions and setting the stage for the disastrous spring and summer of 1934. This is not to say, however, that 1933's weather is of interest only in relation to what followed: 1933, rather, brought as much adverse and perversely interesting weather as any other year of the 1930's. The weather of 1933, then, is to be seen, not only as a prelude to disaster but as a monumental disaster in of itself.

THE 1930'S
1933: A DISASTER?
A PRELUDE TO DISASTER? OR BOTH?

Although 1933, like the first three years of the 1930's, featured intense and widespread drought and heat, it was the year that, in addition, marked the onset of the severe,

suffocating dust storms (often colloquially called "dusters" or "black blizzards") which were to plague much of the nation during the remainder of the decade. Small and apparently isolated dust storms had, of course, occurred during the earlier years of the decade, particularly in 1932. It was in 1933, however, that the "dusters" became disconcertingly frequent and widespread, inaugurating what has now entered American folklore as the Dust Bowl era. According to the January 1933 edition of the U.S. Weather Bureau's Monthly Weather Review, one of the first 1933 dust events occurred in sections of Illinois, Indiana and Michigan on 22 January 1933. This storm which was said to have begun and ended abruptly -- reduced visibility to one mile at some locations. On 23 January, the Canadian press reported that about an inch of "grayish-yellow" snow fell in Chicoutimi, Quebec. The dust "presumably" was caught up in the dry southeastern sector of a low pressure system centered in middle Kansas on 21 January. The January 1933 Weather Review also noted that a severe dust storm had struck parts of Wyoming. Gale force winds, it was stated, had driven small particles of soil, consisting largely of decomposed granite, carrying them "to great heights". Larger particles, up to the size of walnuts had been sent bouncing along the ground, causing large [live]stock...to stampede to shelter. The soil in many plowed fields, in cases a foot deep, "was removed to the gravel". "Large windrows of sand were formed and many ditches filled". Still another -- but apparently less destructive -- storm, described by Weather Bureau commentators as "unusual for Texas" swirled over portions of the Southwest on 24-25 March 1933. Fueled by white colored dust borne aloft by a low pressure system which formed in Nevada, the storm disrupted or endangered air travel, one "experienced" pilot stating that he had been "baffled" by what he termed "mysterious white dust."

The January and March events, however, were but a prelude to a dusty spring, summer and autumn, the latter season producing one of the 1930's most extensive and noteworthy dust events. According to the February 1935 edition of the Monthly Weather Review, this storm, which occurred on 12-13 November 1933, covered much of the United States, reaching from Nebraska to Georgia and New York. By midday on 12 November winds of 45 to 63 miles per hour raged over wide areas of the Great Plains, stretching from the Badlands of South Dakota and the sand hills of Nebraska to Iowa and Minnesota. The strength of the wind was said to have been so great as to whirl gravel and pebbles from country roads and other exposed areas. Fall plowed fields were "marked by clouds of drifting soil" and an airline pilot leaving Omaha found the top of the dust at 9,000 feet. At some ground locations it was said that objects "fifty to 100 feet away could not be seen." The dust cloud was carried in a generally southeasterly direction but with much "spreading toward the east and the south". On 13 November, Mercer, Pennsylvania observers reported visibility of one mile while in Rochester, New York, housewives complained of dust accumulations on "Monday wash hung out to dry".

As noted previously, Minnesota did not escape the ravages of the 12-13 November storm. Also, as noted, the storm was preceded by a few unusually warm late autumn days, temperatures at the Minneapolis Weather Bureau station reaching 78 F on 31 October and 77 F on 1 November 1933. Taking cognizance of the late season warmth, the 1 November edition of the Minneapolis Tribune approvingly noted that "a new one was added to the list of records of unusual weather Tuesday, with the highest temperature ever recorded in

Minneapolis on the last day of October". One St. Paul resident, it added, claimed that a "number of dandelions made their appearance on his lawn". But on 2 November, a jocund Tribune writer chided "the fellow who neglected to put on his storm windows during the brief three day fling at Indian summer was wondering Wednesday night if he were so smart after all. After a record November reading...the mercury tumbled rapidly toward the freezing mark Wednesday night. A chill rain had driven the mercury down to 63 at 7 p.m., to 50 at 8 p.m. and 44 at 11 p.m.".

Nor did temperatures recover in the days following the record setting late fall warmth: most Minnesota stations experienced an unpleasant mix of generally subnormal temperatures and light to moderate amounts of precipitation during the ten day period, 2-12 November. The 12-13 November event was, however, more than unpleasant: it was, rather, one of the most destructive and thoroughly disagreeable storms of its type ever experienced in Minnesota. According to the 13 November 1933 edition of the Minneapolis Tribune, the "wintery storm hammered the northwest Sunday," leaving behind a "trail of damage and death that covered more than six states". "Some sections were pelted by rain, sleet and snow driven by northwest winds of strong gale velocity. Others where fields were bare and dry were darkened by thick clouds of dust that made day seem like night. Winds up to sixty miles per hour were reported in some areas.." Twelve deaths, it was said, were attributed to the storm. In Minneapolis specifically, the strong winds broke windows and toppled power poles, trees and chimneys. According to the Tribune account, Minneapolis Weather Bureau officials described the storm as freakish "almost without precedent", reporting that throughout the entire day (13 November) the barometer "bobbed up and down". Precipitation was also varied and intermittent: at 1112 hours rain started, only to end twenty six minutes later. At 1340 hours, the storm "drove a mixture of snow, rain and sleet across the city" and, at about 1500 hours, the precipitation turned over to what was described as a "stinging snow". Newspaper accounts of the storm also noted that trees were blown down "in all parts of the city" and that the wall of a building at Washington and 8th Avenue North had collapsed under the force of the high winds. The Tribune story further stated that at Windom and Pipestone in Minnesota and at Huron and Vermillion in South Dakota, "the dust was so thick that artificial lights were necessary in the day time. At Fairmont [Minnesota] the dust filled the air and a fifty mile per hour wind broke up the ice on the lakes in the vicinity." Where there was no rain or snow, the strong winds, it was also noted, blew up "huge dust clouds" which swept over the country as far west as Wyoming and north into Canada. In St. Paul, the 13 November 1933 St. Paul Dispatch reported that part of the roof was ripped from the remodeled wing of the old state Capitol Building. The Dispatch further reported that "sections of the Dakotas were blackened Sunday [12 November] by clouds of dust and at Luverne [Minnesota] it was pitch black at midday". Winds, it was stated, had reached seventy miles per hour at Valley City, North Dakota and at Bismarck, North Dakota, winds velocities of 118 miles per hour were recorded at a height of 1,500 feet. Predictably, an autumn (early winter?) storm of such intensity was followed by a cold wave which, as noted previously, pushed temperatures below zero throughout Minnesota on the morning of 16 November. Representative readings included -27 F at Big Falls; -24 F at Angus; -20 F at Roseau; -23 F at Warroad; -7 F at Morris; -2 F at the Minneapolis Weather Bureau station; -9 F at Chaska; -10 F at Maple Plain; and -5 F at Zumbrota. Although the cold soon moderated, giving way to several weeks of generally

above normal late November temperatures, December 1933, in contrast, was frigid. Temperatures during the latter part of the month were, in fact, almost as extreme as those experienced during 1933's early February cold wave, an event which, as previously pointed out, was reminiscent of the Great Cold Wave of February 1899. Readings at most Minnesota stations dropped well below zero on most days during the 1933 Christmas-New Year's week, the lowest reading of -51 F (Big Falls on 28 December) rivaling the -55 F minimum recorded at Warroad on 8 February. Some of the more noteworthy late December minima included -41 F at Argyle; -38 F at Mizpah; -40 F at Detroit Lakes; -30 F at Rochester; -38 F at Crookston; -29 F at Chaska; and -28 F at Maple Plain. Among other reactions to the unusual cold was the Brown County Journal's comments on 29 December: "Old Boreas chilled the northwest with chilling blasts and blanketed the whole area with a white mantle for Christmas. It was thought to be the coldest Christmas Day for many years. The tail end of a snowstorm which struck the northwest visited this section...Saturday night. The white commenced to fall about ten o'clock and shortly after midnight any icy wind blew out of the north. Although the snowfall was light, the cold was intense. In northern Minnesota, the snowfall was over a foot in some places..."

Yet, as suggested earlier, 1933 is not remembered because of its extreme winter cold nor even because of the 12-13 November gale. It is remembered, rather, because of the prolonged and widespread periods of heat and drought which ravaged much of the nation's agricultural sector, causing extensive human suffering and, of course, further damaging an already precarious economy. In Minnesota, field crops, gardens and pastures were scorched by one of the sunniest, driest and warmest summers of record, ample evidence of which is provided by the many gloomy, sometimes despairing articles which appeared in various state newspapers. On 28 June 1933, for example, the Marshall Messenger (Lyon county) dramatically stated that "relentless heat" had continued to "torture" northwest farmers "as they watched small grain crops succumb before the withering blast". Although the damage, it was said, threatened to "encompass corn and potatoes," the major threat was to the area's small grains: "the major devastation to small grains which has prevailed for at least a week in western Minnesota and parts of South Dakota has spread to southern Minnesota where the heavier soil protected the crops during the early stages of the heat wave. Grasshoppers added to the peril in North Dakota and South Dakota but Minnesota, mainly because of protective measures, has not been seriously affected. Lack of pasturage has bothered farmers throughout the northwest as grass plots and ranges dried rapidly." On the same date (28 June), a Minneapolis Star headline proclaimed: "heat retains hold on city as sun shrinks grains." Searing heat, it was explained, had continued to "bake" Minneapolis and most of Minnesota. At least three heat prostration deaths were reported in the city and Andrew Boss, state agronomist, was quoted as saying that the state's crop outlook, already not very good, was "getting worse". This somber view of things was preceded by a 25 June Star article which, referring to a recent report released by Cargill Corporation, said that crops in western Minnesota had "deteriorated badly" and that one half of the normal crop was endangered. Rains, it also stated, were needed in Montana, along the Canadian border and in North Dakota, conditions in the southern half of that state having become "critical". And on 20 June, the Star reported that "crop damage running into hundreds of thousands of dollars" had been reported in the northwest, the result of persistent heat and drought. In the northwest part of LacQuiParle county, farmers, it was said, were plowing under their small

grains. And, still earlier (8 June), a Star banner headline told readers that the sweltering Midwest heat had directly or indirectly contributed to the deaths of at least fifty people. The same article pointed to "acute suffering in farming regions where farmers worked against time to get belated crops in". And, in Youngstown, Ohio, more than thirty five workers had been hospitalized after being overcome by the heat in the steel mills in that city. On 6 June, the Star noted that temperatures had reached 117 F at Kiosk, Kansas and that, in Minneapolis, two persons had been overcome by the heat.

In St. Paul, the 6 June 1933 St. Paul Dispatch reported that "...the reign of heat that has smothered the prairie states....scored a maximum of 93 degrees [here] at 6 p.m. on Monday [5 June]....Thousands of persons thronged the beaches and refreshment gardens...". The same report indicated that temperatures had reached 99 F at Pipestone on 5 June, a reading which, however, was considered "cool compared to the plains of Kansas....". And although significant rains fell in portions of western Minnesota on 4-5 June (e.g. 1.04 inches at Mankato and 0.97 inches at Redwood Falls), the heat, and the accompanying extreme drought, it was emphasized, continued unabated. St. Paul temperatures reached 96 F on 10 June and, following a brief return to normal June readings, the city sweltered under a renewed heat wave which persisted for five days, pushing temperatures to 98 F on 16 June and again on 19 June. But, as in most other areas of the state (and the Midwest), the worst came during the last ten days of the month. St. Paul maxima exceeded 90 F or higher every day from 24 through 30 June, reaching highs of 98 F, 99 F and 98 F, respectively, on 26, 27, 28 June. Nighttime temperatures were equally oppressive, St. Paul's overnight low on 29 June a sweltering 79 F. And on 1 July 1933, the St. Paul Weather Bureau office pointed out probably surprising no one -- that June 1933 temperatures had averaged 78 F, surpassing any previous June average recorded in the Twin Cities since 1819 (when records were first kept at Ft. Snelling). The Weather Bureau also pointed out that June 1933, which had produced a record number (16) of 90 F days was also the fourth driest June ever recorded in St. Paul. Finally, on 29 June, the Marshall County Messenger (Argyle) suggested impending disaster, stating that "with only 0.16 inches of rainfall the past week, crops, badly scorched by the heat wave of the previous week are showing the effects of drought and damage to the fields is growing more serious as the days pass without rainfall". "Reports of widespread damage from heat and drought has sent grain prices soaring, wheat going for \$1.01 on the Minneapolis market Tuesday."

Despite their often overly colorful (perhaps even lurid) prose, the newspaper accounts of June 1933's weather were essentially accurate, providing historically valuable, even if sometimes fragmented, documentation of the unprecedented and widespread heat wave which began in early June 1933, and with but one short break (12-14 June), persisted until the end of the month. Temperatures in the 90's F were recorded at many Minnesota stations during the first ten days of the month, reaching 100 F, 103 F and 106 F, respectively, at New Ulm, Fairmont and Pipestone on 6 June. As noted, the worst of the heat, however, occurred during the last two weeks of the month: New Ulm, for example, recorded maxima of 99 F, 103 F, 101 F, 101 F, 102 F, 103 F, 98 F, 101 F, 101 F and 97 F, respectively, on 15, 16, 17, 18, 19, 20, 25, 26, 27, 28 June. Even far northern Argyle recorded 103 F on 18 June, a reading which, interestingly, followed a chilly minimum of 36 F on 13 June. Other Midwest states suffered as well: June readings of 108 F and 113 F were reported,

respectively, at Winfield and Phillipsburg, Kansas. Moreover, various Dispatch headlines told readers about "withering crops," "blistering sun and hot winds," the most distressing of which appeared on 24 June: "Crops Wither, Animals Die, Dust Covered Fields In Drought Wilted Southwest". Similar comments appeared in the 23 June edition of the Brown County Journal (New Ulm): "New Ulm was the hottest spot in Minnesota during the recent heat wave. The thermometer shot up to 103 degrees on Friday and on Tuesday during the third heat wave of the present season. Hot winds continued until late Tuesday afternoon when cooling breezes and local showers dissipated the heat. Five days in which the maximum temperature was above 100 degrees caused buildings to become [over] heated. The precipitation which fell Tuesday evening was most welcome.....as the ground was parched by the continued heat..Small grains in this vicinity growing on high ground were damaged somewhat. The rain of May was sufficient for the alfalfa and hay crop. The torrid spell was unprecedented for June...". And, in one of the more laconic comments to be found in Minnesota newspapers during the summer of 1933, the 22 June 1933 edition of the New London Times noted that "the dust is getting to be a nuisance, especially in business places".

To make matters worse, the drought and heat, although somewhat less intense, persisted through July and early August 1933. Readings above 100 F occurred periodically during July, particularly in west central Minnesota locations. Maxima of 103 F, 99 F, 102 F and 106 F, respectively, were recorded at Morris on 27, 28, 29 and 30 July. At Beardsley, in far western Minnesota, the heat was even more intense: readings of 106 F, 106 F, 100 F, 106 F, 104 F and 100 F, respectively, were recorded on 25, 26, 27, 28, 29 and 30 July. Predictably, conditions such as these provoked a great deal of journalistic comment, much of it focused on crop prospects, commodities prices and the environmental impacts of the continuing hot, dry weather. One of the first such articles appeared in late June 1933 when a Minneapolis Star banner headlines announced: Wheat Highest In 32 Months: All Grains Climb (24 June); Wheat Spurts Eight Cents (26 June); and Cash Wheat Here Hits \$1.03 (27 June). Such increases, obviously, reflected fears of a general crop failure or, more accurately, what the 29 June 1933 edition of the Star called prospects for the "smallest crop in a generation". Traders it was said, "took full cognizance of the fact that production will be below estimated consumption". In a somewhat more optimistic, if contradictory, vein the 29 June Star stated that wheat prices had "slipped downward fractionally" on the Minneapolis market, a drop which, it was alleged, reflected reports of recent rains in many parts of the northwest.

It was more of the same in July 1933. The 6 July edition of the New London Times asserted that "crop prospects in this vicinity are not as good as we would like. But they are not a complete failure". In its 14 July edition, the Brown County Journal reported that harvesting in the New Ulm area had begun a "week or more" earlier than usual. Some of the winter grain on "normal" ground, it was pointed out, "had already been cut in June" and that hay had been "driven by intense June heat to abnormal maturity". "Heat damage to grain crops can roughly be put at a one third loss compared with normal years". A late July rain event (1.48 inches on 23 July), however, prompted a 28 July banner headline proclaiming a "Million Dollar Rain". According to the Journal story which followed "the long looked for precipitation came Saturday evening. The downpour started shortly before six o'clock and

continued unabated until about two o'clock Sunday morning. This is the heaviest downpour that has visited New Ulm for weeks and came just in time to save the corn crop. The terrific heat in June matured the corn crop rapidly and the continuous heat during July was commencing to fire the stalks in many fields. Not for years has corn been this far along at this time of year. The rain during the early stages was accompanied by a high wind which damaged the corn in some sections..". Similar conditions prevailed in far northwestern Minnesota, the 6 July 1933 edition of the Marshall County Banner (Argyle) noting that "scorching heat continues: showers give little relief". "Moisture," it was emphasized, "has not been sufficient to revive the parched crops and the fields are daily showing the effects of the extreme heat and drought. Damage to crops is most serious in sections where the soil is light. Estimates have placed the crop loss as high as fifty percent". One week later (13 July), however, the Banner reported that "a rainfall of 0.99 inches last Thursday came as a life saver for the crops, reviving them from the effects of a long period of scorching heat and drought. Crops are being forced along rapidly and in ten days or two weeks early seeded fields will be ripe for harvest." A less sanguine report in the 20 July Banner suggested that the beneficial effects of the earlier rainfall were short lived: "high temperatures held out through the past week with only traces of rainfall that gave little relief to suffering crops and pastures. Crops are being forced along rapidly by the continuing heat." Consistent with its earlier predictions, the 27 July edition of the Banner reported that the area harvest had gone into "full swing at the first of the week." "Crops are very spotted and the average yield does not promise to be big. Hordes of grasshoppers are invading late sown fields and, in some localities, are doing great damage". "Low prospective yields for spring wheat, oats and barley," it was added, were due to "drought and extreme heat in the counties bordering South Dakota and as far north as Clay county. This territory and most of the west central part of the state were hardest hit, although certain areas of the south central part were also severely damaged. The Red River valley on the whole still has fair prospects as do other scattered portions of the state. Corn on the first of July gave promise of a good crop but much depends on future weather. The crop reporting board of the U.S. Department of Agriculture characterizes the first six months of 1933 as being less favorable for crop production than the corresponding portion of the crop season for the past fifty years. Estimates indicate that the wheat crop nationwide will be the smallest..since 1893."

Predictably, the Banner's drought and crop stories continued to appear during the remainder of the summer and into the autumn of 1933. On 10 August 1933, Banner readers were told that "varying crops yields" had been reported, "the early wheat running from fourteen to eighteen bushels per acre....Weather during the month of June plunged the state into subnormal precipitation for the first six months of the year. Pastures suffered along with small grains and over wide areas grazing was no longer available with farmers forced to resort to early season feed crops, stored for the coming winter months. Corn fared much better than other crops and growth was exceedingly repaid but its condition was not good, particularly on sandy soil." Then, in comments seemingly at odds with its earlier gloomy assessments, the Banner went on to assert that "the Red River district has the biggest [wheat] crop in years. Yields are as high as twenty five bushels per acre." And, on 17 August, the Banner again quoted the U.S. Department of Agriculture's crop reporting service, stating that "due to continued heat and lack of rain during July in many sections of Minnesota, the August forecast production for nearly all crops is below that of the first of

July. The area which has been most adversely affected by dry weather centered around Big Stone, LacQuiParle and Chippewa counties extending north to Clay county and south nearly to the state line. In some western counties farmers have lost all their crops and starvation of livestock is evident unless these farmers receive hay to sustain their cattle..". Three weeks later, in its 7 September edition, the Banner commented that, according to state entomologist A. G. Ruggles, the "weather conditions this year have been highly favorable to grasshoppers." Although the insects, it was said, had been "controlled in most parts of the state and little damage has been done to crops there are plenty to lay eggs to hatch next spring." In an article which repeated some of what had been reported earlier, the 21 September edition of the Banner noted that estimated Minnesota production of corn, all spring wheat, oats, barley, flax and potatoes as reported on 1 September was 297,930,00 bushels as compared to 439,651,000 bushels in 1932 and to the 1926-1930 average of 381,656,000 bushels. "In nearly all counties in west central Minnesota crops were badly damaged by the long period of hot, dry weather". In some sections, yields will be the lowest on record. Yet, in a later story (19 October), the Banner quoted the federal crop reporting service as predicting that the 1933 Minnesota corn crop would exceed the 1921-1929 average. The corn crop in south central and south eastern Minnesota was characterized as "a near record crop which offsets to a great extent the near failure in the drought area in the west central part of the state and rather poor yields in the rest of the state".

Uncertainty as to the extent and depth of the damage caused by the 1933 drought was not, however, limited to reports carried by Minnesota's out-of-state newspapers. Articles in various July 1933 editions of the Minneapolis Star were similarly ambivalent, some of which were selectively and guardedly optimistic but most of which where predictably (and accurately) pessimistic. On 1 July 1933, for example, Star headlines told readers that "Grain Prices Mount As Drought Fears Revive: Wheat Prices Score Gains Ranging Up To three Cents." And, on 5 July, the Star, in a report attributed to K. A. Kirkpatrick, Hennepin county agricultural extension agent, noted that "rains of last week were insufficient, except in very restricted local areas to be of any definite held to truck crops and small fruits in Hennepin county". The potato crop, it was also pointed out, had been "hard hit". A still more pessimistic report followed on 11 July: "spurred by the most unfavorable government crop report in forty years, wheat futures climbed three and five-eighths to four and one half cents on the Minneapolis market today". "Record small crops," it was added, had been indicated by the most recent U.S. Department of Agriculture monthly crop report, a report which was described as the "most unfavorable" issued up to that point in the 1933 growing season. Yet, on 13 July, the Star noted prospects of a "near record Minnesota corn crop" quoting "crop experts" to the effect that northwest crop conditions had improved since 1 July, creating prospects for "one of the finest stands of corn on record". The same article did, however, acknowledge that heat and drought had damaged small grains "in Minnesota and the northwest beyond recovery". But, in a hopeful, but guarded, mood, the 29 July 1933 edition of the Star, quoting a report released by the Van Dusen-Harrington company, stated that "while heat and drought have taken a heavy toll on northwest small grain crops, moderate temperatures and intermittent rains from now until maturity would assure fairly good crops in areas not already permanently damaged". "Practically no district in the entire territory has escaped the devastating effects of the extreme heat and burning winds. Large areas which under favorable weather conditions could have produced abundant crops were

unable to withstand the two weeks of almost unabated heat and drought". The same article further stated that "rain today appeared to be breaking the heat wave which has held Minneapolis and the northwest in its grip for most of June, bringing welcome relief to sweltering citizens. Precipitation ranged from showers in many parts of the district to a near cloudburst at Keokuk, Iowa where 5.88 inches of rainfall brought a long awaited relief". Interestingly, the Star story went on to note that George Balek, identified as a University of Minnesota gardener, had pointed out that 29 July was the city's thirty eighth "consecutive" day of sunshine. Finally, on 31 July, the Star reported that truck farmers in the area surrounding Minneapolis "face almost totally burned up crops because of the heat and drought". Only twenty percent of the potato crop was said to be "salable" and the tomato crop was reportedly badly blistered. The same edition also quoted a recently released Cargill Corporation crop bulletin, stating that harvest operations in western Minnesota and the Dakotas had revealed "varied crop conditions," an assessment said to have been at odds with "earlier reports" indicating that small grains had been burned out by the long drought. Grains in the Red River valley, readers were told, were "in much better condition than expected".

Yet, whatever its true magnitude, damage to agricultural interests was undoubtedly severe during the summer of 1933, a summer which produced heat and drought of an intensity exceeded or rivaled only by the summers of 1930, 1934 and 1936. Interestingly, however, weather conditions during the spring of 1933, although far from ideal, were generally thought to be more promising than not. Also, and somewhat surprisingly, 1933, its extreme and pervasive summer drought notwithstanding, was a relatively turbulent year which featured heavy, but localized, flooding spring rains and a significant number of severe summer thunderstorms. During much of spring, the Marshall County Banner (Argyle), as an example, reported generally wet conditions. On 13 April 1933, the Argyle area was said to have received four to five inches of snow which "fell all day Sunday [9 April]" and which "delayed spring farm work a full week". And, on 27 April, the Banner noted that "March [1933] was not favorable for the progress of farm work. There were some heavy snows in the southern part of the state. In many parts of the Red River Valley, particularly the northern part, it has been too wet until quite recently to do but little farm work". A lack of spring moisture was, in contrast, noted in the "central and northern portions of the state". The Banner also took cognizance of the continuing drought in the Great Plains, commenting that "much of the winter wheat acreage [in that region] was seeded under unfavorable conditions. Drought conditions prevailed throughout the winter and are still unrelieved in much of this territory [i.e. the Great Plains]. The 334 million bushels now indicated would be the smallest production of winter wheat since 1904....462 million bushels were produced in 1932...". Several weeks later (18 May), the Banner stated that, according to Paul H. Kirk, agricultural statistician for the federal-state crop reporting service, Minnesota production of fall sown winter wheat and rye was expected to be less in 1933 than in 1932. "Early spring moisture in some important wheat growing counties," it was said, "caused abandonment of about sixteen percent of acreage planted last fall".

Yet, despite contradictory, juxtaposed reports of lurking drought and excessive wetness, the Banner continued to paint a generally favorable picture of the early 1933 growing season. During the week of 25 May, the Argyle area received what was described as a

"drenching rain" [0.63 inches]. Although "it was the first moisture crops had had since seeding was done, it came just in time to save a serious setback to some crops. Pastures were making slow progress.... Low temperatures and cloudy weather has prevailed since the rainfall". Another optimistic report followed one week later (1 June), the Banner reporting that rain had fallen on four days of the past week, "the heaviest downpour coming on Monday[29 May] when 0.72 inches gave the ground a thorough soaking..". And, as late as 8 June, the Banner noted that "unusually heavy spring rains have slowed progress on paving projects underway on state trunk highways." Nor, as noted previously, were 1933's replenishing spring rains limited to the northwestern sections of the state. With some significant exceptions, most stations reported above normal spring moisture, some of which fell in March but most of which was recorded during May. An inch or more of rain fell at many stations on 7-9 May, 19-20 May, 22-24 May and again during a particularly wet period, 28-29 May. Individual daily amounts included 4.54 inches at Park Rapids on 23 May; 3.98 inches at a Minneapolis cooperative station operated by J.H. Aschenbeck on 28-29 May; 4.02 inches at Pine river Dam on 23 May; 3.50 inches at Farmington on 29 May; and 2.52 inches at Ada on 23 May.

But, although many stations recorded above normal precipitation during May 1933, a few stations most of them in east central Minnesota were extremely wet. Monthly precipitation totals at such stations as Farmington, Minneapolis and St. Paul exceeded seven inches and, in several instances, exceeded eight inches. Predictably, wet weather of this magnitude was highly newsworthy, partly, of course, because of the effects of excessive rainfall itself but mostly because like so many rainfall events of the 1930's it was seen (prematurely as it turned out) as a "drought breaker". The rains were welcomed as early as 1 May, that day's edition of the Minneapolis Star touting weekend rainstorms which, it was claimed, had relieved an April drought which had threatened gardens "in and out of the city". Even better news followed: on 8 May, the Star reported that Minneapolis had been soaked by a heavy rain which started "intermittently" on Sunday afternoon [7 May] and which by noon on Monday [8 May] had deposited two inches of badly needed moisture. The precipitation, it was emphasized, was "general" over Minnesota and the northwest. And on 13 May, the Star noted that "Old sol peeped out from beneath...[the] clouds today, saw a very wet and bedraggled Minneapolis and decided to stay out. Today was only the second day this month that the sun has shown in earnest. Not since May second has Minneapolis enjoyed a 'fair' day". Finally, as noted previously, the Twin Cities area was inundated by an excessive rainfall which began at about 1340 hours on Sunday 28 May and continued until the late afternoon of the following day. The event, described by the St. Paul Dispatch as a "drenching twenty four hour rain over the entire Midwest", produced 3.26 and 3.14 inches of rain, respectively, at the St. Paul and Minneapolis Weather Bureau stations. The downpour which was said to have extended over Kansas, Nebraska, Missouri, Iowa and much of the Dakotas -- raised local water levels "several inches" in many locales, providing what turned out to be fleeting relief from the 1933 drought. In Minneapolis, the Star (29 May) dourly noted that the rain had "dampened the spirits of Memorial Day holiday outers, washed the pavement and flooded lowlands in various parts of the city." Another report indicated that the rain had flooded part of West Calhoun Boulevard "and was running through [the] drain in Lakewood Cemetery for the first time in several years". Paving blocks, moreover, were washed out of the streets in several parts of the city. In contrast,

the 30 May edition of the Star waxed idyllic, noting that "sunshine and skies flecked with light clouds today brought [out] thousands of holiday outers, following more than twenty four hours of steady rainfall". May 1933, it was also noted, was the wettest May recorded in Minneapolis since 1908. And according to U.S. Engineer Wildurr Willing (St. Paul Dispatch, 25 May 1933), the amount of water stored in the six lakes comprising the "headwater reservoir" of the Mississippi river was 3.5 billion cubic feet greater than in May 1932, an increase attributable largely to May 1933's wet weather. .

In addition to the attention devoted to spring rains (and later to summer drought), Minnesota's newspapers also carried extensive reports of the numerous storms which ravaged portions of Minnesota and other parts of the nation during the turbulent, trying and often vexatious spring and summer of 1933. As early as 2 May, the Minneapolis Star reported that at least one hundred persons had been killed during a tornadic outbreak in four southern states, southern Arkansas and northwestern Louisiana in particular. Nor did Minnesota escape the fury of 1933's numerous storms. The 18 May 1933 edition of the Star, for example, noted that a disturbance accompanied by a "stiff wind reaching a velocity of thirty five miles per hour at times cooled the city Wednesday [17 May] which earlier in the day had sweltered [under] temperatures ranging up to 84 degrees". Severe hail storms, some of them accompanied by funnel clouds, struck portions of Steele, McLeod, Meeker and Kandiyohi counties on 17-18 May, causing considerable damage. A more significant event on 22-24 May produced tornadoes which reportedly killed sixteen persons and injured several hundred others in Kansas and Nebraska. This storm, appropriately described as "death dealing," struck from behind a column of sand and dust and caused millions of dollars in damage. In Minnesota, winds were said to have reached "tornadic proportions" in the Rush City vicinity. Moreover, the 24 May edition of the Star described a storm which "picked up tons of fine dust" from fields in southwest Minnesota. Driven by a "steady" twenty eight mile per hour wind, the dust, as depicted by the Star, "caused Minneapolis housewives to begin anew their spring cleaning.....the dust was so fine that it penetrated window sashes and closed buildings, "depositing a thin film of Minnesota soil on furniture, rugs, clothing, food, in offices and in automobiles. When the wind slackened, the sun shone with full strength after being obscured by sand and dust. Drivers were blinded by stinging dust particles, causing a collision at Fairmont, injuring two. Rain and hail damaged crops, flooded basements and smashed windows along a sixty mile front between Brainerd and Walker. Hail was piled up two feet deep in some places..". In a parallel account, the St. Paul Dispatch (23 May) told its readers that buildings and telephone lines had been damaged by a "severe wind and rain storm" in the Rush City vicinity. Other storms were reported to have struck southern Minnesota and central Wisconsin on 23 May ("...many barns and farm structures were razed, trees and telephone poles blown down...by a raging" wind and dust storm). However, despite a "day of threatening clouds", the storm was said to have "bypassed" the St. Paul area.

Nor did the severe weather end with the 23-24 May event: on 25 May, the St. Paul Dispatch reported that "cloudbursts" in the Brainerd, Detroit Lakes and Duluth areas had caused "washouts on some trunk highways" and, on 5 June, the Minneapolis Star stated that hail, rain and wind had damaged crops in Big Stone county (while Minneapolis "sweltered in high humidity and high temperatures with little relief in sight"). On the same day (5 June),

the Marshall Messenger highlighted a "terrific wind storm" which, it said, wrecked many barns and blew down "scores of trees" in portions of Lyon county. And, on 7 June, the Messenger claimed that twenty persons had been injured by a tornado which struck the Worthington vicinity. Finally, on 8 June, the Messenger described a "freak storm which swept over Lyon and neighboring counties last night". According to the report, the storm "left a blanket of dust in every home but did not do serious damage. The great cloud of dirt boiled up at 7:30 p.m. The gale of wind with its dirt cloud several hundred feet high struck Marshall..Utter calm prevailed just before the great bank of dust swirled up almost straight out of the south. There was a momentary breeze and a few seconds later, the cloud of dirt rolled into town on a terrific wind. For a good fifteen minutes, the cloud swept by. In another hour rain was falling..."

However, apart from storms such as these, June 1933, consistent with the extreme heat and drought which prevailed throughout the month, seems to have produced little turbulent weather. A trend toward wetter conditions, albeit temporary, became evident during the closing days of June: heavy rains (e.g. 1.47 inches at Ada on 29 June) were recorded at some northern stations on 28-29 June and severe thunderstorms pushed into extreme southwestern Minnesota on 30 June. The wetter, stormier trend became more pronounced during the next several weeks, bringing a round of severe storms which swept over much of southern Minnesota during early July. Two inches of rain was reported at Albert Lea on 2 July and, according to the 7 July edition of the Brown County Journal (New Ulm), a "devastating" storm "visited the southern part of the state on Friday and Saturday evening [30 June-1 July]". These storms, said to have swept across the southern part of the state from west to east, caused "many thousands of dollars damage to buildings and growing crops. It is estimated that one hundred barns and other buildings were wrecked by the storm in Martin county alone. Thousands of trees were uprooted and blown down...". Two days later (9 July), the Journal reported that "a windstorm accompanied by heavy rain" had hit the New Ulm area, causing "considerable damage to trees, telephone lines and cables and, in a few instances, to buildings". The same story also noted, incidentally, that abundant precipitation in May had helped to maintain adequate lake and stream levels in south central Minnesota. "Rivers and stream in this part of the state as well as lakes and ponds have showed a marked increase. The Minnesota and Cottonwood rivers are higher than they have been for several years. The thermometer registered 100 degrees on Tuesday. This was a sultry day".

July's first round of storms was followed by a second outbreak which brought heavy and sometimes damaging rains to northern and eastern Minnesota on 8-10 July. On 10 July, a Minneapolis Star headline proclaimed that the rains had proved a "boon to farmers". According to the story that followed, heavy rains had fallen "from Duluth to Red Wing" with rainfall of "near cloudburst" proportions reported in St. Paul. The latter, it was emphasized, had doused the city with 1.9 inches of rain in less than two hours, "flooding basements, halting traffic, stranding automobiles, backing up sewers and tearing up wood block pavement". Four feet of water, it was claimed, had accumulated under the Milwaukee railroad viaduct at Marshall and Snelling Avenues. In its account of the same event, the St. Paul Dispatch reported that 1.75 inches of rain had fallen in less than an hour during the afternoon of 10 July. "Streetcars were halted by debris at Marshall and Snelling...and heavy

mud washed from the banks lining the road made traffic dangerous for a time on T. H. 1 between St. Paul and White Bear Lake...". Basements were said to have been flooded to a depth of three feet in some parts of the city. A second thunderstorm on 11 July brought another 1.1 inches to the St. Paul area, bringing the city's early July rainfall total to three inches. Other rainfall amounts recorded during the 9-11 July outbreak included 2.25 inches at Collegeville and 3.68 inches at Farmington.

Despite the damage which they caused, the early July storms were highly beneficial, bringing what the 10 July Minneapolis Star described as the first rain of consequence in nearly three weeks. Parched areas of North Dakota also received significant rainfall, including a total of 2.10 inches at Max, North Dakota on 9 July. Still another round of thunderstorms brought significant amounts of moisture to many Minnesota communities on 22-24 July. Rainfall amounts reached or exceeded two inches at some locations on those dates, including 3.30 inches at Alborn in St. Louis county; 2.90 inches at Fairmont; 2.33 inches at Grand Marais; 2.05 inches at Rochester; and 2.00 inches at New London. The Minneapolis Star also reported that parts of Lyon and Redwood counties reported "a lashing hail and wind storm [which] flattened barns and crops and killed livestock" on 24 July. Heavy rainfall, it was said, had accompanied this storm, probably the last significant storm event to occur in Minnesota during the remainder of the summer: with a few exceptions the remainder of July and most of August 1933 were dry and quiet. And although some Minnesota stations recorded an inch or more of rain on 15-16 August (e.g. Little Falls, 1.80 inches on 15 August) and again on 23-24 August (e.g. 1.83 inches at Pipestone on 23 August), August 1933 was, like June, an exceptionally dry month. Heavy rains returned to some areas of the state in September, some of which were intense enough to trigger damaging local flooding (e.g. 3.70 inches and 2.52 inches, respectively, at Worthington and Pipestone on 1-2 September). September, however, produced no notably severe storms and, ominously, many areas in west central Minnesota remained abnormally dry during the entire month (e.g. Campbell, 0.45 inches).

Predictably, 1933's generally perverse weather added to the distress and anxiety felt by many in the economically depressed agricultural community, whether in Minnesota or in the other states of the Great Plains and Upper Midwest. The weather, of course, cut crop yields in many areas, reducing farm income and forcing many farmers to seek help through various government and private relief programs. Drought related losses also made it difficult sometimes impossible to store or otherwise obtain seed grain for the ensuing growing season and to provide the food and forage required for the wintering of livestock. The impending shortage of food for farm animals, hay especially, was noted as early as July, the Milan Standard (21 July edition) noting that hay grown on state owned lands was being offered "free" to stricken farmers and would be transported by the railroads from its point of origin at one-third the regular rate. Similarly, the 3 August edition of the Marshall County Banner (Argyle) reported that "thousands of tons of hay will be cut on tax delinquent and state owned lands in northern Minnesota and sold to drought stricken farmers at prices far below market value". And, on 4 August, the Standard reported that the impending lack of animal food was forcing Milan area farmers "to dispose of their livestock before it is ready for market". Many more, it was added, "may be forced to reduce dairy herds before next spring". Two weeks later (18 August), the Standard stated that the Minnesota state

executive council had appropriated \$60,000 for drought relief, "mostly to cut and bale hay. Purpose of these relief efforts, it was said, was to help farmers "carry on who otherwise would have to give up..". The Standard also noted that the Minnesota highway department had joined in the state's efforts to provide income for distressed farmers: "[The] Minnesota emergency highway program is being so planned as to provide jobs for men and teams [of horses] instead of machines within reasonable limits. Particularly in counties where crops have been destroyed by drought or seriously damaged the highway department will endeavor to let contracts as to give work to teams and drivers". The 17 August edition of the Marshall County Banner indicated, moreover, that some state funds were used to pay farmers \$7 per ton probably as a shipping cost reimbursement for hay cut on state lands "and delivered to the nearest railroad station". There were, however, apparent limits to the state's willingness and/or ability to provide for distressed farmers; On 10 November 1933, for example, the Standard glumly reported that the state drought relief fund was "near exhaustion" and that no more feed or hay could be provided "until more money is appropriated". The aid already provided had, it was claimed, aided 10,000 drought stricken Minnesota farmers, a claim at least partially corroborated by the 2 November edition of the Marshall County Banner : " 5,740 tons of hay cut in northern counties have been transported to drought stricken areas at a cost of \$40,000 to the state. Counties receiving hay are Chippewa, LacQuiParle, Yellow Medicine, Swift, Big Stone, Traverse, Douglas, Stevens, Wright and Sherburne". Fortunately additional aid was eventually provided, the 22 December 1933 edition of the Standard noting that two carloads of hay had been distributed to Milan area farmers on 18-19 December and that two additional carloads had arrived on 21 December. These shipments were especially timely for, as the Standard succinctly put it, "many farmers were entirely out of feed". However, despite these and other relief efforts, many Minnesota farmers were apparently hard pressed to provide winter feed for their livestock. On 26 October, for example, the Banner, announced the onset of winter (with two inches of snow at Argyle and twelve inches at Duluth) "throughout the northern section," emphasizing that "straw must be relied on in Minnesota this winter more than usual as feed for livestock because of the shortage of both feed grain and tame hay".

Inevitably, the hardships arising from the drought of 1933 provoked protests, anger, discontent and sometimes open rebellion in the Minnesota farming community. One of the earliest responses to agricultural unrest was a well-intentioned but, as it turned out, counter productive, attempt to shore up commodity prices by limiting production. In this regard, the 7 July 1933, the Milan Standard reported that agricultural leaders from Minnesota, South Dakota, North Dakota, Montana were scheduled to meet in Fargo (North Dakota) "to consider problems in relation to wheat in the federal farm adjustment program. At conferences already held farm leaders have urged that some method be adopted whereby farmers in counties which grow comparatively little wheat can organize on a economical basis such as will make it worth their while to come in under...a program ...offering farmers adjustment payments sufficient to bring the buying powers of their 1933, 1934 and 1935 crops...domestically consumed as human food up to the pre-war [World War I] level in return for an agreement to reduce acreage in 1934 and 1935 by twenty percent or less of their average past production...". Detailed accounts of the federal programs which prompted the Fargo meeting appeared from time to time in 1933 newspapers such as the Marshall County Banner which, on 7 July 1933, informed its readers that the "Marshall

county allotment for wheat for 1934 under the AAA [Agricultural Adjustment Act] will be approximately 654,608 bushels. This means that if wheat growers in the county cooperate in full by contracting to reduce their production for 1934 and 1935, they will receive [payments of] approximately \$98,191 for 1933. The allotment in bushels is arrived at by reducing by twenty percent the average annual production". In a similar story, the 10 November 1933 Brown County Journal informed its readers that a "new corn-hog adjustment plan" was being put into effect by the AAA. Corn acreage, it was said, was to be reduced "at least" twenty percent and hog farrowing and hog marketing by at least twenty five percent in 1934: "Each farmer who agrees to reduce corn acreage and hog farrowing will accordingly receive benefit payments of thirty cents a bushel for corn he does not grow. Adjustment payments on hogs of \$5 per head [will be paid] for reduced hog production".

Production cutback payments, however, were not immediately sufficient to quell farm unrest, examples of which continued to be reported by Minnesota's 1933 newspapers. The 27 October 1933 edition of the Milan Standard noted, as a case in point, that "a general farm strike" had been "called by the Farmers' Holiday Association for the purpose of enforcing its demands for cost of production for what the farmer has to sell to stop foreclosure of farm homes". The strike, it was said, went into effect at noon last Saturday [21 October]. And, on 17 November 1933, the Standard announced that a "mass meeting" was to be held in Montevideo "to discuss federal drought relief in order to save Minnesota from economic collapse". Similarly, the New London Times (16 November) reported that a meeting had been held in Willmar on 14 November "for the purpose of trying to get federal aid to supplement the work of the state in supplying feed for drought stricken farmers".

In addition to its devastating effects on the state's farm economy, the drought of 1933 caused extensive environmental harm, triggering forest fires, lowering lake and river levels and damaging, even killing, trees. One of the most noteworthy examples of the environmental effects of the drought was provided by a 28 July 1933 Minneapolis Star story claiming that Lake Minnetonka "was in danger of drying up". According to the Star, there was an urgent need to replenish the lake's water supply, perhaps, it was suggested, by "tapping overflow waters from the Crow river" via a seven or eight mile long canal to be built at a cost of about \$250,000 from Halsted's Bay to the river. In a follow-up story on 31 July, the Star featured photographs which clearly showed the effects of receding water levels, marshy shallows appearing in places along the lake shore which, prior to the drought, were said to have been covered by deep water. Boat docks, it was emphasized, had to be extended "due to evaporation and lack of any replenishing source of water". Similarly, the 12 May 1933 edition of the Brown County Journal (New Ulm) reported lower water levels in Swan Lake, a lake which it was pointed out, was an important "breeding ground for waterfowl and fish of late years". A petition submitted by local sportsmen's group had, accordingly, requested that "water from the Minnesota river be diverted at a point near New Ulm and be allowed to flow into [the] lake". The 15 September edition of the Journal noted moreover, that, according to the state forestry department, "Minnesota's tree population is being seriously affected by insects which have increased rapidly because of the continued drought". The "vitality" of trees, it was explained, has been "decreased by the long dry spell

which..proved favorable to the increase of damaging insects. Oaks, red and white, have been conspicuously affected." Also, in addition to previously noted grasshopper infestations, the drought favored the proliferation of crop destroying pests: in this regard, the 26 June 1933 Marshall Messenger reported an "outbreak" of army worms which were said to be "attacking" cornfields in the Cottonwood vicinity. And, as if to reassure its readers by pointing out the advantages of drought and low water levels, the 21 September 1933 edition of the Marshall County Banner printed a story taken from the Wabasha Pioneer stating that "the low water mark on the Mississippi river has created acres and acres of meadowland along its banks near Red Wing. For the first time in the long history of the upper river harvesting of a wild rice hay crop has been accomplished. Not many years ago, the river rolled over the present hayfield to a depth of ten to fifteen feet".

Predictably, many of the state's forested areas suffered from drought stress during 1933, creating conditions conducive to an outbreak of forest fires. The 7 September edition of the Marshall County Banner reported, for example, that "a forest fire that started in...Roseau county went out of control Saturday [2 September] and during the two days following burned over an area eight miles long and two miles wide. It burned itself out when it reached the highway but scores of smaller fires are reported and with timber dry from the lack of rain during the past three weeks. Hundreds of men are on guard night and day to battle the flames". One week later, the Banner reported an outbreak of fires near Warroad, stating that last Saturday's [9 September] forty mile per hour winds had "fanned brush and peat fires to an alarming extent. Every available man and boy in [the Warroad] vicinity were drafted as fire fighters". The 1933 forest fire season appears to have ended with the onset of wintery weather and accompanying snowfalls in late October. Moreover, weather unfavorable to the development of forest fires prevailed over much of northern Minnesota in November: on 16 November, as an example, the Banner noted that the Argyle area received about three inches of snow on Sunday 12 November "with a stiff north wind blowing a good sized blizzard [which] raged all day". On Monday, however, the wind "turned to a chinook breeze from the northwest". Interestingly, the "chinook" was followed by a cold wave which, according to Argyle's cooperative observer John Dundas, produced a reading of -21 F on the morning of 16 November. This, according to the 23 November edition of the Banner was followed by a "rebound" which brought "mild and pleasant" weather and a maximum of 38 F on 20 November.

Although some predicted and many undoubtedly hoped for wetter conditions in 1934, the winter of 1933-1934 only brought more drought, setting the stage for a disaster which, as emphasized previously, is without parallel in the climatic history of Minnesota and the Upper Midwest. Winter drought was followed by an intensifying spring drought that spawned frequent dust storms, culminating in a massive storm which obscured the sun over much of the United States on 9-11 May and unprecedented May heat and lack of rainfall which dashed hopes, destroyed crops and brought many areas to the verge of economic and political chaos. It is appropriate, then, as the ensuing title suggests, to characterize Minnesota's weather during the spring and summer that followed the disasters of 1933 as the worst of the worst, the most adverse of the adverse.

THE 1930'S
AS BAD AS IT GETS:
THE SPRING AND SUMMER OF 1934

In what must have been seen as an unwelcome turnaround, the generally wetter than normal conditions which brought heavy snowfall to many portions of Minnesota during December 1933 gave way to a dry January and an extraordinarily dry February. Moreover, despite two brief, but noteworthy cold waves, the first at the end of January and the second at the end of February, the first two months of 1934 were abnormally warm, melting much of the winter snow cover, leaving exposed fields in many areas of the state (the south and central portions, especially). The relative lack of snow cover, combined with what Weather Bureau officials described as "frequent" high winds, was, of course, conducive to localized but nevertheless widespread soil erosion. In many places, soil was blown from exposed plowed fields and deposited in ditches or piled in drifts along fence lines, windbreaks, buildings and any other obstruction large enough to slow the wind and permit the soil to settle. Thick dust, driven by high winds, was reported in east central Minnesota on 22, 23, 24 and 31 January and, during February 1934, thick dust was observed on six dates in several southern Minnesota counties. Blowing dust was also said to have been common in many parts of Minnesota during March 1934. More seriously, however, the lack of winter precipitation left large areas of the state (and the nation) extremely dry, setting the stage for the massive, disastrous dust storms which swept the nation's parched farmlands during the spring which followed.

Although some areas of Minnesota recorded above normal precipitation during March, drought conditions intensified over most areas during the late winter and early spring of 1934. Most Minnesota stations, for example, recorded less than an inch of precipitation during March (following a February which produced only trace amounts of moisture at many locations). And despite a significant rain and snow event which brought one to nearly two inches of moisture to many Minnesota locations during the opening days of April, large scale dust storms soon erupted, not only in Minnesota but throughout the Great Plains. Meteorologist W. A. Mattice, writing in the February 1935 issue of the Weather Bureau's Monthly Weather Review, noted, for example, that the Huron, South Dakota area had experienced sixty dust storms of varying intensity during the first five months of 1934. He noted further that in the eastern half of the state [South Dakota] "where small grain cultivation predominates, every farm has been injured, more or less, by soil erosion, destruction of fences, injury to buildings, loss of crops and the depletion of herds...The total loss to agriculture, transportation and business is estimated at \$200 million...". It was not until 9-12 April, however, that the nation experienced 1934's first major, regional dust storm. According to the February 1935 issue of the Monthly Weather Review, this event, although centered over the Great Plains, the Dakotas in particular, spread dust into the atmosphere in areas as far south as Florida and Louisiana. On 12 April 1934, for example, observers at Louisiana State University, Baton Rouge noted that, on an otherwise cloudless day, atmospheric dust reduced the amount of sunshine recorded by the station's instruments from about ten hours to about five hours. The same report indicated that daytime "shadows were barely discernable" and that "an aviator flying at an elevation of one thousand feet in central Louisiana found visibility so poor that he ascended to six thousand feet to avoid the dust...".

The 9-12 April storm was followed by another of nearly equal severity which, on 18-20 April, spread dust from the Dakotas to as far east as western North Carolina. Still another storm swept over much of the Great Plains on 21-23 April. On 23 April, observers in Topeka, Kansas reported that the sun was obscured by dust at times and that illumination from street lights was dimmed during the evening hours. And on 22 April, observers at Bismarck, North Dakota noted that aviators reported dust at elevations as high as 14,000 feet. Visibility at the Bismarck station was said to have been reduced to two hundred yards at various times during the storm. The same storm also impacted portions of Minnesota, northwestern Minnesota especially. The 26 April 1934 edition of the Marshall County Banner (Argyle) reported for example that "a terrific wind that swept down from the north last Saturday [21 April] created the most severe dust storm this north section has experienced in many years. Clouds of dust were so dense that seeding operations on farms were halted and highway travel was made dangerous and difficult. Motorists were obliged to travel with lights on as a danger signal to approaching cars, and at times the dust was so dense that visibility was completely obscured and drivers of cars were obliged to come to a halt until there was a lull in the storm. With field operations in full swing and the soil powder dry from lack of moisture, the freshly cultivated and tilled fields yielded abundant fine soil to whip into blinding clouds. Sunday brought bright sunshine and calm, the first day of real spring atmosphere, but on Monday the old north wind that has been so persistent in sweeping down with its chilling blast all spring was on the job again with dust flying again...". And,

according to entries in the Minneapolis Weather Bureau's 23 April 1934 daily meteorological journal, the Bureau's cooperative observer at Beardsley, Minnesota reported a "severe dust storm with high northwest winds on 21 April. The storm, according to this report, began at about 1000 hours, creating "poor" visibility at about 1200 hours, followed by "twenty five to thirty minutes of total darkness" during the late afternoon. Interestingly, also, the Argyle Banner's "old north wind" brought very cold late spring temperatures to many Minnesota locations (e.g. Morris, 15 F on 27 April; Rochester, 17 F on 26 April; New Ulm, 20 F on 25 April), readings which were followed several days later by record or near record April warmth (e.g. 96 F at Maple Plain; 93 F at Bird Island, New London and Wheaton; 92 F at Farmington, Cambridge, Chaska, Milan, Redwood Falls, New Ulm and several other Minnesota stations, all on 30 April).

Yet, however distressing it might have been, April's weather was relatively temperate when compared to May 1934, a month which, with the possible exception of July 1936, was the most climatologically adverse and anomalous month of the many hot, dry spring and summer months experienced by Upper Midwest residents during the 1930's. It was a month that opened with record or near record spring heat and ended with record shattering early summer heat. Its extraordinary warmth notwithstanding, the month's distinguishing climatological feature was the massive, choking dust storm which covered much of the United States with a pall of airborne dirt during a three day period, 9-11 May 1934. The storm which was preceded by several days of hot weather with maxima of 98 F at Morris, Campbell and Montevideo, 99 F at Pipestone and 102 F at Beardsley on 8 May was triggered by a vigorous but moisture starved cold front which swept through the Upper Midwest on 9 May. No part of the state and few parts of the nation were unaffected by the huge clouds of dust raised by the storm, and, in many areas, farmers, businesses and others sustained huge losses, whether as a result of destroyed crops or damaged property. According to the 11 May 1934 edition of the Morris Tribune, the "blinding dust storm" was "so severe that it turned night into day....The storm is generally conceded to be the worst ever experienced in this section of Minnesota, exceeding in violence the dust storm of 21 April. Crops have been periled by the...storm to a serious degree. Small grains that were up to an inch or more in height have been whipped and broken off by the high winds. The storm got underway early Wednesday [9 May] and by ten o'clock it was a mean and uncomfortable task to be even outside. The storm grew steadily worse and reached its height at about four thirty in the afternoon...the dust became so thick that day became as dark as night and it was impossible at times to see across the street. The dust sifted everywhere and it was of no avail to keep it out..". Winds, it was said, reached velocities of 58 miles per hour at the Morris station during the storm. The Tribune story further reported that two children had become "lost for a time" during the storm and that dust drifts had piled up on the railroad tracks near Tyler, Minnesota, causing a train derailment, landing a 75 ton locomotive in the ditch adjacent to the track.

The 10 May 1934 Minneapolis Tribune gave a similar account of the storm, featuring a banner headline which told its readers (if, indeed, they needed to be told) that "Dust Storm Blasts Windows, Trees: Grime Whipped Through City and Northwest". The story that followed explained that late afternoon winds had uprooted trees and shattered plate glass windows in various parts of the city and that "dust borne on northwest winds of high

velocity shrouded the sun in Minnesota and neighboring states Wednesday [9 May]". Tribune writers then went on to say that the storm was "the worst storm of its kind in recent years", that day had been turned to dusk, that vehicular traffic had been halted in many areas and that everything was "covered with fine grit". The dust which, it was pointed out, had been "whipped" from the fields of Minnesota, North Dakota, South Dakota and Canada, "moved seemingly in one great cloud which increased in density as the day wore on, giving the skies a wan yellow color through which only a suggestion of sunlight could filter at times....the full intensity of the whirling grime did not reach the city [Minneapolis] until late in the afternoon and early evening when the wind velocity increased....Office buildings and homes could not hold the dust out. Clothing became saturated with the dust. There were times when it was impossible to see across Lakes Harriet and Calhoun. Numbers of large trees, mostly in south Minneapolis, were felled across the streets...". Elsewhere in its coverage of the storm, the Tribune noted that Fergus Falls had reported the worst dust storm in years, requiring residents of that city to turn their lights on in mid afternoon. Wisconsin, it was said, had also suffered from the dust and a number of forest fires which had broken out in drought stricken areas. In Chicago, a city which reportedly had not had a "satisfactory rainfall" since 21 October 1933, temperatures reached 94 F on 9 May, causing at least one heat related fatality. And, in Hottinger, North Dakota, grasshoppers were said to have hatched "weeks earlier than anticipated". Although the Tribune reported that floods had occurred in Norway, Poland, like the United States, was said to have experienced "excessive heat" and forest fires were reported in such disparate locations as Bordeaux, France and Alberta, Canada.

Similar accounts of the 9-10 May storm appeared in the St. Paul Dispatch and the Minneapolis Journal. The 10 May edition of the Dispatch stated that "torrid heat...perils crops as new dust storms swirl over the northwest...dust blowing from the plains shrouded St. Paul at 1:30 p.m. today, completely hiding the sun...airplane traffic was hampered...roads near Fairmont drifted to a depth of six inches...dust rises two miles high....gales whistled over the prairie lands, pouring tons of Dakota topsoil into Minnesota, carrying acres of Minnesota earth into Iowa and Wisconsin...three persons hurt in St. Paul at the peak of the storm when winds reached 47 miles per hour...At Grand Forks, North Dakota, drifts of dust were piled in the city....airplanes in and out of St. Paul were grounded and a fine layer of dust grayed carpets, furniture, dishes and clothing..merchandise in stores suffered....visibility was cut to a few blocks..". In an interesting follow up story on 11 May, the Dispatch reported that Dr. Frank B. Rowley, identified only as an engineer at the University of Minnesota, had calculated that more than 10,000 tons of dirt had "swirled above the Twin Cities alone yesterday [10 May]..". He estimated that the dust in the air weighed about fifty tons per cubic mile on Wednesday [9 May]: 100 tons per cubic mile at 1000 hours on 10 May and 200 tons per cubic mile "during the worst of the storm on Wednesday night [9 May]". Other St. Paul post storm reports indicated that the high winds had snapped off a large numbers of trees, damaged utility lines, killed a large number of cattle and destroyed millions of bushels of Minnesota and Upper Midwest wheat. Highway ditches throughout Minnesota were said to be filled with dust and that the "prospects of wells and streams running dry" threatened water shortages in rural areas of the state. The 9-10 May editions of the Minneapolis Journal, were, predictably, very similar to those appearing in other Twin Cities newspapers: "dust clouds that rose over wide areas as hot winds whipped the dried

soil..in many sections....farmers who had...started corn planting...gave up seeding in despair...a fifty mile per hour gale continued to whip the northwest today [10 May], clogging the air with fine dust and causing untold crop damage...across whole sections of South Dakota and western Minnesota the sun was blotted out and cities were forced to turn on their street lights, motorists had to drive with headlights on..." The Journal did, however, provide several details not found in other newspaper accounts. It pointed out for example, that "an epidemic of colds and fevers is breaking out..because of the unusual weather conditions...". The Journal also reported that Weather Bureau aircraft had flown two miles into the air during the storm, finding that the dust at that altitude was "just as thick..as on the ground". And, like the Journal, Minneapolis Weather Bureau records provided information in addition to that available from other accounts of the 9-10 May storm. The Minneapolis office's 10 May meteorological journal noted that the "air was thick with dust most of the day with visibility reduced at times to less than a mile. Clouds, if any, were obscured by dust. High winds all day began to abate in the afternoon and the dust became lighter, disappearing by night. Sunlight during most of the day had a pale, bluish cast...". Winds during the day [10 May] averaged 21.3 miles per hour with a maximum speed of 44 miles per hour. Relative humidity, as recorded on the morning of 10 May was only fourteen percent and, despite the pall of dust which obscured the sun, the station journal stated that sunshine during the day had been measured as 71 percent of that which would have been possible on a totally clear day.

Although 11 May was a clear, cool day, journalistic attention on the day following the storm remained focused on the dust and its effects. The 11 May edition of the Minneapolis Tribune reported, for example, that the wind and dust had caused damage estimated at \$200,000 [1934 dollars] in the Minneapolis area alone. The Tribune also reported that ninety percent of a thousand acre onion crop in the vicinity of Hollandale in southern Minnesota had been blown away. Some Minnesota side roads, it was said, were impassable, blocked by drifts of dirt. Similarly, many drainage ditches were said to have been filled with dust. And at Rochester, all surgical operations scheduled for 10 May were postponed, dust having seeped through the closed doors and windows of the city's hospitals and other medical facilities. And, according to an Associated Press story quoted by the Tribune, every cubic foot of air over Chicago contained 308,950 particles of dust during the peak of the storm.

As noted previously, the effects of the 9-10 May dust storm extended well beyond the Dakotas and western and central Minnesota. The 10 May 1934 Duluth Herald reported that "driven by a west wind that reached a velocity of 42 miles per hour, a dust storm shrouded this whole district [northeastern Minnesota] in a gray haze that shut out sunlight, hampered shipping and made things miserable throughout the night and this morning. Millions of particles carried by the gale caused the worst dust storm in the city's history. Visibility over the lake [Superior] and bay was nil. The fine grit sifted and swirled through the tiniest cracks in homes and offices. Motorists driving on the highways reported that the air became so full of dust that they were compelled to stop because the road ahead was invisible".

Yet, as noted earlier, the 9-10 May storm was widespread, not only in Minnesota, but in many other parts of the country as well. According to the February 1935 Monthly Weather Review, the effects of the storm were felt over many eastern and southeastern states, areas

of the nation which, because of their generally wetter climate, topography and other factors, were not likely to experience dust storms or even heavy concentrations of atmospheric dust. But given its intensity and the amount of dust which it had lifted into the air, the storm moved relentlessly eastward, its progress documented by the Weather Review with reports from Weather Bureau offices in cities ranging from Madison and Milwaukee, Wisconsin to Buffalo, New York, Washington, D.C., Boston, Massachusetts and Savannah, Georgia. Milwaukee, for example, reported "the worst dust storm of which there is any recollection in Wisconsin.....winds drifted the soil in the fields and in places uncovered newly sown grains. By the morning of the 10th [of May] dense dust clouds covered the sky and this condition continued all day". At Madison, Wisconsin, the dust was said to have appeared in the sky at about 1830 hours eastern standard time on 9 May, persisting until nightfall on 10-11 May. Dubuque, Iowa reported light dust beginning at 2230 hours on 10 May, continuing until 0930 on 11 May. The dust became dense later in the day on 9 May, at times reducing visibility to 800 feet. At Keokuk, Iowa, observers noted that "a dust storm began in the afternoon of May 9 and continued through the 10th, 11th and 12th. Visibility was limited from eleven blocks to a few miles". Farther to the south, Columbia, Missouri observers reported that "the air was quite murky" on 10 May. And farther east, observers at the Buffalo, New York airport stated that "dust was first noted..at the noon observation on May 10...the visibility was five miles. From this time on dust of light intensity was recorded until 2 a.m. on May 11". The visibility was from one and one half to five miles during this period. Similarly, the Pittsburgh, Pennsylvania station noted that "the dust storm ...reported at several western stations on the morning of May 10 was first observed in the vicinity of Pittsburgh as a peculiar yellow haze in the upper air about 6:15 p.m. of the 10th. At the airport station the dust was most dense at the six and seven a.m. observations on the 11th when visibility was reduced to one mile".

At Nashville, Tennessee and Springfield, Missouri, the dust reduced visibility to less than one half mile at various times on 10 May. The dust also reached as far east as Boston, Massachusetts and Portland, Maine, the latter reporting that dust appeared "quite suddenly" at about 0930 hours on 11 May, remaining over the area until about 1730 hours on the same date. Visibility was limited to one mile at 1400 hours on that date. Observers at Boston reported that "a thin veil of dust appeared in the air shortly after daybreak" on 11 May, moving eastward over the ocean during the day. "The dust was so fine that it appeared much as a high haze and was at an elevation of 500 feet or more where visibility was reduced to a fraction of a mile, whereas visibility on the ground was up to two miles". Dust was also reported Raleigh, North Carolina, arriving in that area at about 1440 hours on 11 May. According to Raleigh observers there was a hazy appearance overhead, "dust being observed mainly in looking toward the horizon". Although most of the dust had disappeared on 12 May, remnants of the storm persisted in the mountain regions of the state [North Carolina] until 14 May. At Atlanta, Georgia, the sky took on a "whitish" appearance on 12 May and, in extreme northern Georgia, the "brightness of the sun was much reduced and mountains ten miles away were cut off from view". The May 1934 dust storm was the second such event to affect Georgia in six months, the first being the great dust storm of November 1933. In Washington, D.C. what was described as "dense" dust cloud attracted a great deal of attention, partly because of the rarity of such phenomena on the eastern seaboard but also because politicians struggling with Depression era problems were once

again reminded dramatically reminded of the then desperate plight of American agriculture. According to an article written by Irving F. Hand and published in the May 1935 issue of the U.S. Weather Bureau's Monthly Weather Review, the amount of dust in the cloud which passed over the nation's capitol city on 11 May "showed a higher dust content of the atmosphere than has even been measured...before..The largest number of atmospheric dust particles previously measured by this Bureau [the Weather Bureau] in Washington is 7,077, so the value of 12,180 obtained at 3 p.m. on the 11th exceeds this previous maximum by 72 percent. After the passage of the main cloud, the dust drifted over the city in patches...Measurements made in Virginia on the 13th show an unusually large number of particles on the Blue Ridge.....The size of the particles obtained on the Blue Ridge averaged considerably larger than previously had been measured there.....From aerological and other sources, we have estimated the height of this cloud at two kilometers.....".

Yet, even if the 9-12 May dust storm had not occurred, May 1934's reputation as one of the most climatologically anomalous months of the Dust Bowl years would remain undisputed. For, even without dirt clogged ditches, eroded crop lands and dust filled skies, the month would have been noted for its combination of record heat and dryness. Moreover, as stated previously, May 1934 was noteworthy, not because it marked the beginning of a hot, dry regime but because it marked the culmination of a drought which had began years earlier and which, with but a few brief breaks, persisted through most of the torrid summer of 1934. It is essential, then, to see May 1934, not only as a record setting hot, dry spring month but as part of a continuum of months which made the spring and summer of 1934, when considered as a whole, one of the most distressful periods in Minnesota's turbulent climatic history.

In this regard, the 6 April 1934 edition of the Morris Tribune, as an example, stated that "many" west central Minnesota lakes had dried up and that others were five to six feet below normal levels. In addition, subsoil moisture in the Morris area was said to have "receded from ten to twelve feet below ground". And, a month later (4 May), the Tribune noted that 0.64 inches of rain had been recorded at the Morris station, the first "appreciable" amount of moisture to fall since 1 April. The Tribune further noted that "during the past several weeks some of the seed grains, especially on lighter soils" had been blown out by the "severe winds that brought dust storms of unusual severity...". Similar, but more pessimistic reports followed: on 25 May 1934, the Tribune stated that the "crop outlook continues to become more serious with each passing day. Added to the damage caused by drought and high winds was a severe frost Monday night [21 May]. Many fields, especially those in low places, were affected". And on 1 June, following a week of excessive heat (including a maximum of 106 F "accompanied by a high wind and blistering sun" on 31 May), the Tribune, in comments which no doubt reflected the despairing mood of many of its readers, asserted that "the drought has brought a calamity never before experienced in this county [Stevens]. Nearly all pastures are barren of grass and many farmers are without feed of any kind for their livestock except only that which they can obtain through drought relief. Cattle are dying of starvation. Other cattle are being made ill by the dust and dirt that coats every mouthful of grass".

Nor was this grim picture of the 1934 drought limited to the Morris area: the 17 May 1934

edition of the Marshall County Banner (Argyle) expressed similar views stating that "crop conditions have grown more serious as another week has passed without rainfall to moisten fields which have been whipped dry as powder by continued wind storms. Crops that had gotten above the ground were cut down by the heavy frost last Friday [11 May] when the mercury registered 21 F. And, although the 24 May edition of the Banner noted that "local showers this week have given enough moisture to revive growing crops," the gloom returned the following week [31 May]: "Sunday's scorching hot winds with the mercury at 97 degrees had a telling effect on fields that had stood up under the drought but are now completely ruined". More of the same appeared in the St. Cloud Times Daily which on 7 May 1934 told its readers that "a merciless sun, beating down on the parched prairies of the north central states gave no prospect of relief. Hot winds swept parts of Nebraska, adding to the drought peril. Kansas, Missouri, Wisconsin and Minnesota remained rainless and the moisture deficiency in northern Illinois reached 61 percent since January 1...". A more optimistic report followed on 8 May when the Times reported that "five weeks of drought" were said to have been "broken by a warm, steady rainfall in southern and western Minnesota, bringing delight to desperate farmers whose parched lands had given little prospect of a good harvest". But on 9 May (the first day of the Great Dust Storm), Times journalists pointed out that a record heat wave had pushed temperatures to 104 F in parts of North Dakota and that "excessively hot weather was general throughout most of the northwest, broken only by scattered rains". The same edition also noted, ominously, that reports of "rising dust storms" had been received from southwestern Minnesota where "swirling sands" accumulating to a "depth of six inches" had blocked highways near Fairmont. And on 11 May, a dramatic Times report stated that "apprehension over middle America's crop prospects grew hourly today. Black blizzards of dust swelled the alarm. Whipped by strong winds, the dust clouds from the vast plains of western Canada swept across the border with undying intensity yesterday, befogging the entire area from Montana to Texas to the Ohio Valley...". Similar but more cautious views were voiced by the Brown County Journal (New Ulm), its 11 May 1934 edition reminding readers that "there has been no rain to speak of in Brown county since the forepart of April". This was followed by an 18 May report stating that "the damage to crops in Brown county by the drought as well as by dust storms is material. In many fields winter wheat is a total loss The winter wheat crop will be short in Brown county even if sufficient moisture is enjoyed from this time forth. Owing to the drought the pastures are short and the hay crop throughout the county will be limited. Hay will probably reach a high price. Spring wheat, oats and corn and other small grain crops have been damaged to some extent but damage at this time probably does not exceed twenty five percent. The dust storms of Thursday, Friday and Saturday [10-12 May], the worst that have visited this section, raised havoc in many fields. In some places growing grain was covered with the accumulated dust while in other places the earth was blown from the fields and the seed carried away". And one week later [25 May], the Journal noted that "the hottest day in May in the history of local weather observations occurred Saturday [19 May] when the thermometer presided over by Alex L. Henle, volunteer weather observer, registered 103 degrees. Coupled with the extreme drought that has visited this section, the torrid temperatures further damaged crops and pastures. Squalls of rain and hail accompanied by high winds visited this section during the late afternoon Sunday [20 May]. The precipitation was 0.05 inches in New Ulm...". Finally, on an optimistic but guarded note, the 14 May 1934 edition of the Duluth Herald reported that "general rains" which had

fallen across the corn and wheat belt "were said to have broken a forty five day drought. Whole families turned out into the fields today at dawn. The feel of damp earth underfoot and the sheen of vegetation cleaned of the grime left by...dust storms...turned the countryside of half of the nation into a playground for farm workers. Yesterday's rain, which fell over almost the entire area of severe drought, was worth at least \$5 million to the farmers. Rains, however, were heavy only in a few places and did not replenish exhausted subsoil moisture...". And on 12 May 1934, the Herald provided its readers with coverage of the dust storm which, just two days after the 9-10 May event, once again filled the air with sand and grit. This storm, although certainly less severe than the one that preceded it, was nevertheless significant. According to the Herald's account, it "whooped across the prairies...cutting visibility to a mile. For the third day this week grime filled homes and offices with layers of silt. The storm was confined largely to southern and northwest Minnesota, extending from east of the Twin Cities [where it was driven by a twenty four mile per hour southeast wind] to west of Fargo...". A similar report in the 12 May edition of the Marshall Messenger stated that "a brisk wind coming from the south and east stirred up a new dust storm in southern Minnesota today. Although not as severe as the black blizzard which swept through the entire country the past few days, the wind cast a light haze over a fairly wide area...".

Nor did May's adverse and often devastating weather escape the attention of Twin Cities journalists. As early as 1 May, for example, the St. Paul Dispatch noted that "...farmers, woodsmen scan the skies for rain while temperatures soar to new high marks for this time of year and swelling winds fan new outbreaks of fires in northern Minnesota...". And on the same date, the Minneapolis Tribune noted that "scattered showers" had fallen in south Minneapolis late Monday [30 April] following a then record April maximum of 90 F. Although heavier rains were said to have fallen north of the city, "little rain" fell in downtown Minneapolis (where the Twin Cities Weather Bureau station was then located). The Tribune then quoted R.A. Trovatten, state agriculture commissioner as saying that "much more rainfall will be needed to save Minnesota farmers another dry year. Fields in many sections of the state are now parched. The Montevideo section..is extremely dry. The situation in the Morris area is said to be the most discouraging...". On 2 May, the Tribune again pointed out that "most of the northwest went without much needed rainfall Tuesday, although a few scattered areas received beneficial rain." The heaviest amounts were in South Dakota, the Brookings area reporting rainfalls of up to two inches. More of the same followed on 6-7 May: "dust storms in Canada and forecasts of no big drought relief in the United States pushed wheat up three and one-half cents per bushel on Saturday [5 May]....Strong, hot winds swept across the northwest again Sunday [6 May]. Temperatures were as high as 100 degrees and vast areas went without rain...Clouds of dust drifted from tilled fields where small grain lay ungerminated for lack of moisture..hay lands were further dried...". A few days later [12 May], the Tribune cited reports which asserted that "the worst spring in forty years" had "whittled another 19,580,000 bushels of wheat" from the department of agriculture's 1 May 1934 crop estimates. "Officials calculated that the continued dry weather was trimming about two million bushels a day from the wheat crop". Farmers, it was added, were encouraged to sign wheat production contracts "which will bring payments for reducing acreage. Officials said that in many areas affected by the drought, benefit payments would be the farmer's sole source of income". On 13 May,

Tribune writers took note of the rains which, as noted previously, had fallen in many areas on 12-13 May. Heavy precipitation, it was claimed, had occurred in parts of southern Minnesota, Austin in particular, and in other areas of the Midwest. Heavy rain at Chatfield, Minnesota had, it was said, broken a seven week drought and ended a three day dust storm. In Kansas, Topeka reported a 4.08 inch deluge (while most of that state remained dry). In most areas, however, the rains were not heavy. They were nonetheless thought to have been beneficial, falling slowly and soaking into the dry ground. And on 14 May, the Tribune quoted University farm official Dr. Andrew Boss as saying that "despite weekend rains, the danger of drought remains," a statement which, under the circumstances, did little more than belabor the obvious. In another statement which, under the circumstances, was far from obvious -- Boss claimed that "not more than ten percent of the state's spring sown grain are in bad shape. Particularly in the southern part of the state, spring crops are well rooted. The section of central Minnesota extending north to the timber line is most in need of immediate rain". The same edition of the Tribune also reported that a dust storm had occurred Sunday [13 May] in the vicinity of Sioux City and Cherokee, Iowa.

In addition to dust storms and extreme drought, the last two weeks of May 1934 were excessively hot. The entire Upper Midwest, including virtually all parts of Minnesota were, in fact, scorched by an unprecedented heat wave which began at mid-month, eased for a few days beginning on 20 May and returned with renewed force on 26 May. Representative daily maxima included 96 F, 100 F, 95 F, 103 F, 98 F, 101 F, 100 F, 102 F and 108 F, respectively, at New Ulm on 16, 17, 18, 19, 20, 28, 29, 30 and 31 May; 98 F, 97 F, 104 F and 107 F, respectively, at New London on 16, 17, 29 and 31 May; 104 F at Moorhead on 30 May; 105 F and 108 F, respectively, at Campbell on 30 and 31 May; 101 F, 101 F, 103 F and 108 F, respectively, at Fairmont on 18, 19, 30 and 31 May; 106 F at the Minneapolis Weather Bureau station on 31 May; 107 F at the St. Paul airport station on 31 May; 109 F at Red Wing on 31 May; 107 F at Austin, Winona, Farmington and Fairmont on 31 May; and, as noted previously, an almost unbelievable record setting 112 F at Maple Plain, also on 31 May. Maxima at locations outside Minnesota were equally extreme, reaching 109 F at Spencer, Iowa, 106 F at Sioux City, Iowa, 105 F at Des Moines, Iowa, 104 F at Fargo, North Dakota and 100 F at far northern Winnipeg, Manitoba, all on 30 May.

Heat of such intensity, of course, provoked widespread journalistic comment. The 29 May 1934 edition of the Minneapolis Tribune, for example, called the heat "inordinate," noting that "crop hopes were further dulled and pastures browned deeper as new all time temperature records for the month were experienced over a wide area.". It further noted that grasshopper and cinch bug warnings had been issued in six Upper Midwest states. And on 31 May, at the peak of the heat wave, the Tribune reported "unseasonable heat which set up new all time May records in many localities..added greatly to drought damage in northwest states and increased the forest fire menace in northern Minnesota and Wisconsin". Three women, it was also noted, had collapsed on the streets of Minneapolis on Monday 28 May, victims of heat prostration. At New Ulm, the Brown County Journal reported that the temperature had reached 108.5 degrees on 31 May making it the "hottest day in all New Ulm weather history". The previous record, (108 F) it was pointed out had been set on 27 June 1931. The Journal also noted that temperatures at the New Ulm station had reached or exceeded 90 F on twelve days during May, an unprecedented occurrence for what, in

Minnesota, is a normally temperate late spring/early summer month. And on 31 May, the Marshall Messenger noted that "Lyon county was scorching again under torrid sun, the mercury standing at 100 degrees at noon...".

But, although their accounts provided good documentation of the effects of the May heat wave on the lives and fortunes of Minnesota's citizens, newspapers generally provided little information regarding the meteorological conditions (wind speed, relative humidity, etc.) which accompanied the month's abnormal temperatures. Such detail, however, is obtainable from daily journals kept at Minnesota's first order Weather Bureau stations, the Minneapolis station especially. On 31 May, a date on which temperatures in east central Minnesota soared to near 110 F, the Minneapolis observers noted that the sky was partially covered by cirrus clouds early in the day. These soon disappeared and during most of the forenoon the sky was said to have been cloudless. Lower cirrus clouds began to appear early in the afternoon, reaching a maximum coverage of about forty percent at about 1600 hours before dissipating once again. Light haze due to dust particles in the air was observed from morning until night fall. Although the day was described as "very sultry," relative humidity, as measured at the station's afternoon observation, was a mere thirteen percent. Station instruments also recorded 97 percent of possible sunshine, a peak wind of twenty miles per hour at 1341 hours and an average daily wind speed of 11.5 miles per hour. Not surprisingly, southwesterly winds prevailed throughout the day. The day's minimum temperature was 75 F, a reading which together with the day's maximum of 106 F, yielded a daily average of 90.5 F. On the following day [1 June], the maximum temperature was a relatively temperate 90 F. The station journal, however, noted a "moderate dust storm" which, observers noted, "abated by early morning while light smoke, probably due to bog fires was in evidence throughout the day". May's heat, of course, brought with it a heightened awareness of the true extent of the ravages of the 1934 drought, an awareness mixed with a sense of urgency and a feeling desperation, perhaps bordering on panic in some locations. The 20 May edition of the Minneapolis Tribune reported, for example, that the governor of North Dakota had asked for prayers for rain as "...a parched northwest continued baking under a hot sun...". And, as early as 17 May, the Tribune announced that area senators and congressmen had conferred with A. T. Forsberg, Minnesota's drought relief director, "...in order to work out plans for the immediate and future relief of the state...". Forsberg, it was said, presented photographs showing "...huge drifts of dust, the appearance of snowdrifts..and dead cattle...". On the next day, he recommended "...a drastic reduction in the stock population of the state...". Subsequently, 121 counties in the Dakotas and Minnesota were designated as emergency drought counties.

Although abnormally hot, dry weather prevailed during most the remaining summer months of 1934, copious rains -- rains which temporarily alleviated drought conditions fell in many areas in early June. The first hint of a change in the weather pattern was noted on 28 May, the St. Paul Dispatch pointing out that heavy rains had fallen at Crookston and that, in St. Paul, several brief showers had temporarily lowered the day's sweltering temperatures. Similarly, the 29 May edition of the Minneapolis Tribune reported that "some scattered rains" had fallen in the northwest, noting that "where there were downpours, the water ran off the hard baked surface soil..". More promising, but mixed, news followed, the 2 June Minneapolis Tribune reporting that "...winds and a few scattered showers are slowly cooling

the northwest....Minneapolis after a wind and dust storm early in the morning had a maximum temperature of 87 degrees, almost twenty degrees under the high on Thursday...the humidity, however, was higher...dust storms swept over southern Minnesota..". On 4 June, St. Paul Dispatch headlines told its weather weary readers that "drought checking rains" had fallen over "wide areas" in North Dakota and that "...approximately three quarters of an inch of rain fell at the St. Paul airport but in the loop district the precipitation was much smaller...". On 7 June, the Minneapolis Tribune featured news of a "...steady, soaking rain" which 'moved slowly across southern Minnesota and northern Iowa on Wednesday [6 June], brightening the prospects for corn and forage crops...from the South Dakota border as far east as Fairmont the rain was heavy...". A similarly optimistic story in the 6 June 1934 St. Paul Dispatch stated that "cooler weather and the increasing prevalence of showers has led crop observers in the northwest to issue carefully guarded forecasts indicating that the drought may be ended soon...". On the following day [7 June], the Dispatch featured a banner headline declaring "Drought Ends As Rains Drench Northwest: Crop Outlook In Four States Now Hopeful". The story that followed observed, somewhat poetically, that "cattle lowed in their barns and stream beds, dry for many weeks and in some places damned by drifting dust, filled and gurgled and raced down to the main rivers...". In some areas, the early June rains sometimes accompanied by high winds became excessive, washing out bridges and railroad tracks. Rainfall amounts included 2.52 inches at Little Falls and 3.53 inches at Worthington. In the Twin Cities a "substantial downpour" accompanied by a vigorous electrical storm yielded 1.22 inches of rain at the Minneapolis Weather Bureau station on 7 June, the first really significant precipitation event since early April.

The optimism expressed by the Twin Cities newspapers was, not surprisingly, shared by newspaper reports from other parts of the state. The 7 June 1934 edition of the Marshall County Banner (Argyle) reported that, in that portion of the state, the drought was "broken Monday [4 June] when a steady, soaking rain fell. Lower temperatures followed the rain and with heavy clouds hanging low all day Tuesday [5 June] the moisture soaked the parched fields and pastures. The rain will be of great benefit to crops that were not too far gone to be revived. The grasshopper menace has not yet been relieved. Fields in which they appeared in such great numbers are still being invaded...". One week later [14 June], the Banner remained optimistic (although guardedly so), quoting a USDA crop report as saying that "general crop conditions in Minnesota as of June first broke all records, being the lowest ever reported. However, since that date there have been heavy and general rains in practically all areas of the state. The real drought area is in west central and central Minnesota but had rapidly spread southward so that general conditions in the southern two thirds of the state were becoming very serious..". In a similar vein, the 8 June 1934 edition of the Morris Tribune reported that a drought breaking 1.8 inches of rain had been recorded at the Morris station on 6-7 June, the area's "single heaviest rainfall" since 30 November 1930. The rain, it was said, had "renewed hopes for the corn crop," making possible "the raising of some forage crops". And in New Ulm, the 15 June 1934 edition of the Brown County Journal jubilantly reported that "New Ulm and Brown county are temporarily out of the drought area. Rains during the last week were copious and the whole landscape picture has changed within the last ten days. A car ride through this section of the state presents a far different picture that it did ten days ago. Vegetation has taken on a new life,

pastures have turned green where they were almost burned out and the corn crop has advanced. Farmers having herds of milk cows are pleased that the moisture is assisting pastures. The heaviest precipitation was on Thursday afternoon [7 June] when 3.45 inches fell. Pot holes and small streams were filled with water. Gardens took on a new life. Flood conditions prevailed Friday [9 June] in many sections where a barren, crusty soil existed a week ago. Torrents of water swirled down ordinarily dry stream beds".

Although temperatures during the period, 7-17 June were generally moderate, heat, accompanied by renewed drought, returned at mid-month. Beginning on 18 June, temperatures in the 90's F again became common (e.g. 94 F at Morris, 93 F at New London and 92 F at Montevideo and several other stations), culminating in a heat wave which persisted over most of the state from 22 through 30 June. A record June maximum of 104.2F was recorded at the Minneapolis Weather Bureau station on 27 June, a day which, according to the station's daily meteorological journal opened with "heavy dew" and a sky that was about ninety percent covered with stratus clouds. Cloudiness decreased to about thirty percent by 1000 hours, increasing later in the day, producing a "sprinkle" of rain at about 1300 hours. Mostly clear conditions, it was said prevailed during the remainder of the afternoon with 83 percent of possible sunshine recorded for the day as whole. On the following day [28 June], the station recorded a maximum of only 90 F, a decrease attributable in part to afternoon cloudiness (and the apparent passage of a weak cold front). According to the station journal, cloud cover increased rapidly after 1200 hours and by 1330 hours the sky was "mostly covered" with stratus, altostratus and altocumulus clouds. A few light "sprinkles" of rain fell between 1330 and 1500 hours. Peak wind was twenty one miles per hour from the north and, despite the extensive cloud cover, station instruments measured 78 percent of possible sunshine.

Elsewhere in the state the June heat wave brought temperatures in the 100's F to many locations during the last week of the month. Representative readings included 100 F at Albert Lea, Rochester, Zumbrota and Faribault on 23 June; 101 F at Grand Meadow on 23 June; 104 F at Albert Lea and Fairmont on 27 June; 106 F at Faribault on 26 and 27 June; 105 F at Rochester and Waseca on 27 June; 106 F at Maple Plain on 27 June; and 108 F at New London on 27 June. In words reminiscent of its May 1934 weather stories, the 23 June 1934 edition of the St. Paul Dispatch noted one heat related death, stating that a "scorching sun sent St. Paul temperatures bounding toward the 100 degree mark...the entire Upper Mississippi valley was a furnace, heat waves shimmering over the farm lands....". Although drought was general over most of the state during the last three weeks of the month, some areas did receive substantial amounts of rain on 17 June and again on 20 and 25 June (e.g. Redby, 1.86 inches on 20 June; Ada, 1.63 inches on 20 June; and Milaca, 1.87 inches on 25 June). The late June rains were, in fact, sufficient to once again restore the optimism which accompanied the month's early rains. The 28 June 1934 edition of the Marshall County Banner (Argyle) reported, for example, that "bountiful rains and moderate temperatures throughout the past week gave wonderful weather conditions that have made almost unbelievable improvement in crops. Fields that appeared to have been completely ruined by the early drought and high winds have revived. The weather conditions have been ideal for combating the grasshoppers....". Similarly, the Brown County Journal (29 June 1934) reported that "a crop and pasture survey of Minnesota reveals hopeful conditions due to

recent rains. West central Minnesota is hardest hit and because of the drought and hot winds of May, little recovery is expected for small grains. Northern Minnesota with more abundant rains and a good carryover of moisture from winter storms is apparently in the best crop condition of any section of the state. Most sections of southern Minnesota will harvest a better than average corn crop. Practically all sections will be short of hay. Conditions in Brown county have greatly improved since the rains of several week ago".

July 1934, like late June, was hot and, despite persistent but scattered shower activity, was generally dry. Precipitation statewide averaged 2.24 inches, a value about one third below the then accepted statewide July average of 3.35 inches. Although daily rainfall amounts of one inch or more were common (e.g. 1.35 inches at Albert Lea on 9 July; 1.60 inches at Fergus Falls on 9 July; 1.40 inches at Rochester on 10 July; 1.48 inches at St. Peter on 6 July; 1.74 inches at Tracy on 6 July; 1.48 inches at Crookston on 12 July; and 2.20 inches at Wheaton on 12 July), many Minnesota stations remained dry throughout the month. At Minneapolis, the month produced only one significant rain event, 0.79 inches on 9 July, the remainder of the month producing a scant 0.61 inches of moisture. At Beardsley in far western Minnesota, only 0.39 inches of rain fell during the entire month and many stations, as noted previously, recorded monthly totals of less than one inch. Temperatures, although warm, remained at or near seasonal normals until 17 July when another of 1934's many heat waves pushed temperatures to 100 F or higher at many stations on many days during the remainder of the month. Readings other than the previously noted 113 F at Milan on 21 July included 101 F at Rochester on 22,23 July; 108 F at Morris on 22 July; a string of 100 plus readings at Willmar, 19-23 July; and three consecutive days with maxima of 105 F at the Minneapolis Weather Bureau station, 21-23 July.

Newspaper accounts of July's weather were typically dour or worse, one of the most dour of which appeared in the 27 July edition of the Morris Tribune: "a new all time record [was] established Sunday [22 July] when a blistering sun accompanied by a searing wind sent the temperature to 108.5 degrees [officially recorded as 108 F]. Sunday was the hottest day of a July heat wave that extended over a week. The heat wave did considerable damage to corn, many fields withering and shriveling under the hot blasts". More of the same followed a week later, the 3 August edition of the Tribune dejectedly reporting that the "harvest season is in full swing but there is little for farmers to do. Many Stevens county farmers received nothing at all from their small grain fields. Some farmers are now cutting their corn in an effort to obtain some forage...". And on 17 August, the Tribune noted that the area extending from west central Minnesota eastward through central Minnesota had been "most seriously" affected by the drought: "in western counties there is practically a failure of all principal crops". In a story which expressed a view somewhat different from the Tribune's report, the 13 July 1934 edition of the Brown County Journal claimed that the "copious rain [1.55 inches] of Thursday night [12 July] was greatly appreciated and came just in time to assist the potato crop as well as other garden crops". On 3 August, the Journal, again in contrast to the Morris Tribune's 3 August lament, stated that small grain yields in the New Ulm area had exceeded expectations "in some fields". Wheat yields, it was said, ranged from six to thirty bushels per acre, oats yields from twenty to thirty five bushels per acre. Moreover on 5 August, the Minneapolis Tribune reported that "with harvesting well underway in most of the northwest", reports indicated a wide range of yields. A report from

Worthington, it was claimed, indicated a crop yield averaging "about fifty percent of normal" in Nobles county. "Good yields were in prospect in Lake county". In Washington county yields, however, were said to be about twenty percent of normal. The Tribune also noted that grain had "ripened too rapidly because of the drought". Several days later (7 August), the Tribune further reported that "grain prices in Minneapolis and other markets shot into record highs for the year on Monday [6 August] as reports were received of increasing damage to corn and Canadian wheat. Late summer reports from the Argyle vicinity were, like earlier reports from the same area, sometimes pessimistic and sometimes optimistic. On 12 July 1934, for example, the Marshall County Banner claimed that "another week of good weather and with showers of rain, conditions have been ideal for the crops and they are making good progress". The mood soon changed, however, the 19 July edition of the Banner complaining that "a week has passed without any rainfall and with the mercury soaring into the 90's, crops are beginning to suffer for moisture. Unless rain comes soon, late seeded crops of which there is a large acreage owing to reseeding of fields destroyed earlier will not survive. The plentiful rain that had fallen through June gave the late crops a splendid start but they are now getting a set back". This view of the situation was repeated on 26 July, the Banner stating that "continued hot weather without rain is forcing grain fields to premature ripening and will cut down expected yields". Temperatures, it was noted had reached 102 degrees on 18 July. A week later (2 August), the Banner reported that the area's harvest was underway "with ideal weather". The account then went on to quote a USDA report indicating that crop conditions were "best" in the Red River valley and "certain areas" in the southern part of the state. "West central Minnesota, the main drought area in 1933 has been hit hard again. Hay and pastures are seen as the main problem". And on 9 August, the Banner reported that "flax has been subjected to a severe scorching from the heat wave this week. Late fields are showing the effects of the scorching heat and lack of moisture and flax crops that looked so promising are being prematurely ripened. Corn fields, potatoes and gardens are withering under the scorching heat".

Finally, on 16 August, the Banner carried a story that, at least in the view of its journalist author, provided readers with a definitive account of the 1934 crop situation, both in the Red River valley in general and in the Argyle area in particular. Faced with what seems to have been a possible loss or reduction in the amount of state drought relief aid allocated to Marshall county, the Banner's story was emphatic (even defiant), asserting that although "Good average crops" had been harvested in parts of northern Minnesota, the Argyle area had remained dry, suffering extensive agricultural losses. According to this article, "reports sent out have created the belief that the whole of the Red River Valley is a favored section of the United States and has produced a bumper crop this year, which is not the case. It is true that sections of the valley where there was sufficient rain have a good average crop, but Marshall county is in the dry area of the valley and crops here have suffered from the drought and are not to be compared with those of other sections. Records of the government weather bureau at Argyle show that the moisture from snow and rainfall from October 1, 1933 to June 1, 1934 was but three and three quarters inches. During the twelve months of 1933 there was twelve inches of rainfall, which is far below normal, following previous years of insufficient rain, which left little subsoil moisture to draw from. As a consequence pastures have been killed out and tame hay crops destroyed, leaving many farmers without feed for their stock for the coming winter. The county has not suffered from

the drought alone. The northern part of the county where crops were most promising in the early season was swept by a disastrous hailstorm in July that left fields over a wide area a total waste. The relief office at Warren recently received a letter from W. H. Lamson, Secretary of the Executive Council at St. Paul revealing that the council was not rightly informed as to the actual conditions in Marshall county, as he expressed the belief that there had been sufficient rain here and that we had a good crop and was surprised that application should come from Marshall county for drought relief."

Although some analysts contended that the effects of the 1934 drought had been "over emphasized" (Minneapolis Star, 18 August 1934), most conceded that its human and economic toll had been substantial if not enormous. On 11 August 1934, the Minneapolis Tribune reported that the federal government had predicted the "smallest yield of grain in thirty years," and that ravaging drought had affected not only the grain crops "but directly or indirectly the entire food supply of the nation and cotton as well". The year's production of corn, it was said, was expected to be half a billion bushels less than was predicted on 1 July. Overall, crop yield estimates declined eleven percent from the July estimates and growing conditions were reported as poor everywhere except along the Atlantic coast. The condition of Canadian field crops had also "declined sharply" during July, the result of high temperatures and drought. The same report further asserted that American farmers were not expected to receive more for their products than they had in 1914. Similar accounts, all of them suggesting extensive crop damage (devastation?), appeared at other times during the summer, the 12 July edition of the Marshall County Banner reporting, for example, that the U.S. Department of Agriculture's crop estimates "disclosed that the drought has sharply reduced the prospective yield of flax and rye in the leading producing states, Minnesota and North Dakota. This was followed by a USDA release which, as quoted in the 30 August edition of the Banner, reported the "smallest [Minnesota] flax crop on record". Total yield was estimated at 5,252,000 bushels compared to 6,806,000 million bushels in 1933 and the 1927-1931 average of 18,664,000 bushels. The same report once again noted that west central and central Minnesota had suffered most from the 1934 drought and that in western counties there was "practically a failure of all principal crops". And on 18 October 1934, the Banner quoted yet another USDA report, stating "that if west central Minnesota had not experienced the worst drought in the history of the state, 1934 crop production would have been close to the ten year, 1921-1930, average. According to the same report, combined yields were 59.3 percent of the ten year average in Minnesota; 53.5 percent in Iowa; 38.6 percent in North Dakota; and only 22.3 percent in South Dakota. "Fairly good yields" were reported in southern Minnesota while the Red River valley, it was claimed, had "average yields on the whole".

Predictably, the federal government's dire 1934 crop reports, together with massive anecdotal evidence provided by farmers with burned out fields and pastures, raised the specter of food shortages and higher consumer food prices. In this regard, the 11 August 1934 edition of the Minneapolis Tribune reported that the then U.S. Secretary of Agriculture, Henry A. Wallace, had recognized the growing public concerns, reiterating that "there was no danger of food shortages" but that food prices would be "higher". Although widespread food shortages (famine) did not occur in the United States at any time during the 1930's, large numbers of people were left destitute, often finding it difficult, sometimes

impossible, to provide food for themselves and their families. As a result, there were undoubtedly cases of malnutrition and, worse, deaths directly caused by hunger. Food prices also rose, modestly in most instances. Also, despite large amounts of government aid, the farm unrest that had become prevalent during 1933 continued into 1934, the result of economic and psychological distress attributable to the twin curses of drought and depression. As early as 19 January 1934, the Morris Tribune reported that the Stevens county drought relief office had received 665 applications for federal drought relief funds and that "several carloads" of animal feed had been distributed to the county's distressed farmers. On 2 March, the Tribune noted what it called "open rebellion" among Stevens county farmers, many of whom were angered by what they perceived to be an inadequate county relief effort. A group of thirty five farmers, it was said, had presented their complaints to Minnesota Governor Floyd B. Olson, charging that the county had not received the amount of drought aid that it was promised. According to the Tribune, Stevens county had, prior to March, received only nine carloads of federal drought relief feed "while other counties received a great deal more". On 9 March, the Tribune reported that, during the first week of March, the county had received and distributed ten carloads of grain, seven of wheat and three of oats, shipments which may have been expedited as a result of the previous week's "rebellion". The Tribune also noted that a group of Stevens county farmers had met with Governor Olson, proposing that the government grant seed loans to farmers on a ten percent repayment basis. Tensions apparently continued to rise as summer wore on, the 29 June 1934 edition of the Tribune disapprovingly reporting that "a mob of between 150 and 200 farmers Saturday morning crowded into the office of [Stevens county] sheriff S. J. Ryan at the court house and forcibly prevented sheriff Ryan from carrying out a scheduled farm mortgage foreclosure. It was the first time a foreclosure sale had been stopped in Stevens county but it has been a common occurrence in other counties in Minnesota..." (emphasis added).

In addition to the extensive crop losses resulting from 1934's excessive heat and lack of moisture, many farmers, as noted previously, were hard pressed to provide adequate food and pasturage for their livestock. The severity of this problem was emphasized by the Minneapolis Tribune (17 May 1934) in a story announcing that ".....plans were formulated for government purchase of endangered livestock....". The same account noted that pastures in many parts of the state were totally devoid of grass and that farmers, in desperation, had begun herding cattle to the grassy, weedy areas along Minnesota roadways. Several weeks later (4 June), the Tribune reported that "more than one hundred Minnesota farmers had signed contracts for government purchase of starving animals in the first hours of the relief drive.....plans were formulated for movement of starving cattle from farms to 85,000 acres of the Mississippi Wild Life Refuge in Minnesota, Wisconsin, Iowa and Illinois for grazing under federal supervision...". At about the same time, Minnesota governor Floyd B. Olson imposed an embargo on the shipment of cattle into Minnesota for grazing purposes, ordering the Minnesota National Guard to patrol duty on Minnesota's borders. This effort, however, may have been ineffective, perhaps even unnecessary and ill-conceived. But whether effective or not, it was mocked by the Brown County Journal (22 June 1934): "Minnesota has won her big cow war declared several weeks ago by Governor Olson. This war was the most spectacular war that the state has ever been engaged in and the 574 guardsmen and twenty four officers are now at home recuperating from their task of chasing

straggling cows which wandered over the border from adjoining states. The embargo will be kept in effect, however. The governor asserted that no cattle would be permitted to be shipped into the state except to market. It was necessary to turn back few, if any, cattle coming into the state for feeding purposes". Movement of cattle from desiccated pastures to more promising grazing areas was, however, often seen as a viable alternative to slaughter (or starvation). The 25 May 1934 edition of the Morris Tribune reported, for example, that some Stevens county farmers were attempting to rent pasture land in Wadena, Aitkin and several other north central Minnesota counties, negotiations which apparently had been partially successful, "several herds already having been moved". Such arrangements were nevertheless sometimes resisted by farmers in the more verdant areas. The 31 May edition of the Duluth Tribune, as an example, reported that county agents in the Duluth area had opposed plans to ship livestock into the Lake Superior counties. There was, it was said, "no pasturage to spare" in St. Louis county and, according to the Douglas county, Wisconsin county agent, his area didn't "have enough feed for its own livestock". Yet, according to the Marshall County Banner (5 July 1934), "a survey conducted by the Division of Lands and Minerals in northern Minnesota disclosed that seven counties have surplus pasture that can adequately take care of 70,000 to 83,000 additional head of cattle in the event that hay and feed shortages continue in drought areas. F. A. Wildes, director [of the land and minerals division] stated that more than 60,000 acres have already been leased, principally for hay and pasturage purposes". And in a 16 August article which suggested that the division's survey had been taken seriously, the Banner reported that "seventeen carloads of cattle arrived at Baudette the first of the week, the first shipment of cattle being taken to Lake of the Woods county from sections affected by the drought. Those taking cattle for grazing will receive a dollar per head for the period of grazing which will end October 15..".

As in 1933, various government agencies attempted to allay livestock food shortages by shipping hay and feed into distressed areas. In this regard, the 18 May 1934 edition of the Morris Tribune noted that the "county relief office was kept busier than usual distributing feed and hay shipped to the county [Stevens] for distribution to farmers". Similarly, the 4 May 1934 edition of the Minneapolis Tribune announced that the federal relief administration had allocated an "additional" \$800,000 for drought relief in forty one Minnesota counties. "This amount," it was claimed, "was considered sufficient to keep starving farm animals alive until farmers can grow their own feed".

Although movement of livestock to remote pasturage and distribution of hay and feed undoubtedly did save many farm animals from the ravages of the 1934 drought, many others were slaughtered, shipped off by farmers whose dire circumstances forced them to reduce the size of their herds and flocks. This was done either through participation in federal programs which paid farmers for marketing or slaughtering animals (as well as by curtailing breeding) or, more directly, by shipping animals to slaughterhouses, accepting current (and probably depressed) market prices in return. The magnitude of the sell off was huge: according to the 5 March 1935 edition of the Brown County Journal (New Ulm), North Dakota farmers were "forced to part with 977,120 head of cattle in 1934, more than fifty percent of a total of 1,888,401. The cattle population was reduced by about ten million nationwide". On 29 May, during the height of the late May heat wave, the Minneapolis

Tribune announced that "Dean Walter C. Coffey, head of the college of agriculture at the University of Minnesota, was named Wednesday [23 May] as regional director for six northwest states of the federal-state drought relief program. His selection and that of six state directors took place at a morning meeting at University Farm, at which organizational plans were perfected for the great drive for help to farmers in drought areas. The first step, that of the purchase of 1,200,000 cattle in the drought area embracing 134 counties in Minnesota and the Dakotas and six in Texas will get underway Friday, and it is hoped to have the major portion of the buying completed within ten days.....The program, shaped ...by officials of the AAA [Agricultural Adjustment Administration] and the department of agriculture in cooperation with state farm school experts and agricultural leaders, centers on purchase by the government of cattle for which there is no feed because of drought damage to crops and pastures...". And, on 7 August 1934, the Minneapolis Tribune announced that "U.S. Comptroller General McCarl has approved the expenditure of \$10 million for drought relief funds for the purchase of sheep and goats in the western drought area. Between three million and five million sheep and goats are expected to be purchased. The government will buy only ewes, paying \$2 for animals one year old or older and \$1.40 for angora goats one year old or older. The purchase is necessary to relieve emergency conditions in the drought stricken areas". In a similar report, the Marshall Messenger (18 May) announced that the "government will start buying cattle immediately from farmers on relief rolls or those in distress". Interestingly, the same edition of the Messenger claimed that three thousand to four thousand South Dakota farm families "might be moved to state owned farms and given a chance to buy them on reasonable terms". The Morris Tribune also reported extensively on the cattle buying program, announcing as early as 1 June 1934 that the federal government was beginning to purchase cattle "on the drought stricken farms of the northwest in an effort to relieve the serious lack of feed". The purchase price, it was said, would range from \$4 to \$20 per head with about five thousand cattle expected to be slaughtered in Stevens county alone. The same article also noted that St. Paul markets had been flooded with "emaciated cattle arriving by truck and rail from virtually all points in the five northwest states". Two weeks later, the Tribune noted that "fourteen carloads of cattle purchased in Stevens county by the federal government have been shipped to [the] So. St. Paul stockyards". And on 22 June, the Tribune reported that "thirty five carloads of cattle numbering over 1,300 have been shipped from Stevens county since the drought relief purchasing program was started". In still another account, the Milan Standard (15 June 1934) reported that four carloads of cattle had been shipped from the local stockyards to the So. Omaha, Nebraska stockyards "under the cattle buying plans of the FERA [Federal Emergency Relief Administration]. The same edition of the Standard further noted that "a shipment of 60,300 pounds of soybeans" had arrived in Montevideo and would be "distributed by the Chippewa county relief office to all persons eligible for seed". And on 31 May, the Marshall Messenger announced, somewhat dramatically, that the government "sharpened its axe today preparatory to starting a wholesale slaughtering program to free from misery a million drought stricken cattle and simultaneously aid their financially stricken owners. Cattle unfit for food will be killed and buried on the farm. Meat from cattle fit to be shipped to packing plants will be distributed to the poor. Owners will be paid \$4 to \$20 per head". The emergency cattle buying program was, however, apparently discontinued in the autumn of 1934, a decision which seems to have been opposed by Minnesota drought relief officials. According to the Minneapolis Star (6 October 1934), the government had

recently proposed ending the program, provoking "vigorous protests" on the part of county drought relief directors. State drought relief director P.E. Miller, it was said, had estimated that "an additional 50,000 cattle" should be purchased in Minnesota "to relieve drought stress". And, according to the 20 October 1934 edition of the St. Paul Dispatch, the AAA announced that it had, since 1 May 1934 and at a cost of \$3.5 million, bought 240,116 head of cattle and 15,000 head of sheep in Minnesota and "other states".

However, as noted previously, the government's livestock purchasing program had several objectives, one of which, as stated, was short range, compensating farmers for disposing of animals threatened with starvation. The second was a longer range objective, namely the reduction or even elimination of the surpluses that had depressed the farming sector of the economy during the 1920's and, despite the drought and talk of food shortages, during much of the 1930's as well. Farmers, accordingly, were paid for reducing the production of livestock as well as the production of field commodities such as corn. Many Minnesota farmers, attracted by the prospect of government payments and the longer range prospect of higher prices for their commodities, were eager to participate in the program. The 2 March 1934 edition of the Milan Standard reported, for example, that about sixty percent of "all corn and hog raisers in Chippewa county have signed contracts in the corn-hog reduction campaign". But, on 13 August 1934 the Minneapolis Tribune reported that "planning wartime vigilance over the nation's food and feed supplies next fall and winter, the AAA is preparing a drastic revision of its 1935 grain control program. Next year's [AAA] wheat acreage plan is likely to call for the same acreage planted during the years 1927-1932 rather than a fifteen percent reduction from that figure". Although the Tribune did not say so directly, the pending rollback probably reflected fears that further cutbacks in grain production might, immediately following 1934's disastrous crop season, create serious shortages of cereals. The government's efforts to curtail agricultural production did, of course, continue, the New London Times (1 August 1935) reporting, for example, that "corn-hog contract signers who this year fail to produce or who do not at least try to produce at least twenty five percent of their 1932-1933 base hog production may be disqualified from receiving 1935 hog payments. With the large number of sows being sold every day to the packers and with feed crop prospects in almost all parts the state the best they have been for several years, practically all contract signers should be able to comply....". Predictably, the AAA's programs, together with drought induced crop losses did drive up the prices that farmers received for their commodities (or at least for those farmers that were fortunate enough to have commodities to sell). The effect of the higher prices was highlighted by the Minneapolis Star (11 October 1934) in a story which stated that "with the farm value of Minnesota's principal crops already up approximately \$2 million since September 1, farmers of the state are holding their corn for a boom following the government crop report which predicted the smallest crop in forty years...". All of which prompted Chester C. Davis, Minnesota AAA administrator, to boast (Minneapolis Star, 12 October 1934) that "the first major objective of the AAA, adjusting production to consumption, has been reached. From this point on the problem is to maintain this balance".

All things considered, then, state and federal expenditures for the purchase of livestock, feed, hay and seed grain and other 1934 agricultural drought relief measures were large (large at least by the fiscal standards of the day). In at least some instances, however,

farmers were enjoined to "repay" the benefits received, not in cash but in contributed time and labor. The 20 July 1934 edition of the Morris Tribune reported, for example, that "work projects were being laid out so that many farmers will begin working out the value of the hay and feed they have received in recent months". The projects, it was said, would include "such jobs as cleaning and brushing " along roadways and "cleaning out culverts, road ditches and bridges". And, although material gleaned from other 1930's newspapers indicates that Works Progress/Projects Administration (WPA) and Civilian Conservation Corps (CCC) projects sometimes provided employment for economically distressed farmers, there was little to suggest that in-kind payback programs of the type described by the Tribune were either extensive or effective.

Nor were farmers the only ones adversely affected by 1934's hot, dry weather. Predictably, conditions during much of the year were conducive to an outbreak of forest fires and grass fires. As early as 30 March 1934, the Milan Standard warned that "because so many parts of the state are extremely dry" there was a "great danger" of fires. And the threat, not surprisingly, soon became very real, the 1 May edition of the Minneapolis Tribune reporting that a fire that had "raged through the state game preserve in Anoka county and laid waste to an area of twenty five miles" . The fire was, however, "checked Monday [30 April] by a heavy shower just as the flames once more got beyond the control of fifty volunteer fire fighters and threatened the village of Wyoming. Several buildings burned at Wyoming and every able bodied man was called out Sunday night [29 April] to fight the spreading fire". The Marshall Messenger (1 May 1934) commented on the same event, stating that the fire had destroyed farm property and killed "thousands of game birds" On 11 May, the Tribune reported that the village of Pease, five miles north of Milaca, had been similarly endangered when "high winds drove a peat bog fire into the town, threatening to destroy the entire village". Several buildings were burned but the town itself was saved by "dying winds". The Tribune also reported that a "serious fire" had broken out near Hudson, Wisconsin "where wind fanned flames through a sanatorium housing thirty patients, razing five buildings". Similarly, the Marshall Messenger (2 May) reported that a brush and timber fire had broken out near Onamia, menacing the community, a threat which ended when a light rain "smothered the flames". A week later [9 May], the Messenger reported that a "wind whipped conflagration" had "threatened the extinction of the city of Wabasha, terrorized the city's three thousand residents early today [9 May] and spreading through warehouses, elevators and other buildings caused several thousand dollars in damage. The terrific blaze lashed by high winds was brought under control after a desperate struggle by firemen from three neighboring communities, the Wabasha fire department and hundred of volunteers. A gale which blew away from the city saved the community itself from destruction. The blaze may have been started by spontaneous combustion in a grain elevator".

The danger of grass and bog fires was soon followed by an imminent outbreak of forest fires, the 10 May 1934 edition of the Duluth Herald warning that although no forest fires had been reported in the "immediate vicinity" of the city, the "hazard is now extremely high according to state forestry officials". This was followed by a 12 May story in which the Herald announced that "CCC workers and forestry employees will be stationed at strategic points throughout the Superior National Forest to be on hand in case of fire outbreaks". The opening of the 1934 fishing season, it was added, had heightened the need for

"precautionary measures".

By the end of May, forest fires had broken out in many parts of northern Minnesota, one of which according to the 28 May 1934 edition of the Herald had "leveled a wooded area of approximately 640 acres near Lake Eshquaguma before being brought under control by a crew of three hundred recruited in the district. Two Virginia, Minnesota women narrowly escaped death when driving in the path of the roaring fire". The Herald also noted that "at least ten forest fires were reported burning in various section of northeast Minnesota. A fire at Lake Nichols, thirty miles north of Duluth yesterday swept over a large area on the south shore of the lake. A fire at Bass Lake, east of Cotton, burned four hundred acres".

According to the Marshall Messenger (28 May 1934), the Nichols Lake fire burned eight cabins and houses and, at the scene of another fire near International Falls, firemen, it was said, had saved fifteen homes with water drawn from a nearby creek. The next day [29 May], the Herald cautioned that the "forest fire situation remains grave," but noted that "a new blaze covering about thirty acres near Finland is under control". Moreover, on 31 May, a Minneapolis Tribune headline announced: "Forest Fire Hazard Increases: One Death in North Woods Reported". And, four days later (4 June), the Tribune stated that forest fires were "raging beyond control" in northern Minnesota.

Forest fires, of course, continued to erupt throughout most of the summer of 1934 and, like such fires in other drought years during the 1930's, were the cause of much human suffering and loss of property. Northern Minnesota forests, however, were not the only natural resource threatened by 1934's adverse weather: Minnesota's usually plentiful water supply was threatened as well, lakes and river levels dropped, subsoil moisture was depleted, farm wells ran dry and wildlife perished. The 3 August 1934 edition of the Brown County Journal (New Ulm) reported, for example, that "the dry bed of the Minnesota river at Granite Falls is having its second good sized drink in nine months, quenching its thirst with water from Lac Qui Parle Lake. The water is being released to relieve an emergency situation in Granite Falls. Last year the river was much drier than it is now". Yet, in a statement seemingly at odds with its earlier statement, the 10 August edition of the Journal noted that the "Minnesota river is at its record low at many eastern Minnesota points," adding, somewhat incongruously (and arguably inaccurately) that "rains during the early part of July broke the drought in this region". Low water levels, sometimes accompanied by slow burning fires in desiccated peat bogs and dried up lakes and sloughs, were also a source of environmental pollution, an unpleasant instance of which was reported by the Minneapolis Star (14 August 1934): "low water levels are blamed for the thick and unpleasant aroma from the Mississippi river near the Ford bridge and the acrid aroma arising from peat bog fires along Minnetonka Boulevard between St. Louis Park and Minnetonka Mills. The fires are burning slowly and making life miserable for persons in the area. Low water levels [have stopped] the normal carrying away of sewage and runoff of oils and other stuff from industrial plants. G. E. Lyon of the army engineers' office in St. Paul stated that the flow of water over the dam was is now about 700 cubic feet per second, an extremely low rate. On August 3, the rate was 502 cubic feet per second, the lowest in the river's history". And, as if to dramatize the extent and depth of the 1934 drought, the Marshall County Banner (8 November 1934), claimed that U.S. Weather Bureau records "show a precipitation deficit of approximately 57,869,988,978,643,896 [57.9 quadrillion] gallons of water" since 1 January 1920. Since that time, it was stated, Minnesota "as a whole in 39.51 inches behind in precipitation which

if laid out evenly over the entire area would amount to 7,736,629,542,572.7 cubic feet of water. From January 1 to August 1, 1934, the deficiency alone amounts to 5.42 inches and has been responsible for the lowest water levels in the history of the state. But one year of the past fifteen, 1928, gave Minnesota a normal rainfall" Interestingly, also, the drought adversely affected state highway construction and maintenance operations, the Duluth Herald (18 May 1934) noting that, according to the state highway department, "continued dry weather has made smoothing operations difficult on gravel and light bituminous roads, resulting in excessive amounts of loose gravel and rough spots in various places".

Inevitably, 1934's hydrologic crisis provoked disagreements and disputes relative to water policies and practices. One of the more interesting and acrimonious of these was fueled by the New London area's Izaak Walton League, a group which thought that the drought had been caused by (or at least abetted by) the agricultural drainage practices of the 1920's. Articles supporting this view appeared frequently in the New London Times during the 1930's, one of the most vehement of which was published on 17 May 1934: "right now it seems as if only good luck can bring a fifty percent normal crop of small grains. Pastures are barren. Relief hay is being shipped to us from Kansas, Nebraska and Oklahoma at tremendous cost to the taxpayers. The skies seem to be padlocked. For twenty years we have robbed Mother Earth of the water which she was so generously returning to us in time of need. We sent this water down the Mississippi...ditch promoters spent about \$600,000 of county money to dig about four hundred miles of ditch to drain lands which were serving as a water reservoir....". The Walton League's complaints, of course, reflected a desire to protect and maintain wildlife habitats, a concern which pitted sportsmen and environmentalist against farmers and their desire for well drained tillable land. But whether or not the ditching which raised the League's ire was the real culprit or not, it is certain that lowered lake levels, burned out grasslands and dried swamps substantially reduced Minnesota's fish and game bird population. According to the 18 October 1934 edition of the St. Paul Dispatch, the shortage of birds in the "southwest areas due to drought" had prompted the state's commissioner of game and fish to shorten the 1934 pheasant season. This decision which, according to the Dispatch, affected sixty one counties, shortened the pheasant hunting season by seven days (from sixteen and one half days to nine and one half days). Similarly, the 30 October 1934 edition of the Dispatch, announced that, due to a shortage of birds, the 1934 duck season had been shortened and bag limits reduced.

Despite its extreme dryness, the summer of 1934, like the dry summer of 1933, produced a surprisingly large number of severe thunderstorms, some of them accompanied by hail and damaging winds. On 30 April, for example, a storm in the Hutchinson vicinity dropped "marble sized hail" which "completely covered the ground". The storm, however, was "confined to a small area". Damaging winds were reported in the Morris area on 19 June and again on 1 July and, according to the U.S. Weather Bureau's June 1934 Minnesota climatological report "damage from tornadoes and windstorms during the month [June] mainly in the extreme southwestern and extreme southeastern counties was estimated at over \$1,066,200 [1934 dollars]..". According to the 22 June edition of the Milan Standard, a "violent windstorm caused much damage in this area on Tuesday evening [19 June]. Over one hundred barns were damaged in Lac Qui Parle county. The same storm complex did "considerable damage in the New London area, the 21 June New London Times reporting

that New London and surrounding communities were "visited by a severe windstorm on Tuesday night [19 June]". The storm nevertheless was said to have brought "very beneficial" rain. One of the worst thunderstorms of the summer occurred in far northern Minnesota on 1 July. According to the Marshall County Banner (5 July 1934) this storm described as a "terrific hail and windstorm" "broke out along the Canadian border in North Dakota on Sunday afternoon" and "swept in a southeasterly direction across the Dakota line into Minnesota and extended as far south as Bemidji, leaving ruined grain fields and heavy property damage in its wake. Heavy damage reported at the village of Stephen. Argyle was just outside of the storm's fury". And, according to the 8 August 1934 edition of the Minneapolis Journal, "a blanket of rain swept across North Dakota and Minnesota closely behind FDR's special train last night and early today, drenching each parched pasture and field upon which the president's eye had rested. The rain cut a swath approximately one hundred miles wide across North Dakota and Minnesota with the heaviest fall concentrated on the cities the presidential train visited," cities which included Devils Lake and Fargo, North Dakota and Breckenridge, Morris (1.19 inches) and Willmar (0.62 inches) in Minnesota. "Some" storm damage was reported and, in the Twin Cities area (0.69 inches), there were reports of a "possible" tornado which, fortunately, did not reach the ground. The worst storm of the summer, however, swept across much of Minnesota on 18-19 August. This storm, which marked a transition from heat and drought to a cooler, wetter regime, reached "near tornadic proportions, bringing death to three persons, injuring several others and leaving a trail of property damage from one end of the state to the other" (Minneapolis Journal, 19 August 1934). In its 19 August edition the Minneapolis Tribune stated that "preceded by swift black clouds that turned day into night, a violent electrical storm driven by a fifty mile per hour wind swept through the Twin Cities and the northwest late Saturday afternoon [18 August] and left death and destruction in its wake. It took a toll of three lives, two on the iron range and one in St. Paul and threw into darkness the city of Wausau, Wisconsin, as well as Shakopee, Robbinsdale and Deephaven in Minnesota, destroying buildings, uprooted trees, [breaking] windows, caused fires and impeded communications and traffic. It churned up lakes and tossed boats on shore....John Hall, a Cloquet farmer was killed when his small house was picked up by the wind and dashed to earth two hundred feet away....Dr. George Young...Minneapolis was injured when his hydro-airplane was lifted from South Long Lake near Brainerd and thrown against trees along the shore.....".

But, despite the change in weather patterns which temporarily ended Minnesota's extreme drought, other parts of the country were not so fortunate, some of the worst weather conditions of the 1930's occurring not in 1934, but in 1935. With the possible exception of the Great Drought of 1930, the drought of 1934 was, however, more widespread than any of the 1930's droughts (including 1936) that followed or preceded it. According to the 8 February 1935 edition of the Brown County Journal, "one fourth of the [then] forty eight states had the least ever recorded rainfall or their rainfall approximated previous dryness records. Record dry states included South Dakota, North Dakota, Colorado and Indiana. All sections of the country except along the Atlantic coast, the Gulf area and the Pacific northwest had less than normal rainfall..". The Journal also noted that North Dakota had received only fifty four percent of its normal rainfall during 1934 and that temperatures for the entire year were "much warmer than normal" over most of the United States". Other

sources noted that in May 1934, drought conditions prevailed in twenty seven states, covering more than seventy five percent of the country. The Weather Bureau's Monthly Weather Review indicated, moreover, that, with the exception of a small area in the southeastern United States, the entire country experienced above normal temperatures during May. And, with the exception of a few areas chiefly in the southeast and mid-Atlantic, May precipitation was below normal. Temperatures during June and July 1934 were above normal in virtually all parts of the country and, except for a few favored locations (far southeastern Minnesota among them), July's heat was combined with widespread drought. For the year as a whole, temperatures averaged above normal, the exceptions being confined to areas of the northeastern United States, New England especially. The year's warmth was, not surprisingly, combined with below normal annual precipitation, only a few small, favored areas (extreme southeastern Minnesota again among them) receiving above normal amounts of moisture. Still another indication of the extent and depth of the 1934 drought was provided in an article written by Marshall J. Chambers, an Albuquerque, New Mexico Weather Bureau official and published in the January 1935 issue of the Monthly Weather Review. He stated that "the 1933-1934 drought was by far the most severe of any in the history of the state (New Mexico). There have been periods when less precipitation was received but never before a drought when temperatures remained so consistently high for so long a time.....Some twenty individual station records of heat were broken and the extreme heat record for the state (116 degrees) was equaled. Water impounded in reservoirs for irrigation became increasingly low. Early in August 1934 Elephant Butte reservoir reached its lowest known level...Stream flow, in the largest streams of the state was the second lowest of record....Millions of acres of land remain idle.....In the eastern plains section of the state, top soil was blown from fields and carried until some obstruction....was reached. There the soil was piled up until it reached a depth of four to ten feet. Thousands of miles of fences in this section were buried....Figures compiled by the director of drought relief show that 400,000 head of cattle were purchased before the end of October.....Many thousands of both sheep and cattle perished before the purchasing program was inaugurated....Ranges have reached the worst condition on record...". And, consistent with these and other similar reports, the 1934 edition of the Department of Agriculture's "Yearbook of Agriculture" estimated that, because of drought, approximately thirty five million acres of formerly cultivated land could no longer be cultivated. The yearbook also estimated that 100 million acres now in crops had lost all or most of their topsoil and that, in addition, another 125 million cultivated acres were rapidly losing topsoil.

Locally, the Minneapolis Tribune (1 August 1934) reported that the "Weather Bureau in Washington announced that July 1934 shattered a good many heat records in the middle west and southwest. Never has heat in any one month been so intense over so widespread an area nor have such abnormally high temperatures persisted day after day without a break....The records from some of the country's hot spots include Des Moines, Iowa, Columbia, Missouri, North Platte, Nebraska, Concordia, Kansas, Oklahoma City, Oklahoma and Ft. Smith, Arkansas". Columbia, Missouri and Concordia, Kansas, it was stated, recorded twenty one and twenty three days, respectively, with maxima of 100 F or higher during the month. The Tribune's reports also included extensive, specific coverage of the effects of 1934's late July heat wave, both as it effected the Twin Cities area and the nation

as a whole. This outbreak of hot weather scorched the entire midwest and, as noted previously, raised Minneapolis temperatures to 105 F on three consecutive days. On Sunday 22 July, the Tribune stated that "most of the nation again Saturday [21 July] was nature's oven and Minneapolis was one of the hottest cities in the state. The mercury..reached a maximum of 105.2...The temperature rose rapidly from 73 degrees at daybreak and by noon had gone beyond the century mark...At 7 p.m., the reading was an even 100....The Associated Press reported that the third day of the heat wave had added ninety deaths to its toll, bringing the [nationwide] aggregate to 190 in seventy two hours. 108 F at Cincinnati was an all time record for that city. The Federal Farm Administration added sixty five more counties to the emergency drought relief list Saturday and put forty five others on a secondary classification [as having] the worst crop catastrophe in forty years". In its 23 July weather commentary, the Tribune reported further that "Minneapolis and the rest of Minnesota roasted under a sun Sunday that sent the mercury to 104.8 in the city...the heat was blamed for two deaths in St. Paul...Rising steadily and quickly, the temperatures reached 90 at 10 a.m. and 100 at 1 p.m....many city residents sought some measure of comfort at beaches and picnic grounds. Others stayed home on the theory that a minimum of physical motion would bring the least discomfort". A total of 278 heat related deaths , it was added, had been reported nationwide. On 24 July, after another day of 105 degree temperatures, Tribune readers were promised "cooler weather and relief from the intensive heat". "Four persons in Minneapolis were overcome by the heat and four died in St. Paul...Minnesota deaths due to the current heat [have] reached twenty five. At Quincy, Illinois where the mercury touched 112 degrees, hospitals limited the use of operating rooms to emergency cases....Dr. R. K. Hayes, professor of agronomy at University Farm said Monday [23 July] that the moisture is being baked right out of the soil...He made a trip to the Red River valley and said crops prospects there were fair to good but the soil could not stand many days of the..heat wave". Nationwide, the toll of heat related deaths had claimed to a total of 507, including 125 in Illinois and 154 in Missouri. Finally, on 25 July, the Tribune claimed that "more relief from the heat wave appeared on the way for Minneapolis after the mercury dropped to a high...of 93 degrees at 4 p.m. Tuesday [24 July]....the roasting heat took a toll of ten lives per hour to send the death list above seven hundred for the current heat wave. The midwest saw new, and most disastrous, damage to crops and livestock...".

Reports indicating the extent of the distress and the damage caused by drought and heat also appeared in the 11 May and 8 June 1934 editions of the Brown County Journal, the first of which stated that "as another dry heat wave headed into the northwest Saturday [5 May], the federal AAA [Agricultural Adjustment Administration] issued a statement officially classifying 352 counties in eleven states as drought stricken. One Minnesota county [Nicollet] was included in the group but many more are expected to be added". The second report confirmed the predictions of the first, noting that a number of counties in eight states had been added to earlier lists of "serious drought stricken counties...as relief officials rushed plans" for carrying out a federal \$525 million relief program. Minnesota counties added to the list included (at that time) Blue Earth, Brown, Carver, Cottonwood, Dakota, Goodhue, Jackson, LeSueur, Martin, Nobles, Rice, Scott, Sibley, Wabasha and Watonwan. Finally an article by S. D. Flora, a Topeka, Kansas Weather Bureau meteorologist noted that July 1934, the hottest month of record in Kansas, had caused 206 deaths (with 430 for the

summer of 1934 as a whole). In contrast, only thirty three heat related deaths were reported during July 1931, the state's second hottest July of record.

Yet, as noted, drought conditions began to ease in August 1934, marking the beginning of a period of more temperate weather which, in Minnesota at least, brought heavy autumn rains, generally adequate spring and summer precipitation and, with several notable exceptions (e.g. February and July 1935), cooler temperatures. This interregnum, in turn, was followed by an extremely dry fall (1935), by one of the worst winters (1935-1936) in Upper Midwest (perhaps even national history) and by another round of extreme heat and drought during the summer of 1936. The 1934-1935 hiatus, even though it was followed by another disastrous drought, is, nevertheless, a significant, unique part of the meteorological history of the 1930's, perhaps again at least in Minnesota -- one of the more consolatory intervals in an otherwise notably disconsolate decade.

THE 1930'S HIATUS: AUGUST 1934-AUGUST 1935

Despite its reputation as the month that ended the 1934 drought, August 1934, as noted previously, was in fact a generally drier than normal month. Although heavy rains occurred in a few isolated locations (e.g. Worthington, 3.88 inches on 14-15 August; Fairmont, 2.00 inches, also on 14-15 August; and Chaska, 1.88 inches on 8 August), the month's moisture, although welcome, was generally too late and too little to repair the damage done by the excessive heat and drought which held Minnesota and most of the nation in its grip from early spring until late summer. Moreover, its notably cool ending notwithstanding, the first part of the month was, like July 1934, warmer than normal, featuring temperatures of 100 F and higher at many Minnesota stations (e.g. 104 F at Pipestone and 102 F at New Ulm, respectively, on 8 August; 102 F at Milan, Wheaton and Redwood Falls on 18 August; and 100 F at Morris and Campbell on 18 August). Also, with the exception of the northeast and the mid-Atlantic, August was a hot month nationwide.

Typical reactions to August's weather was, nonetheless, one of qualified optimism, the 17 August 1934 edition of the Morris Tribune reporting, for example, that August's moisture had "revived pastures to some extent but came too late to be of much good to any crops except possibly a few cornfields. In other sections of the state, where all the crops had not been so severely dried and burned, the recent rains will do more good". The 16 August edition of Marshall County Banner (Argyle) expressed a similar view, stating that the recent rains had come too late "to improve conditions except for corn and potatoes". Several weeks later (6 September), the Banner further noted that "soaking rains are needed to replenish the water supply...many wells have gone dry and farmers are obliged to haul water long distances".

Although Argyle received a mere 0.67 inches of rain during the month, the much longed for heavy, soaking rains did fall over much of Minnesota during September 1934, a month which brought generally wetter and cooler weather to Minnesota and much of the central United States. At New London, the 3 September edition of the New London Times reported that 2.60 inches of rain had been recorded on 2 September, letting "the sunshine of hope break through the clouds of dust with which we have been plagued". The same report noted that, as of 31 August, lake levels Kandiyohi county "ranged from nine feet, six inches to one foot, 9.5 inches". Some lakes, it was said, were "completely dried up". Similarly, the 7 September edition of the Brown County Journal (New Ulm) exuberantly reported that "a slow, soaking rain fell Saturday [1 September] over the entire central portion of the United States. Practically all of Minnesota had continuous rain over the weekend with the southern counties getting the greatest benefit". A week later (14 September), the Journal noted that "many southern counties stand to harvest a near normal corn crop," adding that many west central counties had "very poor prospects".

Yet, even though they may have been of limited benefit to 1934's drought ravaged crops, the September rains were sufficient to at least partially restore the state's subsoil moisture, raise lake and river levels and materially improved meadows and pastures. Although significant rains fell in many areas during the first several days of the month and again on 14-15 September, the month's heaviest rains were recorded during the period, 23-26 September, including 5.72 inches at Zumbrota; 4.86 inches at Rochester; 4.18 inches at Red Wing; 3.84 inches at Cambridge; 2.94 inches at New London; 3.56 inches at Mora; 2.67 inches at the Minneapolis Weather Bureau station; and 1.72 inches at Morris. In the New London area, September rainfall totaled 7.77 inches and, according to the New London Times (25 October 1934), water again began flowing under "Neer's bridge". Times readers were also told that the flow into Mud Lake under the bridge "near Metcalf's" was also "quite heavy," the result of September's copious rains.

October 1934, unlike September, was much warmer than normal, temperatures, as noted previously, reaching the mid to high 80's F at many Minnesota stations during the period, 10-16 October. With the exception of a few isolated locations (e.g. Two Harbors, 2.27 inches of rain, 4-6 October), most of the month was also dry, no doubt mitigating the beneficial effects of September's rains. Wetter weather, however, returned during the last half of the month, this time bringing heavy rainfall to northwest Minnesota, an area which, for the most part, had received little moisture during September. Angus, Argyle, Hallock

and Warroad recorded 2.18, 2.32, 1.40 and 2.50 inches of rain, respectively, on 16 October; Roseau, 2.15 inches on 15 October. At Argyle, the 16 October event the first significant rain to fall in that area in weeks was featured by the Marshall County Banner (18 October) as a "heavy rain" which "set in early Tuesday morning" and was "accompanied by thunder and lightning". "The heavy downpour continued through most of the day. Cisterns were filled to overflowing". Still heavier and more widespread rains fell in most areas of the state during the period, 19-22 October, the Morris Tribune (26 October 1934) enthusiastically reporting that an "all day soaking rain" (1.35 inches) had fallen on 20 October. In the Argyle area, the second heavy rain in a week fell on the same day (20 October), "another soaking" rain which, in the words of an obviously pleased (if not jubilant) Banner writer, "combined with mild weather to restore pastures and meadows". The pastures, it was said, were "coming out with heavy green growth that will help to relieve the feed shortage". A similar report from the New Ulm area (Brown County Journal, 26 October 1934) described a "severe electrical storm" which occurred on Friday evening (19 October). "During the storm lightning struck a telephone cable terminal, creating havoc with telephone communications in part of the city. Copious rains fell from Friday evening to Saturday afternoon. The moisture [3.10 inches] was sorely needed and pastures and lawns responded readily. Except for the absence of foliage on the trees, one is reminded of summer by the balmy autumn temperature and the fresh looking flowers in the garden".

Apart from the generous rains that fell in most areas of the state during the month, the most unusual and noteworthy weather event during October 1934 was the cloudburst that flooded the Twin Cities area on 19-20 October. Rainfall amounts during this event included 3.95 inches at Chaska; 2.34 inches at Maple Plain; and 4.03 inches at the Minneapolis cooperative station then maintained by J. H. Aschenbeck. The greatest amounts, however, appear to have fallen over downtown Minneapolis and parts of St. Paul, the Minneapolis Weather Bureau station recording 5.39 inches of rain in a two day period, 19-20 October. Besides bringing much needed moisture, the downpour caused extensive damage in the Minneapolis-St. Paul area. According to the 20 October 1934 edition of the Minneapolis Star, the storm had dropped 4.55 inches of rain "from Friday night up to 7 a.m. today [Saturday], the heaviest rainfall since September 12, 1903, when 4.96 inches fell". "The heavy rain fell in a period of less than eleven hours, reaching its peak shortly before midnight....Rainfall flooded streets in Minneapolis and St. Paul, stalled countless numbers of automobiles and poured into basements. The rainfall was general over Minnesota, parts of Wisconsin, Iowa, North Dakota and South Dakota and had untold value to northwest agriculture. Prof. Andrew Boss of the University Farm said it was of great benefit to winter crops and pastures but the most benefit was building up a supply of moisture for next year. Millions of gallons of water poured into dried up sloughs and raised lake levels. The downpour reached its height just as the Minneapolis Symphony Orchestra ended its first concert of the season at Northrup Auditorium....traffic was entangled on campus for several hours....Some enterprising residents near Clinton Avenue and 36th Street pulled their duckboats out of garages and basements to rescue motorists marooned in their cars at that intersection. The water was two to three feet deep along Wayzata Boulevard in front of Dunwoody Institute and many motorists were forced to abandon their cars....Two hundred calls in one hour to the fire department from residents with flooded basements. In the LaSalle Avenue apartment district many apartment basements were reported flooded so

deep that the furnace fires were extinguished....C. A. Bossen, superintendent of maintenance at the park board estimated that the storm raised city lake levels six inches...".

In a parallel report, the St. Paul Dispatch (20 October 1934) reported three inches of rain at Hutchinson which it said (erroneously) was the heaviest amount of rain recorded outside the Twin Cities. "A few trains were delayed by the downpour. Heavy rains were general throughout the northwest, flooding county roads and raising havoc with hunters beginning the pheasant season. Amounts over an inch were common in Wisconsin and Iowa, less in North Dakota and South Dakota. The storm was marked by almost continuous lightning flashes and the rain flooded old lake beds". The Dispatch also noted that weather related traffic accidents injured eight persons in St. Paul and that washouts had occurred along Pt. Douglas Road southeast of the city and "under" the Northern Pacific Railroad tracks between Kellogg Boulevard and 16th Street. As in Minneapolis, however, the storm was, on balance, beneficial, raising Ramsey county lake levels by about four inches.

Yet, however informative as they were, newspaper accounts of the 19-20 October storm failed to mention several important details which, fortunately, did not escape the attention of Minneapolis Weather Bureau officials. The Minneapolis station's daily meteorological journal noted, for example, that "light rain" began falling at about 1755 hours on 19 October, soon becoming a "steady" and "heavy to excessive" rain which continued until about 2400 hours. A total of 1.76 inches, it was reported, fell in a period of fifty minutes between 2254 and 2344 hours alone. Journal entries on the following day (20 October) stated that the "rain which began yesterday continued with "brief interruptions" until 0915 hours. For three hours and ten minutes beginning at 2210 hours yesterday the rate of fall "continued at a rate of one inch per hour". Another thunderstorm with heavy rain, it was added, developed at 1430 hours on 20 October, producing a brief fall of hail between 1530 and 1540 hours. Conditions on 20 October also included a "light fog" which persisted until late evening.

October's generous rainfall -- or as in the instance of the Twin Cities, excessive rainfall -- was followed by a period of approximately three weeks in which little or no precipitation was recorded anywhere in Minnesota. At Morris, the period from 25 October to 19 November was totally dry; at the Minneapolis Weather Bureau station, only 0.06 inches of moisture fell between 24 October and 18 November; and at Argyle the 21 October to 18 November total was also a mere 0.06 inches. And, while much of the state remained dry throughout November, southeastern Minnesota received significant, sometimes excessive, amounts of rain and snow late in the month (e.g. 1.9 inches at Zumbrota on 20 November). November 1934 was also an unusually warm month, both nationwide and in Minnesota. November's general dryness notwithstanding, late 1934's halting recovery from earlier drought conditions resumed during the early winter of 1934-1935, December and January, as noted previously, bringing heavy snow to many portions of the state. Although it brought welcome moisture to many localities, the December-January snowfall, especially when combined with the bitter cold which often accompanied it, made life difficult in many rural areas. According to Minneapolis Weather Bureau officials "many side roads were blocked for extended period and traffic delayed". Predictably, also, livestock, in many instances already weakened from a lack of summer forage, suffered greatly from the cold.

The winter's cold and snow, not surprisingly, were often accompanied by high winds and rapid changes in temperature. The 28 December 1934 edition of the Morris Tribune noted, for example, that a storm on Saturday [22 December] had "come up suddenly" with winds averaging thirty miles per hour from 1800 to 2400 hours with a "maximum velocity of forty miles per hour". And three days later, Christmas Day, winds reached twenty four miles per hour, temperatures ranging from a maximum of -8 F to a low of -24 F. On 4 January 1935, the Tribune noted that temperatures at the Morris station had ranged from 42 degrees on 2 January to -14 F on 3 January, an "overnight" drop of 56 degrees. The Tribune also reported a minimum of -33 F on 23 January 1935, the lowest temperature recorded in Morris since 26 January 1927. Similar reports appeared in the Brown county Journal (New Ulm), one of which (7 December 1934) emphasized that "more snow fell during the storms of the past week than in any other single month of the past year. Four and one half inches fell in New Ulm on Friday [30 November] and was accompanied by considerable wind. The fall was the heaviest in the eastern part of the state". In contrast, according to the Journal, no snow fell at Marshall, a community a relatively short distance west of New Ulm. The Journal also reported a second storm which "began on Sunday evening [2 December] and continued throughout the day on Monday. Eight and one half inches fell...The snowfall will be beneficial to crops next spring." Unlike the first storm, the second was "accompanied by little wind so there was not much drifting". On 25 January 1935, the Journal reported that a "widespread cold wave extended all the way to Texas". Highways in the New Ulm area were described as "blocked" by snow, curtailing train and bus services. And on 1 February 1935, the Journal noted that "rural mail carriers have had difficulty due to the large amount of snow on highways during January". The same report noted further that the Izaak Walton League, concerned that the deep snow had made it difficult for pheasants to find food, asked local "carriers" to spread corn along the highways in the New Ulm area. Yet, although widespread, the 1934-1935 winter snowfalls missed some areas of the state. The Argyle area, for example, recorded only about twelve inches of snow in December and January combined, prompting the 13 December 1934 edition of the Marshall County Banner to note that "there is barely enough snow to make the ground white and nothing resembling a storm or blizzard has yet been experienced".

January's cold, snowy weather ended abruptly at the end of the month, giving way to a warm, dry February, a month which opened with temperatures in the high 40's F at many stations and, at far northern Two Harbors, with a maximum of 51 F on 2 February. Moreover, 23 February, a day prior to the onset of a brief late season cold wave, brought fifty degree readings to many localities (e.g. New Ulm and Pipestone, 54 F; and Tracy, 52 F; New London and Redwood Falls, 50 F). February's combined warmth and dryness, of course, raised fears of renewed drought. Any such expectations notwithstanding, much of Minnesota, however, experienced a spring which, in stark contrast to the spring of 1934, turned out to be notably cool and wet. This change in the weather pattern unfortunately, affected a relatively small geographical area and it was not until May that wetter than average conditions become general over the Great Plains. Predictably, then, many areas continued to be raked by early spring dust storms, the 1 March 1935 edition of the Brown County Journal article noting, for example that dust storms had swept across "large portions" of the Middle West on Sunday and Monday [25-26 February]. And more storms

followed, a colorful and detailed account of which, including the infamous "black Sunday" dust storm of 14 April 1935, can be found in Donald Worster's book, "Dust Bowl" (op. cit, pp. 14-25). This book, more than any Minnesota newspaper story, provides an extensive account of the disaster, an account which is quoted in part as follows:

"In the memory of older plains residents, the blackest year was 1935, particularly the early spring weeks from 1 March to mid-April, when the Dust Bowl made its full blown debut. Springtime in western Kansas can be a Willa Cather world of meadowlarks on the wing.....lilacs by the porch, a windmill spinning briskly and cold, fresh water in the bucket but not in 1935. After a February heat wave (it reached 75 degrees in Topeka that month), the dust began moving across Kansas, Oklahoma and Texas, and for the next six weeks it was unusual to see a clear sky from dawn until sundown. On 15 March, Denver reported that a serious dust storm was speeding eastward. Kansans ignored the radio warnings, went about their business as usual, and later wondered what had hit them. Small town printer Nate White was at the picture show when the dust reached Smith Center: as he walked out the exit it was as if someone had put a blindfold over his eyes; he bumped into telephone poles...fell to his hands and knees, and crawled along the curbing to a dim houselight. A seven year old boy wandered away and was lost in the gloom; the search party found him later, suffocated in a drift.....Near Colby, a train was derailed by dirt on the tracks and the passengers spent twelve dreary hours in the coaches.....In the following days, as the dust kept falling, electric lights burned continuously, cars left tracks on the dirt covered streets, and schools and offices stayed closed. A reporter at Great Bend remarked on the bizarre scene: ' uncorked jug place on sidewalk two hours, found to be half filled with dust. Picture wires giving way due to excessive weight of dust on frames....Lady Godiva could ride through the streets without even the horse seeing her.'

"The novelty of this duster, so like a coffee-colored winter snow, made it hard for most people to take it seriously. But William Allen White, the Emporia editor, called it 'the greatest show' since Pompeii was buried in ashes. And a Garden City woman described her experience for the Kansas City Times: 'all we could do about it was just sit in our dusty chairs, gaze at each other through the fog that filled the room and watch that fog settle slowly and silently, covering everything including ourselves in a thick, brownish gray blanket. When we opened the door swirling whirlwinds of soil beat against us unmercifully...The door and windows were all shut tightly, yet those tiny particles seemed to seep through the very walls. It got into cupboards and clothes closets; our faces were as dirty as if we had rolled in the dirt.....'

"By the end of the month conditions had become so unrelenting that many Kansans had begun to chew their nails.....The mood of the people had begun to change, if not to apocalyptic dread...at least to a fear that this was a nightmare that might never end. By 24 March southeastern Colorado and western Kansas had seen twelve consecutive days of dust storms, but there was

worse to come. Near the end of March a new duster swept across the southern plains, destroying one half of the wheat crop in Kansas, one quarter of it in Oklahoma and all of it in Nebraska five million acres blown out. The storm carried away from the plains twice as much earth as men and machines had scooped out to make the Panama Canal, depositing it once again over the East coast states and the Atlantic Ocean. Then the wind slackened off a bit, gathering strength as it were, for the spectacular finale of that unusual spring season Black Sunday, 14 April.

"Dawn came clear and rosy all across the plains that day. By noon the skies were so fresh and blue that people could not remain indoors; they remembered how many jobs they had been postponing, and with a revived spirit they rushed outside to get them done. They went on picnics, planted gardens, repaired hen houses, attended funerals, drove to the neighbors for a visit. In mid-afternoon, the summery air rapidly turned colder, falling as many as fifty degrees in a few hours, and the people noticed that the yards were full of birds nervously fluttering and chattering and more were arriving every moment, as though fleeing from some unseen enemy. Suddenly there appeared on the northern horizon a black blizzard moving toward them; there was no sound, no wind, nothing but an immense 'boogery' cloud. The storm struck Dodge City at 2:40 p.m. Not far from there John Garretson, a farmer in Haskell county, Kansas, who was on the road with his wife, Louise, saw it coming, but he was sure that he could beat it home. They had almost made it when they were engulfed; abandoning the car, they groped for the fence wire and, hand over hand, followed it to their door. Down in the panhandle Ed and Ada Philips of Boise City, with their six year old daughter, were on their way home too.....It was about five o'clock when the black wall appeared, and they still had fifteen miles to go. Seeing an old adobe house ahead, Ed realized that they had to take shelter and quickly. By the time that they were out of the car the dust was upon them, making it so dark that they nearly missed the door. Inside, they found ten other people, stranded, like themselves, in a two room hut, all fearing that they might be smothered, all unable to see their companions' faces. For four hours they sat there, until the storm let up enough for them to follow the roadside ditch back to town.....

"A Kansas cattle dealer, Raymond Ellsaesser, almost lost his wife that day. She had gone to Sublette with her young daughter...On the way home she stopped along the highway, unable even to see the winged hood ornament on her car. The static electricity in the storm then shorted out her ignition, and, foolishly, she determined to walk the three quarters of a mile home. Her daughter plunged ahead to get Raymond's help, and he quickly piled into a truck and drove back down the road, hallooing out the window. Back and forth he passed, but his wife had disappeared into the fog like dust, wandering straight away from the car into the field, where she stumbled about with absolutely no sense of direction. Each time she saw the truck's headlights she moved that way, not realizing her husband was in motion too. It was only by sheer luck that she

found herself at last standing in the truck's head beams, gasping for air and near collapse.

"The last of the major dust storms that year was on 14 April, and it was months before the damages could be fully calculated.....An epidemic of respiratory infections and something called 'dust pneumonia' broke out across the plains.....Many dust victims would arrive at a hospital almost dead, after driving long distances in a storm. They spat up clods of dirt, washed the mud out of their mouths.....Old people and babies were most vulnerable to the dusters as were those who had chronic asthma, bronchitis or tuberculosis, some of whom had moved to the plains so that they might breathe the dry air.....the Red Cross thought the situation was so serious that it set up six emergency hospitals...In Topeka and Wichita volunteers worked in high school sewing rooms to make dust masks of cheesecloth; over 17,000 of those masks were sent to the plains.....On 29 April the Red Cross sponsored a conference of health officers from several states. Afterwards representatives of the Kansas Board of Health went to work on the medical problem in more detail.....From 21 February to 30 April, they counted twenty eight days of 'dense' dust at Dodge City and only thirteen days that were dust free. Dirt deposited in bakepans during the five biggest storms gave an estimated fallout of 4.7 tons per acre. Agar plate culture showed...only harmless soil bacteria, plant hair and micro fungus spores. But the inorganic content of the dust was mainly fine silicon particles, along with bits of feldspar, volcanic ash and calcite' and 'silica,' they warned, 'is as much a body poison as lead.....producing after sufficient contact, silicosis of the lungs.....The death rate from acute respiratory infections in the forty five western counties of Kansas, where the dust was most intense, was 99 per 100,000, compared with the state average of seventy; and the infant mortality rate was 80.5, compared with the state's 62.3.

"The medical remedies for the dust were at best primitive and makeshift....Hospitals covered some of their patients with wet sheets and housewives flapped the air with wet towels to collect dust. One of the most common tactics was to stick masking tape, felt strips or paraffin soaked rags around windows and door cracks. The typical plains house was loosely constructed and without insulation, but sometimes these methods proved so effective that there was not enough air circulation inside to replenish the oxygen supply.....But most often there was no way to seal out the fine, blowing dirt; it blackened the pillows around one's head, the dinner plates on the table, the bread dough on the back of the stove.....Livestock and wildlife did not even have those crude defenses...'In a rising sand storm,' wrote Margaret Bourke-White, 'cattle quickly became blinded. They run around in circles until they fall and breathe so much dust that they die. Autopsies show their lungs caked with dust and mud.' Newborn calves could suffocate in a matter of hours, and the older cattle ground their teeth down to the gums trying to eat dirt covered grass.....Where there was still water in the rivers, the dust coated the surface and the fish died too. The carcasses of jackrabbits, small birds, and

field mice lay along roadsides by the hundreds after a severe duster.....

"Cleaning up houses, farm lots and city stores after the 1935 blow season was an expensive matter. People literally shoveled the dirt from their front yards and swept up bushel baskets full inside.....Carpets, draperies and tapestries were so dust laden that their patterns were indiscernible. Painted surfaces had been sandblasted bare.....the heaviest burdens lay on city work crews who had to sweep dirt from gutters and municipal swimming pools, and on housewives who struggled after each blow to keep their houses clean.....The emotional expense was the hardest to accept, however. All day you could sit with your hands folded on the oil cloth covered table, the wind moaning around the eaves, the fine, soft talc sifting in the keyholes, the sky a coppery gloom and when you went to bed the acrid dust crept into your dreams.....after May 1934 most of the worst dust storms were confined to the southern plains region; less frequently were they carried by those high altitude currents moving east or southeast. Two types of dusters became common then: the dramatic 'black blizzards' and the more frequent 'sand blows.' The first came with a rolling turbulence, rising like a long wall of muddy water as high as 7,000 or 8,000 feet. Like the winter blizzards to which they were compared, these dusters were caused by the arrival of a polar continental air mass, and the atmospheric electricity it generated helped lift the dirt higher and higher in a cold boil, sometimes accompanied by thunder and lightning, other times by an eerie silence. Such storms were not only terrifying to observers, but immensely destructive to the region's fine, dark soils, rich in nutrients. The second kind of duster was a more constant event, created by the low sirocco like winds that blew out of the southwest and left the sandier soil drifted into dunes along fence rows and ditches.....A single storm might rage for one hour or three and a half days. Most of the winds came from the southwest, but they also came from the west, north, and northeast and they could slam against windows and walls with 60 miles per hour force. The dirt left behind on the front lawn might be brown, black, yellow, ashy gray or, more rarely, red, depending upon its source. And each color had its own peculiar aroma, ranging from a sharp peppery smell that burned the nostrils to a heavy greasiness that nauseated.....".

Although, as late as 1 May, the St. Paul Pioneer Press reported that "new dust clouds" had rolled over "an eighteen million acre region in New Mexico, Texas, Oklahoma, Kansas and Colorado," the relatively wet weather which saved Minnesota from 1935's devastating spring dust storms soon spread into the Great Plains, providing a temporary reprieve from the conditions described in Worster's book. According to the May 1935 issue of the Weather Bureau's Monthly Weather Review, "dust storms and dusty conditions were infrequent during May 1935. Compared with the previous months of March and April, there was very little dust in the air at any time. There were only eighty four instances of dusty conditions reported and sixty seven of these were of very light intensity. Only two stations reported ten days with dust...The..percentage of normal precipitation shows a large area in the western plains where the rainfall was 200 percent or more of the normal for the month [May], with most of the central and northern plains averaging well over 100 percent. The

reports...also illustrate the decrease in the intensity of the dust. The state report from Colorado noted no dusty conditions worthy of mention between the 11th and the 30th.....In Kansas, also, the report states that dust storms occurred over western parts up to the 12th, but were not observed again until the last week of the month....".

In Minnesota, wet, cool weather during April and May, although putting a temporary end to the drought (and the dust storms which accompanied it), retarded farm operations, no doubt provoking complaints about the "backward" spring. As noted previously, however, the effects of, and the fears raised by, the 1933-1934 drought lingered into 1935. Evidence of such continuing concerns included an 8 March 1935 Brown County Journal article quoting W. C. Coffey, University of Minnesota school of agricultural official, as warning that "it will take the northwest five years to recover from the effects of the drought. Livestock herds have been reduced to subsistence levels and farmers are forced to drive twenty five to thirty miles for water in many drought areas". Similarly, the 12 April 1935 edition of the Milan Standard noted that \$85,063 in federal payments to farmers who had agreed to reduce corn and hog production had been received by Chippewa county officials. Chippewa county farmers, it was added, "have now received a total of \$415,507 for their cooperation with the Agricultural Adjustment Administration in the 1934 corn-hog program. Payment was at the rate of \$2 per hog less the local costs of administration". And, on 3 May 1935, the Standard reported that Dr. Charles E. Kellogg, acting chief of the University of Minnesota farm's soil survey, had "emphasized that some soils are far more subject to blowing than others. The solution to soil blowing lies in devoting pasture and sod crops to those soils most subject to blowing". And, in its 22 March 1935 edition, the Wheaton Gazette reported that "during the past week hay and feed have arrived at several points in Traverse county, including three carloads shipped to Wheaton. The hay belongs to the Rural Rehabilitation Corporation and is offered for sale to persons having farm credit loans. It is also used for filling relief orders. Feed grain may be bought directly from elevators or is given out on orders issued from the feed relief office". The same edition of the Gazette also carried an alarmist quote attributed to Henry C. Oberholser, USDA ornithologist, in which he predicted "Extinction of wild ducks in five years unless steps are taken to protect them. Recent droughts in the United States and Canada have been heavy blows to wild fowl as practically all their good breeding grounds have been destroyed". And, as late as 10 May, the Gazette noted that "although tractor fuel andfeed were made available to farmers who had given first liens on their crops to Traverse county for seed loans, there are still more than one hundred farmers in the county who are having difficulty securing feed for work horses to put in their crops".

Another perduring effect of the drought was a renewed emphasis on tree planting and farm windbreak projects. These projects, characteristically, had a two-fold objective, the first of which was to replace trees killed by the drought and the second, and more ambitious, of which was to reduce soil erosion, provide wildlife habitats and, hopefully at least, to tame and beautify the country's vast windswept prairies. As early as 12 April 1934, the Marshall County Banner reported that "windbreak planting in the Red River Valley was rapidly gaining momentum. 1934 is expected to be a banner year for windbreak planting". A year later, the Wheaton Gazette (19 April 1935) stated that "how to replace farm windbreaks seriously depleted by drought and other causes is one of the most serious problems

confronting Traverse county farmers . An average of ninety percent of the windbreak trees have either died during the last two years or have been seriously weakened by drought and other causes. Because of the widespread demand by Minnesota farmers, a special windbreak planting program will be undertaken this year by the Minnesota Agricultural Extension Service in cooperation with a committee of interested farmers". And, although restoration and/ or establishment of windbreaks was of general concern to many Minnesotans during the 1930's , drought damage to trees was probably not as great in some regions as it was in extreme west central counties. The 2 August 1935 edition of the Milan Standard reported, for example, that "with soil moisture more abundant this year than any of the past several years, Chippewa county farmers will be turning their attention to improvement and replacement of windbreaks. Not only are tree planing conditions more favorable than usual but the favorable conditions have given new life to native trees".

The most grandiose tree planting program of all was, however, announced by the federal government in 1935. According to the 8 February 1935 edition of the Brown County Journal (New Ulm), this proposal contemplated a federal commitment of \$75 million to plant a massive shelterbelt which would entail planting of two billion hardy, drought resistant trees (chiefly green ash and red cedar) in a zone one thousand miles long and one hundred miles wide. Miniature forests, it was said, would be planted in strips, lessening erosion, retarding winds and reducing evaporation. The project, for which only \$1 million was immediately available, was expected to be completed within ten years. Unfortunately (or , from some points of view, fortunately), this proposal was partially, haphazardly implemented, its history recounted as follows by Worster (op. cit. pp. 220-223):

"Planting shelterbelts of trees was another agronomist solution, although it was one the Soil Conservation Service had little to do with in the beginning. The idea was to manipulate the climate, stop the winds, and save the soil. A row of trees around a house, everyone know, cut the wind's velocity and cooled the air in summer. Expand the row around the farm, across the plains, and the dust would cease to blow, crops would have a better chance. The Russians had planted shelterbelts to that end in the Ukraine during the 1880s not solid blocks, as in a forest plantation, but strips lining the fields. President Roosevelt, himself an ardent tree planter on his New York estate, was sure that the same remedy would work in the west; nothing, in fact, appealed more to him as a solution for the Dust Bowl. Trees would humanize the harsh, inhospitable plains. They would turn its drabness into a garden of shade and greenery, and no one would ever want to leave; farmers would put down their roots alongside the hawthorn and mulberry. Critics hooted and raged; the idea was as silly as pouring plaster of Paris on listed ridges or spraying banana oil on the dust. Congress repeatedly refused to go along, complaining of the high cost. Geographers such as Ellsworth Huntington and ecologists such as Frederic Clements argued that it was going against nature to plant trees in a semi-arid climate.....But Roosevelt persisted against all those criticisms, until in the end he could say that, if he had not been altogether right, he had not been completely wrong, either. Trees did get planted, 220 million of them on 30,000 farms, and a high percentage have survived to this day, bringing many of the

benefits they were supposed to. But hardly any of them were planted in the Dust Bowl.

"Given \$500,000,000 to spend on Great Plains drought relief in 1934, Roosevelt siphoned off a small part of it for the Forest Service to gear up for a shelterbelt program. Paul Roberts was appointed project director, and he immediately moved to Lincoln, Nebraska, to organize nurseries, hire trained help, and most important, decide where to put the trees. By March 1935 the foresters had settled on a shelterbelt zone and had their first saplings in the ground. Trees were to be planted where they had a chance to grow, in a narrow one hundred mile zone running from Childress, Texas to the Canadian border essentially along the 99th meridian, the transition line between the tall grass prairie and the shortgrass plains. 'West of this line, wrote Raphael Zon of the Forest Service's scientific staff, extensive planting of shelterbelts is considered hazardous, because of the low rainfall, difficulty of establishment, short life, poor survival and adverse soil conditions...such a land should best be converted to grass and a simpler form of use, such as grazing'.

"It was useless to expect, then, as the public did, that the trees would stop the dust storms they were too far to the east for that. Instead, their purpose was to keep the desert from creeping into the farmland on the rim of the Bowl. But despite the conviction of the Prairie States Forestry Project personnel in Lincoln that it was a worthy objective, there was no way to get an appropriation through Congress for their support; through the rest of the decade they limped along as a WPA appendage, trying to do a professional job with relief laborers. In 1942 they stopped planting trees, and the shelterbelts, many of them as tall as a man by then, were turned over to the Soil Conservation Service for it to manage.

"The first belt was planted near Mangum, in the southwestern corner of Oklahoma, although more trees were planted in Nebraska than in any other state. The typical belt was a strip eight rods wide, one half mile long, and containing ten to twenty rows of trees. Down at Childress, a typical belt was fifteen rows across: two of cottonwoods at the center, flanked by honeylocust, osage orange, hackberry, ash, ailanthus, walnut, soapberry, and desert willows, forming, at maturity, an upside down 'V.' Around the St. John vicinity of Kansas, fast growing Chinese elms were planted with cottonwoods and honeylocusts, and more rarely, catalpa, apricot, tamarix, and cedar. It was the responsibility of the farmer on whose land they were placed to fence them in against rabbits and keep the weeds down. In return, his fields got protection: winds below twenty miles per hour were reduced by more than half over distances from four to eight times the height of the trees. With belts growing a mile, better yet, a half mile, apart there was far less evaporation of precious moisture, improved refuge for winter weary cattle ; and, as in the English hedgerows, the trees were filled with birdsong from spring to midsummer. All this for a little over \$20 per acre in labor and materials, which was five to ten

times the cost of High Plains land. Fourteen million dollars spent on the shelterbelts a pittance, of course, in the New Deal budget, but it was as much as the federal government spent on all its submarginal land purchases in the region. Viewed as a contribution to the plains' ecological recovery, it was of little utility; the money might have been better used to buy more abused lands, revegetate them, and set them aside as scientific or wilderness reserves. But, on the other hand, the project gave many men work, gave farmers a practical amenity, and gave the agronomist another tool to make western agriculture more secure...".

Yet, despite the lingering effects of the 1933-1934 drought, not the least of which was the need to create or restore wind breaks and to replace drought damaged trees, the spring of 1935, at least for most Minnesotans, was filled with promise. Frequent and often generous rains during April (and to a lesser extent during March) raised lake and river levels, restored depleted subsoil moisture and, most importantly, boosted the expectations of Minnesota's drought weary agricultural community. What was called a "remarkable comeback" was extolled by the 12 April 1935 edition of the Brown County Journal (New Ulm) in a story which pointed out that Alex J. Henle (New Ulm's cooperative observer) had reported 1.68 inches of precipitation during March 1935, an amount which "added to the precipitation of the preceding months assisted in insuring a good crop in this section this year". Heavy snows and rain throughout the northwest during the past two days, it was added, "has placed a good cheer attitude over this portion of the country. Parts of South Dakota had snow nearly every day last week. Practically all of Minnesota, the southern part of North Dakota and the eastern one third of South Dakota is in good to excellent condition. This large territory not only has good surface moisture but a growing amount of subsoil moisture.. Seventeen and one half inches of precipitation has been recorded in this area since September 1st, 1934". On 10 May, the Journal again emphasized the improved weather conditions, contrasting the cool, wet April of 1935 with the dry, dusty April of the previous year. And on 25 May, the Journal reported that copious rains had fallen in the southwestern portions of the country since the "terrific dust storms" of early spring. The Texas panhandle, Oklahoma, southwest Colorado and southwest Kansas were said to have been included in the "rainbelt". Expressing a similar mood, the 26 April 1935 edition of the Wheaton Gazette stated that "many farmers say that the prospects for a good crop are better than for years. Housewives refuse to scold about the mud being tracked into houses because they say it is much better than dust". And on 31 May, the Morris Tribune noted that "the cooler weather this spring has brought the small grains along in fine shape but it has been a little too chilly to bring the corn along very fast".

Besides its rainy, cool weather, one of the most distinguishing meteorological events of the spring of 1935 was the heavy snow storm which swept across Minnesota on 1-2 May. It was the state's worst May snowstorm since 1892 and an event not to be repeated until 1954, a generation later. Snowfall totals ranged from 11.0 inches at Wheaton to none at a number of stations, most of them in northern Minnesota. Other amounts included 7.9 inches at Fergus Falls; 8.5 inches at Beardsley; 5.1 inches at Moorhead; 3.5 inches at Morris and Spring Grove; 4.0 inches at Maple Plain and Collegeville; 3.0 inches at the Minneapolis Weather Bureau station; and 2.8 inches at St. Cloud. As these totals suggest, the west

central and east central portions of the state were hardest hit. According to the 2 May 1935 edition of the Minneapolis Tribune, the snow combined with sleet and ice to "tear down wires" in area one hundred miles wide, toppling 1,000 utility poles, many of which landed on area highways, temporarily blocking traffic. In the words of the 2 May 1935 edition of the Tribune "winter celebrated the advent of May by belatedly distributing its largesse over the Twin Cities and environs. The damage wrought by rain, sleet, snow and wind was extensive. Telephone, telegraph and power poles were torn down by the burden of the ice on the lines within a radius of fifty miles from Minneapolis, thereby blocking some highways completely, forcing traffic detours and greatly impairing electric and communications services. When Northwestern Bell Telephone Co.....made tabulations late Wednesday evening [1 May], they found at least 300 poles and their tangled wires were on the ground in Minneapolis alone. To the north, northwest and northeast of the city, where the storm seemingly obtained its greatest effects, 200 more poles were down. In St. Paul, the Tri-State Telephone and Telegraph Co. reported that 500 of its poles were down and 600 telephones out of service. There were more than one hundred reports of wires on the ground in St. Paul, and trees were blown across streets and sidewalks in some sections of that city....Damage was also reported in the vicinity of Alexandria, Brainerd, St. Cloud, White Bear, Owatonna and in western Wisconsin.....Sleet and ice formed on the wires to the thickness of an inch, and heavy weights of ice were splattered against the poles by the force of the wind which reached a velocity of twenty seven miles from the east....In Minneapolis, where the temperature was at 34, and a year ago it was 87 degrees on the same date, the storm caused numbers of minor accidents. The storm began in the morning as rain, but shortly before 2 p.m. the rain changed to sleet and then to snow. The high wind whipped...the precipitation from the east but most of the snow melted as it fell. Early in the evening there was a switch back to rain, and then again to sleet.....Rains fell over most of the northwest Wednesday, adding further to soaring crop hopes. More rain fell Wednesday in southwestern Minnesota than was received during the entire month of May..1934...In the North Dakota area where the drought began in 1931, farmers Wednesday were gleeful over the falling rain.....Rains measuring up to an inch fell over South Dakota Tuesday night and Wednesday, boosting the year's total far above normal. Rainfall at Sioux Falls in April totaled 5.98 inches, the heaviest since weather observations were started forty four years ago....".

The St. Paul Pioneer Press gave a similar account of the storm, its 2 May edition noting that "a May Day snow and wind storm ripped out telephone poles, caused trouble on power lines and crippled traffic throughout the state on Wednesday [1 May]. Damage mounted into many thousands of dollars as rural communities reported ice weighted wires snapped and twisted by thirty mile per hour winds.....The storm started with rain Wednesday morning, turned to snow by mid afternoon.....The snowfall was estimated at nine inches by M.R. Hovde [Minneapolis Weather Bureau meteorologist], equal to nearly an inch of rain. Most of it melted as it fell, however. On the road to White Bear Lake, poles were down all along the way....all four Twin Cities radio stations were off the air for brief intervals late Wednesday due to power and line trouble....The precipitation insured good planting conditions for corn. The slight dip into freezing temperatures carried no threat to crops according to Andrew Boss of the University Farm. The precipitation promoted growth of small grains....". On the following day [3 May], the Pioneer Press noted that "full crews"

were still at work throughout the state restoring telephone service. The same edition also pointed out that "In other parts of the country, prolonged downpours, sleet storms and tornadoes caused numerous injuries and property damage. North Dakota and South Dakota received their share of the heavy downpours. Pierre, South Dakota endured its eighth day of heavy rain. Fields were flooded". And on 5 May, the Pioneer Press reported that the May snowfall had "covered" southern Wisconsin, amounts "between" five and six inches having fallen at Milwaukee, five and one half inches at LaCrosse. The same article emphasized, however, that "the unusual precipitation of the past seven months has brought prospects of million dollar crops. To the St. Paul water department, it means saving \$200 every day. The chain of lakes furnishing St. Paul with its water is filled to overflowing. Pumps at Fridley which for the past seven or eight years have been pouring thirty five million gallons of water a day into St. Paul's lake reservoirs have been shut down, saving \$200 per day. Pumps will be shut down for at least a month".

The 3 May 1935 edition of the Morris Tribune, like the Twin Cities newspapers, featured the May snowfall, telling its readers that "May ushered in Wednesday with a driving rain which later in the day turned into a heavy, wet snow. The snow continued all Wednesday night and most of Thursday [2 May]. The rainy weather that marked the month of April retarded seeding of crops. The rain and snow that arrived with May is further retarding [farm] work. Pastures and hay lands have benefitted greatly. Precipitation from January through April was about two inches above normal". The 3 May edition of the Wheaton Gazette was even more profusive, both in its account of the storm and in its praise of 1935's drought breaking precipitation: "what old timers say is a record snowstorm started Wednesday evening [1 May] and by eleven o'clock Thursday the ground was covered six inches deep. Up to eleven o'clock yesterday the moisture from a rain which started during Tuesday night and from the snow amounted to 1.26 inches....So far in 1935, the rainfall has been 6.8 inches, compared with slightly more than an inch during the same period last year. It is reported that the main part of Lake Traverse has from three to four feet of water in it. It looks like the drought is ended (emphasis added).Snow was still falling on Friday".

Although the last two weeks of May 1935 were relatively dry, cool weather persisted throughout the entire month. The highest May temperature recorded anywhere in Minnesota was 83 F, the lowest statewide May maximum since 1905. According to Minneapolis Weather Bureau officials, the growth of vegetation was retarded by the cool weather during the first part of the month, reportedly making rapid progress thereafter. Small grains it was said took firm root and stood out well and, in marked contrast to May 1934, pastures made "good growth". And, perhaps most comforting of all, the month, at least in Minnesota, was free of dust storms.

May's cool, wet weather, moreover, continued through June 1935, a month which brought frequent and sometimes heavy rains to most regions of the state (e.g. 5.32 inches at St. Peter, 15-18 June; 4.58 inches at Maple Plain, 15-16 June; 4.88 inches at Winnebago, 16-19 June; 4.39 inches at Onamia, 14-16 June; 4.09 inches at Beardsley, 16-19 June; 4.01 inches at Wheaton, 15-16 June; 4.48 inches at Fairmont, 15-19 June; and 4.79 inches at Mankato, 16-19 June). For the state as a whole, it was the coolest June since 1928 and the wettest since 1925. The month was also cool and wet over much of the United States, the Middle

West and Great Plains especially, some of the Dust Bowl areas in Texas and Oklahoma receiving drenching (and no doubt welcome) June rains. Predictably, June's wet weather was accompanied by numerous thunderstorms, some of which were accompanied by tornadoes and hail. The 14 June 1935 edition of the Brown County Journal, as an example, reported tornadoes in the Garvin and Albert Lea areas "with wind, hail and rain in other communities". In New Ulm, the rain was "so heavy that sewers in some parts of the city were unable to carry away the surplus water [which] backed up in basements".

And, like the cool, moist spring which preceded it, June's copious rainfall continued to replenish Minnesota's lakes, rivers and subsoil. The cool, rainy weather was not, however, without its drawbacks. According to Minneapolis Weather Bureau officials, "weather conditions were ideal for small grains, meadows and pastures but too cool for corn, potatoes...Cultivation and haying were delayed, showers being too frequent for proper curing of hay...Growing crops made little advancement during the first decade [of June] and some replanting of corn was necessary.....". In a similar vein, the Brown County Journal (21 June), noted that "nearly three inches of rain" had fallen in some parts of Brown county during the preceding seven days, causing some small grain crops to grow "rank". Farmers, accordingly, were said to be hoping "for a discontinuance of moisture for a time at least". The rain, however, was of great benefit to pastures which, according to the Journal, were in "excellent" condition. The same article also asserted that New Ulm was now out of the "drought area". The amount of precipitation recorded at the New Ulm station between 1 September 1934 and 1 June 1935, it was emphasized, was 10.84 inches greater than the amount recorded during the same period in 1933-1934. "Ponds which have been dry for several years now have water in them. Sloughs are filled and small streams and creeks are running water, many of which have been dry for three or four years. Experts tell us that the distribution of temperature and rainfall through the summer is highly important. Bumper crops are warm at both ends and cool in the middle. Farmers in this locality feel they are in better condition than they have been for three years". But conditions were, nonetheless, not ideal, the 28 June edition of the Journal noting, for example, that the cool and wet weather was "retarding" the New Ulm area's corn crop.

In a surprising turnaround, June's cool weather ended abruptly at the beginning of July 1935, a month which turned out to be the warmest July recorded in Minnesota since 1916. And, although some areas of the state continued to receive ample rainfall, others experienced serious moisture shortfalls (e.g. New Ulm with a July total of only 0.88 inches). The heaviest rainfalls were recorded in northern Minnesota (e.g. Argyle, 5.21 inches;; Angus, 6.83 inches; Virginia, 6.23 inches; and Leech Lake Dam, 9.33 inches). Several stations in west central Minnesota (e.g. Morris, 6.52 inches; Wheaton, 4.75 inches; and Beardsley, 4.92 inches) also enjoyed above normal precipitation, rains which were especially beneficial in an area which was among those hardest hit by the heat and drought of previous summers. And, although few areas of the state escaped July's heat which persisted without significant relief during most of the month the highest temperatures were recorded in southwestern and west central Minnesota. Pipestone, for example, recorded twenty seven days with maxima of 90 F or higher, the highest of which was 105 on 27 July. Similarly, New Ulm's cooperative observer recorded maxima of 90 F or higher on twenty four days, including the state's July 1935 high of 108 F on 27 July. Minnesota, however,

did not suffer alone: July 1935 was warmer than normal in most areas of the United States, the Great Plains region especially. And except for the areas in the southeastern part of the country, July was also drier than normal, perhaps providing a foretaste of the drought which was to envelop much of the nation in 1936.

Minnesota newspapers, of course, took cognizance of the July heat, the 8 August 1935 edition of the Brown County Journal pointing out that "July 1935 was the most torrid month of record in New Ulm. The mean temperature for the month was the highest recorded in the sixty years since official records began. It was also [one of] the driest. Lack of moisture played havoc with growing crops and vegetation. Rust became prevalent in the wheat fields and corn began to suffer. It was a most uncomfortable month with high temperatures and high humidity. Only July 1877 and July 1934 were drier". The Journal also noted that twenty of July's days were recorded as "clear," a statistic consistent with the eighty five percent of possible sunshine recorded during the month at the Minneapolis Weather Bureau office. Predictably, the Morris Tribune gave a different account of July's weather, the Morris area enjoying as it did, above average July rainfall. On 12 July, the Tribune reported that two "torrential rains visited this section during the past week," bringing 4.2 inches of precipitation. The rains, it was stated, "flattened grain fields, flooded low spots and ruined the prospects of a bumper crop. High winds that accompanied the storm aided in the devastation of the crops.....The rain Wednesday afternoon [10 July] was of cloudburst proportions. A total of 2.11 inches fell in a period of about twenty minutes. Another big rain came on Thursday evening [4 July] with 2.09 inches". Other areas of the state also suffered damage from July storms, one of which was described by the Brown County Journal (5 July 1935) as a wind and hail storm which struck "the first blow to the [at that point in the season] splendid crops, damaging corn and grain over a narrow strip extending nine to northwest of Sleepy Eye".

Prospects of a bumper crop were also dimmed in some areas of the state by various diseases and predators, attacks attributed to conditions created by the combined effects of a cool, wet early summer and the hot, humid July that followed. The 19 July edition of the Brown County Journal reported, as an example, that the wheat crop in the New Ulm area had been "heavily damaged by rust, scab and joint worms". The same conditions were noted by the Morris Tribune (12 July): "a further threat to the crop.....is rust. The hot, muggy weather of the past week combined to create a perfect situation for the spread of rust". Minneapolis Weather Bureau officials also expressed concern, stating that July's "warm, moist weather was conducive to rust development on small grains, especially spring wheat which had been sown late and was more susceptible in its critical stage. Black stem rust spread rapidly during the week ending July 22nd and caused severe damage to spring wheat, which was almost ready for harvest and looked like a bumper crop..." . And, at the peak of the 1935 grain harvesting season, the Morris Tribune reported that "grain binders, many of which saw little action during the past two years, have been humming throughout the county [Stevens] this week. With the exception of wheat most small grains will bring an average yield. Wheat has been hit hard by black rust. The corn crop has forged to the front during the hot weather of recent weeks". Several weeks later, the Tribune emphasized the extent of the damage done by the rust, announcing that wheat yields had been "materially reduced" and that "many fields" had been "destroyed". Likewise, the 26 July 1935 Milan Standard told its

readers that "reports from the wheat fields in this vicinity are to the effect that the ravages of rust are extremely serious".

July 1935's warmth persisted but with diminished intensity through much of August a month which, although dry and warm in most parts of the nation, favored Minnesota, Wisconsin and parts of the Dakotas with wetter than normal weather. Moreover, the end of the month was marked by an incursion of cold air which brought freezing or near freezing temperatures to many areas (e.g. Argyle, 30 F on 31 August; Crookston, 33 F on 31 August; Morris, 37 F on 28 August; Worthington and New Ulm, 36 F on 28 August; and Zumbrota, 38 F on 29 August). This late summer intrusion of cold air, coming as it did after a long period of warmer than normal weather, was, of course, considered newsworthy. The 13 September edition of the Brown County Journal noted, for example, that "August 1935 furnished one of the lowest minimums for that month. Thirty six degrees was three degrees above the low set in August 1931. Yet August was a hot month. The six or seven weeks of remarkably hot weather pulled the corn crop through in Minnesota. This crop had a bad start and was about two weeks late on July first...". Similarly, the Morris Tribune (30 August 1935), after reporting that "several" rains during the past week had "served to further retard threshing operations in this section," pointed out that "the weather this week has been unusually cold for August and light frosts were reported in some places Tuesday night [27 August]. Furnace fires have been in order for several days. A cold rain set in on Thursday [29 August] and intermittent showers fell all day".

The most distinguishing feature of August's weather, however, was not its frosty ending but, rather, its wetness. As noted previously, it was the wettest August recorded in Minnesota as a whole since 1928 with recurring, and often damaging, heavy rains. What Minneapolis Weather Bureau officials described as "unusually" heavy rains occurred in the vicinity of LeSueur on 1-2 August, in the Owatonna area on 15 August, in southern Big Stone county on 17-18 August and in southern Stearns county on 19-20 August. Flood damage to property and growing crops was estimated at \$228,500 (1935 dollars), tornado and wind damage at \$70,000. One of the most unusual even bizarre rain events occurred in the Morris area on 17-18 August, a storm which, if did not literally rain toads, must have left many with the impression that it had done just that. In the words of the 23 August 1935 edition of the Morris Tribune, "a downpour of cloudburst proportions struck Saturday evening [17 August]. A severe electrical storm accompanied the rain and lightning struck several locations in the county. The water ran over the curbs in many sections of the city. Store basements as well as the basements of many residences were flooded. Millions of little toads appeared as if by magic after the big rain. The sidewalks and streets and gutters in many places throughout the city were literally covered with toads (emphasis added). The rains have again filled many sloughs and low places throughout the county and many creeks are again running. On a few farms, shocks of grain are reported to be standing in several inches of water....". At Morris, total August rainfall exceeded six inches, boosting the summer's total to more than seventeen inches. Other notable August totals included 10.11 inches at Waseca, 8.22 inches at Artichoke Lake; 9.03 inches at New London; and 7.31 inches at Pipestone. For the state as a whole, the August average was 4.52 inches, a value approximately forty two percent greater than the then accepted long term (1891-1935) August normal.

Its overall warmth and wetness notwithstanding, August 1935 was a transition month, its month end cold signaling the beginning of a cold autumn a cold autumn which, in turn, foreshadowed the disastrously cold, stormy winter of 1935-1936. The month's wetness also marked the end of a twelve month break in the drought which, previous to August 1934, had prevailed almost unbroken during the first four years of the 1930's. In many areas of Minnesota, the autumn months of 1935 were extremely dry, September-November precipitation totals falling below one inch at several west central Minnesota stations (e.g. Alexandria, 0.80 inches; Morris, 0.58 inches; 0.84 inches at Campbell). And although above average precipitation was recorded at many southern and east central Minnesota stations during October (e.g. Minneapolis, 3.95 inches; New Ulm, 3.80 inches; Maple Plain, 4.24 inches; and Cambridge, 4.72 inches), statewide averages for all three autumn months fell below the then accepted long term normals. December 1935, although colder than normal (the state's fourth consecutive cold December), brought frequent, if not heavy, amounts of precipitation. The month both opened and closed with relatively warm weather, severe cold prevailing in most areas from 18-28 December. Late December's moderating temperatures persisted during the first days of January 1936, ending abruptly around 5 January. After that date, the state was swept by frequent blizzards and intense, unrelenting cold waves, a combination which gives the winter of 1935-1936 an undisputed place in any listing of the worst climatic episodes of the 1930's. What follows, accordingly, is a detailed account an account replete with stories of almost unbelievable adversity of one of the worst winters in the history of Minnesota and the Upper Midwest. A winter which truly deserves to be called the winter from hell.

THE 1930'S
THE WINTER OF 1935-1936:

THE WINTER FROM HELL

It began with an outbreak of frosty temperatures at the end of August 1935 and ended with an early spring cold wave which brought below zero temperatures to many parts of Minnesota during the first week of April 1936. It, of course, was the weather regime which gave Minnesota and much of the Upper Midwest one of its coldest, stormiest winters in weather history, namely the famous (infamous?) winter of 1935-1936. As noted, the first hint that change was in the air came at the end of August 1935, temperatures dropping into the 30's F or lower at many Minnesota stations during the last several days of the month. The next, and stronger, hint, however, came in early October 1935, temperatures dropping to unusually low early season levels during the period, 4-10 October (e.g. 14 F at New Ulm on 6 October; 12 F at Morris on 10 October; 10 F at Beardsley on 10 October; 16 F at Moorhead on 10 October; 17 F at Worthington and Willmar on 10 October; 14 F at Rochester on 6 October; and Roseau, 9 F on 6 October). Early November was also unseasonably cold, bringing temperatures near to or even below zero F at many west central Minnesota locations during the first ten days of the month (e.g. Morris, 1 F on 2 November; New London, 1 F on 6 November; Campbell, -1 F on 1 November; and New Ulm, 3 F on 10 November). Much of the last half of December 1935 was also cold, temperatures falling to into the -30's F in northern Minnesota and the -20's F in many other locations. Both November and December were snowier than normal with November snowfalls heaviest in the northern part of the state and December snowfalls heaviest in west central and southwestern locales.

But, as noted previously, the worst weather of the winter settled into the state in mid-January 1936, marking the beginning of an extended period of blizzards and bitterly cold temperatures, a pattern which persisted for a period of about forty days, finally moderating at the end of February. Nor was the cold limited to Minnesota. According to the January 1937 issue of the Weather Bureau's Monthly Weather Review, record low statewide February mean temperatures were established in eight states: Iowa, Missouri, Montana, Nebraska, North Dakota, South Dakota, Wisconsin and, surprisingly, Washington. Minimum temperatures reached record lows of -60 F, -58 F and -52 F, respectively, in North Dakota, South Dakota and Wisconsin, all in February, and -25 F in Kentucky in January.

Inevitably, the winter's extreme weather dominated the news as reported by the Minnesota media during the winter of 1935-1936. These reports, of course, documented the human suffering, the economic losses and the psychological effects of the weather on a beleaguered population in ways that cannot be captured by climatic statistics alone. Newspapers, in fact, began to emphasize the onset of winter as early as October 1935, headlines in the 11 October edition of the Brown County Journal proclaiming that "winter starts during October: coldest period so early in the month ever recorded". One month later (8 November), the Journal announced the arrival of another cold wave, noting that the temperature in New Ulm had fallen to 7 F, a reading which was followed by "heavy precipitation". Many fields, it was added, had been "put under the plow as the weather conditions have been favorable for this activity". On 15 November, the Journal noted the droughty conditions which had accompanied 1935's cold autumn, stating that "rainfall this

fall has been slight and if the precipitation in October had not been rather generous, farmers in this section would be faced with the probable recurrence of drought condition". Later in November, the Journal (22 November) reported that a "London fog visited southern Minnesota on Sunday [17 November]. Traveling by car Sunday night and Monday morning was extremely hazardous. Street lights were on in New Ulm until late Monday morning". Fog and cold soon yielded to sleet, snow and bitter cold: on 13 December, the Journal noted that a sleet storm on 12 December had made travel "precarious" in the New Ulm area but that early rain and above freezing temperatures, fortunately, had soon melted the ice. Two weeks later, however, the New Ulm area experienced its first heavy snow of the season, the Journal (27 December) stating that eight to ten inches of snow had fallen during the past week. Temperatures, it was said, had fallen to -17 F and that "a real blizzard" had developed during the early hours on the following day. Similarly, the Morris Tribune reported that a forty file mile "gale" on Christmas Eve had "piled up the snow" in that region of the state.

Yet, sleet, snow, fog and early season cold waves notwithstanding, the wintery conditions experienced during the closing months of 1935 were but a prelude to the disaster which, as noted, descended on Minnesota and the Upper Midwest during the first days of January 1936. A deep cold wave the first in a series of deep cold waves entered northern Minnesota on 7 January. Minima recorded on that date included -41 F at Roseau; -38 F at Big Falls; -35 F at Baudette; -25 F at Morris and New London; and -21 F as far south as St. Peter. This was followed by a few days of warmer weather, temperatures rising into the 30's F at many Minnesota stations on 10 January. Several days later, however, temperatures at most stations had once again fallen below zero, marking the beginning of a period of sustained cold that brought sub zero readings to many Minnesota stations everyday during the period, 13-31 January. At Argyle, no reading above zero F was recorded during the last sixteen days of January and, on the morning of 22 January, the station recorded a minimum of -40 F, the month's lowest. At Morris in west central Minnesota, minima of zero F or lower were recorded every day from 12-31 January, the most extreme of which included -38 F on 22 January and -37 F on 24 January. The maximum temperature on 22 January was a stinging -20 F and, according to the 24 January edition of the Morris Tribune, the day's Arctic temperatures were accompanied by a "high wind which made it miserable to venture out. Old timers scratched their heads trying to recall when they had experienced more severe weather. All outside work, except the most necessary was suspended". And, on 31 January, Tribune headlines proclaimed the obvious, pointing out that the "record cold wave continues grip". No temperatures above zero F, it was said, had been recorded from 17 to 28 January, causing "many homes to have trouble with freezing water pipes". As the Morris and Argyle readings suggest, the worst of the January's cold descended on the state on 22-23 January, bringing minima of -50 F or lower to several northern locations (e.g. Warroad, -55 F and Big Falls, -52 F) with readings of 30 F or lower recorded at many southern stations (e.g. Worthington, -30 F; New London, -40 F; Chaska and Farmington, -25 F; Rochester, -32 F; St. Peter, -36 F; Maple Plain, -36 F; and Zumbrota, -33 F).

Interestingly, much of east central Minnesota was temporarily shielded from the extreme cold which had enveloped much of the state on 13 January. Beginning on 18 January, however, this area, including the Twin Cities, began to experience bitterly cold readings, temperatures dropping to -34 F and -32 F, respectively, at the Minneapolis Weather Bureau

station and the St. Paul airport station on 22 January. At St. Paul, 18 January was the first of thirty six consecutive days with below zero minima, a record unsurpassed in the annals of that city's weather history. Minneapolis, similarly, experienced a thirty six day stretch of below zero minima extending from 18 January through 22 February 1936. East central Minnesota's rendezvous with extreme cold was, of course, duly noted by Twin City newspapers, the Minneapolis Tribune in particular. On 19 January, following the area's first encounter with the bitter cold, Tribune headlines told readers that "Sub zero wave due to remain for a day or two". The story that followed noted that the "crest of the cold wave" had reached eastern Minnesota, "pushing the mercury downward steadily". "It was forecast that the cold would remain through Sunday and Monday with little mitigation. Two persons died at Sisseton, South Dakota, of carbon monoxide poisoning when their car stalled in a snowdrift. Heavy snows fell in Nebraska, Missouri, Illinois and Iowa, blocking up roads. Primary highways in North Dakota were reported as closed by drifts". Unfortunately, however, any expectations raised by the "day or two" wording of the 19 January forecast were soon dashed, the 20 January edition of the Tribune conceding that "hope for an early break in the cold wave was dispelled Sunday night [19 January] when the Weather Bureau forecast lower temperatures on Tuesday. The nation quailed before winter at its worst Sunday night. From Maine to Texas and the Rockies to the eastern seaboard, the elements buffeted the land. Winds laden with snow howled across the northern states".

Even worse news followed. And soon. The 21 January edition of the Tribune noted that the cold wave had continued unabated and, more disconcertingly, reported that two more days of severe weather had been forecast. On the following day (22 January), a screaming banner headline told Tribune readers that "Temperature Skids to 20 Below Zero: Entire Northwest in the Grip of the Years Severest Cold". In Minneapolis, the drop in the temperature, it was reported, had "accelerated" late in the evening "while a brutal northwest wind whipped loose snow through the streets as in a blizzard". On 23 January, the day after the temperature at the Minneapolis Weather Bureau station had "hit an all time low" [of -33.5 F at 0900 on 22 January], the Tribune reported five cold related fatalities in the northwest, including that of man who had been found frozen to death on the doorstep of his Minneapolis home. The same report also stated that "all" work on outdoor projects had been "halted" in Minneapolis; that injuries on icy streets had "multiplied;" that rural mail carriers in southern Minnesota had been "forced to abandon their routes;" that traffic was "almost completely tied up;" that passenger trains were stalled at Butterfield, Bingham Lake and Mountain Lake; and that pedestrians had "deserted" Minneapolis streets. The Tribune story also reported that temperatures had fallen to -40 F at Winnipeg, Manitoba and to -36 F at Fargo, North Dakota.

Any hopes, however faint, for an early end to the cold wave were dashed once again on the following day. According to the 24 January edition of the Tribune, the end of the cold wave had been "postponed": according to the Weather Bureau "whatever improvement experienced Friday, probably will be wiped out by a new attack of colder air Saturday [25 January]. The same edition also reported that Northwestern Line train no. 202 from Omaha had arrived twenty seven hours and thirty seven minutes late after having been stalled in snowdrifts in southern Minnesota. At International Falls, it was said, the temperature had dropped to -56 F on Thursday morning [23 January]. On 25 January, the Tribune noted

that "temperatures may rise, but not for long". It also reported that the Minneapolis Park Day dog derby (which had been postponed several times in 1931 because of warm weather and lack of snow) had been postponed because of the cold weather. Tragically, a Hutchinson salesman had been found frozen to death near Raymond, Minnesota and at Embarrass, Minnesota, a farmer had frozen to death "while making his way from the barn to the house". And in its 26 and 27 January editions, the Tribune gloomily reported that "whatever hope has been entertained that the tenacious cold was on its way out receded with the mercury in the northwest states Saturday night. Because there was a temperature rise during the daylight hours of Saturday, the belief was common that conditions were changing for the better. It was a false surmise. No moderation in sight as the cold continues into its second week. The below zero wave extended from the Rockies to Indiana and freezing cold was felt in the deep south".

Nor, of course, was coverage of January's adverse weather confined to Twin Cities newspapers. As previous quotes from rural, out state newspapers indicate, no part of Minnesota was spared the misery which accompanied the month's bitter cold, a fact emphasized by the 24 January 1936 edition of the Brown County Journal. After noting that temperatures in New Ulm had fallen to -32 F on Wednesday morning [22 January], the Journal went on to say that "a strong northwest wind hurled the biting blast in the teeth of those who were abroad. Sharp particles of snow picked up by the swirling zephyr [when] flung against the face felt like particles of fire. Tuesday night's icy blast was the second of the week. The blasts were sufficient to send almost any human scurrying for the woollens. The mercury dropped like a plummet Sunday evening. The cold blast was widespread and reached to the Gulf of Mexico. The north pole temperatures played havoc with school attendance Wednesday morning. Many children as well as several teachers suffered painful frost bites. All trains on the Minneapolis and St. Louis road were cancelled Wednesday for the duration of the cold spell. The sub zero weather has proved a handicap for mail service". The extreme cold, moreover, was a factor in a disastrous fire which destroyed or badly damaged twelve professional and business enterprises "in the heart of New Ulm" on Friday [24 January]. According to the 31 January edition of the Brown County Journal the "blaze gutted four downtown buildings...Two fire hydrants were frozen and could not be used. Firemen's coats were covered with ice and faces and hands became frost bitten". The temperature at the time of the fire was said to have been "hovering" around -35 F. And , also on 31 January, the Milan Standard reported that "the recent cold wave has set an all time record in many places. Locally, the temperature dropped as low as minus thirty five degrees on two separate days, according to Torfinn Opjorden, official observer".

But bad as it was, January's adverse weather -- any expectations to the contrary notwithstanding -- was followed by even worse conditions during much of February 1936. Many communities were brought to the brink of disaster by blizzards, often accompanied by heavy snowfall, which swept across Minnesota and much of the Upper Midwest on 3-4 February, 8-9 February, 13-14 February, 17-18 February and 26-28 February. The stormy conditions, moreover, were often accompanied by, or followed by, extreme cold, the worst of which brought record low temperatures to many parts of the state on 15-16 February (e.g. Ada, -53 F; Warroad, -52 F; Crookston, -51 F; Fosston, -48 F; Little Falls, -46 F; Milan, Fergus Falls and Wadena, -42 F; Morris, -41 F; Chaska, -37 F; Maple Plain and

Rochester, -34 F; St. Peter and Zumbrota, -33 F). As then calculated, February temperatures statewide averaged -5.5 F, a value nearly eighteen degrees below the then accepted Minnesota February normal. The statewide average snowfall was 18.8 inches, a value nearly three times greater than the then accepted February normal of about seven inches. Individual monthly snowfall totals ranging from twenty five to thirty inches were common at most Minnesota stations, amounts which, driven by high winds, buried railroads and highways, effectively isolating many rural communities.

Like January's frigid weather, February's weather dominated the pages of Minnesota's newspapers, filling them with reports of weather related fatalities, food and fuel shortages, stalled trains and distressed farm communities. Some of the most extensive coverage of the month's weather was provided by the Minneapolis Tribune, virtually every February 1936 edition of which featured news of a new cold wave, a blizzard or, worse, accounts of human suffering caused by what must have seemed to be a never ending series of weather related disasters. The first of the February articles were, however, comparatively lighthearted, the 1 February 1936 edition of the Tribune reporting, for example, that the cold weather threatened to "bring another postponement of the Minneapolis...park board's dog derby". This event, it was said, would "probably be postponed for another week". And, on 3 February, the Tribune featured a ground hog story, noting that, although "the prolonged reign of sub zero weather was broken temporarily in the northwest Sunday [2 February]..the Weather Bureau and the ground hog joined in predicting that a renewal of severe weather was not far away. Sunshine made it possible for the groundhog to see his shadow which, according to that variety of weather forecasting, means six more weeks of winter. Operating on a more scientific basis, M. R. Hovde, U.S. Weather Bureau meteorologist, likewise predicted several weeks more of cold".

The first of February's blizzards, however, brought an abrupt change in the Tribune's mood, its 4 February edition featuring a banner headline which told readers that the storm had tied up traffic in many parts of the state, that drifts had crippled train traffic and closed roads south of the Twin Cities. According to the account that followed "persistent snows driven by winds late Monday night [3 February] threatened to tie up all traffic in southern Minnesota. Snow began falling in Minneapolis before midnight Sunday and continued in various degrees of intensity throughout Monday. A north wind swirled the snow through the streets and piled it into drifts. Traffic conditions were hazardous. In some places in southern Minnesota, the snow already measured three and one half feet on the ground. Bus schedules were disrupted and the Milwaukee Railroad cancelled all trains in the southwestern part of the state. Concerns were being felt in the southern part of Minnesota over fuel supplies. With railroad service doubtful, some communities had coal to last only a week or less. The Fairmont municipal power and light plant has coal enough for one week....Northwest airways flights to Chicago were cancelled. Many roads in North Dakota were blocked. The storm also swept over Iowa. In Colorado, a high wind sent a boxcar scooting along the tracks for four miles before it was upset. A dust storm preceded the blizzard in Colorado".

Another Tribune banner headline on 5 February announced the arrival of another cold wave, noting that "mercury drops as blizzard abates". Wind and snow, it was stated, had isolated

many towns and that, because of the cold, snow plowing had been halted in many areas. The story that followed expanded on the previous day's dour report, emphasizing that "bitter cold borne on the tag end of a raging blizzard assailed Minnesota and the Dakotas Tuesday night [4 February]. The storm abated leaving scores of communities isolated because of great drifts piled on highways and railroad tracks. Snow plows at six important state highway maintenance points were called off the job late Tuesday because of high winds and cold. Engineers said snow removal would be impossible until the winds died down....The worst blizzard in twenty years was reported in the Willmar area. Roads were blocked and rail traffic was extremely difficult. Heavy snow blocked many roads in Wisconsin. Milwaukee reported itself almost isolated as far as transportation was concerned. Heavy snow blocked roads in Illinois and five deaths there were attributed to the storm. The freezing weather drove deep into the south. Rivers were swollen out of their banks in eastern Mississippi, Alabama, northwest Georgia and North Carolina. Temperatures as low as eight degrees at Amarillo, Texas".

The 6 February edition of the Tribune focused on the aftermath of the storm, noting that "the task of digging the drifts from roads and rail lines in the state has progressed far by Wednesday night [5 February]. Most of the main highways are open. Trains and busses, however, were still running late. Minneapolis is into its twentieth consecutive day of sub zero temperatures. The Chicago and Great Western train from Omaha arrived Wednesday at nine a.m., twenty five hours late. Roads were still blocked between Sanborn and Balaton, Marshall to the west state line and other areas in southwest Minnesota. High drifts reported at Windom and Redwood Falls". The same report further noted that temperatures had fallen to -37 F, -35 F and -32 F, respectively, at Pembina, Jamestown and Fargo, North Dakota.

On the following day [7 February], the Tribune featured an account of a stalled Chicago and Northwest train, the locomotive of which was pulling coaches carrying eighty nine passengers when it "smashed into a huge snowdrift and stopped Tuesday night". "The engine's boiler froze and there was no heat. Early Wednesday, the passengers were rescued and brought to Jackson, Wisconsin". The same edition of the Tribune noted that "lowered wind velocities gave highway and railroad crews an opportunity to buck away the drifts that have isolated many communities. Main line trains were reported running close to schedule. Snow bank canyons almost ten feet high for one half mile were reported on the highway leading into Fairmont. Continued bitter cold, slow freight movement and inability of some snow bound mines to operate heightened the coal shortage in Iowa. Some South Dakota areas were also in danger of a cold shortage". The same report also pointed out that temperatures in Canada's MacKenzie river basin, the presumed source of northwest's cold weather, had fallen as low as -56 F.

Any respite from the weather was short lived, however: as noted, a second February blizzard struck the northwest on 8-9 February, prompting another banner headline in the 9 February edition of the Tribune: "blizzard ties up entire northwest: four die, trains, busses stalled between towns". In other headlines, the Tribune claimed that the "entire state of Iowa said to be in virtual isolation," that temperatures had fallen to -52 F in the Black Hills region of South Dakota and that smaller communities in North Dakota were facing a fuel shortage. The story that followed was filled with a sense of impending, if not imminent,

disaster: "raging out of the west, a blizzard unprecedented in at least a score of years was sweeping across the nation Saturday night [8 February], isolating thousands of communities and paralyzing transportation and leaving death and deprivation in its wake. Practically the entire southwestern section of Minnesota was snowbound. Smaller communities in Minnesota, North Dakota and South Dakota have begun to experience an acute coal shortage. All bus service out of Minneapolis was cancelled except to a few nearby points...Saturday night the street department was operating fifty four plow trucks, twenty seven trucks hauling snow and two snow loaders with a crew of about four hundred. Highway 7 passable to Excelsior but not beyond. Village of Edina reported as isolated....Milk shortage feared unless road reopen". The same story also noted that storm had reached the Texas panhandle and that parts of the west were suffering from "bitter cold" (with minima of -22 F at Goodland, Kansas and -25 F at Denver, Colorado).

Predictably, the news became progressively alarming, reflecting both the persistence of the adverse weather and its cumulative effect on the lives of Upper Midwest residents. The 10 February edition of the Tribune featured yet another banner headline which told readers that wind and drifts had halted snow plows, that hundreds of northwest towns were still isolated and that southern and southeast Minnesota was still "virtually snowbound". Conditions in northern Minnesota, however, were said to have been "somewhat better" than those in southern regions. In the article that followed, the Tribune continued to stress the magnitude of the weather disaster, claiming that "rail and highway transportation in Iowa was paralyzed," that milk and coal shortages threatened many areas, the threat of the coal shortages characterized as becoming "more acute". Food rationing, it was said, was in "prospect" in Sioux Falls, South Dakota with an "expanded" fuel scarcity looming in northwest South Dakota. The same article also stated that "except for the area immediately surrounding the Twin Cities and sections to the north, efforts to restore the vast snowbound northwest region to something approaching normal were all but useless. On highways and railroads, crews prepared for heavy duty worked at top speed to plow out transportation routes but their efforts were nullified as the wind whipped up the snow left by Saturday's blizzard and piled it back into cuts as soon as the plows had passed. Some slight progress was made on a few roads leading south and southwest from Minneapolis but in general transportation in the southern one half of Minnesota was still at a standstill. Autos were stranded in drifts along many roads. A St. Paul to Stillwater bus carrying eight passengers was stuck in a snowdrift near Lake Elmo for six hours early Sunday [9 February]. The threat of a milk famine for the Twin Cities was averted, H.R. Leonard, general manager of the Twin Cities Milk Producers Association said Sunday. Despite the deep drifts, farmers using teams and sleds managed to get their milk to the main roads where it was picked up by truck. Although the supply was low, it was sufficient to meet Monday's needs. Because of too much snow, many Midwest ski tournaments had to be called off. A dog team took one hundred fifty pounds of food Sunday to miners and truckers snowbound at a mine near Jefferson, Iowa. Drifts fourteen feet deep were reported in the Willmar area. Late Sunday, the only highways open were 52 to Rochester, 14 from Waseca to Winona and 65 from the Twin Cities to Owatonna. In Des Moines, Iowa, farmers without coal were sheltered in the courthouse or in the homes of relatives. Washington, D.C. had its heaviest snow storm in fourteen years..".

More of the same followed, the 11 February edition of the Tribune reporting that although "with a few exceptions in southern and southwestern area, Minnesota had cleared its main roads and highways," most rural roads remained blocked. Rail and bus transportation, moreover, was characterized as "not back to normal" and coal shortages, insufficient milk and food supplies were "still a problem". In Iowa, such shortages had become "acute" in a "dozen cities and towns". "Extreme hardships" were reported in parts of South Dakota where, it was said, many towns remained completely blockaded by the snow. In Livingston, Wisconsin, a community of five hundred which had gone for a week without train service, less than twelve tons of coal remained on Monday [9 February]. A carload of coal was "tied up" on the snow blocked railroad only seven miles distant. Beginning on 12 February, the Tribune regretfully reported that yet another blizzard had invaded the northwest. Although reportedly not as "severe" as the blizzard of the week previous, it was, nevertheless, powerful enough to "pile drifts on highways and close roads once again". The storm began in the Dakotas on 12 February, bringing snow to western Minnesota late in the evening of the same day. And although the snow, initially, was not accompanied by high winds, blizzard conditions soon developed, the 14 February Tribune reporting that "rising winds" had drifted a fresh fall of snow ranging up to four inches. Reports from Fargo, North Dakota indicated that a combination of light snow and twenty mile per hour winds had reduced visibility to less than one half mile. The break between the 8-9 and 12-14 February blizzards had, fortunately, allowed crews to restore service on the state's main railways, making it possible for trains to bring much needed shipments of coal to at least some southern Minnesota communities. Most North Dakota highways (and presumably railways as well) remained blocked or "heavy", however. The Tribune also reported that highway crews were forced to use dynamite (emphasis added) to break up the hard, compacted drifts which blocked some area roads.

On 15 February, the Tribune announced the arrival of a new cold wave which, following the Valentine Day's storm, once again complicated snow removal and relief efforts. According to the Tribune, "shovelers and rescue parties worked to open roads to take fuel and food to isolated communities in several states. A number of towns in Minnesota, South Dakota, North Dakota and Iowa were in straits, some lacking food, some coal and some both. Snow locked southern Minnesota put rationing of food and fuel on a more rigid basis Friday [14 February]. Nearly all transportation in the area was at a standstill. There were no reports of an absolute lack of fuel but supplies were so low that a half ton was the most that one could buy. Many dealers were entirely without supplies. Not a train moved in or out of Pipestone. Towns in the St. James area reported only two trains in three weeks but had a good supply of fuel and food. At Worthington milk was being rationed to families. A train carrying coal to Round Lake was derailed by drifts. A carload of coal arrived Friday at Marshall where fuel was being rationed in one half ton lots....". The same edition of the Tribune also reported that the Duluth harbor was "ice blocked" and that temperatures had dropped to -44 F at Devils Lake, North Dakota and to -40 F at Fargo. Bismarck, North Dakota, it was noted, had entered its thirty sixth consecutive day of sub zero weather. In addition, fears of crop damage resulting from a combination of cold weather and dust storms in Kansas, Colorado, Texas and Oklahoma drove wheat prices up one cent per bushel in trading on Friday [14 February].

In an interesting, but perhaps apocryphal report, the 15 February edition of the Tribune claimed that a thermometer located on a nursery farm ten miles south of Erskine, Minnesota, had registered -69 F (emphasis added) at 0630 hours on 6 February 1936. According to Martin Lind, owner of the nursery, "a blue heavy mist seemed to hang all over" his farm at that time. He vouched for the accuracy of the thermometer in question, stating that he had paid \$2.50 for it (the 1930's price of a presumably high quality instrument).

As the new cold wave settled into the area on 15-16 February, conditions continued to deteriorate, the 16 February edition of the Tribune reporting two "cold related" deaths in the Twin Cities. Train service and highway travel, it was emphasized, "continued to labor under heavy difficulties Saturday [15 February]." "Some communities saw a renewal of transportation which meant replenishing of dangerously low fuel and food supplies, others are still snow locked. Thirty two men from Ormsby, a village of 107 persons, twenty five miles north of Fairmont fought their way through snow drifts to Odin, four miles away to obtain bread, butter and other supplies. Ormsby has been without train service for nearly a month and roads have been blocked for a week". The same report also noted that temperatures had fallen to -49 F at Minot, North Dakota. And, on 17 February, the weather provoked another banner headline which, after a day of record setting minima, told the Tribune's winter ravaged readers that temperatures had dropped to -50 F in North Dakota and, worse, that more cold and snow were "on the way". According to the article that followed "a new polar blast swept across the northwest Sunday night [16 February]. With it came threats of more snow storms and dangers of prolonged isolation for some of the communities just digging out or still locked in by drifts". In North Dakota, winds reaching thirty miles per hour had swept up "loose snow," creating blizzard conditions in many parts of that state. Moreover, a minimum of -50 F, it was reported, had been recorded in Williston, North Dakota. In Minneapolis, the temperature had dropped to a low of -26 F at 0600 on Saturday. This reading, it was cautioned, had been taken from instruments on top of the five story federal building in downtown Minneapolis: temperatures at street level, it was said, were six to ten degrees colder than the official reading. Tragically, also, the cold claimed another victim, a sixty year old man whose frozen body was found in a "shack" in Plymouth township west of Minneapolis.

And once again worse news followed. The 18 February edition of the Tribune featured yet another banner headline, this time proclaiming the arrival of another disruptive blizzard. In the story that followed, the Tribune reported that "high winds and new snow bringing about blizzard conditions yowled over large areas of the Dakotas and western Minnesota Monday night [17 February] undoing the work accomplished in recent days in opening of transportation facilities. The high wind made the Red river valley the frontier of westward transportation with many trains being held up in western Minnesota and eastern North Dakota...Pipestone reported a blizzard which had been raging since Monday noon and that recently opened highways were blocked once again. Lake Wilson, eleven miles west of Slayton reported that the last fuel had been sold three days ago. Neighbors are sharing with neighbors. Three carloads of coal consigned to Lake Wilson were being held at Heron Lake, thirty six miles east but rail lines were so badly drifted as to preclude the possibility of delivery for days. Roads in the Willmar area were closed by drifts once again. Big clouds of flying snow made skies gray over Bismarck, North Dakota, during the day. Winds filled

roads in North Dakota as fast as they could be cleared..... William Junke, a farmer living five miles east of Comfrey, Minnesota walked to town to get supplies and food, On the way home he got tired and sat down to rest. His seat was a cross arm on a thirty foot telephone pole (emphasis added).....Coal rationing began Monday in Shenandoah, Iowa. The local Red Cross is providing food to the snowbound city. All highways in the north part of Iowa are snow choked".

Although most Minnesota stations recorded below zero minima for several days following 16 February's record setting cold, a distinct warming trend began on 19 February, a change which must have been accompanied by a huge, collective sigh of relief. This change was duly noted by the Tribune (19 February) with a headline which told its readers that the cold "eases its grip as winds die down". The same edition also reported that train service to Fairmont had been "partially restored" on Tuesday night [18 February]. And, citing another instance of determination in the struggle against the elements, the Tribune reported that "a bobsled loaded with provisions got through to the farm home of William Beadle, thirteen miles southeast of Fairmont. The family of ten had been without food or fuel for two days".

More good news followed. On 20 February, the Tribune was able to state definitively that the "Arctic spell" had come to an end. The northwest, it said, was "almost warm" Wednesday [19 February]. "During the day, hundreds of communities found the mercury a few degrees above zero. The less severe weather and the absence of high winds enabled the work of clearing roads in Minnesota and the Dakotas to progress more rapidly. A heavy freight movement was reported in the Pipestone area as the blockade of the Great Northern road was lifted". Temperatures continued to moderate, reaching the high 30's and low 40's F at many stations on 23-24 February (e.g. 43 F at Winona; 42 F at St. Cloud; 41 F at Minneapolis Weather Bureau station; and 40 F at New London). According to the 24 February edition of the Tribune, the city, warmed by a smiling sun, began to see some melting of the accumulated winter snow. The same article went on to point out that "disintegration of the northwest's snow drifts started Sunday [23 February] under temperatures that brought an end to the record breaking reign of below zero weather". The warmth formed "small pools of water on loop streets and sidewalks" and brought out "coatings of frost on the facings of loop buildings". There were also "two reports of robins being sighted". Temperatures, it was said, had reached 52 F at Rapid City, South Dakota. The return of warmer weather, however, was not an unmixed blessing, the Tribune reporting that "vast clouds of dust churned over parts of Colorado, Texas, Nebraska, Oklahoma and Kansas on Sunday on the heels of a departing cold wave. Gales accompanying the dust smashed plate glass windows in stores in Pueblo, Colorado and forced motorists to stop their cars and turn on their lights". Similarly, the 25 February edition of the Tribune reported that "snow slides, floods and grinding ice floes loosened by warming winds that swept a major part of the nation, took a reported toll of at least seven lives Monday [24 February]. The same winds, rushing to fill low pressure areas over western Nebraska and northern Wisconsin scooped up soil from the bare fields in the southwest, creating scenes reminiscent of last years' blighting series of dust storms. The second dust storm in as many days fogged skies over parts of Texas, Oklahoma, Kansas and Colorado. Winds reached forty miles per hour in some areas. Visibility ranged from one fourth to three fourths miles. In the Nemaha river valley in Nebraska more than two feet of snow melted in two days...".

Unfortunately, late February's respite from the winter's seemingly endless stretch of perverse weather was short lived. Another snow storm entered the northwest on 27 February, prompting still another weather related Tribune banner headline: "Traffic Blocked, More Snow Due". In the words of the story that followed "a heavy snowstorm which, with rising winds and falling temperatures, took the semblance of a blizzard in some localities Wednesday [26 February] making traffic impossible in large areas of the northwest. The southwest part of the state was hardest hit. Visibility [was] 150 feet at Marshall and all traffic stopped . Traffic in the Twin Cities was impeded and visibility was at times one hundred yards or less. Twelve to twenty inches of snow in parts of southwest Minnesota. Because of old drifts and the necessity of throwing snow over banks already ten feet high in many places, the task of clearing roads appeared greater than at other times during the winter. The main highway between St. Cloud and Minneapolis was reported impassable late in the day. Northern Minnesota got less snow but much of the wind. Snow choked highways were reported in the Rochester, Austin and Albert Lea areas".

Nor, of course, was journalistic coverage of the winter's events limited to Twin Cities newspapers. Reports in many out state newspapers were as extensive as -- but sometimes more colorful than the accounts appearing in metropolitan newspapers. The 7 February 1936 edition of the Brown County Journal (New Ulm) stated, for example, that "a blizzard Tuesday morning followed a snowfall of nearly twenty four hours duration which tied up traffic on highways in this part of the state almost completely. Eleven inches of snow fell. Tuesday morning [4 February] a high wind swept across Minnesota and made life miserable for man and beast out in the open. In the rural districts, it was impossible to see any distance during the greater part of the day. There was no snowfall but the wind which raged swept the snowfall of the previous day into swirling clouds which filled the air and closed many side roads and blocked trunk highways in many parts of the state". Two weeks later, the Journal focused on the weather's impact on local transportation, emphasizing that "the past week has been one general round of fighting by railroad and highway crews to keep rail lines and highways open for traffic in this part of Minnesota. Many cities and villages are becoming fearful that the coal shortage would become so acute that householders would suffer. Just as traffic was beginning to take on normal proportions Old Man Winter stirred up another blizzard for this part of the state. Thursday morning of last week highways and rail officials were rejoicing that railroads and main highways were open for traffic and that coal and foodstuffs were moving into southern and western Minnesota. But the thermometer dropped and wind whipped the snow into cuts and disrupted rail and highway traffic once again. The respite from blizzards on Wednesday of last week permitted the railroads...being opened for traffic to transport sufficient coal to New Ulm for all immediate needs. The coal dealers rationed this coal out to their customers". And one week later (28 February), the Journal was forced to report another blizzard, a blizzard that abruptly ended a brief warm spell which, as the Minneapolis Tribune happily noted, had brought robins to several Twin Cities backyards. In the Journal's words, this "raging blizzard" had "harassed" the New Ulm area on Wednesday [26 February], "tying up traffic of all kinds". "Heavy snow laden with moisture began to fall early in the morning and continued throughout the day. During the early morning hours there was no wind and the temperature was near the freezing point but about ten o'clock the wind veered to the northwest and soon an old time blizzard was

raging. Mr. Henle [New Ulm's Weather Bureau cooperative observer] estimates that ten inches of snow fell during the blizzard...The wind was about thirty miles per hour and this closed all the trunk highways as well as the state aid and township roads. Many cities and villages were isolated. Highways were closed tighter than at any previous time during the winter by the fact that the cuts forced by high piled snow filled rapidly, packed tight and formed a solid mass.....".

Similar accounts appeared in the Morris Tribune, the 7 February 1936 edition of which noted that the Morris area had, at that point, suffered though twenty seven consecutive days of below zero weather. Minima of -37 F and -32 F, readers were reminded, had been recorded at the Morris station on 31 January and 5 February, respectively. Moreover, the area endured a "full grown blizzard" on 4 February, a blizzard which, in the words of the Tribune, "was one of the worst in years but not as severe as in other sections of the northwest. Thirty five mile per hour winds at eight a.m. whipped up a blinding screen of snow. Winds of forty two miles per hour were recorded at 10 a.m." Roads were drifted badly and visibility was reduced to ten feet". Two weeks later, the Tribune reported that the areas's string of below zero days stood at forty with a minimum of -41 F on 16 February. And, like other areas of the state, the Morris area experienced "blizzard conditions" on 17 February. Although, as noted, temperatures warmed during the last week of February, many areas of the state including the Morris area experienced yet another blizzard at the end of the month. According to the 28 February edition of the Tribune, nine to ten inches of snow, accompanied by "severe drifting," was recorded at the Morris station on 26 February. Of this amount, six to seven inches were said to have fallen in about four hours on Wednesday morning [26 February]. The same article also noted that "six to ten foot snow drifts have barred automobile travel and have even made it exceptionally difficult for farmers to get to town by team".

Farther to the south, the Milan Standard (14 February 1936) reported that "a heavy blanket of snow fell quietly on Friday [7 February]. Late that night a steady northwest wind arose and the result was a blizzard of the worst kind. Highways and side roads were blocked, trains were unable to make their usual runs. The blizzard continued until Sunday evening [9 February]". And, as at Morris, temperatures in the Milan area dropped below -40 F on Sunday 16 February, setting what the Standard [21 February] described as a "new all time record [-42 F]". In a story which emphasized the human dimensions of the area's extreme weather, the same edition of the Standard further reported that Dr. M. A. Burns [a Milan physician] had "frozen his face in the blizzard Thursday evening last week. He attempted to reach a patient by team and sleigh but the horses become exhausted from wading through the heavy snow. He then walked a mile, bucking the wind". Finally, on 28 February, the Standard reported that approximately six inches of snow fell in the Milan area on 25-26 February. "Towards evening [26 February], a strong wind piled the snow in large drifts, completely tying up all auto traffic. Even walking was made difficult by the huge drifts". Similarly, the New London Times (23 January 1936) reported the coldest week recorded at that station since 1912 (with a minimum of -42 F on 22 January). And, a month later, the Times (20 February), emphasized that "New London and vicinity have been suffering the past several days with some of the coldest weather in its history. Train service has been very poor. New London has been somewhat of a deserted village the past two weeks as all the

county roads have been blocked making it nearly impossible for the farmers to get into town".

In addition to widespread human misery and the extensive disruption of economic activity, 1935-1936's extreme winter weather adversely affected animal life, making it difficult for farmers to provide food for domestic animals and, of course, causing widespread hunger and starvation among the state's wildlife population. Minneapolis Weather Bureau officials, for example, noted that, as a result of the cold, many farm animals "lost weight" during the winter and that "heavy" yard feeding was required. Minnesota newspapers, moreover, reported extensive loss of wildlife, game birds especially. As early as 25 January, the Minneapolis Tribune, briefly noted that "pheasants were reported dying". A more detailed and emphatic account followed on 4 February 1936, the Tribune emphasizing that extensive "suffering" among the pheasant population had been reported in the southern part of the state. "In Martin county hundreds of birds were reported dead on the snow swept prairies and others badly disabled, their wings coated with snow". Lack of food and shelter/cover, it was said, made the situation "even more critical". Several days later (9 February), the Tribune emphasized the extent of the disaster, stating that, according to some reports, the quail population in "some south central areas, had been "wiped out". Prairie chickens, it was added, had been "killed by the hundreds in some areas". What was described as an "appalling" destruction of pheasants was also reported. Sportsmen's organizations and others, however, responded to the challenge by organizing drives to provide food and shelter for distressed wildlife. In this regard, the 20 February Tribune reported that Hennepin county sportsmen's groups and individuals had distributed 60,000 pounds of feed "to help save song and game birds from the deadly winter".

Other aspects of the winter's effect on wildlife were reported by the Morris Tribune and the New London Times. According to the 28 February edition of the Tribune, a report from the Red Wing area "indicates that numerous woodpeckers have been found clinging to the sides of trees, frozen to death. They died while attempting to get food from frozen tree trunks". And, according to the 27 February edition of the Times, as many as two thirds of the pheasant population in the New London area may have "starved to death" during the winter. This report, however, was challenged by a later report (23 April) which stated that the effects of the winter on the area's pheasant population may have been "exaggerated". The same article further noted that "pheasants had started nesting in dried lake bottoms in 1934 when the drought reached its peak. Many nests were destroyed last year [1935] when water was restored to the lakes".

Yet, despite their invaluable contribution to the meteorological history of the winter of 1935-1936, newspaper accounts are, perforce, anecdotal, impressionistic, often fragmented and perhaps sometimes exaggerated. For a more comprehensive and objective view of the weather events of the "winter from hell" snowfall especially it is necessary, then, to return to the data compiled by U.S. Weather Bureau observers during the period, October 1935 through April 1936. Temperature records kept during that period are, of course, unanimous in documenting a period of abnormal cold which began in October 1935 and which persisted with but little relief into the early spring of 1936. Snowfall and meltwater records, in contrast, are more problematic, suggesting, inter alia, that reports of twenty to

thirty foot snow drifts were either unrepresentative of conditions generally or, worse, were apocryphal, perhaps reflecting the distorted judgements of overawed, winter weary observers who, using the drier winters of the early 1930's as a basis of comparison, tended to exaggerate the size of the drifts encountered during the winter of 1935-1936. Moreover, snow cover/snow depth records kept by Minnesota observers during the winter of 1935-1936 are notably incongruent, sometimes seemingly randomized, thus providing little consistent information regarding the "true" depth of accumulated snow.

Morris observers, for example, recorded a snow cover of only six inches on 31 January 1936, a value which, despite significant February snowfalls, shrank to 5.5 inches on 16 February, increasing to only 8.5 inches on 29 February. Nearby Fergus Falls, in contrast, reported snow cover values of nine inches on 15 January; eleven inches on 31 January; 16.6 inches on 15 February; twenty six inches on 29 February and seven inches on 15 March. At New Ulm, snow depth values were even more disproportionate, including 22.5 inches on 15 January; 25.5 inches on 31 January; 44.25 inches on 15 February; an almost certainly unrepresentative, exaggerated value of 55.75 inches on 29 February; and 15.5 inches on 15 March. The Minneapolis Weather Bureau station recorded snow cover values of 3.5 inches on 1 January; 8.3 inches on 10 January; 7.8 inches on 20 January; eight inches on 31 January; 13.8 inches on 10 February and 14.5 inches on 29 February, amounts which, given the nearly thirty inches of snow recorded in January and February, seem low. Also, in contrast, the St. Paul cooperative station (then located in downtown St. Paul) recorded a snow depth of twenty nine inches on 29 February, a value exactly twice that recorded by Minneapolis observers on the same date. Not all 1935-1936 snow depth records can, however, be dismissed as incongruent or worse: less disparate, less questionable records were kept at stations such as Waseca (ten inches on 15 January ; twelve inches on 31 January ; twenty five inches on 15 February; twenty eight inches on 29 February; and twenty five inches on 15 March); Collegeville (twelve inches on 16 January; 10.25 inches on 31 January; twenty four inches on 13 February; twenty three inches on 29 February; and seventeen inches on 15 March); and Moorhead (7.6 inches on 31 December 1935; eighteen inches on 29 February; and 2.8 inches on 31 March).

Also, as noted previously, daily snowfall records (i.e. measurements of newly fallen snow) compiled during the winter of 1935-1936 , like corresponding snow cover records, are sometimes problematic, displaying variations that probably reflect faulty or erratic measurement techniques, not differences in the amounts of snow that actually fell at the stations involved. The Maple Plain observer, for example, recorded 80.4 inches of snow during the 1935-1936 season, a value more than double that recorded a few miles south at the Chaska station and approximately twenty five percent more than that recorded at the Minneapolis Weather Bureau station, a few miles to the southeast. Yet, despite differences in the way in which snowfall was measured (a task no doubt complicated by blowing and drifting), at least some of the records kept during the winter of 1935-1936 are consistent and accurate enough to document real variations in the amount of snow which fell in various parts of the state. It is apparent, for example, that portions of west central Minnesota remained relatively dry during the 1935-1936 winter season, evidence of which is provided by snowfall values recorded at Alexandria (with a seasonal total of less than thirty inches), Morris (with a total of about forty inches) and Wheaton (with a total of about

thirty four inches).

Moreover, despite the obviously poor quality of many 1935-1936 snowfall and snow cover records, there is no reason to doubt that the period from November 1935 through April 1936 was -- with exceptions such as the aforementioned west central region -- abnormally snowy. And windy: whatever snow fell was blown about, whipped into huge drifts which formed around buildings, fences and other obstacles. Thus, although reports of twenty and thirty foot snowdrifts are open to legitimate challenge, newspaper accounts regarding stalled trains, blocked roads, isolated towns and blizzards are undoubtedly essentially accurate in their portrayal of the effects of the winter of 1935-1936, especially as experienced by people in southern and central Minnesota. And, as indicated previously, the New Ulm area was among the most adversely effected, evidence of which was provided by the 10 April 1936 edition of the Brown County Journal. According to this report, 75.9 inches of snow had fallen at New Ulm since the previous autumn, an amount slightly greater than the snowfall recorded at the same station during the winter of 1916-1917. The Journal, in emphasizing the effects of the winter's weather, further noted that "many farmers were compelled to leave their cars in the garage for months at a time. Many roads are now in unserviceable condition as a result of the hard winter". And, on 15 May, the Journal reported that the season's snowfall total had risen to 85.9 inches, exceeding the 75.8 inches recorded during the 1916-1917 snowfall season. The previously reported value, it was pointed out, had been augmented by April snowfalls totaling ten inches.

Predictably, recovery from the devastations of the winter of 1935-1936 was slow and sometimes turbulent. Although the melting snow helped to maintain or, as in many areas, restore depleted subsoil moisture, it also triggered local flooding and left many secondary roads in extremely poor condition. According to the March 1936 issue of Weather Bureau's Minnesota climatological bulletin, "the rapid melting of the deep snow layer in southern Minnesota during the last decade [of the month] resulted in a number of creeks and rivers in extreme southeastern counties overflowing their banks. Vast areas of lowlands were inundated....Dirt roads were the worst in years...". More flooding was reported in April 1936, the result of melting snows (in the Ada area especially) and excessive rains (e.g. 4.38 inches at New London on 30 April-1 May) which fell in several central and southeastern Minnesota counties at the end of April, causing damage estimated at more than half a million dollars.

The slowness of the spring recovery was, of course, noted by Minnesota newspapers, the 6 March 1936 edition of the Brown county Journal reporting, for example, that "maintaining anywhere near a normal schedule of mail delivery on rural routes is impossible because of the snow blocked condition of many country roads". Fortunately, however, a combination of melting snows and human effort facilitated recovery, allowing the 13 March edition of the Journal to report that "the Minneapolis and St. Louis railroad is again operating over its line through New Ulm after nearly five weeks of being snowbound. The blizzard of February 7th closed the road on that day and it was not opened again until a rotary snowplow completed the task on Wednesday of this week". And, on 27 March, the Journal told its readers that "melting snow coupled with rain throughout the watershed of the Minnesota river and its tributaries caused that river and numerous smaller streams to rise to levels

exceeding anything since 1919....Flooding was reported in North Mankato....".

Similar reports were featured in several March editions of the Milan Standard, the first of which (6 March) emphasized the extent to which portions of Minnesota remained snowbound. According to this particular account, "an airplane [which] was called from...Minneapolis to transport a Sanborn farm girl over impassable roads to a hospital cracked up near Springfield and it was necessary to call out dozens of farmers who fought drifts for three hours to get the girl to town for treatment". Better news followed on 27 March, the Standard cheerfully reporting that "most of the large volume of snow in this neighborhood has now disappeared. At no time has the temperature risen very high so that the snow has been melting gradually. A great deal of standing water was expected but this was not the case. The snow melt was gradual but the ground was so dry that when cold weather came there was not enough moisture in it to freeze. Now it is in a porous condition ready to absorb any amount of water".

Recovery from the winter of 1935-1936 was further delayed by an abnormally cold April. According to the January 1937 edition of the Weather Bureau's Monthly Weather Review, "the month of April 1936 was cool for the season over nearly all sections east of the Rocky Mountains....The monthly departure over the eastern two thirds of the country ranged generally from deficiencies of one or two degrees in the more southern sections to four degrees or more in the area from the Lake region westward to the northern Great Plains.....several states reported the lowest monthly minimum of record: Arkansas with seventeen degrees; Idaho, minus twenty one degrees; Nebraska, minus fifteen degrees; Oklahoma, six degrees; Oregon, minus twenty three degrees.....". In Minnesota and much of the Upper Midwest, wintry conditions prevailed during much of the month. On 2 April, for example, the Moorhead Daily News reported that a "blustery snowstorm whipped over the Midwest today, disrupting traffic." Eight inches of snow were said to have fallen in Milwaukee, Wisconsin while Chicago experienced its "worst April snowstorm since 1926". Several days later, the Daily News noted that the temperature had fallen to 2 F in Moorhead on the morning of 7 April with readings as low as -26 F reported in parts of Canada. Winnipeg, it was claimed, had recorded a low of -16 F; Devils Lake, North Dakota, a low of -2 F. Other wintry minima, also recorded on 7 April, included -11 F at Argyle; -9 F at Crookston; -1 F at Fergus Falls; -2 F at Morris; 7 F at New Ulm; 1 F at New London; 6 F at Farmington and Grand Meadow; and 8 F at Zumbrota. The state's lowest official reading on that date was, as previously noted, a near record April minimum of -18 F at Warroad. Also, as in the southern part of the state, snow melt in the Red River Valley triggered local flooding. According to the 13 April edition of the Daily News the "backbone of the four day flood" in the Ada vicinity had been "broken," allowing conditions in that area to "rapidly return to normal". Merchants and householders, nonetheless, were still pumping out flooded basements and many farmers, it was said, were making ditches to drain their waterlogged fields. And, on 16 April, the Daily News was able to report that although the Buffalo river had set a twenty year high water mark during its four day "rampage" through the Hawley area, "no great damage resulted". On a less confident note, the 13 April edition of the Daily News stated that "soil conditions [in the Red River Valley] are causing some speculation. Reports indicate that the subsoil moisture, at first believed plentiful because of the bountiful winter snowfall, is actually somewhat scarce. The ground froze so hard that

a large portion of the water from the melting snows ran off".

Predictably, April's cool weather, combined with spring rainfall and the large amounts of water released by the spring snow melt, seriously delayed the 1936 crop season.

Minneapolis Weather Bureau officials, among others, noted that, despite a period of dry, sunny and windy weather at the end of the month, field operations for the spring as a whole had been "seriously delayed". Similarly, the 24 April edition of the Morris Tribune stressed that spring farm work was "off to a late start," delayed in part by a "heavy, wet" snow which had fallen on the day previous. The Tribune further noted that, during the past two weeks, Morris area farmers were "rushing" field work in an effort to compensate for time lost because of the lateness of the season.

Regrettably, the return of warmer weather and disappearance of the winter's snow cover created conditions favorable for return of the dust storms which had plagued the Great Plains during the previous four years. According to the June 1936 issue of the Weather Bureau's Monthly Weather Review "gale force winds" were again frequent during the spring of 1936. "Crops, pastures and fields, already suffering from a lack of moisture and the storms of February, were further damaged by spring dust storms. On March 1, 1936 light dust began to blow in central Colorado and by the 4th the storm had spread from the Black Forest region in Colorado over the lower Arkansas River Valley into the Panhandles of Oklahoma and Texas.....Dust was intense on the 13th and during the following day, practically the entire region east of the mountains was covered by a dust pall, reducing visibility to one hundred yards to one mile in Colorado.....and to twenty five feet at Kenton, Oklahoma Panhandle, where daylight was turned to darkness. In this region, the dust clouds turned from a red blackish color at the beginning to a yellowish red later. A driving wind accentuated the storm. A maximum velocity of thirty three miles per hour was reached at Pueblo, Colorado...and the air was filled with driving silt....reducing visibility to ten feet on the main arterial highway between Denver and Pueblo.....The driving sand removed paint from automobiles and pitted windshields....Areas of ungrazed grassland in the foothills was covered with fine dust.....Residents from extreme southeastern Colorado and extreme southwestern Kansas on March 25 and 26 [noted]..... a storm [that] was the most severe and of the longest duration of any ever experienced in that region....clouds of whirling silt appeared russet, blue, orange and black in succession...On the 31st, the storm covered the entire region south of the fortieth parallel east of the mountains, far into the upper reaches of the Arkansas river and westward along the Colorado-New Mexico boarder to the San Juan and Dolores river valleys, where the heaviest dust in the history of those sections was reported. At Pueblo, the sky was turned to a saffron blue and when the dust clouds settled, they brought darkness to the city....Veils of coppery hued silt were observed over western counties.....A phenomenal accumulation of muddy snow in the form of balls, the diameter of silver dollars, fell over some north central districts of Colorado.....Snow fences running parallel with and about one hundred feet north of east-west highways were, in many areas, completely covered with dust drifts....Drifts frequently filled road ditches and interred with traffic on the highways...".

Fortunately, dust storm activity waned somewhat during April and May 1936. According to the Monthly Weather Review, "conditions which had prevailed during the preceding

months continued in April, but with less frequency and mostly with diminished severity.....The area affected by dense dust was also less...A few of the April storms in Colorado were comparable with those of the preceding month in that there were complaints of crop damage...and traffic was hindered, sometimes for hours, by decreased visibility....Dust storms were less frequent during May than in the preceding month and dense dust occurred over a smaller area...the maximum number of dense dust storms decreased by about fifty percent, while the area covered was considerably smaller..."

The Monthly Weather Review also noted that "in some portions of Minnesota seeded fields were damaged where grain was not high enough to keep the soil from being blown away..". And on 8 May 1936, the Morris Tribune reported that "dust filled the air here on Wednesday [6 May]. It was reminiscent of the hazy days of two and three years ago when dust storms were common. The dust was reported to have originated in Nebraska". In general, however, Minnesota was minimally affected by blowing dust during the spring of 1936, a fact no doubt attributable to the state's heavy March snowfall and the moisture released by the spring snow melt. Several stations did, nevertheless, report "light" dust on 22, 24 and 28 March; on 15, 16 and 20 April; and on 6, 7, 15, 16, 18, 21 and 22 May. Yet, the state's spring dust storms, although much less severe and much less widespread than those which occurred during 1933 and 1934, were nonetheless indicative of incipient but deepening drought. Despite a few locally heavy rains, April 1936 was notably dry at most Minnesota stations. And, although heavy rains did fall in many locales during the first ten days of May and again on 22-23 May, the month overall was drier than normal. More ominously, the dryness was soon accompanied by warmer than normal temperatures. May was one of the warmest Mays recorded in Minnesota up to that time, maxima at many Minnesota stations reaching the 90's F during the closing days of the month. Although most Minnesotans appear not to have recognized it as such, late May's heat, in fact, was a foretaste of a burning, desiccating heat wave which settled into the area late in June and which culminated in a record shattering hot July. The result was a summer which, despite the generally optimistic outlook encouraged, among other things, by the winter's beneficial moisture, was as hot and dry as the winter had been cold and wet. As it turned out, then, 1936 was a year of extremes a year that, with the possible exception of 1838, was without historical precedent. It was, in a few words, a year in which a winter from hell was followed by what can aptly be characterized as a summer from hell.

THE 1930'S
THE SUMMER OF 1936:
THE SUMMER FROM HELL

The summer of 1936, it is fair to say, got off to a generally auspicious, if sometimes turbulent start. May 1936 rainfall, as noted previously, although generally below normal, was adequate in most areas. Crops, meadows and pastures were in generally good condition, aided in some areas by heavy rains which fell during the closing days of April and the opening days of May. Other areas received generous rains during the last ten days of May (e.g. Pipestone and Redwood Falls, 3.12 inches and 2.55 inches, respectively, on 22-23 May), sustaining the high expectations which accompanied the month's warm, sunny weather (with 73 and 80 percent of possible sunshine recorded, respectively, at the Weather Bureau's Minneapolis and Moorhead stations). The state's newspapers, predictably, reflected the sanguine outlook held by many Minnesota crop and weather watchers during the early summer, an example of which appeared in the 8 May edition of the Brown County Journal: "a drenching rainfall which fell Thursday morning and Friday of last week broke a drought of several weeks and insured quick and rapid growth of pastures and grain. Yet, beneficial as it might have been, the rain was "torrential" in some areas, accompanied by hail and thunderstorms which, according to the Journal, struck portions of the northwest on 7 May, "inflicting heaviest damage in southeast Minnesota and southwest Wisconsin. Tornadoes howled across a twisting one hundred mile course in northern Iowa and southern Minnesota, causing five deaths".

And, although the specter of drought soon began to appear in some areas of the state, the northwestern and west central areas in particular (e.g. May precipitation at New London, Morris and Crookston was only about fifty percent of normal), cool weather and moderate rainfall during early June was enough to sustain the season's earlier optimism. In this regard, a still confident Journal (12 June 1936) reported that "the almost all night rain of Friday [5 June] was welcomed in this section. The lack of precipitation was not greatly evident but below normal precipitation has been noted in this area for the past six months. However, the cool weather caused the lack not to be crop reducing. Crops in Brown county are in excellent condition (emphasis added). Minnesota is evidently out of the dust bowl this year but some portions of South Dakota, North Dakota and Montana remain in the drought area". And a week later (19 June), the Journal described the Minnesota crop outlook as "good" while describing the situation in North and South Dakota as "less

fortunate".

Similar early season reports appeared in the Moorhead Daily News, a newspaper which, ironically, was published in an area which, as it turned out, was ravaged by the 1936 drought to a much greater extent than were many other parts of the state. On 1 May, the News, like the Journal, carried reports of the storms which had brought copious rains to parts of southern Minnesota but which, unfortunately, had spawned tornadoes, damaging winds and hail. According to the Moorhead report "two persons were killed and scores injured...as a result of a terrific tornado which ripped across southern Minnesota last night. There were whole areas where not a single farm building was left standing....The storm started in Iowa, roared across the border for two hundred miles and spent its fury in Minnesota". Damage was estimated at \$200,000 (1936 dollars) and "entire herds of livestock" were said to have been destroyed. On the following day, the Daily News noted that "highways in the vicinity of Winona were buried under rock slides and vast sheets of yellow mud after torrential rains peppered down all day yesterday and the Mississippi river swelled out of its banks. Miles of secondary roads and fields were washed out by another cloudburst in the Morrison county area".

On 13 May, the Daily News noted that thirty percent of Clay county's alfalfa crop and "practically all winter rye" had been killed by severe winter weather, optimistically predicting, however, that the lost acreage would soon be reseeded. Ten days later (23 May), Moorhead readers were told that "generous rains ranging to more than two inches" had covered "wide sections" of the northwest. "In Clay county, however, a "good rain was needed as topsoil is beginning to blow. In the Sioux Falls area of South Dakota, the last vestiges of the 1933-1934 drought are believed to have been completely wiped out as a result of rains during the past twenty four hours. Lowland areas around Sioux Falls are reported as underwater this morning". And, as late as 9 June 1936, the Daily News asserted that "northwest farmers are said to be optimistic about crop prospects, their hopes buoyed by soaking rains which drenched the plains of Minnesota, North Dakota and Wisconsin all day yesterday and last night". In a similar vein, the 9 June 1936 edition of the Minneapolis Star reported that three days of "soaking" rains had "cheered farmers and increased crop prospects" in many areas of the northwest, including the Dakotas and Nebraska (much of the latter having been "blanketed by wind, rain and hail"). Still another mostly optimistic report appeared in the 1 July 1936 edition of the St. Paul Dispatch which, quoting a study done by the St. Paul Association, asserted that only fourteen percent of the population and thirteen percent of the farms "in the immediate Twin Cities market area" were seriously affected by the drought. The same edition of the Dispatch also quoted a Minnesota Agricultural Society study which claimed that the condition of the state's crops at that point in the summer was "approximately eighty percent as good as last year". The same study further reported that "only half a dozen counties in west central Minnesota have been affected by the drought. Conditions in the southeast counties are especially favorable".

Although temperatures remained relatively cool during much of June, it soon became apparent that drought had returned, both the frequency and quantity of rainfall falling off markedly after 10 June. For the state as a whole, June precipitation was less than fifty percent of the then accepted normal, a number of stations (e.g. Alexandria, Campbell, Albert

Lea, St. Cloud and Milaca) recording less than one inch of moisture. At Moorhead, June precipitation totaled a meager 0.48 inches, the least amount recorded at that location during the entire period, 1891-1936. Moreover, during the closing days of the month, unseasonably warm air invaded the western part of Minnesota, pushing temperatures to 105 F at Canby, 103 F at Beardsley, 102 F at Redwood Falls, 100 F at Wheaton; and 100 F at far northern Ada, all on 24-25 June. The state's newspapers, of course, soon became aware of the encroaching drought, their earlier optimism quickly giving way to a pessimism which, as the summer wore on, verged on desperation, even panic. As early as 26 June, the Morris Tribune, as an example, drew attention to the deepening drought, noting that "high temperatures, hot winds and a lack of rainfall has taken a toll on the crops. The small grain crop is now practically nil. Hay and pastures are short". And on 3 July, the Tribune featured what it described (prematurely, if not foolishly) as "drought breaking" rains, noting that "nearly an inch of moisture" had been recorded on Sunday and Tuesday [28, 30 June]. This amount (0.35 inches on 28 June and 0.61 inches on 30 June) was touted as having "apparently broken the drought that has hung on since early May". Only 1.25 inches of moisture, it was emphasized, had been recorded at the Morris station from May 10th to June 28th. The Tribune further noted that the "dry spell was accompanied by high winds that added to the damage done to crops. Crop prospects were brightened by the rain but much small grain is being pastured by farmers while others are plowing under some fields. Hail storms did great damage in some areas...".

As bad as it was, late June's weather was but a prelude to the disaster which descended on Minnesota and much of the nation on 4-5 July. Beginning on those dates, many stations in the state recorded maxima near or above 100 F or higher on ten or more consecutive days, heat which, combined with burning sunshine, drying winds and an almost total absence of precipitation, caused untold human suffering (with numerous heat prostration deaths) and destroyed crops, pastures and wildlife alike. Daily maxima included 104 F, 101 F, 101 F, 96 F, 106 F, 106 F, 106 F, 105 F and 108 F at Minneapolis on 6, 7, 8, 9, 10, 11, 12, 13, 14 July, respectively; 114 F, 103 F, 103 F, 104 F, 110 F, 106 F, 106 F and 105 F at Moorhead on 6, 7, 8, 9, 10, 11, 12 and 13 July, respectively; 107 F, 108 F, 105 F, 98 F, 104 F, 104 F, 104 F, 103 F, 104 F, 105 F, 104 F, 108 F, 107 F, 107 F, 100 F and 103 F at Pipestone on 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 July, respectively; 101 F, 103 F, 101 F, 98 F, 102 F, 107 F, 107 F and 104 F at Argyle on 6, 7, 8, 9, 10, 11, 12, 13 July, respectively; 102 F, 106 F, 103 F, 104 F, 103 F, 107 F, 108 F, 107 F, 104 F and 100 F at Winona on 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 July, respectively; and 110 F, 102 F, 101 F, 101 F, 109 F, 105 F, 107 F, 106 F, 100 F, 100 F and 105 F at Fergus Falls on 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 July, respectively. Average July temperatures, moreover, exceeded 80 F at many Minnesota stations, including Redwood Falls and Canby (83.0 F); Pipestone (83.4 F); New Ulm (81.2 F); Minneapolis (81.4 F); Albert Lea, Faribault and St. Peter (80.4 F) and Zumbrota and Ada (80.0 F). As noted previously, many stations recorded less than one tenth of an inch of precipitation during the entire month and, statewide, rainfall averaged only 0.73 inches, a value approximately twenty five percent of the then accepted statewide July normal of 3.30 inches. July, also as noted previously, was extremely sunny, most Minnesota stations classifying twenty or more of the month's thirty one days as clear days (i.e. as days with cloud cover of twenty percent or less). And, in an interesting sidelight, the 1 July 1936 edition of the Minneapolis Star quoted Minneapolis Weather Bureau official

M.R. Hovde as stating that although June was "a fairly cool month what July will bring is another matter. July is our hottest month". These comments, although undoubtedly unwelcome, must, nonetheless, have enhanced Hovde's reputation as a weather seer.

Inevitably, the weather dominated Minnesota news coverage during July 1936, provoking numerous banner headlines and a cascade of stories which, variously, featured record breaking temperatures, crop destroying drought, heat prostration deaths and drought relief efforts. On 6 July, a Minneapolis Star banner headline (City Swelters: Northwest Bakes) was followed by a story which, among other things, noted that drought fears triggered a five cent per bushel increase in the price of wheat; that a "blistering sun continued to bake parched farmlands in the northwest"; that "every Weather Bureau station" in South Dakota had reported maxima of 106 F or higher; and that temperatures had reached 117 F at LaMars, Iowa and 108 F at Dickinson, North Dakota. The same account further noted that "with the drought rapidly spreading to new areas, weather reports held little hope for desperately needed moisture". On the following day, Star headlines told readers that "Thousands Swarm Beaches To Escape Heat: Overnight Low of 80 : 99 At Noon". Minneapolis water consumption it was said "reached a record volume late Monday [6 July] and residents were asked by the city water works department to refrain from sprinkling lawns between four and eight p.m. At seven p.m. Monday, water was being pumped into the mains at the rate of 191 million gallons per twenty four hours, the highest rate on record".

On 8 July, the Star touted drought breaking rains, noting that rain had fallen in some drought stricken areas (e.g. 1.48 inches at Devils Lake, North Dakota). According to this report, "scattered rains have brought some measure of relief to parched humans and animals and raised hopes that stock saving forage crops might be rescued. The rainfall was confined largely to northern areas along the Canadian border". The Star also claimed that state crops "hold good..... Most of Minnesota has a good corn crop. The condition of oats and barley in southern and northwest Minnesota is still good but poor in most of the Dakotas, according to the Cargill Corporation's report of July 8th. Only a small section of central Minnesota shows wheat in bad condition". Three days later (11 July) the Star, featuring a headline which raised false hopes by promising a break in the heat wave, a bit of optimism inspired by what was described as a "definite prediction offered by the Weather Bureau to a city already baked by a week of record temperatures". Five heat related deaths, it was added, had occurred in Minneapolis during the "past twenty four hours". And at Paradise, Indiana, temperatures, it was reported, had reached 110 F on 10 July, a reading which followed eight consecutive days with maxima "near" 100 F. On 13 July, the Minneapolis Weather Bureau, assuming that cool temperatures (42 F) recorded in Montana would soon reach Minnesota, again predicted "cooler weather," this time saying that it would arrive on Tuesday [14 July]. Sounding a more somber note, the same edition of the Star reported that the heat wave had taken one hundred lives in the Twin Cities, many deaths having occurred "on the streets, in parks and other public places. City hospitals are asking for more donated fans to relieve the suffering of their patients. General Hospital ambulances have fallen behind on calls because of the tremendous load of heat prostration cases".

Apparently undaunted by its previous failures, the Weather Bureau, according to the 14 July

edition of the Star, continued to predict the arrival of cooler air, promising that "thundershowers tonight will break Minneapolis's record heat wave". On the same day, however, the Star noted grimly that "General Hospital is crowded to capacity with heat prostration victims and emergency cases were sent to University Hospital during the night. Police squad cars....were pressed into service to rush heat prostration victims to the hospital. Nationwide, heat deaths are expected to reach the 2,000 mark". And, as if to assuage the suffering of sweltering Minneapolis residents, the Star added that "a blizzard swept through the mountain country near Climax, Colorado over the weekend. This region is in the Rocky Mountains more than 11,000 feet above sea level".

Fortunately for the Weather Bureau's reputation, somewhat cooler weather did arrive in the Twin Cities on 15 July. According to the 15 July edition of the Star, a rainfall of 0.04 inches on Tuesday [14 July] night was followed by cooling winds which drove the mercury down to a low of 64 degrees". Although heralded by the Weather Bureau as a "break" in the heat wave which, according to the Star, "broke all Minneapolis heat duration records, " the cool interlude provided but a brief respite from the heat. Maxima near 100 F were recorded in Minneapolis on each day through 18 July, a date which finally (and fortunately) marked a return to normal or near normal July temperatures. This change was correctly anticipated by the Weather Bureau which, according to the 17 July edition of the Star, stated that "thundershowers predicted for the northern section of the state tonight and Saturday are expected to bring somewhat cooler weather to Minneapolis". This forecast, however, was highly tentative, the Star noting that the "veering of the wind to the southeast drove the mercury up rapidly [today] from its overnight low of 79 degrees. Unless the wind changes back to the north or northwest later today, the temperatures are expected to climb over the 100 degree mark". Finally, several days later [20 July], the Star was able to report a "definite break" in the fourteen day heat wave "as cool winds swept out of the north across Minnesota". Interestingly, the 20 July Star carried a story which, although probably intended to amuse the newspaper's heat weary readers, nonetheless emphasized the desperation felt by many in the drought stricken Midwest. According to this account, "several hundred persons praying for rain during a union church service in a Council Bluffs, Iowa city park were forced to run for shelter as the rain came down accompanied by an eighty four mile per hour wind".

Weather stories parallel to those featured by the Star and other Minnesota newspapers also appeared regularly in the Minneapolis Tribune. Beginning in early July, the Tribune carried a series of news items which, initially, warned of deepening drought but which later focused attention on the ravages of the July 1936 heat wave. On 2 July, for example, the Tribune reported that "much of Canada's wheat area is threatening to duplicate the drought havoc in the United States. Reports from the spring crop territories sent grain values skyward on Wednesday [1 July]". On 5 July, the Tribune warned readers of a drought induced grasshopper infestation, noting that Dr. Lee A. Strong, federal entomologist, in discussing the "war on grasshoppers", had pointed out that areas threatened by the "pests includes Iowa, Nebraska, Oklahoma, Missouri, Kansas and parts of Minnesota, North Dakota and South Dakota". Two days later (7 July), the Tribune took note of the exploding July heat wave, reporting that "records were broken in many communities in the northwest on Monday [6 July]". Temperatures were said to have reached 118 F at Napoleon; 112 F at

Devils Lake; 118 F at Jamestown; and 114 F at Bismarck, all in North Dakota. In parts of Illinois, the heat was said to be so intense as to "blow up" highways. The news took on a more hopeful tone (at least temporarily) when the 9 July edition of the Tribune, like the Star, told readers that "scattered rain moving eastward out of Montana Wednesday afternoon and evening [8 July] brought relief to drought stricken sections of North Dakota". An even more hopeful report appeared on the following day (10 July), a Tribune headline proclaiming "widespread rains over the northwest". "Long awaited rains" were described as "a reality in areas of the northwest Thursday [9 July], bringing some relief to parts of Montana and generally in North Dakota. Sizeable showers fell at scattered points from Argyle to Worthington....A storm with wind was reported at Frontenac, ten miles south of Red Wing". The showers, however, did little to mitigate the heat: on 8 July, maxima of 110 F, 104 F and 115 F were recorded, respectively, at Jamestown and Bismarck, North Dakota and at Aberdeen, South Dakota.

And in Minneapolis, as in other parts of the northwest, the heat continued unabated. The 11 July edition of the Tribune reported that the temperature at the Minneapolis Weather Bureau station had equaled the city's "all time heat record," a maximum of 106.3 F having been recorded at 1500 hours on 10 July. The same edition of the Tribune also noted that "only a few scattered rain showers fell Friday [in Minnesota] as the week old heat wave spread over the United States and much of Canada. The zone of 100 degree heat extended from Kansas to Connecticut and Maryland". In the northwest, the heat, it was said, had claimed seventeen additional victims as 10 July temperatures soared to 110 F at Bismarck, North Dakota; 108 F at Grand Forks, North Dakota; 114 F at Jamestown, North Dakota; 113.5 F at Aberdeen, South Dakota and 107 F at Eau Claire, Wisconsin. Moreover, residents of Mitchell, South Dakota, it was reported, had offered "mass prayers" for rain and, in North Dakota, many towns and farms were said to be facing a serious water shortage. In addition, the 11 July edition of the Tribune, no doubt responding to the consternation and puzzlement of many of its readers, quoted B. R. Laskowski, federal meteorologist at Huron, South Dakota, who explained the "why of the protracted heat wave", stating that it (the heat wave) was caused by a "low pressure area which continues to hang over Montana instead of following the customary eastward movement".

Understandably, the Midwest crop situation was the topic of several articles published by the Tribune during the height of the July heat wave. On 11 July, the Tribune quoting from the 1 July report of the federal crop reporting service, stated that "crop prospects were poorer than in any previous year except 1934". On 12 July, in an article which qualified (contradicted?) the previous day's report, the Tribune claimed that "the crop outlook is hopeful despite the heat. The drought damage is overestimated in many sections with losses nowhere near the ravages of 1934. According to J.H. Cleland, Tribune staff writer, the corn crop is far from ruined. Reports of universal or even general devastation are greatly exaggerated. In the country west and north of Willmar, it is apparent that the drought has been heavier than in eastern sections.....Southern Minnesota was less severely hit by the drought and high temperatures than other sections of the state with an abundance of hay and good yields of corn and small grains in prospect, according to Paul H. Kirk, federal crop statistician. But that picture, Kirk cautioned, was up to July 1st only".

The 12 July edition of the Tribune, like the Star, also accepted the Weather Bureau's reassuring but unfortunately defective forecasts, noting that the heat was "seen as near its end as rains were advancing eastward out of the Rockies. In eastern Montana, the rain and cool breezes settled dust that was inches deep on fields and highways". On a more somber note, however, the same story pointed out that the Associated Press had reported "at least" 690 heat related deaths in the United States in the past eight days. On 13 July, the Tribune, still relying on the Weather Bureau's flawed forecasting, featured a banner headline which told its heat exhausted Minneapolis readers that temperatures had fallen to the 60's F in the northwest and that rains and a "cool wave" said to be moving east were "due to arrive" in Minneapolis by Tuesday [14 July]. The cooler weather, it was said, was "expected to advance across the Dakotas and into Minnesota". In the meantime, temperatures rose into the 100's F at many Upper Midwest stations (including Minneapolis) with a reading of 110 F reported at Eau Claire, Wisconsin on 12 July.

On Tuesday 14 July, although temperatures soared to 108 F in Minneapolis and 107 F in St. Paul, the Tribune remained hopeful, stressing (and probably overstating) the significance of the rains which were said to have fallen in the "drought areas". An "advancing cold front", it was said, was edging farther into the "zone of 100 degree heat late on Monday" and that "Weather Bureau forecasts promised showers and cooler weather ...for Minnesota, eastern North Dakota and eastern South Dakota. Rains splashed the drought parched Dakotas and northwest Minnesota Monday [13 July]. Winnipeg [Manitoba] was soaked by torrential rains". Optimistic forecasts notwithstanding, abnormally high temperatures remained entrenched in many areas, including the Cando, North Dakota area, where, according to the Tribune, a "train derailed when the rails were buckled by extreme heat".

Fortunately, however, rain (although light) and cooler weather (although of brief duration) did arrive in the Twin Cities area on the evening of 14 July. The 15 July edition of the Tribune, in an understandably exultant mood, stated that the "reign of 100 degree heat in Minneapolis was broken Tuesday evening by showers and a sudden switch in the wind that dropped the mercury fifteen degrees in less than an hour. Showers starting just before seven p.m. brought welcome relief after a high of 107.8 [officially recorded at 108 F]. Shortly before the showers the wind switched from the southwest to the north and blowing at thirty two miles per hour whipped clouds of dust from the country into the city. The rain was the first in Minneapolis since July 3rd. People on Calhoun beach cheered when the rain began". Yet, on a less sanguine note, the Tribune was forced to report that the day's heat had caused twenty two deaths and that the city morgues and hospitals were "jammed". Seventy nine and forty nine heat related deaths, it was added, had occurred in Minneapolis and St. Paul, respectively, since the heat wave began. For the state as a whole 560 heat related fatalities were reported during the same period.

As noted previously, the 14-15 July hiatus notwithstanding, suffocating heat persisted in most of the Upper Midwest until 18-19 July. On 16 July, the Tribune reported nineteen additional heat related deaths, noting that the city's eleven day toll had risen to one hundred. Nationwide, the toll was said to have reached 4,000. But still sounding an optimistic note, the same story claimed that "prospects of further rains in western sections of North Dakota and South Dakota and northern Minnesota have lent further hope to residents of the dry areas..Cooler temperatures with shifting winds and scattered rains have aided state forest

fire fighters to subdue blazes in northeast Minnesota. Corn, potatoes and garden crops were reported as generally revived throughout the state". The Tribune's report conceded, nonetheless, that the "heat had returned," temperatures reaching 104 F at Bismarck, North Dakota. It was also noted that "during the heat wave, milk distributors in the St. Cloud area had been forced to go outside their normal producing area to get sufficient pasturage for their dairy herds".

On 16 July, the Tribune, still wedded to its optimistic view of the drought and its effects, reported that "J. H. Cleland [Tribune staff writer and author of an earlier and hopeful view of the Minnesota crop outlook] is still optimistic about Minnesota crop prospects. A trip through the great mixed farming belt west and north of Minneapolis to the Dakota line revealed widespread damage to fields and pastures everywhere but no signs of complete devastation. In Stevens, Grant, Swift, Pope, Douglas, Kandiyohi, Meeker, Stearns, and Wright counties, harvest of small grains have been cut in half in most fields and pastures burned brown but no grains or grasses have been destroyed". In another reassuring report on 17 July, the Tribune quoted United States Department of Agricultural officials as saying that "the nation's food supply for the next twelve months is about three percent less than the same period in 1935-1936 but is still ample for the nation's needs". Temperatures, it was added, had reached 114 F at Arkansas City, Kansas and 112 F at Pierre, South Dakota on the previous day. In Minneapolis, however, 0.10 inches of rain fell during a brief shower on Thursday night 16 July, an event which, according to the Tribune, meant that "the Weather Bureau had correctly interpreted the meaning of the clouds that began piling up late Thursday".

Although, as noted, the July heat wave moderated after mid-month, the Tribune's response to the cooler temperatures was subdued, its optimism seemingly dampened by the false hopes raised earlier by disappointing Weather Bureau forecasts.. On 18 July, for example, Tribune writers noted that "the heat wave which has gone contrary to Weather Bureau predictions several times during the past two weeks...softened a bit Friday night [17 July] but showed no signs of a general retreat. Heavy clouds that cut off the sun's rays helped to hold the mercury in check Friday but did little toward bringing long awaited moisture. A few drops fell in Minneapolis in the afternoon and sidewalk wetting showers dampened the city in the evening. Heavy showers fell at Winona Friday night..". The same edition of the Tribune also told readers that "navigation on the upper Mississippi became difficult Friday as the water level continued to drop. Curtailment of barge traffic is threatened unless rains come soon, Major Dwight F. Johns of St. Paul, district engineer said Friday. Already the navigable channel in the upper river has only a little more than five feet of water in places compared to the normal of six feet or more. Forest fire dangers in northern Minnesota have increased as the hot, dry weather continued". And on 19 July, the Tribune reported that the Minneapolis Weather Bureau attributed "delays in the cool off in part to heat build up in the city's pavements and buildings," a statement which, although accurate, also undoubtedly helped to mute criticism of earlier forecasting errors.

On 20 July, however, the Tribune was able to report that the heat wave had been "definitely broken" by weekend showers, allowing "many northwest communities to settle back and enjoy cooler weather. During the early evening hours, the mercury in Minneapolis dropped

to 65 degrees. Showers lessened to some extent the damage done to crops during the torrid spell". Yet, fears of another heat wave soon returned, the 22 July edition of the Tribune stating that "rising temperatures for most of the northwest were forecast Tuesday [21 July]". The same edition also reported that the drought had caused an estimated fifty percent reduction in the Iowa corn crop and that "drought conditions were general from the Rocky Mountains in Montana to the Hudson Valley in New York, southwest over Pennsylvania, central Maryland, the Ohio Valley and the northwest part of Arkansas and most of Oklahoma". And near the close of the month, the Tribune (27 July) emphasized the continuing drought, stating that the "clouds which hung over the Twin Cities and much of Minnesota Sunday [26 July] failed to bring badly needed rain but drove temperatures down slightly".

The effects of the July heat wave were also the subject of numerous articles in St. Paul newspapers, the St. Paul Dispatch especially. On 3 July, reporting on one of July's rare summer storms, the Dispatch noted that a hail and windstorm had "obliterated" a large area of "sun baked" crops in Yellow Medicine county. Damage, it was said, was "estimated at from \$50,000 to \$75,000. The hail stripped crops in four townships over an area of about forty five square miles". In St. Paul itself, the drought and heat soon strained the city's ability to provide water for the needs of its residents. In this regard, the 11 July edition of the Dispatch reported that "two new water storage tanks have been put into service, increasing water pressure in districts which have suffered most from low water pressure during the heat wave. The ban on sprinkling between four p.m. and nine p.m. will not be lifted for another week or until abnormal consumption ends". At the height of the heat wave, the Dispatch (14 July) stressed that "purchase of an electric fan in St. Paul today was almost an impossibility. Cheaper fans as well as those of better quality have been snapped up. Chances of getting fresh stocks are 'pretty thin'. The fans are going like hot cakes all over the country". As an interesting sidelight, the Dispatch noted that Northwest Airlines pilots had reported a temperature of 75 F at four thousand feet on the afternoon of 14 July.

More ominously, the 14 July edition of the Dispatch reported that H. R. Leonard, manager of the Twin Cities' Milk Producers' Association had stated that milk production in the Twin Cities area had been "cut about thirty percent since a month ago. The situation may become serious if the drought continues". This warning was reinforced by R. A. Trovatten, Minnesota commissioner of agriculture who, according to the 15 July Dispatch, stated that the area's milk supply would be "materially affected" by the drought. The Dispatch, however, reassured its readers, stating that "unless the drought gets worse," no changes in St. Paul's milk, butter and bread prices should be expected. In contrast, Leo J. O'Regan, St. Paul market master, was quoted as saying that "people who want green vegetables will have to pay heavily for a rather poor product".

Predictably, the Dispatch continued to feature weather stories during the remainder of July. On 16 July, the newspaper's headlines noted a four cent per bushel "boost" in corn prices, a rise attributable to the "boiling sun" and its effects on the nation's corn crop. The same edition reported that "six more" heat related deaths had occurred in St. Paul with a cumulative national toll that was said to have reached 4,137. Three and five additional heat related deaths were reported in St. Paul on 17 and 18 July, respectively. The 18 July

Dispatch also noted that "reports of showers loosened a flood of selling on the Chicago and Kansas City corn markets, plunging prices down by the four cents permitted limit" (erasing the previous day's increase which, as noted, was triggered by pessimistic, drought related crop reports). On 20 July, the Dispatch reported (prematurely as it turned out) that the drought appeared to have been "definitely broken" by "generous" rains which had fallen over parts of the northwest. One week later (27 July), another weather story claimed that "widespread clouds gave promise of heading off an invasion of heat in the Midwest for the second time this month". Although 26 July temperatures, it was noted, had risen to 108 F in Des Moines, Iowa and 113 F in Fremont, Nebraska on that date, cloud cover held the 26 July Twin Cities maximum to a moderate 85 F. In a story published on 29 July, the Dispatch focused on the hydrologic effects of the drought, quoting C. L. Batchelder, head of the U.S. Geological Survey in St. Paul. According to this source, the low stage of the water in the Red River of the North and its tributaries was causing "severe water stringencies" in such towns as Fargo and Grand Forks in North Dakota and Thief River Falls and Crookston in Minnesota. The upper Mississippi river, however, was said to be "not quite down to its 1934 all time record low". Finally, on 30 July, the Dispatch reported that corn prices had again risen four cents per bushel in Chicago trading, the result of a new U.S. Department of Agriculture report which said that about one half of the "total corn acreage in Missouri, Nebraska, Oklahoma and South Dakota was damaged beyond recovery".

Also, in an interesting aside, the 21 July 1936 edition of the Dispatch carried a wire service story stating that the U.S. Coast Guard had discovered a "puzzling dearth of icebergs in the North Atlantic" during the 1936 summer season: "for the first time since iceberg records started twenty three years ago, no berg crossed the danger line this year. The danger zone is south of the forty eighth parallel. Since 1913, the number of icebergs that floated south of the forty eighth parallel averaged 420 per season" (emphasis added).

In addition to the Twin Cities newspaper accounts, much information relating to the July 1936 heat wave is to be found in the Minneapolis Weather Bureau's daily meteorological journals. On 6 July, the Twin Cities first extremely hot July day (104 F), Weather Bureau officials noted that the sky was "cloudless all day" with one hundred percent of possible sunshine. The day was also described as "very sultry again". The average wind speed was 10.4 miles per hour with a maximum speed of sixteen miles per hour from the south. The prevailing wind direction was south. On the following day (7 July), Minneapolis observers again recorded one hundred percent of possible sunshine and an average wind speed of 11.1 miles per hour. Prevailing winds were from the southwest with a maximum sustained speed of twenty one miles per hour, also from the southwest. Journal entries on 8 July indicated yet another day with one hundred percent of possible sunshine and hot southwest winds. On 9 July, another scorching day, Weather Bureau staff noted a "sprinkle of rain in some parts of the city during the early afternoon". The average daily wind speed was 10.7 miles per hour with a maximum speed of eighteen miles per hour. Sunshine was again one hundred percent of possible and prevailing winds were from the south. It was more of the same on 10 July: one hundred percent of possible sunshine and winds generally from the south, averaging 9.1 miles per hour. Minneapolis observers did, however, note "some high cirrus clouds at times during the day". On 11 July, a day that was described as "very sultry", prevailing winds had shifted to the southeast with a daily average wind speed of 8.0 miles

per hour. Conditions changed somewhat on 12 July with light winds averaging 5.2 miles per hour, mostly from the south. Although "much local smoke" was noted at 0700 hours, the day, like so many days before it, featured one hundred percent of possible sunshine. The record also indicated that eight fatal heat prostration deaths had occurred in Minneapolis, and another eight in St. Paul for a daily Twin Cities total of sixteen. On the next day (13 July), the fourth consecutive day with maxima in the mid-100's F, winds remained relatively light (averaging 5.2 miles per hour), blowing mostly from the southwest. Once again, station instruments recorded one hundred percent of possible sunshine. Thirty five fatal heat prostration deaths were noted as having occurred in Minneapolis, twenty five in St. Paul, making a daily total of fifty nine. On 14 July, the date on which Minneapolis temperatures soared to 108 F, Minneapolis observers documented twenty two new heat related deaths in Minneapolis and another forty nine in St. Paul. Average daily wind speed was 6.5 miles per hour with a thirty eight mile per hour gust from the northwest at 1807 hours. According to the journal record, a "thunderstorm preceded by a wind squall" entered the Minneapolis area at about 1800 hours "with considerable dust in the air and visibility limited to about two hundred feet for a few minutes". The percentage of possible sunshine was eighty two percent, a decrease attributable to the evening cloudiness. On 15 July, observers noted another twenty five heat related deaths, nineteen in Minneapolis and six in St. Paul. The percentage of possible sunshine, as on so many days during the month, was one hundred percent. The atmosphere, however, was filled with "light smoke during the night and into the day," a phenomenon which the Weather Bureau staff attributed to "forest fires in parts of northern Minnesota". And on 16 July, a day with a maximum of 98 F, "light smoke" persisted until about 1030 hours. Percent of possible sunshine was recorded as ninety four percent.

Documentation of the July 1936 heat wave was not, of course, limited to accounts in Twin Cities newspapers and to records kept by Minneapolis observers. Non-metropolitan newspapers, particularly those in western portions of the state an area which suffered from heat and drought to an extent even greater than east central Minnesota featured numerous weather stories, many of them more graphic and poignant than those published in the Twin Cities press. Of these, those written by Moorhead Daily News reporters and editors were perhaps the most disconcerting, published as they were in an area which received less than ten inches of moisture during 1936 (with only about two inches recorded during the entire summer, June through August). As early as 16 June, the Daily News took note of the deepening drought, stating that "a crop killing drought said to be the worst in the history of the northwest is costing the American farmer a million bushels of grain daily, grain experts reported today". Similarly, the same newspaper's 25 June edition emphasized the seriousness of the situation, pointing out that "the hot, dry winds of the past week have ruined the small grains. Cattle are being herded in droves along the roadsides while many farmers are feeding their cattle hay". And, on 3 July, the Daily News reported that although "scattered rains" had provided a "measure of relief to much of the drought stricken American farm belt," the lack of moisture had, according to "private crop experts," already caused "northwest farmers ten million bushels of wheat" in June alone. The same edition further noted that "the drought combined with a plague of grasshoppers and cinch bugs has already cost the agricultural northwest and estimated \$100 million (1936 dollars)". On 6 July, the situation had become desperate as Moorhead temperatures soared to 114 F,

further searing crops and pastures. In the words of that day's edition of the Daily News, "the high temperatures unrelieved by rain wrought devastation on crops and pastures in this vicinity. A burning, brow dampening sun beat down...Vast grain fields in west and central Canada are seriously threatened by drought...Trainloads of bawling, thirsty, bony livestock rolled out of the Dakotas, the plains of Montana and Wyoming. Sold at sacrifice for whatever the market would bring, the livestock were moved to easterly regions where the withering force of the drought has not yet been felt. University of Minnesota experts said that crops are in a critical state east of the Dakotas. Trade in wheat futures was halted abruptly on the North American grain exchange today when holders refused all bids after prices ratcheted up the full five cent limit permitted in a single trading session". Temperatures, it was also noted, had reached 117 F at LeMars, Iowa and 116 F at Jamestown, North Dakota, both on 5 July.

On the following day (7 July), the Daily News featured a screaming banner headline which told weather scourged readers that the drought remained unbroken and that new heat records had been set in the Moorhead area. "Cattle and other livestock," it was said, "were dying the by the thousands of hunger and thirst". Grain prices, it was added, had "soared" on the nation's commodity markets, "wheat, corn and oats" having become "almost priceless". More despairing reports followed on 8 July, the Daily News claiming that "not over fifty percent of a normal [crop] yield is expected in Clay county. Throughout the county, the agricultural picture is pessimistic as farmers in some areas cut grain for hay. The barley crop was reported as a failure. In general it is too late for rains to be of any material benefit. On 9 July, the Daily News carried another front page banner headline which stated that the drought loss had mounted to \$200 million (1936 dollars). The ensuing story went on to explain that "conservative estimates place at \$200 million the loss of crops and livestock as a result of thirty one terrifically hot, rainless days in the northwest. ...The Hawley area is confronted with the worst drought in many years and farmers are despondent with prospects of about forty percent of a normal yield. Corn and potato plants are withering....The dryness of the grass has presented a serious fire problem". Predictably, crop damage accelerated as the heat persisted, the 10 July edition of the Daily News reporting that "drought losses are now estimated at \$250 million. In twenty four of North Dakota's fifty three counties everything is reported to be in ruin. On 33,974 impoverished farms, once fertile black soil is now dust". The drought, of course, increased the demand for water in cities and towns in the Moorhead area, some of which, as noted previously, experiencing serious shortages. The 11 July edition of the Daily News reported, however, that although Moorhead city wells were being "pumped night and day to meet the unusual demand for water, no restrictions on consumption were planned...". The same edition also noted a "serious fire hazard in northern Minnesota forests," an area in which "numerous small peat fires" were said to be burning. And on 16 July, the Daily News, highlighting the extent to which drought and heat had depleted the area's water supply, reported that "more than fifty miles of the Buffalo river through Clay county have dried up, leaving only pot holes of water as springs feeding the stream have failed. Farmers along the stream will be forced to haul water for their livestock".

On 13 July, the Daily News reported that the heat had claimed eight lives in the Moorhead area. The same edition also featured a story warning readers of a probable increase in milk

prices, the result of extensive dessication of pasture land. Many pastures, it was said, had been "burned to a dry, hard crisp under a blazing sun [with] a resultant fall in dairy production". Loss of milk production, in turn, "promises to boost America's milk bill. In Chicago alone an increase of \$9,000 per day was predicted with prices expected to rise eleven to twelve cents per quart. A shortage was threatened in Minneapolis and St. Paul". And, repeating a report published in the Twin Cities newspapers, the Daily News went on to quote H.R. Leonard, manager of the Twin Cities Milk Production Association: "there is enough milk on hand to assure a plentiful supply for the next two days but production is already below the corresponding period in 1934 and 1935. Consumption during the hot weather has taken a pronounced jump". Higher corn prices were also predicted by the Daily News in a 23 July story stating that "farmers may harvest only two billion bushels of corn this year, according to United Press reports. But prices will be higher. All but an alarmingly small portion of the early corn crop has been destroyed by drought". Similarly, the 26 July edition of the Daily News predicted that the drought would raise prices for canned goods. And probably the price of potatoes as well: the 27 July edition warned that "only generous rains followed by cooler weather will save the [Red River] valley's remaining potato crop. Potatoes are a main source of income for many...valley farmers...fifty percent of the crop may be lost".

Besides heat and drought, Moorhead area residents were vexed by numerous dust storms during the summer of 1936. On 7 July, for example, observers at the Moorhead Weather Bureau station noted that blowing dust had restricted visibility to three miles during the interval between 1830 and 1930 hours. On 8 July, the same observers commented that the dust storm which "started yesterday" continued until about 1400 hours. Visibility, it was said, was restricted to six miles from 0600 until 1200 hours. Another similar storm was noted on 2 August 1936, the air reportedly "filled with light dust" from 1600 to 2200 hours. Visibility was again limited to six miles.

Conditions rivaling those experienced by Red River valley residents also prevailed in west central Minnesota during the summer of 1936. On 10 July, the Morris Tribune, like the Moorhead Daily News, reported that "searing heat and burning winds have maintained a stubborn grip during the past week. The mercury reached 105 degrees on Monday [6 July]. The heat and wind added greatly to the damage to farm crops already damaged by a lack of moisture in May and June". And, on 17 July, the Tribune characterized July's heat wave as "the most serious on record. The heat has taken thousands of lives and, combined with a lack of rain has burned fields and pastures over several states.....Many residents have been made ill by the sweltering heat...The corn crop has been seriously damaged". The same account further noted that temperatures of 105 F, 102 F, 104 F, 104 F, 103 F and 101 F had been recorded at the Morris weather station on 10, 11, 12, 13, 16 and 18 July, respectively. At the close of the month (31 July), the Tribune noted that "mostly poor" crop yields had been reported by Stevens county farmers. Moreover, the corn crop was described as "shriveling up," as "thoroughly ruined".

Farther to the south, accounts of the drought published in the Brown County Journal (New Ulm) paralleled those appearing in the Morris and Moorhead newspapers. On 10 July 1936, as an example, the Journal stated that "the blistering heat which started Saturday [4 July]

and continued unabated since yesterday [9 July] caused considerable damage to small grain crops in Brown and adjoining counties as well as burning up pastures and forage crops. During the early hours yesterday, a heavy rain fell at Olivia, Morton and points in that region. This area was not included in the rain belt. About nine o'clock yesterday rain visited this sector, and although the shower was not heavy, it assisted greatly in lowering the heat. The small grain crop in Brown county was damaged considerably by the heat and will be from nothing to fair according to predictions of county [extension] agent Paul W. Kunkel". On 17 July, the Journal told its readers (most of whom undoubtedly harbored vivid, but unpleasant, memories of the day) that, on 14 July, the temperature at the New Ulm weather station had reached a record 111 F. Although the heat was "almost unbearable" farmers were in fields harvesting "dead ripe grain". "Many farmers were using tractors because the heat was so terrific that horses could not withstand its effects...At noon on July 14th, observer Henle reported a temperature of 98 degrees and a sigh of relief was heaved because it was not anticipated that the mercury would go above 100. But during the afternoon a light fall of rain occurred and following that the mercury shot upward rapidly. During the evening, however, cooling breezes brought relief". The same edition of the Journal further noted that small grain yields in the county were only "fair" and that the corn crop was "beginning to suffer because of the drought and heat". Interestingly, also, the Journal writer pointed out that many horses had died during the heat waves of 1931 and 1934 but that because farmers were now "using more care," the number of equine deaths had been reduced. The same Journal story further noted that New Ulm's municipal wells had pumped one million gallons of water on 11 July and that the city's elm trees were shedding their leaves, having been attacked by an infestation of green aphids which, it was thought, was attributable to the hot, dry weather. The 17 July Journal also included a plea on behalf of drought stricken North Dakota farmers seeking to buy "surplus hay". New Ulm area farmers who "have more hay than they need" were encouraged to sell it to their less fortunate counterparts. And on 24 July, the Journal reported that "many New Ulm residents [who] have been sleeping on lawns and screened porches have found relief due to a cool wave over the weekend [18-19 July]. Buildings and residences have been superheated from the long protracted heat wave. Sunday was an enjoyable day with a temperature of only 94 degrees... Sunday night temperatures dropped into the 60's. Precipitation [has] generally assisted crops in many sections of southern Minnesota. Copious rains were reported at St. Cloud, Jordan, St. Peter and Worthington. Nationally, crop losses due to the 1936 drought are estimated at \$1 billion or more by Chicago crop experts. This plus other millions due to loss of hay, forage crops and livestock...".

Any hope of an early end to the torment which accompanied July's heat and drought was dashed during the first weeks of August 1936. Very little rain fell at any Minnesota location prior to 14 August and abnormally warm temperatures prevailed in most areas until late in the month. Record or near record maxima were recorded at several stations on 8 August (e.g. Beardsley, 105 F; Campbell, 103 F; and Fergus Falls, 100 F) and on 15 August readings of 100 F or higher were recorded in many Minnesota communities (e.g. 106 F at New Ulm; 105 F at Faribault and St. Cloud; 103 F at the Minneapolis Weather Bureau station; 104 F at the St. Paul airport; and 108 F at the St. Paul cooperative station). Finally, following a short period of cooler weather which followed general, but mostly light rainfall on 14-15 August, a late summer heat wave on 23-24 August once again pushed

temperatures above 100 F in many localities (e.g. 107 F at Pipestone and Worthington; 105 F at Tracy; 103 F at Winnebago; and 102 F at New Ulm). Fortunately, however, moderate to heavy rains fell in many areas during the last ten days of the month, checking the forest fires which had seared many areas in northern Minnesota during July and early August, reviving pastures and improving the condition of late maturing crops. Rainfall amounts included 4.45 inches at New London on 20-21 August; 2.54 inches at St. Cloud on 21 August; 3.14 inches at Milaca on 20-22 August; 3.48 inches at Zumbrota on 27-28 August; 3.07 inches at St. Peter on 28 August; and 3.26 inches at Waseca on 27-28 August.

Consistent with the continuing drought and heat, early August weather stories were much the same as those published earlier in the summer, in July in particular. The 13 August edition of the Minneapolis Tribune, as an example, warned of higher milk prices. In a quote attributed to U.S. Department of Agriculture (USDA) forecasts, the Tribune noted that higher prices for dairy products could be expected during the remainder of 1936. The dairy situation, it was stated, "is colored chiefly by the reduced pasture and feed supplies, by the small stock of butter in storage and the shrinkage of milk production since June". Reports of reduced production and the implied threat of increases in the price of food were also featured in at least two other August Tribune articles, the first of which (11 August) reported that USDA forecasts pointed to a corn yield forty four percent below "normal" and about 2.6 percent less than the "short crop" of 1934. Spring wheat yields, it was added, were expected to be 32.8 percent of normal. The second article (19 August) stated further that "hot winds sweeping over Iowa and Kansas continue unabated (with temperature of 115 F or higher reported in parts of Iowa), damaging already deteriorated crops as corn production expectations dropped to the lowest level in fifty years. Price of corn futures rose to \$1.16 per bushel. The Interstate Commerce Commission (ICC) broadened provisions of an earlier order providing for reduced freight rates on shipment of livestock from North Dakota and Montana to feeding points in other areas. Rates provide for payments of eighty five percent of the regular rate for shipment to feeding points and fifteen percent of the regular rate on return".

The continuing drought and its effects were also featured in the Brown County Journal, the 7 August edition of which, quoting the Brown county extension agent, reported that "one half of the county's corn crop is probably lost". The same article also noted that the Minnesota river at Mankato had dropped eighteen feet since April and was currently running at two feet. April's level of 20.18 feet, it was said, was the highest recorded at Mankato since 1921. One week later (14 August), the Journal reminded its readers that July 1936 had been the hottest month recorded in New Ulm up to that time. According to the A. L. Henle, New Ulm's cooperative weather observer, it was also the second driest July of record. And on 11 September, the Journal provided a summary of the summer's weather, emphasizing that New Ulm temperatures had exceeded 100 F on fifteen days during the period, June through August, an occurrence which was said to be "almost unheard of in this section". In an amusing (but somewhat bizarre) aside, the Journal claimed that the "unbelievable" heat had hatched [chicken] eggs laid in secluded nests, leaving "chicks to run around without any hens". It was also noted that because the heat and drought had caused a serious shortage of summer vegetables, "many vendors shacks along roadsides near the Twin Cities were boarded up".

Like the Journal, the early August issues of the Morris Tribune were preoccupied with the continuing drought and its effects. On 7 August, the Tribune reported that dry conditions in the Morris area were the cause of a "prairie fire reminiscent of those which swept the countryside quite often years ago burned over a considerable acreage of land owned by the West Central School and Crocus Valley Farms last Friday [31 July]. The fire was fanned by high southerly winds and swept with astonishing rapidity across a field owned by the school. Other farmers in the county have suffered from fires during the past week". In the following week's edition (14 August), the Tribune, contending that conditions, although bad, were not as bad as they could be, quoted a Minnesota Crop Reporting Service report which "indicated that the damage done to most Stevens county crops is less than that suffered in 1934". The county's 1936 oats crop, it was said, was "forty one percent of normal as compared to ten percent in 1934; wheat was also forty one percent of normal as compared to nine percent in 1934 and pastures were twenty seven percent of normal as compared to thirteen percent in 1934". And, in an article seemingly at odds with the altruistic advice (share your hay) offered earlier by the Brown County Journal, the Tribune asserted that "Minnesota's surplus hay supplies should be kept in the state so that no acute shortage will materialize during the winter months. Dairymen and livestock producers are urged to act soon in obtaining supplies of hay and other roughage". And, on 21 August, the Tribune noted that, despite recent rains (1.02 inches during the period, 9-18 August), precipitation was still "five inches below normal so far this year".

A similar, but more extensive, summary of moisture deficits was compiled by New London's cooperative observer, Harold Swensen. In a New London Times article published on 27 July 1936, he noted that, with the exception of 1926, New London precipitation had been "deficient" in every year since 1916 (including 1931 with a deficit of 9.15 inches and 1932 with a deficit of 8.20 inches). The "steady decline in rainfall during the past twenty years," he added, accounted for the area's "fast drying" wells. This report, in turn, was updated by Swensen several weeks later. In an article appearing in the 13 August edition of the Times, he noted that only 5.06 inches of precipitation had fallen in the New London area between 1 August 1933 and 31 May 1934. In contrast, however, 41.63 inches had been recorded during the period, 1 June 1934 and 31 August 1935. The present drought, he went on to point out, began in September 1935 with only 12.71 inches of moisture recorded between 1 September 1935 and 31 July 1936. Yet, despite the intensity of the 1936 drought and the heat which accompanied it, the New London area, he emphasized, had avoided a "complete crop failure". This "astonishing" fact, he speculated, may have been attributable to the surplus moisture which fell during 1934-1935 and which "was conserved in the soil with little or no runoff". The New London area, nonetheless, did not escape unscathed, the 20 August edition of the Times reporting that "everywhere we can see dry grass, dry underbrush and fire hazards of every description. We have already had two sizable timber fires".

Fortunately for Minnesota residents, the summer's drought and heat, as noted previously, was temporarily broken by cooler, rainier conditions which, over most areas, became evident in mid-August. This shift in weather patterns, of course, changed both the tone and content of late August newspaper reports. The rains also prompted what can accurately be

described as a collective sigh of relief (if not elation) on the part of the state's populace, rural and urban alike. The onset of wetter conditions was first noted in Twin Cities newspapers on 14 August, a day which, in the words of the Minneapolis Star, brought the "first general rains since early June". The following day, although marked by record breaking heat, brought more rain (along with thunderstorms and damaging winds) to many areas of the state, the Twin Cities included. The 16 August edition of the Minneapolis Tribune carried a banner headline proclaiming that a half inch of rain had "soaked" Minneapolis during the late afternoon of 15 August, an event which was touted as the "heaviest single" rain to fall in the city since 6 June 1936. According to the story that followed "a driving rainstorm, the first in two months, swept over Minneapolis and much of the state Saturday afternoon. In rural sections, it brought promise of revived pastures and garden crops, although it came too late to aid small grains. The storm rode into Minneapolis on a thirty eight mile per hour wind gust shortly after four p.m. For five to ten minutes, the wind digging into the dry soil in the city kicked up a heavy dust storm. The temperature stood at 102.8 degrees at three p.m. It slacked off to an even 100 degrees at four p.m. and during the next hour, during the rain, dropped to 70 degrees. Electric service was disrupted for brief periods in parts of the city due to fallen wires. WCCO and KSTP radio were off the air for more than an hour. Firemen fighting grass fires ...at various places in the city were...helped by the rain".

A similar but more dramatic story in the 16 August edition of the Minneapolis Journal began its account of the previous day's weather with a pithy statement that obviously masked a great sense of relief, perhaps even joy: "it rained in Minneapolis last night. That was the best news that broke in the city. It broke a sixty day drought". The Journal then went on to report that the rain "came with a burst of wind that caused thousands of dollars in damage, wrecked several buildings, sent trees crashing to the streets and whipped power, light and telephone lines from their moorings. Swirling dust was the harbinger of the storm. In the loop men and women dashed for cover. Then came the rain. Men, women and children ran into the streets. Some of them cheered. Everyone laughed. (emphasis added). The mercury sizzled up to an August high of 102.8 degrees before the heat was broken by rain...The previous record was 99 degrees set August 15, 1913. Yesterday was the hottest day since the all time mark of 107.8 was established July 14. Rainfall, which totaled .44 inch, was the heaviest since the 1.02 inch rain which fell June 6. The last appreciable fall was .40 inch on June 16. The clouds, driven by wind that once hit thirty eight miles per hour, dumped thousands of tons of water onto parched pavements and arid lawns and fields in a downpour that lasted fifteen to twenty minutes. Then the storm eased off to a steady rain for another half an hour. The storm drenched a section of the state extending from Moorhead in the northwest to Red Wing in the southeast. High winds accompanied the rain most of the way. Hail fell in some sections. A \$12,000 barn of the Northland Milk Company and several smaller buildings were flattened near New Brighton. Roofs were ripped from tourist cabins at Osseo. In the forest fire area, rangers reported only a sprinkle. The storm kicked up clouds of dust as it roared down out of the northwest. It hit Lake Minnetonka area before the city. Dust buffeted the countryside in clouds so dense that, according to reports from Deephaven, motorists couldn't see more than a few feet with their lights on.....".

Comments entered in the Minneapolis Weather Bureau's daily journal on 15 August both

corroborate and augment the newspaper accounts of that day's weather events. According to this source, station instruments recorded 79 percent of possible sunshine and a peak wind gust of forty one miles per hour at 1633 hours. Observer entries further noted "only a few clouds during the forenoon and early afternoon. Light smoke from forest fires in northern Minnesota was in evidence during the morning but had mostly disappeared by two p.m. Clouds began to gather rapidly after 2:30 p.m....a severe dust squall preceded the thunderstorm. Rain began at about 4:30 p.m. and became heavy in a few minutes. A high wind accompanied the rain...".

Although certainly helpful (and welcome), the 14-16 August rains were, as noted, generally too light to significantly ameliorate the 1936 summer drought. They were, however, soon followed by rains which were heavy enough to soak much of the state's parched soil, to restore pastures and to provide some aid to late maturing crops. In this regard, the 22 August 1936 edition of the Minneapolis Tribune reported that "heavy electrical storms moved out of the southwest corner of the state on Friday [22 August], drenching a wide area of Minnesota. More than two inches in some areas will greatly benefit pasturage and field crops, late garden produce, some corn and potatoes. The corn crop is too far along to be aided generally, but the Friday rain fell in areas of Minnesota where corn will be aided most. The storm of Friday blew down a number of trees in Minneapolis and flooded basements and streets and put a number of telephone and electrical currents temporarily out of commission. Three inches of rain fell at Miller, South Dakota...". And, according to the New London Times (27 August), the "big rains" which fell in that area on 21-22 August were sufficient to bring Kandiyohi county lakes up to a level higher than that recorded at the end of August 1934. In a similar vein, the 4 September edition of the Brown County Journal (New Ulm) reported that "a period of thirty six hours brought 2.43 inches of rain to New Ulm on Thursday [27 August]. Clouds hung low with intermittent showers throughout the day. At about six p.m. a heavy rain began and continued until midnight. Some areas had hail sufficient to do some damage to the corn crop. Some turkeys were killed in the southern part of the county". In a follow up article on 11 September, the Journal noted that "pastures were much improved by the recent rains" and that "agricultural experts" held out "some hope for the late potato crop". The August rains, it was added, came in time to "save a large portion of the corn crop" and to "facilitate fall plowing".

Suffocating heat and prolonged drought, however, were not the only weather related disasters to befall Minnesotans and other northwest residents during the summer of 1936. There was, in addition, a massive outbreak of forest, peat and grass fires which burned over large sections of Minnesota and other states, destroying many acres of timber, threatening farms and towns in exposed areas and often filling the air with acrid smoke. The fires, probably the worst and most extensive of those which erupted at any time during the 1930's, followed the relatively fire free summer of 1935 (a summer which, according to state forestry officials, was Minnesota's most fire free summer in eight years, i.e. since the summer of 1927).

Predictably, the 1936 outbreak began in July, the cumulative result of the drought which had prevailed in northern Minnesota and other fire prone regions of the country during the previous ten months, particularly during the six weeks beginning in early June 1936. As

early as 7 July, the St. Paul Dispatch reported that "gray clouds of smoke rolled over northern Wyoming and southeast Montana today as more than a thousand fire fighters fought to control fires which raged on several fronts. More than ten thousand acres of land burned over near New Castle, Wyoming. Fires [burned] along a ten mile front in the Big Horn National Forest". Nor was the early July outbreak limited to the Rocky Mountain states. On 14 July, the Moorhead Daily News noted that serious fires had erupted in northern Minnesota where, it was reported, "airplanes carried additional equipment and men to fight a forest fire threatening one million acres of national forest near Ely. The blaze was started two days ago by dry lightning and broke away from a crew of 320 men late yesterday, racing uncontrolled through the tinder like fallen jackpine toward Brule Lake. Three hundred additional men were flown to the fire scene while pumps and hoses were shipped from the U.S. Forest Service regional headquarters at Milwaukee, [Wisconsin]". On the following day (15 July), the Daily News reported that "sixty six new fires are now said to be raging in drought stricken areas of Minnesota". All fires, however, were said to be under control," a view also expressed by the 16 July edition of the Minneapolis Star which claimed that, according to local U.S. Forest Service officials, "all forest fires in Minnesota, Upper Michigan and northern Wisconsin were Under control today. The fire hazard, however, remains critical". Similarly, the 19 July 1936 edition of the Moorhead Daily News reported that "light rains" in the northeastern Minnesota timber country "helped to get twenty to thirty forest fires under control in the Superior National Forest".

In contrast, the 17 July edition of the Daily News suggested an increasingly desperate situation, stating that "two thousand men are fighting twelve forest fires in the Superior National Forest. Airplanes, trucks, motor boats and even canoes were pushed into service by forestry officials striving to transport fire fighters..".

Bad as it was during the first part of July, the fire situation became even worse during late July and early August 1936, a period which brought, in addition to widespread forest fires, an outbreak of peat bog and grass fires. The increasing seriousness of the fire menace was brought to the attention of Minneapolis readers as early as 2 August in a Minneapolis Tribune report which emphasized that "forest fires and prairie fires long feared as the drought steadily sucked moisture from woods and fields, raged Saturday [1 August] in a half dozen Minnesota localities and in other northwest states. Volunteers and CCC camp men joined forces with forest rangers in combating the blazes...Everywhere they were hampered by lack of natural water...that would serve as a check to the spread of the flames. Closest to the Twin Cities was the peat fire that burned along a mile and half front seven miles southeast of Anoka. The fire, which had been smouldering for several days jumped highway no. 10 on Friday [31 July] and consumed valuable farm land. One hundred youths from a CCC camp near White Bear Lake went into action Saturday, bringing the fire fighting force to three hundred. The fire along highway no. 62 west of University Avenue was moving slowly but the fire fighters found it difficult to extinguish. For the most part the land being burned over was peat bog of little value. But the fire threatened to move into hayland. Numerous haystacks have already been destroyed. Traffic on highways in the vicinity was slowed due to dense smoke. A heavy shower Saturday afternoon checked a fire burning through pine timber and grasslands endangering eighty homes near Crosby...".

A similar story in the 3 August edition of the Minneapolis Star stated that "with the entire northwest as dry as tinder, crews ranging from twenty to 150 men today continued to battle scattered fires after holding them in check over the weekend. The fire danger, state forestry officials reported, was intensified by low water levels and it was feared that if a fire gets underway in the heavy timber, small towns standing in the pathway will be [threatened]. Near Minneapolis, at Anoka near Ham Lake, farmers, forest rangers and Civilian Conservation Corps (CCC) crews struggled through low rolling clouds of smoke to circle peat fires and prevent further devastation of crop lands. Near Hinckley, motorists were warned to proceed carefully through a three mile timber area where fires raged. So heavy was the smoke that authorities limited auto speeds to ten miles per hour". In a parallel account, the 3 August edition of the Minneapolis Tribune noted that showers had helped to check the fires that "burned through forests and fields in several parts of Minnesota" and that flames had been "brought under control at least temporarily at Crosby, Anoka and the Buhl area". A "three mile swath," it was said, had been "cut by blazes at Hinckley". The Tribune cautioned, however, that although the peat bog fire southeast of Anoka "apparently was under control...there were indications that the slow burning fire was eating deeply into the ground".

On 4 August, the Minneapolis Star persisted in reporting that the Twin Cities area peat bog fires had been brought under control. The same edition noted, nevertheless, that "a north and northeast wind with an eight mile velocity today brought Minneapolis and St. Paul whiffs of the Anoka...smoke. Since early this morning, the smoke has been detected in all parts of the city". The Star also reported that the drought fire danger had shifted from the peat bogs....to "widely separated points in the Superior National Forest near the Canadian border, in some of the major stands of pine remaining in the state. A whipping wind from Canadian fires drove glowing embers into the tinder dry virgin pine regions, starting dangerous blazes near Lake St. Croix northwest of Ely and between Gunflint and Rose Lake in the eastern forest. At the latter fire, an area of eighty acres was involved and a large crew was battling the blaze with hand pumps, axes and shovels. Smoke was so thick in the area that watch towers were useless to discover fresh fires started by flying sparks, but the water patrol and an airplane were co-operating to send crews to freshly threatened districts. It was estimated that approximately 1,400 men were ready for fire fighting duty in the Superior forest.... It was thought, however, that with a continued north and northwesterly wind, the Superior forest would continue to be menaced by Canadian blazes, and some fear was expressed that, spread over a three hundred mile front, the fire fighting forces would be so widely spread that their efficiency would be affected. A crew of four hundred men [were] expected to have one fire, covering three hundred acres southwest of Ely, under control by tonight. It also was reported that the fire was gaining headway near Long Lake in Cook county, having skipped the lake in spite of efforts....to prevent it...". In Minneapolis, C. A. Bossen, park superintendent, asked picnickers to "carefully extinguish cooking fires they build in the parks...". According to the Star report, the city's parks were so dry as to constitute a serious fire hazard.

Moreover, fears that the Twin Cities area's smouldering peat bog fires would break out anew were realized on 7-8 August when, according to the Minneapolis Tribune, fires, fanned by a "stiff wind," flared up along Wayzata Boulevard about two miles west of

downtown Minneapolis. The flames, it was said, "spread rapidly and burned over several hundred acres of land from which hay crops had been harvested". On 9 August, the Tribune again focused its attention on northern Minnesota, reporting that the forest fire situation there had become alarming, "scores of fires" reportedly burning out of control. According to the Tribune's account, many homes had been burned, one person had died and 150 were homeless as a result of fires which ravaged "large areas of dry cut over and forest lands in northern Minnesota and northern Wisconsin". Dozens of fires which had erupted in several areas (the Superior National Forest, especially) were, it was said, challenging the efforts of "a weary fire fighting force totaling nearly 8,000 men. More than 1,000 CCC boys and volunteers were fighting a huge blaze in the Markham-Palo area which had already burned over an estimated 12,000 acres...South of Nashwauk, 2,000 men were battling a fire in the farming district where approximately thirty five homes have already been destroyed. A 1,500 acre fire two miles southeast of Cromwell was reported under control late Saturday, although more than three hundred CCC and PWA workers were still on the job. A plea for an unlimited number of fire fighters came from the Nashwauk and Keewatin districts where at least six blazes were reported raging. Governor Olson Saturday night authorized mobilization of the Duluth national guard for eventualities growing out of the rampant fires in the Markham-Palo district. Twenty five military vehicles were prepared for immediate duty on orders from Adj. General Ellard A. Walsh.....A note of optimism was sounded from a few sections where the fire fighters received the aid of showers..."

In another report, the same edition (9 August) of the Tribune stated that, in the Moose Lake area, the "smell of live wood smoke, an inescapable reminder of the terror of 1918, is drifting over the woods and fields...Scattered fires burning through swamps and woodlands have set nerves on edge as weary fire fighters, men from CCC camps and WPA crews and others recruited by forest rangers, carry on the strength sapping efforts to check the blazes. Saturday night the fires were temporarily at least under control but there was no slacking of vigilance. Men who have had but eight hours of sleep in the last thirty six were back on the patrol lines. Up to now there has been no immediate threat to the town of Moose Lake or other communities of this region, but with the situation comparable to that of October 1918, when a raging fire claimed hundreds of lives, there is a distinct feeling of uneasiness.....Now the fires are crackling spasmodically through the trees that have grown up since that 1918 fire. Parched by a long dry spell that has seen no rain of consequence for six weeks, the brush and wooded tracts and marsh lands provide ready fuel. Thursday the slow burning fires were fanned to dangerous proportions....Largest, and most dangerous of the fires was one fifteen miles southwest of Moose Lake....There the fire was still burning slowly Saturday evening but not with sufficient fury to jump Willow river, now dwindled to a stream almost dry in spots..."

On 10 August, the forest fires, said to be raging on sixty fronts, warranted a Minneapolis Star banner headline which told readers that 6,000 "weary men" were currently battling the "flames in the forests of the state". The story that followed stated that "all" northern Minnesota WPA projects were suspended, freeing an additional 3,100 men for service on the fire lines. In Wisconsin, 8,000 to 10,000 men were reportedly fighting "disastrous fires which have raged out of control in the Brule river district for more than a week". In the Aurora, Minnesota area "scores of homes" were said to have been threatened as a blaze

burning on a ten mile front , leaped fire lines and roads". "At one point, 1,800 feet of hose and giant pumps were used to bring water from a lake in order to save a township hall and a school near Aurora....Thirty families were homeless in this area after flames swept their farms over the weekend. Workers succeeded in heading off the fire when it was six miles from Aurora.....The Red Cross was caring for one hundred refugees at the high school in Aurora, and furnishings saved from evacuated homes were piled high in the basement...A fierce blaze was raging along Pequayam lake, about thirty five miles north of Duluth. More than 500 men, including CCC men, were battling the flames on a front seven miles long and three miles wide. Some of the finest timber in the state has been destroyed, rangers reported. Forty fires were crackling through timber land in the Cloquet area.....School buses, highway trucks and all available trucks were pressed into service to rush fresh crews to the fire lines....Governor Floyd B. Olson from his summer home on Gull lake today issued blanket authority to Adj. General E. A. Walsh to purchase equipment or hire men to fight forest and brush fires in northeastern Minnesota...Wisconsin state foresters announced that persons visiting the fire area out of curiosity would be conscripted to help battle the flames....In addition to the menace of cigaret and cigar stubs, forest rangers found dry lighting their biggest enemy in trying to control forest fires....Northwest airline pilots reported today the smoke pall from forest fires hangs over the ground all the way from LaCrosse, Wisconsin ...to Fargo and Pembina, North Dakota. The haze extends upwards about 200 to 300 feet, but is not interfering with plane operations...Five fires were started by cigaret stubs near Hinckley, including one that started to sweep the Hinckley golf course....In the Cloquet ranger district....there has been only 0.54 inches of rain in the last five weeks....".

In addition to its reports from the northern Minnesota fire lines, the 10 August Star included an article describing the ways in which fire crews performed their challenging and undoubtedly hazardous, daunting and often futile tasks. According to the forest rangers quoted in the Star account, "you dig and you hope and you chop down trees and you pray the wind doesn't shift. If you are lucky, you have pressure tanks men carry on their backs and sometimes you have big pumps if there is water handy...Far ahead of the path of the flames men dig trenches, fell trees and set a back fire. Thus, the flames come to a place where there is no more fuel and the fire is under control. But treacherous winds often fan embers across the fire line, the fire making a suction that creates a wind. Then the work starts all over again. Where fire is close to water and if there are roads, huge pumps and engines are set up and water is poured on the fire and unburned areas. In other sections, fire fighters walk in goggled with wet handkerchiefs over their faces and with clothing soaked with water. To their backs are strapped water tanks, under pressure. They play tiny trickles of water on the fire and hope....Persons drafted to fight fires in northern Minnesota are paid twenty cents per hour and are fed in camps. They once were paid more but rangers discovered the lure of a job fighting fires caused many 'strange' fires to break out....".

As noted, smoke generated by the 1936 fires spread over wide areas of the northwest, east central Minnesota included. The Minneapolis Weather Bureau's 10 August daily meteorological journal noted, for example, that "smoke from forest fires and local bog fires was very much in evidence most of the day. Similarly, on 11 August, Weather Bureau observers recorded "light smoke from northern forest fires and local bog fires". And on 12 August, "moderately thick smoke" was said to be present in the atmosphere over the Twin

Cities "throughout the day".

Beginning in mid-August, Minnesota's forest fires, although remaining a serious problem, began to wane, the result of rains which fell over many portions of the fire area during the last half of August and the first half of September 1936. As early as 12 August, the Minneapolis Star was able to report that "rains which fell in the heart of the Superior National Forest Tuesday night [11 August] abated the threat of raging fires in the twenty eight million acres of timber. Promised rain gave fire fighters in the St. Croix State Forest area hope of extinguishing a blaze which already has destroyed 3,500 acres of timber land. From the Moose Lake ranger station it was reported that more than three hundred men, equipped with tractors, hand pumps, axes and shovels had partially controlled the St. Croix fire north of Duxbury [Wisconsin] which menaced more than 3,000 acres of timber Tuesday night". The Star's 12 August account was followed by another optimistic, but nonetheless highly cautious, story published on 13 August, a report which stated that "while more than 10,000 men were standing guard over smouldering fires in northern Minnesota which had been controlled on virtually all fronts (emphasis added), added firefighters were being drafted from border and Range towns for duty on the front lines near International Falls where a fire raged out of control. A blaze in the Kabetogama lake region had swept through 6,500 acres of valuable timber". Three days later (15 August), however, the Star was able to report that the Kabetogama fire, along with other "major" fires near Magrath, Warroad and Tom Lake had been "brought under control".

Yet, optimistic reports notwithstanding, the forest fire menace, although abated, continued though much of August. The 13 August edition of the Minneapolis Tribune emphasized the continuing danger, pointing out that "pressure pumped water, shovel brigades and raw manpower were thrown into the battle against forest fires which threatened to engulf the town of Aurora [a community which had been besieged by encroaching fires for several days previous]. Militia were posted on highways in the fire zones and those passing [by] are pressed into service unless they can show good cause for not so doing". Moreover, on 14 August, the Tribune reported that fires had broken out north of Warroad and in other areas in the northwest part of the state "while fires in the northeast part of the state were being placed under control [partly, of course, as a result of the aforementioned 11 August rains]". The fire near Warroad was reputed to "seven miles long, covering several sections of timber". And, on 18 August, the Tribune emphasized that new fires had broken out, stating that "fire fighters in northern Minnesota forest hope that rains may come to their aid. At Tom Lake, 1,000 men are on duty while one hundred are battling a fire at American lake, two hundred at Magrath. There is a major fire in the Superior National Forest where 575 men fought flames that were spreading at an alarming rate during the past twenty four hours. The Kabetogama blaze forty miles east of International Falls was also reported as breaking over new territory". Fortunately, however, late August brought substantial, sometimes heavy rains to portions of the fire ravaged areas (e.g. Big Falls, Pigeon River Bridge and Leech lake Dam, 2.00, 2.50 and 1.86 inches, respectively, on 28 August), the result of which was a decline in both the extent and incidence of forest fires. Additionally, substantial rains fell over much of the same area in early September (e.g. 1.63 inches at Baudette on 14 September; 1.50 inches at Grand Rapids on 10 September; and 1.50 inches at Redby on 14 September), further moderating the dry conditions which had triggered the

summer's fires. Finally, although dry, October 1936 brought light to moderate snowfalls to many northern Minnesota locations, effectively ending the 1936 forest fire season.

Yet, while forest, grass and bog fires (together with heat and drought) were ravaging much of the state's vegetation, Minnesota farmers continued to expand and/or restore farmyard windbreaks or, more generally, to establish greenbelts along streams and fence lines. According to the 20 March 1936 edition of the *Morris Tribune*, as an example, orders for 20,525 windbreak trees had been received from twenty seven Stevens county farmers and landowners. The trees, it was said, were to be secured by the "county windbreak committee through the local Rural Resettlement Office". Cost of the trees was \$1.50 per hundred. And in the drought stricken Moorhead area, the 22 April 1936 edition of the *Moorhead Daily News* reported that "more than 900 trees and 300 cuttings have been planted along Clay county streams during the past few weeks in connection with a youth relief project, thus providing shelter for game birds which suffered extremely during the past winter".

In addition to its impact on crop yields, its destruction of vegetation and wildlife and its disruption of normal human activity, the extreme heat and drought which marked the summer of 1936 also both strained and challenged public and private relief programs. As in 1934, the federal government bought up undernourished or starving livestock and provided funds for alternative employment for distressed farmers. And, also as in 1934, private relief agencies were required to provide extensive aid to residents of drought stricken areas. As early as 23 June 1936, the *Minneapolis Star*, in an alarming report, noted that drought conditions in North Dakota had become "very severe" and that farmers in some sections of that state faced "actual hunger". An estimated 46,000 or more than half of North Dakota's 87,000 farm families were said to be in "need". A week later (30 June), the *Star* reported that aid for 75,000 needy farm families had been "drawn up" in St. Paul. According to this report, Harry Hopkins, chief of the Works Project Administration (WPA) had promised that farmers "left unable to make a living from the blistered soil of the Dakotas and Montana would be cared for". The cost of the proposed program was estimated at \$50 million to \$100 million (1936 dollars).

A similar, but more detailed story in the 1 July 1936 edition of the *Minneapolis Tribune* announced that, according to Hopkins, 25,000 northwest farmers were to be placed "immediately on public works rolls". In addition, another 45,000, it was said, might be "hired later if necessary. \$50 million to \$100 million will be spent on dams, roads and other public projects. The program will be centered around construction of dams to conserve water. Second in importance will be farm to market roads and rural schools. Secretary of Agriculture Henry Wallace said that continuation of the drought for another three weeks in the corn belt would throw one million or more cattle into the market and require \$20 million to \$30 million in federal money to purchase them". In its next day's edition (2 July), the *Tribune* reported further that the Agricultural Adjustment Administration (AAA) had "revised plans in the north central region by providing additional incentives to increase acreage of soil conserving crops. But farmers have found it difficult to divert sufficient number of acres to earn soil conservation payments because pasture and clover killed by the 1934 drought were replaced in 1935 by soil depleting crops to provide temporary forage". In still another drought relief report, the 3 July edition of the *Tribune* told readers that the

U.S. Secretary of Agriculture [Wallace] had "ordered full speed ahead on cattle buying as part of a drought relief program for farmers in the northwest drought area. The....department has tentatively allocated \$5 million for this purpose and will buy up to one million cattle if necessary". And, on 11 July, the Tribune reported that 16,500 of the 75,000 WPA jobs authorized for the drought area had been filled. The Tribune also reported that the AAA (apparently responding to concerns expressed in the Tribune's 2 July story) had modified its soil conservation program "to increase supplies of feed crops in the north central region".

A similar series of reports appeared in early July 1936 editions of the Minneapolis Star, the first of which (3 July) announced that "federal drought relief machinery was thrown into high gear today as government agencies moved swiftly to attack the problem on three fronts. Relief to farmers and livestock in the parched plains of western Minnesota, the Dakotas, Montana and Wyoming will be conducted through the emergency WPA program, rural rehabilitation and the government buying up one million distressed cattle". Wheat prices, it also noted, had "soared to new highs as buying increased on private reports of excessive damage to spring wheat". On 4 July, the Star echoed earlier reports, stating that the northwest was to receive \$13,350,000 in drought relief aid and that the WPA was "launching water conservation and farm to market road projects to provide employment for up to 75,000 persons". Resettlement loans and grants averaging \$200, it was added, would be made to as many as 25,000 drought distressed farm families. In an incidental, but not irrelevant, story, the Star also noted that the then well known and highly touted thirty minute motion picture, "The Plow that Broke the Plains" had been shown at the University of Minnesota's newsreel theater. The film, it was explained, "strikingly told" the story of "how the plow turned under the grass that held the soil together and conserved the meager moisture of.... 625,000 square miles and left it as the future great American desert...". On 6 July, the Star underlined the success of the newly inaugurated relief effort, stating that "approximately one thousand farmers in the western part of the state whose crops have been ruined by drought were at work on WPA projects. This number will be increased as necessary". Evidence of the (presumed?) success of the WPA program was provided a few days later by Howard O. Hunter, assistant WPA administrator, who according to the 10 July edition of the Star claimed that "Minnesota has shown the greatest improvement among the states included in the drought area". This claim, however, may have been made prematurely: the drought continued to deepen over many areas during the next six to seven weeks, increasing the demands placed on relief agencies, whether public or private. Although not directly pertinent to Minnesota, evidence of continuing and arguably intensified distress was provided by the Star in a 10 August report stating that "a national appeal for clothing for families on drought stricken farms in the Dakotas and possibly other states may be necessary, acting Works Progress Administrator Aubrey W. Williams, stated today...".

Nor, of course, was coverage of 1936 drought relief efforts limited to the Twin Cities newspapers. The 3 July 1936 edition of the Moorhead Daily News reported, for example, that government officials were hastening plans for a federal cattle purchasing program "designed to relieve northwestern breeders whose feed supplies are burned out by drought....an initial allotment of \$5 million has been made to provide for 80,000 to 100,000 farm families expected to be thrown on relief in the spring wheat area because of drought

and insects". On 9 July, the Daily News re-emphasized the extent of the disaster, noting that "government agencies are pushing distribution of relief funds to one million destitute farmers". And in an 11 July report, Daily News readers were told that the WPA had announced plans to provide jobs for more than 20,000 persons in six southern states. In west central Minnesota, the Morris Tribune (3 July), like other newspapers published early in July highlighted prospective relief efforts, repeating the WPA's pledge to provide "immediate" work for farmers who are in "dire straights as a result of the drought". On 10 July, the Tribune announced that Stevens county had been designated as one of the Minnesota counties eligible for drought relief, noting that twelve county farmers had already been "certified for WPA work". By 31 July, the number of such certifications had risen to seventy nine, reaching a total of eighty one by 7 August. And on 17 July, the Milan Standard reported that 549 farmers in the eighth WPA district had been certified as eligible for employment under the drought relief program, a number which, by 31 July, was said to have risen to 1,125. The Standard (21 August 1936) also suggested that the WPA relief efforts were sometimes controversial and contentious, reporting that a "a mass meeting called by the Minnesota Labor Association was to be held in Montevideo to protest...the bringing here of outside labor to work on the Lac Qui Parle project as long as there are men here who need employment. Demand will also be made for higher wages for relief workers....WPA officials explain, however, that the bringing of outside labor does not deprive a single person in the eighth district WPA of a job".

Yet, despite its intensity and its widespread, devastating effects, the drought of 1936 was not thought by many agricultural specialists and climatologists to be as severe or as destructive as the drought of 1934. This assessment, although questionable in some respects, appears to have been generally accurate, at least for much of Minnesota. The reasons for the difference between the two episodes include the fact that the drought of 1936 was shorter in duration and was preceded by a wet winter, by a relatively cool spring and early summer (April and June, especially) and, perhaps most importantly, by a relatively cool, wet year (1935). This meant that, in some regions at least, depleted subsoil moisture had been at least partially restored, thus mitigating the amount of crop damage done by the heat and drought of July 1936. But, comparisons with 1934 notwithstanding, the drought of 1936 was, by any standard, an extreme climatological event. In this regard, the 17 June edition of the Minneapolis Star noted that, according to a recent Cargill Corporation crop bulletin, "the drought sector in the Dakotas and western Minnesota is going through a period similar to the drought of 1934. Even with generous rains from now on grain crops will be practically a failure in that territory. Rains in the past twenty four hours were scattered in sections of the northwest, giving some farmers renewed hope that crops will be near maturity before the hot weather comes...". Similarly, the 24 June edition of the Star reported that "drought conditions are not as bad this year as in 1934 but rainfall in the Dakotas has been below normal for eight of the past ten years and has been lighter this year up to May 1st than in any similar four month period of record". And, on 1 January 1937, in a summary of the prior year's events, the Minneapolis Tribune compared the drought of 1936 to a "huge scythe which cut great swaths through the harvest of Midwest grains. Following so closely on the heels of 1934's destruction, commodity supplies on hand are drastically reduced".

Nor were the effects of the 1936 drought and heat limited to a few states. According to the January 1937 issue of the Weather Bureau's Monthly Weather Review "high temperatures and accumulated deficiencies of rainfall began to materially affect crop conditions in the midwestern states at the close of June. In parts of the United States...May, June, July, August and September [featured] almost constantly above normal temperatures. Only three states, California, Michigan and Minnesota, had temperatures below normal in June. The New England district was the only section below normal in July.....and in August every state and section, with the exception of the northern part of New England..reported mean temperatures above normal....New [June] maximum monthly temperatures were established in the following eight states: Arkansas, 113 degrees; Indiana, 111 degrees; Kentucky, 110 degrees; Louisiana, 110 degrees; Mississippi, 111 degrees; Montana, 111 degrees; Nebraska, 114 degrees; and Tennessee, 110 degrees....During July, a new record maximum was established in the following states: Illinois, 115 degrees; Indiana, 116 degrees; Kansas, 121 degrees; Michigan, 112 degrees; Missouri, 118 degrees; Montana, 113 degrees; Nebraska, 118 degrees; New Jersey, 110 degrees; North Dakota, 121 degrees; Oklahoma, 120 degrees; Pennsylvania, 109 degrees; West Virginia, 112 degrees; and Wisconsin, 114 degrees. The average departures from normal [July] were exceptionally large in most states in the Mississippi and Missouri valleys. In the Dakotas the excess exceeded eleven degrees. In August, the heat wave over the midwestern and interior valley states continued unabated. Nine states established new maximum records [including South Dakota, 116 degrees]....Less than seventy percent of normal rainfall for the crop growing season occurred in Montana, the Dakotas, Nebraska, Kansas, Minnesota, Missouri and Arkansas.....".

Surprisingly, and undoubtedly much to the relief of Dust Bowl residents, the summer of 1936, in contrast to the spring and summer of 1934, produced few dust storms of consequence. According to the Monthly Weather Review, "only a few dust storms, mostly local in character, occurred during July 1936...Dust was reported locally over the Great Plains northward to the Canadian border, but the number of occurrences was small...Kansas, Nebraska, the Dakotas, Iowa, Montana and Wyoming were among the states experiencing dense dust during the month. At Havre, Montana, visibility was reduced to about one city block for three minutes on the 17th; the storm on the 19th at Sioux City, Iowa, reduced visibility to three hundred feet for a brief period....General rains on the 27th terminated dusty conditions in southeastern Colorado....While August rainfall was decidedly subnormal in most Plains states and the southwest....dust storms were fewer than in several other months of 1936. Only a few dust storms were reported and the frequency seldom exceeded six for the month...They were most frequent from the 16th to the 23rd.....The storms in September were mostly light in character though occasional dense dust was reported in Montana, North Dakota, Nebraska, Colorado and Oklahoma. Light dust was noted over most western sections from Texas and New Mexico northward and in the upper Mississippi valley. Light dust was general in eastern Montana and Colorado and in Nebraska and South Dakota.....Bismarck, North Dakota reported a visibility of one fourth mile at times on the 13th...".

Predictably, the effects of the 1936 drought spilled over into 1937, chiefly in the agricultural sector of the economy. In many areas, the drought left farmers with insufficient grain for

1937 seeding, a problem which the federal government attempted to resolve by purchasing and distributing seed grain to needy farmers. According to the 5 August 1936 edition of the Minneapolis Tribune, this program "got underway in Washington [D.C.] on Tuesday [4 August] with the announcement that eight million bushels of seed will be purchased for distribution next winter and spring. It is estimated that half the seed will be bought in the northwest. Sales will be made on the basis of cost plus storage, handling and transportation charges. The program is estimated to cost \$10 million. It is expected that seed will be bought on the open market. In 1934, the government bought over nineteen million bushels of seed. It sold about two thirds of it to drought belt farmers for their 1935 planting and the remainder last winter for use in 1936". In a parallel story, the 4 August edition of the Minneapolis Star stated that "the Agricultural Adjustment Administration today announced plans to purchase two million bushels of seed grains to be distributed to farmers in the drought area. The purchases will include primarily spring and durum wheat and will be financed by a loan of \$10 million from the commodity credit corporation".

Predictably, also, the ravages of the 1936 drought (together with the cumulative effects of a series of dry years beginning in 1930), resulted in significant increases in commodity prices (and, as noted earlier, increases in consumer food prices). In this regard, the 9 August 1936 edition of the Minneapolis Tribune pointed out that the "general index of prices received by Minnesota farmers for their products" had risen ten percent during the thirty day period from 15 June to 15 July 1936. Crop prices, it was said, had increased 34 percent during that period, "including gains of twenty three cents for wheat and twenty four cents for corn. Drought damage was the primary cause of the advance according to a study completed Saturday [8 August] by W. C. Waite and W. B. Garver of the agricultural economics division of University farm. The July 15 figures do not record the entire gain in farm income, however, since all farm commodity prices have increased substantially since then. The figures shown by the economists in their monthly index show that wheat advanced from \$0.88 [per bushel] on June 15 to \$1.11 on July 15; corn from \$0.45 to \$0.69; oats from \$0.19 to \$0.32....flax from \$1.51 to \$1.87; potatoes from \$0.65 to \$0.95 and hay from \$4.48 [per ton] to \$7.02....".

Obviously, then, farmers who were fortunate enough to have commodities to sell, benefitted from the drought of 1936. But any such good fortune notwithstanding, most upper Midwest farmers (as well as many others) suffered extreme financial and psychic hardship during 1936, a year that, by any measure, was a climatological disaster. Yet, more positively, it was also a year of transition, a year which, although grueling, was, in Minnesota at least, the last year of the great drought, the last year of widespread crop failures and the last year of extreme and unremitting heat. This is not to say, of course, that the last three years of the 1930's were totally free of heat and drought, whether in the nation generally or in Minnesota in particular. Nor is it to say that the Dust Bowl era ended with the summer of 1936: many areas of the country continued to experience dust storms and severe drought until 1940, when, it is generally agreed, normal precipitation finally returned to the drought stricken areas of the west and southwest. In Minnesota, however, the remaining years of the 1930's were marked by generally, although not consistently, wetter and more moderate weather conditions, a trend which became evident during the winter months of 1936-1937. That winter, according to the Weather Bureau statistics of the time,

was one of the wettest ever recorded in Minnesota and snow , particularly in much of west central Minnesota, piled up to depths even surpassing those of 1935-1936. Yet, despite the inconvenience -- even hardship -- which they caused, the winter's snows helped to replenish much needed subsoil moisture and to improve 1937 crop prospects. However, given its severity and its excessive snowfall, the winter of 1936-1937 must be seen as something more than a milestone marking the great drought's last gasp. It is, rather, a climatic episode which, like the winter of 1935-1936, stands out as one of the most noteworthy climatic events of the 1930's. It is an episode, then, that will be treated separately, the topic of the discussion that follows.

THE 1930'S
THE WINTER OF 1936-1937:
MORE SNOW, LESS COLD

As noted previously, the winter of 1936-1937 was one of the wettest winters ever recorded in Minnesota. This change in the state's weather patterns must, however, have surprised most Minnesotans, following as it did on the heels of an autumn which was almost as dry as the preceding summer. And an autumn which, accordingly, must have led many to expect a continuation, perhaps even an intensification, of the 1936 drought. Although rains in late August and early September brought some relief from the severe drought which had held sway from early June through mid-August 1936, late September was extremely dry, establishing a pattern which prevailed in most areas through November.

Moreover, the period from October through mid-December was marked by dust storms, a few of them severe. According to the December 1936 issue of the Monthly Weather Review, "dust storms were reported during October from eastern New Mexico and the Texas Panhandle northward to the Canadian border and from the Rocky Mountain states eastward to the middle Mississippi valley. These storms were generally of light intensity and short duration....The storms of the 30th [of October] were classified as the worst of the season in eastern South Dakota; at Huron the visibility was reduced to 1,300 feet.....During November dust was widespread, being reported from...Texas to the Canadian border and from the rocky Mountains eastward to...Tennessee.....Most of the storms occurred late in the month.....the greatest number being reported in the Great Plains. Dust was encountered at various altitudes by aviators, the height of the dust clouds ranging upward to 4,000 feet [in] Kansas and 6,000 feet at Chicago.....General storms were reported in Iowa and the Dakotas.....In portions of North Dakota street lights were necessary at times when the visibility was the least. In central South Dakota and portions of Iowa were the worst in two years. In general, minimum visibility in the densest storms was one half mile, but in portions of Nebraska, it was reduced to one fourth mile on the 22nd and to one hundred yards on the 24th.....Light dust was reported in the Plains states during December.....In North Dakota, light dust was general on the 19th and several storms occurred in central Montana where Geraldine.....reported a 'terrific dust storm from six p.m. of the 19th to three a.m. of the 20th....".

In Minnesota, significant and as in the nation generally, sometimes severe dust storms occurred on 30 October, 20 November and 19 December 1936. Of these, the first was limited to the northwestern and western portions of the state, the Moorhead Weather Bureau station reporting that the air in that vicinity was "filled with dust" from 0900 hours "until sometime during the night" on 30 October. The dust, it was noted, was especially dense from 1300 to 1700 hours, reducing visibility to one fourth mile "during much of the afternoon". The 20 November storm, however, was more general, raising clouds of thick dust over large portions of the state. At the Moorhead Weather Bureau office, "light dust was first observed" at about 1000 hours on that date. The wind then increased in velocity and the dust became "dense" at about 1040 hours. Visibility, it was reported, was reduced to one half mile by noon, driven by winds described as being "very strong at times". In other parts of the state, the storm "caused some injury to winter grains". But what was probably Minnesota's worst dust storm of the three occurred on a mild December day, beginning in the morning and continuing until evening. At Moorhead, the storm began with light dust in the morning and dense dust from about 1200 hours to about 1315 hours. And, according to the Minneapolis Star, the storm, accompanied by a strong wind, "rolled" into the Twin

Cities late in the afternoon of 19 December. The dust clouds, it was claimed, were from soil "picked up in North Dakota and made heavier by dirt accumulated in Minnesota. Spring like temperatures preceded the dust storm....[which] was heaviest along the western Minnesota border. As the blow diminished with nightfall, temperatures dropped slowly in North Dakota....Top soil freed of snow by recent thaws was picked up in North Dakota by the wind which at times reached a velocity of forty miles an hour. In Valley City, North Dakota, Louis Craver, 84, suffered a hip fracture when a gust of wind threw him to the sidewalk. At noon the storm had moved into Minnesota, and at Crookston and Fergus Falls, it was necessary to turn on lights. Snow was melting at Fergus Falls when the storm struck.....Electric service on branch lines in the vicinity of Bismarck, North Dakota was interrupted by the storm..."

Besides dust and drought, the fall of 1936 featured several periods of abnormal cold, a pattern which, as it turned out, dominated Minnesota's weather during much of the ensuing winter. As noted previously, record or near record below zero temperatures were recorded at many stations during late October and again in early November. And October, although abnormally dry, brought light to moderate snowfall to many areas of the state. According to the 23 October edition of the Morris Tribune, as an example, two inches of snow fell on 21 October, the earliest October snowfall recorded at the Morris station since 1919. The snow, moreover, was followed by winter like temperatures with minima of 15 F, 15 F and 9 F recorded by Morris observers on 21, 22 and 23 October, respectively. Another round of winter like weather followed at the end of October, the 6 November edition of the Tribune noting that "rain and snow on Saturday night [31 October] and Sunday [1 November] developed into a blustery all day blizzard on Monday..". The rain and snow, it was also noted, was preceded by a "severe dirt storm" on 30 October.

The state's weather patterns, however, changed markedly during December 1936, a month which brought above normal temperatures and above normal precipitation. Although the warmth proved to be temporary, ending abruptly at the end of the month, the trend toward wetter conditions, as emphasized in an earlier discussion, marked the beginning of a sustained recovery from the state's prolonged drought. The month's heaviest precipitation, however, fell during the week of 24-31 December, a period which was also marked by unseasonable warmth. Temperatures on 25-27 December rose to 50 F or higher at many stations (e.g. 57 F at Fairmont and Zumbrota; 56 F at Winnebago and Faribault; 54 F at Rochester; 53 F at Albert Lea, all on 26 December and 56 F at Winona on 25 December). Precipitation which, depending on location, came in the form of snow, sleet and/or rain, totaled nearly two inches in some areas during this period (e.g. 1.95 inches at Collegeville on 29-30 December). At the Minneapolis Weather Bureau station 0.57 inches of rain was recorded on 26 December, the greatest amount of precipitation to fall in any one day at that station since August. Snowfall was also unusually heavy averaging 12.9 inches statewide, the greatest such value recorded in any December since 1927.

The closing days of December, however, marked the end of the 1936-1937 season's mild interlude, a transition emphasized by, among other sources, the 8 January 1937 edition of the Wheaton Gazette. According to the Gazette account, " the warmest holiday season in history," was followed by a new year that "started with an old fashioned winter. Intermittent

drizzle during the last week of December made roads over most of the Minnesota icy and unsafe. Snow started falling on Saturday [2 January] in this vicinity and by Sunday there was 10.6 inches of snow. There was a three inch fall on Monday [4 January] and on Tuesday [5 January] another three inches fell". Similarly, the 8 January edition of the Morris Tribune reported that "the first week of the year brought sub zero weather and blizzards with the result that the normal schedule of business and events has been considerably disrupted. Heavy snows last Friday night [1 January] and Saturday and again on Monday and again on Wednesday, each of which was accompanied or followed by a high wind, blocked streets and highways. [The] several inches of snow on Friday night and Saturday morning was followed by a gradually rising wind that wound up in a raging blizzard in the afternoon and evening. Trains were delayed hours behind schedule. Most of the streets in Morris were impassable to automobile traffic. Grocery delivery men during the past several days have had to revert to horses and bobsleds in order to make their rounds in the city. Many side roads are blocked to anything but teams [of horses] ".

The onset of the winter's severe weather was also noted by Twin Cities newspapers, the 3 January 1937 edition of the Minneapolis Tribune reporting that " a cold wave swept across the northwest Saturday night [2 January] on the heels of a snowstorm that left over a foot of snow over seven states. High winds piled drifts that blocked secondary roads in many places and handicapped traffic on main roads. Only traces of snow fell in Montana but as the storm moved eastward it grew much heavier. The storm extended over the Dakotas, Kansas, Minnesota, Nebraska, Iowa and Wisconsin. Minneapolis residents struggled with a thick layer of snow that demanded much shoveling. In the Crookston area all county roads were blocked by drifts...". On the following day [4 January], Tribune headlines told readers that "sub zero cold held a blanketed northwest in its grip". Four deaths in Minnesota, one of which occurred in Minneapolis, were attributed to the "frigid wave" and "in southwest Minnesota crews were busy digging out city streets and county roads. Travelers delayed by the disruption of bus and train schedules crowded Pipestone hotels. Sioux Falls, South Dakota was virtually isolated by the storm". Moreover, as the winter deepened, newspaper reports began to sound more and more like those which dominated the news during the winter of 1935-1936. In this regard, the 5 January edition of the Tribune stated that "highways were drifted shut in parts of Minnesota Monday night [4 January] and snowplow crews gave up work until such time as the winds abate. Roads about Crookston were blocked and Fergus Falls and Bagley reported drifted roads. Deep snows have cut Sioux Falls, South Dakota from airmail service. Drifts at the airport there were three feet high. A group of thirty five spent Sunday night standing up in a service station five miles south of Beresford, South Dakota. Their automobiles had become stalled in drifts which reached as high as six feet. Dogsleds were being prepared Monday night to take provisions from Bayfield, Wisconsin to residents of Madeline Island in Lake Superior. Ice had brought a shutdown in ferry services...". In a more dramatic account on 9 January, the Tribune told its readers that "winter used all of its weapons on the northwest Friday [8 January]. Snow, sleet , ice and cold were distributed in abandon. In the south and western sections of the state [of Minnesota], heavy snows were whipped into drifts. Roads were blocked in many locations. The snowstorm brought traffic to a virtual standstill in a number of places in southern Minnesota, Snow plows were unable to cope with the drifts. Trains on the Northwestern and Milwaukee lines were cancelled. Roads in the Mankato area were

impassable and roads in southeastern North Dakota were in bad condition. Drifts six to eight feet high were piled up across roads in Iowa".

On 10 January, however, the Tribune was able to report that "an interruption in the cold wave allowed snow plow crews working at top speed to open virtually all main roads. Fairmont was snowbound for two days but reported resumption of bus and train schedules Saturday [9 January]". This break was, unfortunately, short lived: on 15 January, the Tribune carried another round of bad weather news, noting that "sweeping in from the snow blanketed Dakotas on the wings of an icy wind, a new cold wave took a grip on Minnesota late Thursday [14 January]. The frigid blast whipped across the state a few hours after a heavy snow blanketed North Dakota and tied up transportation in many sections of the state". Three days later (18 January), the Tribune reported that yet another cold wave "began an attack on the northwest Sunday night [17 January]". The cold, it was said, was expected to spread as far south as Missouri and as far east as Illinois. Nor did conditions improve during the remainder of the month. On 21 January, the Tribune announced that a "severe cold wave borne on gale velocity northwest winds followed Wednesday's [20 January] snowstorm into Minnesota and the Dakotas during the night. A blizzard was dashing eastward through the western half of North Dakota. In the eastern part of North Dakota highways were generally still open but drifting had set in. Trains and busses were late into the Twin Cities in most instances. Visibility was poor in the Crookston area and snow plows were inactive. Many smaller roads were blocked in the Fairmont area and a severe storm was reported at Pipestone....Blizzard winds of thirty three miles per hour at Jamestown, North Dakota with roads blockaded....Thirty six mile per hour winds in northeast South Dakota with eleven inches of snow. Highway traffic has ceased completely in that area...". On the next day (22 January), the Tribune emphasized the blizzard's aftermath, stating that "the northwest is slowly digging itself out of a heavy covering of snow...Emergency crews were out with plows all day in an effort to open highways and railroad lines...". And, as if to remind upper Midwest residents of the drought of 1936, January's snow was sometimes mixed with dust, the 24 January 1937 edition of the Moorhead Daily News reporting, for example, that from about 0800 to about 1015 hours, "light dust" accompanied the snow which fell on that date. Dust was, it was also said, remained in the air until about 1500 hours.

The cumulative effects and intensity of January's cold, snowy regime were reflected in newspaper accounts appearing at, or shortly after, the end of the month. In this regard, the 29 January 1937 edition of the Wheaton Gazette noted "friends are being sought by the Traverse County Game and Fish Protection League to feed the pheasants. The heavy snow and cold weather has been hard on the birds". And in its next issue (5 February) the Gazette quoted Wheaton's cooperative observer Chester Tetzlaff, pointing out that January 1937 was the wettest and second coldest January of record at that station (with an average monthly temperature of -1.05 F). Tetzlaff also noted that he had recorded 64.4 inches of snow at the Wheaton station during the period, 1 November 1936 through 31 January 1937. In a similar report the Morris Tribune (also on 5 February) emphasized that "heavy snowfalls have produced a record January precipitation of 2.55 inches and 22.5 inches of snow". High winds of blizzard proportions prevailed during many days in January, piling heavy snowfall into huge drifts in many places and making all traveling, especially by

automobile difficult to impossible. An unusual amount of snow is lying in the fields".

Although it was much warmer and less snowy than February 1936, February 1937 was much colder and considerably wetter than normal. And, as in the previous February, blizzards continued to pile snow into immense drifts, blocking roads and railroads. According to the 12 February 1937 edition of the Morris Tribune, the weekend of 5-7 February brought "two of the severest blizzards of the year.....with more than a foot of snow being recorded on Friday and Sunday, tying up the bulk of all traffic in this section of the state for periods ranging from one to two days up to nearly a week. Snow plows have battled huge drifts all week to open up main highways but many rural roads are drifted so deeply that they are expected to be blocked until spring. The storms of last week combined with heavy snowfall and drifting in January have brought farmers in this section face to face with the difficult problem of trying to get to town for fuel, food and medical attention. A number of farmers during the past week have come by horseback or walked long distances into town. Travel by team is almost impossible. The Northern Pacific branch line to Morris was snowbound from Saturday until Thursday of this week when a rotary snow plow finally managed to break through. Friday's storm started with a heavy snowfall late in the afternoon and in a few hours rising winds had whipped the powdery snow into a blinding storm that caught many travelers unprepared on the highway. Heavy snow on Sunday turned into another raging blizzard and held sway until Sunday night and Monday [8 February]. The People's Dairy was threatened with a milk shortage Monday, when only about one half of its usual supply could be obtained from farmers. Dr. C. E. Caine spent six hours Saturday going to the Ole Graff farm six miles northeast of Donnelly, although there was a snowplow ahead of him as well as seven men with shovels..."

One week later (19 February), the Tribune grimly reported that "this week's weather story is just last week's over again another weekend blizzard that halted highway traffic and marooned travelers. Since last Saturday's blizzard, however, the weather has moderated considerably. Wednesday (17 February) and Thursday [18 February] brought thawing temperatures. The [weekend] storm was featured by one of the hardest winds of the winter. Beginning early in the morning, it caused heavy drifting, especially in canyons that had previously been cut through huge drifts on highways and roads. Drifts six to eight feet deep are the usual thing and drifts twelve to fifteen feet deep in depth are not uncommon. Great difficulty was experienced in opening even trunk highways and many secondary roads remained blocked for several days". The depth of the drifts was further emphasized by the Wheaton Gazette (19 February) in a story which noted that "a huge hill of snow has been heaped onto the already high banks in the back yard of the Stapher home where the boys are having an elegant time with skis".

Moreover, if Tribune accounts are to be believed, weather conditions at least in west central Minnesota improved little during the closing days of February. According to the 26 February Tribune, "state and county highway crews continued to battle storms and drifting snow this week. High winds all week caused drifting every day, especially in the country. Morris was on the lower fringe of a heavy snowstorm and blizzard that swept down from the northwest Tuesday [23 February] and was severe enough at Elbow Lake and Glenwood so that highway patrolmen finally halted traffic in those localities. Wednesday [24

February] brought some freakish weather. A whirling mixture of snow and dust at times obscured vision to such an extent that it was barely possible to see across the street. But a few minutes later the sun was shining. One county highway crew reported that the dense snow and dust whirling through huge cuts in the drifts made it difficult even to breathe".

Not surprisingly, wintery conditions lingered into the early spring of 1937. In Minnesota, the month featured a mixture of generally colder than normal temperatures, drought in the northern part of the state and heavy snowfall in many central and southern locations (e.g. Morris and Pipestone, 19.0 inches; Bird Island, 24.9 inches; Marshall, 23.7 inches; and Winona, 15.5 inches). April, although colder than normal, was, in contrast to March, unusually wet, particularly in the northern and central portions of the state. Although temperatures reached the thawing level at most stations during the first ten days of March, near blizzard conditions were noted in parts of the state on 23-24 March. In the Morris area, the first days of March were marked by thawing temperatures "that caused a decided drop in the huge snowdrifts..." (Morris Tribune, 5 March 1937). The snow, it was reported, "melted so rapidly" that crews of city workers had a difficult time opening up storm sewers "fast enough to carry the water off". On 26 March, however, the Tribune regretfully noted that a "grand mixture of rain, sleet, snow and dirt that wound up into a storm of almost blizzard proportions Wednesday morning [24 March] featured a two day storm that started Tuesday. Mixed with the flying snow Wednesday was a large amount of dirt which had been whipped up by the high wind". And on 9 April, forced to report yet another delay in the onset of spring, the Tribune reported that "another storm brought a total of 5.5 inches of heavy, wet snow last Saturday [3 April], further delaying farmers from getting into the fields to start spring work. There are still snowdrifts four to five feet deep in many places in this section". (emphasis added).

Statistically, the winter of 1936-1937 was, as noted, warmer than the corresponding period in 1935-1936. January, however, was nearly as cold as (and, in some instances, even colder than) January 1936. Temperatures dropped to -30 F or lower at some stations during the first ten days of the month and at many stations during the last ten days of the month. Notable monthly minima included -46 F at Meadowlands; -45 F at Redby, Cass Lake and Hallock; -44 F at Warroad; -37 F at Campbell; -35 F at Morris; -33 F at Milan and -34 F at New London. East central Minnesota, however, escaped the worst of the cold, the Minneapolis Weather Bureau station, for example, recording a monthly minimum of only -18 F. Bitter cold persisted through the first ten days of February, bringing minima of -25 F or lower to many stations on 10 February (e.g. New London and Campbell, -28 F; Morris, -27 F; Farmington, St. Cloud and Rochester, -25 F; and Taylors Falls, -31 F).

Yet, the intensity of the cold notwithstanding, it was snowfall, not subnormal temperatures, which distinguished the winter of 1936-1937, meriting it a well deserved place in Minnesota's gallery of adverse winters. Unfortunately, however, 1936-1937 seasonal snowfall records kept by Minnesota observers are highly disparate and, in several instances, probably unreliable. As noted previously, the Campbell observer recorded approximately 73 inches of snow in January and February, including twelve inches on 2-3 January; nearly sixteen inches on 4-8 January; five inches on 14 January; eleven inches on 20-21 January; sixteen inches on 4-9 February; and seven inches on 14-16 February. At the end of January,

however, the amount of snow on the ground (snow cover) was recorded as 17.5 inches, a seemingly implausible value at the end of a cold month during which nearly fifty inches of fresh snow were recorded. At Morris, seven inches of snow were recorded on 1-2 January; four inches on 6 January; seven inches on 22 January; and 12.5 inches on 6-8 February. End of month snow cover values recorded by the Morris observer included twelve inches on 31 January and seven inches on 28 February. In contrast, the Wheaton observer recorded snow covers of thirty eight inches on 31 January, fifty one inches on 13 February and fifty inches on 28 February, values which were probably derived from unrepresentative and/or skewed measurements. Individual storm totals recorded at Wheaton included 11.6 inches on 3-4 January; 6.5 inches on 6-8 January; nine inches on 20 January; and 17.8 inches on 6-8 February. At New Ulm, seven inches of snow were recorded during the 1-2 January storm, a value eclipsed by the fourteen inches recorded at that station during the late season blizzard which brought heavy snows to much of southern Minnesota on 23-25 March 1937.

But however incongruous (and inaccurate) they might be, snowfall records from stations such as Morris, Wheaton and Campbell clearly indicate that 1936-1937 winter precipitation was much heavier in west central Minnesota than in many other areas of the state. In east central Minnesota, for example, the Minneapolis Weather Bureau station recorded only about twelve inches of snow in January 1937 (including five inches, 1-4 January and three inches on 20 January); approximately eight inches in February 1937 (including only 4.1 inches during the blizzard of 6-8 February); and about eight inches during March 1937 (including 5.8 inches during the 23-25 March storm).

From a nationwide perspective, however, the cold, snowy conditions experienced by upper Midwest residents during the winter of 1936-1937 pale in comparison to a much greater disaster, namely the floods which inundated much of the Ohio river valley during late January and early February 1937. According to the Weather Bureau's Monthly Weather Review the flood "actually had its beginning in the latter part of December 1936, when moderate to heavy rains began over the entire Ohio river watershed. After several months of comparatively low stages in the Ohio river a general rise began in the lower portion during the last week of December and developed within one month's time into the greatest flood of record. The flood resulted from excessive rains which followed during the month of January.....All previous records were broken along the Ohio river from slightly below Point Pleasant, West Virginia to...Cairo, Illinois.....At Cincinnati, Ohio, with a stage of eighty feet on January 26 the flood stage was exceeded by twenty eight feet and the previous highest stage recorded there, 71.1 feet in 1884, was exceeded by 8.9 feet. The height of the flood was the greatest in the Louisville, Kentucky district, where the stages were about thirty feet above flood stage.....".

The floods were, of course, both devastating and lethal, the topic of extensive and often dramatic reports in Twin Cities newspapers. One of the first such accounts appeared in a 20 January 1937 Minneapolis Tribune story stating that "forecasts of more rain in the southern portions of Illinois, Ohio and Missouri [have] added to the growing tension over runaway rivers in the mid-continent Tuesday night [19 January]. Levees crumbled anew before the pressure of swirling streams, routing families and inundating farms. The Ohio river is expected to reach sixty feet at Portsmouth and Cincinnati, Ohio...". The magnitude of the

disaster that followed was emphasized in subsequent issues of the Tribune: "80,000 left homeless as flood peril grows in ten states" (22 January); "Cincinnati flood twenty feet deep, 150,000 homeless, sixteen dead" (23 January); "flood rises, Louisville in panic. Ohio river at Cincinnati set a new flood mark of 77.8 feet" (25 January); "Louisville under martial law, 200,000 homeless. Floods extend from Pittsburgh to Cairo, Illinois with growing flood fears along the lower Mississippi" (26 January); "flood losses estimated at \$300 million, 750,000 homeless" (27 January); "more than 480 deaths at Louisville" (28 January); and "Paducah, Kentucky to be completely abandoned, 60,000 to be moved to high ground in Arkansas and 20,000 more in Missouri" (31 January). According to the Monthly Weather Review, the flood crested at various points along the Ohio river between 26 January and 4 February (e.g. Parkersburg, West Virginia on 26 January; Louisville, Kentucky on 27 January; Evansville, Indiana on 1 February; and Cairo, Illinois on 3-4 February). Finally, before subsiding, the swollen waters poured into the Mississippi river, triggering flooding at various points farther to the south and west (e.g. St. Louis, Missouri).

Not surprisingly, the precipitation which fell during the winter of 1936-1937, although excessive in many areas of the country (Minnesota included), did not bring about an immediate end to the drought, particularly in the Great Plains and Upper Midwest states. Recovery during the last three years of the decade was slow and often tentative, marked as it was by the need to restore badly depleted subsoil moisture, by recurrent intervals of drought and, in some areas at least, by persistent dust storms. In this regard, Minneapolis Weather Bureau officials, although describing conditions at the end of February as "favorable, especially in the dry western counties where snowfall was generally heavy", took a quite different view a month later, stating that "the top soil has sufficient moisture for present needs except in the Upper Red River Valley..but subsoil moisture is greatly deficient (emphasis added) over much of the state". Yet, although halting and uneven, the recovery which began during the winter of 1936-1937 persisted and expanded, effectively ending the Dust Bowl era, first in areas of the Upper Midwest and later in drought ravaged areas such as Kansas, Oklahoma, Colorado and Texas. Interestingly also, the late 1930's were marked by numerous abnormal weather events (e.g. the wet May of 1938, the dry autumn and warm December of 1939, etc.), combining a generally promising recovery with a wide range of unique, sometimes beneficial but often unfavorable meteorological events.

THE 1930'S 1937-1939: RECOVERY

It was probably dismissed by many weather weary folks as but another passing break in a drought which was soon expected to return. Any such expectations notwithstanding, April 1937, at least in Minnesota, did, however, mark the beginning of a real change in the spring and summer weather patterns of the 1930's. A relatively dry and sunny March was followed by generous April precipitation, the first of which fell during the opening days of the month, Snowfalls in excess of ten inches were recorded at several northern and western Minnesota stations, most of it falling during storms on 3-4 and 25 April. Precipitation was correspondingly heavy with amounts of more than one inch recorded on 3-4 April (e.g. Montevideo, 1.50 inches and Collegeville, 1.22 inches). Most of the moisture, however, fell

during the last ten days of the month, an excessively wet period which brought frequent rains to most parts of the state. Rainfall amounts were often heavy, ranging from two to more than three inches at many stations (e.g. 3.20 inches at Little Falls, 22-25 April; 2.95 inches at Gull Lake Dam, 22-24 April; 2.78 inches at Bemidji, 24-26 April; 4.18 inches at Wadena, 22-30 April; 4.21 inches at Wheaton, 23-30 April; and 3.25 inches at Hallock, 23-30 April).

Wetter than normal conditions, moreover, continued during May, daily rainfall amounts exceeding two inches at several Minnesota stations (e.g. 2.10 inches at Milaca on 11 May; 2.20 inches at Wheaton on 21 May; 2.04 inches at Big Falls on 31 May; 2.41 inches at Winnebago on 25 May; and 3.95 inches at Chaska on 29 May). The above normal rainfall did not, however, bring an immediate end to the dusty conditions which has plagued much of Minnesota during the preceding five years. Light dust was reported at various locations on 11, 12, 14, 15, 24, 28, 29 and 31 May. At Minneapolis, the Weather Bureau reported "moderately thick dust" during the early and mid-morning hours on 12 May, reducing visibility to 1.25 to 2.5 miles. The sky, it was said, was "entirely obscured" at times "with the sun's disc faintly visible through the dust clouds". And at Moorhead, "moderate dust" was reported on 29 May, reducing visibility on some highways in that area to one fourth mile in the early afternoon. In some instances, seed was blown out of Moorhead area grain fields.

In many parts of the Great Plains, in areas bypassed by the heavy spring rains which favored Minnesota, the dust storms were even more persistent and severe. According to the Weather Bureau's Monthly Weather Review, dust storms were "widespread" in many regions, March and April 1937 reportedly bringing "the most extensive dust storms that have prevailed in recent months. In March, light dust was reported at the surface or aloft, from the Rocky Mountains eastward to the Atlantic coast and from extreme southern Texas to Canada.....During May 1937 dense dust, damaging to wheat and other crops and injurious to livestock was reported in most states from northwestern Texas and New Mexico northward.....Severe dust was reported on as many as twenty one days of the month in portions of Oklahoma....At Malta, Montana, the storm of the 28th was the worst ever seen for an hour and a half dust blew at a terrific rate, so thick that the greater part of the time it was impossible to see the radiator cap on a car (from the driver's seat).....At Helena [Montana] air and highway traffic was halted.....Nebraska, New Mexico, Montana and Wyoming reported crop damage from blowing soil during the month. In North Dakota, the Dickinson Experiment Station reported that soil blowing about the middle and near the close of the month was the most severe ever experienced....Numerous dust storms occurred in Colorado and on the 21st visibility was reduced to from one quarter to one half mile in most southeastern counties where conditions were reported as "dark as night" and 'absolutely black'.....".

The Monthly Weather Review (May 1938) further noted that 1937 as a whole was "marked by subnormal precipitation in practically all of the Great Plains area and some adjoining states. Subsoil moisture was greatly deficient and dry surface soil was easily transported by even light winds.....A large central area, including Wisconsin and Illinois....and Iowa, Missouri, Montana, the Dakotas, Nebraska, Kansas, Oklahoma, Texas, Colorado....received

subnormal precipitation for the entire year. In this area, totals ranged from only 75 percent..of normal.....Most Great Plains states, Missouri, Illinois, Wisconsin and Iowa had considerably more rain than in 1936, the increases over the preceding year varying from ten percent in Kansas to 48 percent in North Dakota. Texas, with only 87 percent of normal, had thirteen percent less than in 1936. In Iowa, Missouri, Wisconsin and Illinois increases over the preceding year ranged from five to twenty percent.....May was the relatively driest with only six states receiving normal rain, or more, to west of the 80th meridian...". In addition, 1937's droughty conditions reportedly "stalked" the Canadian wheat lands, Saskatchewan and Alberta in particular. According to the 23 July 1937 edition of the Minneapolis Tribune, more than a million persons in that area were "adversely affected," approximately 400,000 of whom were said to be in need of drought relief.

Fortunately, however, the summer of 1937 favored Minnesota and parts of the Dakotas with normal to above normal precipitation. Although much of northern and east central Minnesota was dry during June, many of the state's southern stations recorded above normal to excessive amounts of moisture (e.g. Grand Meadow, 7.45 inches; Mankato, 7.15 inches, 4.38 inches of which fell on 13 June; New Ulm, 7.98 inches, 4.55 inches of which fell on 13 June; Springfield, 6.75 inches, 4.36 inches of which fell on 12 June; and Grand Meadow, 7.45 inches). Interestingly, also, freezing or near freezing temperatures were recorded at most Minnesota stations on 7-9 June (e.g. Detroit Lakes, 34 F on 8 June; Morris, 35 F on 8 June; Farmington 34 F on 9 June; Grand Meadow, 33 F on 9 June; Rochester, 31 F on 9 June; and Zumbrota, 32 F, also on 9 June). In parts of South Dakota, early June brought a surge of wintery weather which, according to the 8 June 1937 edition of the Minneapolis Star, marooned motorists on snow drifted roads and killed "hundreds of nearly sheared sheep". Snow in the Leeds, South Dakota area was said to have drifted to depths of as much as four feet (an exaggeration, perhaps) and at Rapid City, South Dakota, ranchers reported "heavy stock losses". Minima of 30 F and 28 F, respectively, were reported at Minot, North Dakota and Lemmon, South Dakota.

The remainder of the summer of 1937 was, at least in Minnesota, alternatively dry and wet. As noted previously, excessive precipitation in northern Minnesota in mid-July resulted in losses estimated at more than \$2 million (1937 dollars) in Lake of the Woods, Pennington, Roseau, Beltrami, Marshall, Red Lake and Clearwater counties. Rainfall totals during this period included 5.27 inches at Fosston, 11-16 July; 4.03 inches at Winnibigoshish, 14-16 July; 5.60 inches at Warroad, 14-16 July; 3.83 inches at Wheaton, 14 July; 3.94 inches at Itasca State Park, 14 July; 5.13 inches at Gonvick, 14-16 July; 4.25 inches at Gull Lake Dam, 14 July; and 3.24 inches at New London, 14 July. Many northern stations, moreover, recorded record or near record July precipitation (e.g. Warroad, 8.33 inches; Argyle, 7.31 inches; Hallock, 7.23 inches; and Redby, 8.12 inches.

The heaviest rains, however, fell in the Lake of the Woods area, the Baudette area especially, causing extensive flood and wind damage. In this regard, the 23 July 1937 edition of the Baudette Region reported that "another big rain of an inch and one half fell in Baudette before daylight this morning. It was accompanied by an electrical storm that lit up the heavens and wakened citizens of the village. With this downpour, the rainfall in Baudette in the last ten days has reached the tremendous total of ten and one half inches.

These figures are from the records of Frank Hickner, who is in charge of the government Weather Bureau [station]. Fields have been underwater and some damage has been done to crops but it is expected that they will come back.....Several small bridges were washed away and section men stayed up nights watching bridges over the C.N. Railway. Water was running over highway number 72 and other roads in the district. This morning the rain was accompanied by a high wind that blew the roof partly off the William Hathaway home. Two large signs in Spooner were blown down....Even four feet of dirt and gravel was not enough to keep down three tanks at the Farm Bureau service station when about six inches of rain fell.....last week. The tanks which were to be used for kerosene had not yet been filled and their buoyancy lifted them through the mud that had formed...The rain was perhaps the heaviest since 1919.....A few hay fields where hay had not been cut and not yet stacked were hardest hit.....The rainfall of the past week brought the Baudette river up to the highest point since July 4, 1919....this year's rise in the water level lacked two and five eights inches of equaling the high water mark of eight years ago.....".

Similarly, the 22 July edition of the Roseau Times-Region noted that "a two day rainfall starting Tuesday [of] last week dropped 3.75 inches of moisture here to about six inches at Baudette and over five inches at Warroad. Louis Enstrom at Malung...stated that he measured four and five eights inches....The downpour was heavier the farther south and east one went. While no official measurement was had from Wannanska, conservative folk estimated that the rainfall in that section was close to six inches....Basements in Baudette and Warroad were flooded. From Warroad came the report that, driven by the wind, the water in Lake of the Woods piled up at Warroad to a point of 1062.7 or a trifle more than three feet from the top of the concrete banking the Warroad river in that village....Willow creek went on a rampage in the Roosevelt territory, washing out bridges....The ditches draining into the Warroad river and the river itself were full to overflowing. Inundation of hay, alfalfa and potato fields and grains has caused big damage in the east end of the county...Hay creek running from the south by way of Salol was brimful...Mud creek and Pine creek went on a rampage...All fields in the Roseau lake bed were covered with water. One flax field...of 200 acres was in this area and is counted as a complete loss...A. F. Hayes reported a rainfall of eight inches in...Beaver...".

In stark contrast, much of the southern part of Minnesota, as noted previously, experienced extreme drought during July, a drought which, however, was decisively broken by widespread heavy rainfall during August. Precipitation exceeded two inches at many stations during the opening days of the month (e.g. 3.55 inches and 3.60 inches, respectively, at Long Prairie and Milaca on 2 August), again at mid-month (e.g. 2.85 inches at Austin on 11 August) and once again during the last week of the month (e.g. 4.40 inches at Orr on 29-30 August; 4.37 inches at Bemidji on 29-30 August; 4.12 inches at Redby on 28-29 August; and 3.34 inches at Collegeville on 30-31 August).

August was also unusually hot, both in Minnesota and in the nation as a whole. Temperatures in Minnesota averaged nearly seven degrees above the then accepted statewide normal, making August 1937 the warmest August recorded in the state since 1900. Although some stations, particularly those in the west central portions of the state recorded temperatures of 100 F or greater, the month, unlike months such as July 1936 and

May 1934, was characterized by prolonged periods of sustained heat, not by extreme, record breaking heat waves.

Predictably, the summer of 1937 was, despite interludes of drought, generally favorable for crop development. The 11 June 1937 edition of the Minneapolis Tribune reported, for example, that "crop prospects in the northwest and Minnesota [are] strikingly better than at any time in 1936. Bumper yields are predicted in Minnesota winter wheat and rye, according to the United States crop reporting service". In a more nuanced report, 17 July Tribune stated that the North Dakota grain harvest although expected to be "about five times the 1936 harvest" would, in all likelihood, be about 25 percent below the average for the five year period, 1927-1932. According to United States department of agriculture officials (as quoted by the Tribune), a combination of heat, drought and grasshoppers had reduced production in most areas of that state. Recent rains, however, were said to have "improved conditions in some parched areas". In contrast, the 18 July edition of the Tribune predicted a "fine harvest" in the northwest, an optimistic report which was reaffirmed by a later department of agriculture report (quoted in the 24 July edition of the Tribune) which anticipated the best nationwide wheat crop since 1927. In a similar vein, the 19 June 1937 edition of the Minneapolis Star, apparently in a euphoric mood, stated that "eastern and central South Dakota today is a veritable garden spot". A more sobering report followed on 22 July, the Star reporting that "wheat futures rose sharply on the Minneapolis grain market today. Appearances of black stem rust in scattered northwest wheat fields [caused] crop authorities to keep their eyes on the weather as the factor that will determine whether the infestation remains negligible or spreads". In west central Minnesota, the 2 July edition of the Morris Tribune optimistically predicted that "farmers in this section will harvest the finest crop of small grains in years if present prospects can be carried to fruition. Ample rain and almost ideal growing weather during June has resulted in an exceptionally heavy stand of grain". On 30 July, however, the Tribune was obliged to report "spotty" grain yields, noting that black stem rust had "caused considerable damage, with several varieties of wheat being especially hard hit. Corn continues to look good. Rust, heat and lodging [presumably caused by rain and wind] have damaged many fields of other grains". Finally on 13 August, the Tribune reported that "threshing yields throughout this section continue to run spotted with both good and bad yields but with the latter in the majority". Yet, despite the damage attributable to storms and disease, Minnesota's 1937 crop yields -- at least if statistics compiled by the University of Minnesota are to be believed -- were at least as good as and probably better than yields during the earlier years of the decade. In this regard, the 7 January 1938 edition of the Morris Tribune stated that 1937 Minnesota farm income, as estimated by Warren C. Waite, University of Minnesota agricultural economist, was \$305 million, the greatest since 1930, the result of what the report called "good yields"..

Not surprisingly, 1937's warm, wet spring and summer was relatively stormy. In addition to the damaging floods in the Chaska area (in May) and in northern Minnesota (in July), the year featured a tornado which swept through parts of Yellow Medicine, Lyon and Murray counties on 17 May. Hailstorms, although generally limited in extent, caused damage in several areas of the state, most of which (about \$250,000) was reported in July. Winds storms were also prevalent, one of the most noteworthy of which was reported by the 28 May 1937 edition of the Morris Tribune. According to this account, "one of the worst wind

storms in years struck this section of the state last Thursday evening [27 May], leveling or severely damaging a number of buildings in the county [Stevens]. Winds raged between 45 and 50 miles per hour". Interestingly, the summer's weather events included scattered, highly localized downpours, one of which dropped 0.87 inches of rain in downtown Minneapolis during the noon hour on 16 July (Minneapolis Star, 16 July 1937). Although street drains overflowed and basements were flooded in the Minneapolis Loop area, only 0.01 inches of rain fell in the vicinity of 36th Street and Portland Avenue, a short distance to the south.

Although a few Minnesota stations recorded heavy rain and/or heavy snow during the autumn and early winter of 1937, the closing months of the year were generally dry. For the state as a whole, precipitation was approximately thirty percent below normal in September, forty percent below normal in October, fifty percent below normal in November and ten percent below normal in December. Yet, this siege of dry weather notwithstanding, 1937 overall turned out to be the second wettest year recorded in Minnesota during the entire period, 1930-1939. Moreover, 1937 annual precipitation at some stations (some of which had experienced the worst of the 1933-1936 drought) was double that recorded in the previous year and, in several instances, was the greatest recorded in any year during the 1930's. At Alexandria, 1937 precipitation was more than twice the amount recorded in 1936 and slightly greater than the amounts recorded in 1935 and 1930. At Argyle, 1937 was the wettest year since 1930 and, as at Alexandria, total annual precipitation was more than double the amount recorded in 1936. At Collegeville, 1937 was the second wettest year of the decade. Precipitation at that location totaled 25.6 inches, a value about ten percent greater than the long term station average (23.1 inches). In west central Minnesota, Milan observers recorded 27.5 inches of precipitation during 1937, a value approximately four inches greater than that recorded in any other year during the 1930's. At Morris, another west central station located about thirty miles north of Milan, observers recorded 26.3 inches of precipitation, a value approximately ten percent above the long term station average and, with the exception of 1935, the greatest amount recorded in any year between 1929 and 1940. In central Minnesota, New London observers recorded 26.5 inches of precipitation during 1937, an amount approximately twenty percent greater than that station's long term normal and, like corresponding values recorded at many other Minnesota stations, the most moisture recorded in any year during the 1930's. In the drought stricken Red River Valley, Moorhead observers recorded 19.9 inches of precipitation during 1937, a value which, although less than that station's then accepted normal (23.3 inches), was more than twice the mere 8.9 inches recorded at the same location during 1936. Similarly, 1937 was the wettest year of the decade at Redwood Falls, Roseau and Wheaton. The latter, located in a relatively dry area in far west central Minnesota, received 31.1 inches of precipitation during the year, a value more than sixty percent greater than the then accepted long term Wheaton average. Conversely, however, 1937 precipitation at stations such as Worthington, Rochester, Pipestone, New Ulm, Minneapolis and others was either below or near normal. The Minneapolis Weather Bureau station, for instance, recorded only 22.6 inches of precipitation during the year, making 1937 the eighth driest year recorded at that location during the 1930's. And, at New Ulm, 1937 precipitation, although near normal for that station, was significantly lower than the annual totals recorded in 1930 and 1932.

Interestingly, also, Minnesota's 1937's weather patterns were, in many important respects, similar to those experienced in 1935 (i.e. a relatively wet spring and summer followed by a dry autumn). This coincidence undoubtedly led many to expect that 1938, like 1936, would be a dry year, perhaps even a severely dry year. Fortunately, however, the opposite occurred: 1938, portions of northern and northwestern Minnesota excepted, was a notably wet year, the state's wettest, in fact, since 1911. The onset of wetter than normal conditions was, nevertheless, not immediate: for Minnesota as a whole, January 1938 precipitation was about twenty percent below the then accepted normal while the amount of moisture that fell during February, although near normal overall, was markedly deficient at many stations in the northwestern and west central parts of the state. In addition, light dust was reported in parts of the state on 24 January and again on several days in late March, no doubt reinforcing fears of continued drought.

Yet, its general dryness notwithstanding, the late winter of 1938, February especially, provided hints of changing weather patterns. Some regions of the state received ample precipitation, whether as snow, sleet and/or rain. Warroad, for example, recorded 17.5 inches of snow during February 1938 with a 1.20 inches of precipitation on 13 February, the greatest daily amount reported anywhere in the state during the entire month. Other stations, however, recorded substantial amounts of moisture at mid-month (e.g. 1.07 inches at Worthington, 15-17 February). And on 18 February, the Morris Tribune reported that "icy highways, streets and sidewalks during the past week have offered a continual threat to the safety of motorists and pedestrians. Several days of thawing weather accompanied by fog and sleet and finally by rain on Saturday [12 February] followed by a decided drop in temperature resulted in a heavy coat of ice on roads and streets...".

The spring of 1938 opened with an unusually warm March, both in Minnesota and in the nation as a whole. Temperatures in Minnesota averaged more than eight degrees above the then accepted statewide March normal, an early spring influx of southerly air pushing temperatures into the high 70's F at many southern and central Minnesota stations on 21 March. More importantly, the closing days of the month brought moderate to heavy precipitation to many portions of the state, signaling the beginning of a wet regime which, with a few breaks, dominated the spring of 1938. Some individual precipitation values recorded during this period included 2.20 inches at Grand Marais on 29 March; 2.05 inches at Duluth on 29-30 March; and 1.59 inches at Two Harbors on 29 March. Lesser but still substantial amounts were recorded at many southern and central stations (e.g. 1.21 inches at St. Peter on 29-30 March; and 1.03 inches at Zumbrota on 29-31 March). For the state as a whole, March was the wettest March since 1927.

The wet weather which characterized the closing days of March ended abruptly during the first part of April with little or no precipitation recorded at most Minnesota stations during the two week period ending on 14 April. Beginning in mid-April, however, copious amounts of moisture fell in most areas of the state, many stations recording an inch or more of rain on 14-15 April (e.g. 1.18 inches at Farmington on 14 April; 2.81 inches at the St. Paul airport station, 14-16 April; 2.84 inches at Taylors Falls, also on 14-16 April; and 1.90 inches at Albert Lea on 16 April). Moderate to heavy precipitation was, moreover, recorded at most stations during the remainder of the month, particularly during the period 24-28

April. Amounts recorded during this period included 3.20 inches at Meadowlands; 2.62 inches at Gull Lake Dam; 2.55 inches at Itasca State Park; and 2.40 inches at Cass Lake. Heavy rains in the Brainerd vicinity on 27 April (with 2.52 inches recorded by the Brainerd observer on that date) triggered local flooding, causing damage estimated at \$27,000 (1938 dollars). For the state as a whole, April 1938 precipitation was approximately 150 percent of the then accepted normal, making it the second wettest April recorded in the state since 1896. And, although snowfall during April was generally light, some sections of Minnesota experienced significant snowstorms, one of which "blanketed" the New Ulm area on 5-6 April. According to the New Ulm Daily Journal, what was described as a "million dollar snow" covered much of New Ulm and Brown county, reaching a depth of "nearly four inches". The snow, the Journal emphasized, was "heavy and wet and farmers are jubilant over the beneficial effect it will have on early small grain. The spring blizzard extended to Chicago, Cleveland [Ohio] and many other areas in the midwest..."

The late April rains, however, were but a prelude to the persistent, typically excessive and often destructive rains which, with the exception a few areas in the northwestern corner of the state (the Hallock area in particular), drenched Minnesota during May 1938. Rain (and sometimes snow) fell somewhere in the state on virtually every day during what, predictably, was a cloudy and cool month. Daily rainfall amounts often exceeded one inch with three day cumulative totals of three inches or more at several stations (e.g. 3.50 inches at Farmington, 17-19 May; 3.40 inches at Fort Ripley, 4-6 May; 3.12 inches at Mizpah, 4-6 May; 3.43 inches at Reads, 4-6 May; 3.74 inches at Gull Lake Dam, 3-5 May; and 4.25 inches at Hastings, 18-20 May).

Newspaper accounts of the May downpours were, of course extensive. The newspaper commentary was, not surprisingly, often ambivalent, alternatively praising the replenishing rains and complaining about the dreary, often destructive weather which accompanied the persistent wetness. The 7 May 1938 edition of the New Ulm Daily Journal noted, for instance, that a "heavy storm" had caused damage in parts of Brown county on Tuesday [3 May] and that snow which melted upon reaching the ground had fallen in New Ulm on the morning of 7 May. On 9 May, the Journal reported that more than four inches of rain had fallen in New Ulm during the preceding week and that, as a result, water levels in the Minnesota, Cottonwood and Little Cottonwood rivers had risen "several feet". The same article further noted "raging floods" in northern Minnesota, adding that the Mississippi river was at "flood stage at many points". Similar reports emphasizing the downside of the May 1938 rainfall appeared in the 4 May edition of the St. Paul Dispatch. According to this source, heavy rains and an outbreak of severe storms "raged" across central Minnesota, western Wisconsin and parts of Iowa on 3 May, causing extensive damage, "heavy losses of livestock" and at least two fatalities. Rainfall amounts included a ninety minute downpour of 3.5 inches at Osakis. St. Paul airport observers recorded 1.22 inches during a storm which featured hail and high winds sufficient to damage some St. Paul area fruit trees. The winds, it was reported, also blew a 25 by 40 foot piece of metal roofing into a residential yard on Albemarle Street. On the following day (5 May), the Dispatch explained that "St. Paul was the rain center of the nation," a point of "merger" for several storm systems which "formed a disturbance of considerable intensity...". The same account also noted that a May "snowstorm" had "swept" into western Minnesota (but that most of the snow had melted

as it touched the ground); that 2.96 inches of precipitation had fallen at Bemidji during the previous four days; and that rain had turned to snow in the Crookston area. Several days later, the Dispatch reported that blossoming fruit trees had escaped damage "when a threatened frost failed to materialize....". Snow, however, was said to have fallen in parts of Iowa and Nebraska. And on 6 May, the Morris Tribune noted that more than two inches of rain had fallen in that area since Sunday [1 May], an amount which "was augmented by a slow drizzly rain which prevailed during the day" on 6 May.

Heavy rainfall, as noted previously, persisted through the last three weeks of May, causing additional flooding and retarding agricultural activities. According to Minneapolis Weather Bureau officials, the rains were nonetheless beneficial, replenishing subsoil moisture (which, it was emphasized, was "greatly deficient" (emphasis added) in many parts of the state). Many localities, the Twin Cities included, were deluged by heavy rains again on 17-18 May, including an overnight total of 1.9 inches in St. Paul and an estimated five inches in the vicinity of Hastings. The 18 May edition of the St. Paul Dispatch reported that, as a result of the excessive rainfall, the foundation of the eighteen million gallon water reservoir in Highland Park had been weakened, confronting that part of the city with the possible release of "mighty wall of water". At Hastings, the rains washed out the main lines of the St. Paul and Burlington Railroad. Finally, on 31 May, the Dispatch reported that clouds and rain had cooled off St. Paul (where temperatures had risen to 85 F, the highest reading since 2 May). At the same time, rains of up to two inches were reported in "scattered" portions of Minnesota with cloudbursts reported in parts of southern Minnesota (flooding highway 74 near Whitewater) and in western Wisconsin. In reports which paralleled those carried by the Twin Cities newspapers, the 17 and 19 May editions of the New Ulm Daily Journal complained that the rains had retarded corn planting and other seasonal agricultural activities, that roads in many parts of Brown county were covered with water, the result of a downpour on 16-17 May (1.75 inches at the New Ulm cooperative station). Similar complaints were voiced by the Morris Tribune, the 20 May edition of which stated that "drizzly weather held sway during much of the past week again. The continued cold, wet weather has hampered and delayed farmers in their corn planting operations but offsetting this delay is the fact that all rains this month have been slow and steady, allowing the moisture to soak into the soil, helping to restore some of the subsoil moisture".

But whether for good or for ill, the precipitation which fell during May 1938 was greater than any corresponding amount recorded in May since the wet years of the early 1900's. As noted previously, May 1938 was the wettest May recorded in Minnesota during the entire period, 1891-1938, surpassing both May 1892 and May 1908, the state's previously wettest Mays of record. Average precipitation for the state as a whole was 6.55 inches, a value more than double the then accepted statewide May average of 3.22 inches. At Morris, May precipitation (including a "light" snowfall on 8 May) totaled 5.84 inches, the greatest amount of moisture recorded by Morris observers in any May since 1916. According to the 3 June 1938 edition of the Morris Tribune, May's rainfall, although excessive, was, on balance, beneficial, creating conditions which were "ideal for small grains, hay and pasture crops, although somewhat unfavorable for corn. Most of the corn planting has been completed and any delays that have been experienced will undoubtedly be more than compensated by the moisture build up in the topsoil..". On the same date (3 June), the New

Ulm Daily Journal told its readers that May had been the wettest recorded in New Ulm in twenty years. And, on 1 June, the Minneapolis Star reported that Minneapolis had "broken a new weather record in May". Measurable precipitation, it was said, had been recorded by Minneapolis observers on twenty days during the month, exceeding by one the number of such days recorded in May 1906 and again in May 1915. The Star's account, like similar accounts in other Minnesota newspapers, also emphasized the beneficial aspects of the month's rains, noting that they had "done much to restore subsoil moisture".

The worst aspects of May's excessive precipitation was, of course, the widespread flooding which, as already noted, caused extensive damage in many parts of the state. On 9 May, the St. Paul Dispatch reported that sixty percent of Aitkin county was under water and that 400 St. Paul river dwellers had been "warned to prepare for emergency flight from their shanties and houseboats.....". The Mississippi river reached levels at or near flood stage early in the month, cresting at St. Cloud on 11 May and apparently without causing extensive damage cresting at the Twin Cities on 12-13 May. According to the Dispatch, water "thundered" over St. Anthony Falls on 11 May at a rate of 35,000 cubic feet per second, the highest flow recorded at that point since 1922. On the same date, water stood "over a foot deep" on the river road from St. Paul to Mendota. On 10 May, the New Ulm Daily Journal reported that the rising waters had caused contamination of drinking water supplies in flooded areas of northern Minnesota, prompting the state's adjutant general (E. A. Walsh) to ask the state board of health to "take drastic measures to prevent outbreaks of disease". And on 12 May, the Journal noted that a forty foot dam on Mud Lake (near Thief River Falls) had been "dynamited in an effort to relieve flooded conditions in eastern Marshall and western Beltrami counties...".

In addition to the various journalistic accounts, a detailed and more systematic account of the May 1938 floods, particularly those that inundated large sections of northern Minnesota, was provided by Minneapolis Weather Bureau officials in Minnesota Climatological Data, no. 5, vol. XLIV. According to this report, the "May 1938 flood in the extreme upper Mississippi river was the result of a prolonged period of heavy rains that began on April 14th and continued almost daily until May 13th. The area of the Mississippi watershed is 19,680 square miles or about the combined area of the states of Vermont and New Hampshire. There are twenty six cooperative stations in this area which is an average of one precipitation gage per 770 square miles. The average catch of these rain gages for the entire period of thirty days was 8.10 inches. As the Mississippi river above Minneapolis is a prairie and woodland stream with low banks and only moderate width, it became apparent that as the April rainy period was prolonged into May, the river's channel capacity would be exceeded and inundate vast areas of lowlands along the main stream. On the 1st of May the river was well within its banks, but continued rains raised the stages above flood limits on May 6th at the two upper gaging stations, Aitkin and Fort Ripley...On May 11th a special river bulletin was issued as follows: the Mississippi river at Fort Ripley showed little change since Tuesday morning [10 May]. The gage reading Wednesday [11 May] was 10.78 feet, a rise of 0.03 feet. The flood stage at this place is 10.0 feet. The river will rise slowly at all points south of Fort Ripley to Hastings...during Wednesday night and Thursday and will begin to fall at all points Friday [13 May]. The expected high water at Minneapolis will be about 15.3 feet or 0.7 feet under the flood stage of 16.0 feet. The highest stage expected at

St. Paul will be approximately 11.4 feet or 2.6 feet below flood stage. These advices were substantially verified; the river reaching a crest of 15.0 feet at Minneapolis, and began falling late Friday, May 13th. The flood stage at Minneapolis is 16.0 feet. The crest at St. Paul was 11.2 feet on Saturday, May 14th. Flood stage at St. Paul is 14.0 feet. [The crest at Aitkin was 15.7 feet on 12 May. Flood stage at that point was 12.0 feet.] It was fortunate that the areas affected included no great centers of population and human distress was not widespread. Crop losses were confined principally to meadow and hay lands. On cultivated fields along the stream, the water remained on the fields for nearly three weeks and destroyed corn and potato plantings. Crop losses are placed at \$55,000. The major damage was to highways along the river or crossing its lowlands and is placed at \$1,000,000.....A number of streams in north central and southeastern counties overflowed their banks...Lakes and streams were unusually high and there was much standing water in low places.....".

Beginning in June, 1938 weather patterns changed once again, ushering in a summer which in northern Minnesota especially, was somewhat drier than normal. It was also a summer of contrasts, some areas receiving excessive, but typically isolated, rains while others remained dry and dusty. Light dust, for example, was reported at several Minnesota locations on 6, 13, 14 June and again on 18 August. And, in neighboring South Dakota, two persons were hurt in a head on collision caused by a June dust storm near the community of Aberdeen (Minneapolis Star, 14 June 1938). Dust storms, moreover, continued to plague residents of the Kansas-Oklahoma-Colorado-Texas Dust Bowl. According to a report written in February 1939 by U.S. Weather Bureau official Robert J. Martin (and published in the Weather Bureau's Monthly Weather Review) these storms, however, were "not nearly so widespread as in 1934, 1935 and 1936". Yet, as Martin pointed out, "there were some sections of the country, particularly in the Dust Bowl itself, where occasional storms were as severe as any reported during recent years. The most severe storms generally came early in the year, particularly during the winter and early spring months when winter wheat was most susceptible to damage from drifting soil. Reports were all too frequent of tender growth being cut and eroded away by flying grains of sand or of young growth being buried....there were a few reports of dust being observed in central and eastern sections of the country, especially during March and May, and locally in several other months....".

Additional evidence of a kinder, gentler Dust Bowl (together with evidence of American agriculture's increasing ability to cope with drought) was provided by an article written by Robert Geiger, an Associated Press feature writer and published in the 11 September 1938 edition of the Worthington Globe. Writing from Amarillo, Texas, the heart of the 1930's Dust Bowl, Geiger stated that "the old timers were right: the dust bowl does shrink when it gets wet. That came home to me during a dust bowl trip which brought me here to the office of soil conservator H. H. Finnell, the headquarters of the government's fight against the blow area. Redrawing a map of the bowl on the basis of the latest rain reports, Finnell said [that] control of the so-called dust bowl is nearer realization today than at any time since it came into existence. Unexpected rains have caused him to slash millions of acres off his 1939 blow area projections. In 1935-36, fifty million acres of land were blowing away. Townspeople couldn't see across the street and farmers caught only an occasional glimpse of the sun for months. We can't say those days are gone forever but next spring southwestern

skies should be less dusty than in any spring since 1932, Finnell commented. The area where severe dust storms may originate next winter under present conditions is composed of sixteen million acres the 'wild acres' of the dust bowl. This all bears out the predictions of old timers who said the southwest would 'green up' almost overnight when rain fell again.

"I drove down south of Amarillo [sic] to the little town of Hereford to see one of these old timers who never lost faith and who had made his own drought relief. Hereford is out of the dust bowl now and even the dry land farmers there have good crops, but Joe Evans was sitting pretty even before the rains came. Evans, a middle aged...farmer who made \$30,000 in wheat during one season in the twenties, heard from agricultural agents that the dust bowl problems would require generations to solve. He agreed in principle but decided that, in his own case, it would have to be solved right then in 1936. Gambling that plenty of water was available far beneath his dusty acres, he drove down two wells, 175 feet deep. To a pump on each he rigged a powerful automobile engine and started pumping water at the rate of 2,000 gallons a minute. Then he carefully contoured and terraced his lands, as government experts recommended, to save what rain might fall. He planted corn and livestock feed on most of the 1,200 acres he was able to irrigate from his wells. On one tract he raised some wheat. Last year, he tells me proudly, when I discovered I could make only \$5 a ton from grain sorghum [sic] harvested on 1,000 acres, I bought cattle and fed the sorghum [sic] to them, making \$10.50 a ton. That's what it's possible to do when a farmer keeps his eggs in more than one basket. Now with normal rainfall as well as irrigation water, he has corn eight feet tall, feed crops better than anything around him and 25,000 bushels of wheat in storage....".

Newspaper accounts suggest, however, that Minnesota farmers and others, although expecting generally good 1938 crop yields, were, on the whole, probably less confident and ebullient than Geiger's Texas farmer. Reasons for a more restrained, tentative outlook included extended periods of summer dryness which threatened crops in some areas of the state. In addition, some areas suffered crop damaging storms, the threat of grasshopper infestations and, most serious of all, the development and spread of weather induced plant diseases.. Early in the season, the Morris Tribune (24 June 1938) touted what it called an "unusually good hay crop". The same article further noted that west central Minnesota's corn crop, responding to late June's "really hot weather," was making rapid strides". A week later, however, the Tribune (1 July) noted that crop prospects had been dimmed by a heavy rain [2.3 inches] which on Wednesday night 29 June had "caused considerable lodging of grain throughout the county [Stevens]". Barley fields, it was said, "were especially hard hit". More bad news followed a week later: on 8 July, the Tribune emphasized that west central Minnesota crops were threatened with rust damage, the result of "frequent rains followed by periods of hot, muggy weather. Reports have it that all grains have leaf rust but the extent of the damage has not yet been determined". The outlook brightened again in mid-July when rust damage to growing crops was slowed, even halted, by cooler weather (Morris Tribune, 15 July 1938), a turn of events which contributed to was what described as a "good small grain harvest" (Morris Tribune, 22 July). Twin Cities newspaper reports of agricultural prospects, like those carried by the Morris Tribune and other Minnesota newspapers, also mixed cautious, qualified reports with what, in some

instances, can best be described as unbridled and, as it turned out, somewhat unwarranted optimism. The 3 June 1938 edition of the Minneapolis Star, for example, quoted a Cargill Corporation crop report which, while claiming that "ideal weather conditions" prevailed in the Upper Midwest's spring wheat area, noted that "grasshoppers could do a tremendous amount of damage to all grains". On 11 June, in contrast, a euphoric Star writer noted that "from all sections of the northwest optimistic reports of agricultural conditions poured in today as continued ideal weather boosted crop prospects to the best level in years. The United States department of agriculture forecasts the largest total wheat crop in the history of the United States". Such forecasts, however, proved to be somewhat unrealistic: as it turned out reduced acreage together with damage caused by grasshoppers, by leaf and stem rust and by alternating drought and/or episodic flooding lowered 1938 yields, yields which, at least in Minnesota, were notably disappointing, falling well below 1937 levels. In this regard, the Worthington Globe (13 September 1938) reported that "thedrop in yields of farm products noted by Nobles county farmers in comparing 1938 with 1937 [extends] to the state in general. According to a September 1 crop report released by the federal-state crop reporting service, the indicated [1938] production of Minnesota's nine major crops was 395,596,000 bushels, 14.8 percent less than the final 1937 production but 9.6 percent greater than the average for the ten year period, 1927-1936. Part of the decrease in indicated production is due to smaller acreage and to a sharp decrease in the production of oats and winter wheat.....Minnesota farmers, however, will have ample hay and forage this year and in many cases a surplus.....". The variability and often less than optimum character of Minnesota's 1938 crop season were further summarized by Minneapolis Weather Bureau officials in their annual summary of the year's weather: "weather conditions at the beginning of the growing season were favorable for agricultural interests...However, a prolonged period of cool, wet weather , that set in about the middle of April delayed farm work, retarded the growth of vegetation and some small grains yellowed or were drowned in low places.....Planting of warm weather crops, especially corn, was unusually late. Grains and grasses thrived under favorable conditions in June. Frequent thunderstorms in July caused severe damage...to crops, principally in extreme southern counties. Good yields of grain were harvested, except in extreme southern counties where there had been too much rain, and yields and quality were disappointing. Heat and drought in August caused considerable deterioration of vegetation...".

The erratic precipitation patterns which marked the summer of 1938 persisted into ensuing autumn, a season which featured a combination of heavy rainfall and extreme drought, the latter setting the stage for an outbreak of forest fires which burned through large sections of northern Minnesota timberland in late September and early October. The season's drought was particularly intense during September and October, many northern stations receiving less than an inch of moisture during the entire period, 1 September - 31 October (e.g. Big Falls with a combined September-October value of 0.35 inches). The drought, however, was not limited to northern Minnesota: much of southern Minnesota, although inundated by excessive rainfall during the first half of September, received little moisture during the six weeks from mid-September until the end of October. Yet, the September rains, when and where they occurred, were often notably heavy, heavier, in fact, than many of the rainstorms which inundated portions of the state during May. The Morris Tribune, for instance, noted that two heavy rains totaling 3.15 inches had fallen in the Morris area

during the week ending 12 September, moisture which it was said, "was welcomed by farmers as it will help to put the ground in condition for fall plowing". Other rainfall amounts included 6.26 inches at Isle, 5-9 September; 4.24 inches at Gull Lake Dam, 6-10 September; 8.91 inches at Albert Lea, 6-13 September; 5.00 inches at Moose Lake, 6-10 September; 5.79 inches at Winona, 5-12 September; 6.77 inches at Rochester, 8-10 September; 6.66 inches at Farmington, 5-10 September; 6.49 inches at Windom, 6-9 September; 7.40 inches at Taylors Falls, 6-10 September; and 9.02 inches at Fairmont, 5-14 September. .

The heaviest rains of the month, however, fell in extreme southwestern Minnesota, the Worthington area in particular. This precipitation was initially welcome, the 6 September 1938 edition of the Worthington Globe reporting that "the southwestern Minnesota countryside, besieged by four weeks of drought, perked up considerably today after a soaking rain which brought over two inches of moisture...the corn crop will fall far below last year....sections of the county which did not get the heavy August 6 rain report that the crop is badly curtailed by lack of moisture...". Two days later, the Globe, reflecting the damage caused by a rainfall of cloudburst proportions, reported that "Nobles county set about repairing damage this morning after a deluge which brought 4.41 inches of rain in a few hours. The storm set in at about 10:30 p.m. after a day of stifling humidity and rain poured down for several hours until ditches and drainage systems were filled to capacity. Except for the big flood of June 29, this morning's rain would have set a long time record for this section. The fall of 4.61 inches on June 29 was more destructive to crops and farm lands because fields were less protected by vegetation....Damage in Worthington may run into thousands when homeowners and stores consider harm to furniture, equipment and stored goods done when sewers backed up and flooded basements.....water poured in through basement windows to fill cellars and backed up sewers broke plugs and caps to flood other basements from below...". On 13 September, the Globe noted that 9.07 inches of rain had been recorded at the Worthington station since 1 September, bringing the year's total to 36.16 inches of "rain, snow and sleet". "Fall pastures and late hayfields have spurted with abundant moisture. Farmers struggling with silo filling problems were considerably handicapped by the repeated rains which are rapidly turning the lowlands into lakes and swamps". And on 15 September, the Globe, having become alarmed by the continuing heavy rainfall, reported that "lakes, creeks and drainage ditches rose to the highest level in many years as the result of continuing rains.....old timers report the greatest amount of water in the county since September 1903. The Lake Ocheyda dam was periled by high water today and Okabena is out of its banks on all sides with the old east lake bed rapidly rising to the point where it will be a lake again after many years of raising farm crops....over eighty acres of land are under water with fences, haystacks and buildings....".

Nor, as previously indicated, were September's heavy rains and the floods which often followed limited to far southern and southwestern Minnesota. The 10 September 1938 edition of the Minneapolis Tribune, for instance, reported heavy rain and flooding in the Jordan area, noting that "a five hour rain bringing about an inch an hour made a raging torrent of Sand Creek at Jordan Friday night [9 September] and spilled water over highways and streets. Twenty families were forced from their homes...Basements were flooded...Travel on highway 169 was blocked by the flood...". On the following day [11

September], the Tribune somberly reported that "the toll of dead from the floods and heavy rains storms that have sent torrents raging down creeks and rivers in Minnesota and Wisconsin reached a total of eight Saturday [10 September]. As the flood rolled down the Mississippi, U.S. Army engineers opened flood gates in the Mississippi dams. The flood crest was expected to reach Winona Sunday [11 September]. Washed out highways and railroads [are] being repaired, road crews removing heavy layers of silt that has washed across traffic routes...". And, on 12 September, the Tribune stated that what was described as the "worst flood since 1884 rolled down the Chippewa river bottom lands in Wisconsin Sunday night [11 September]....Rising steadily during the day, the Chippewa reached a level of 16.5 feet, five and one half feet above flood stage at Durand, Wisconsin and was still rising...". In a later story, the 20 October Tribune pointed out that summer rainfall had raised water levels in Christmas Lake ten inches, a rise which was said to have been "in addition to the thirty four inches" induced by "two and one half months of pumping". Adolph Meyer, Hennepin county consulting engineer was then quoted as saying that Lake Minnetonka could be raised "just as Christmas Lake has been raised. The three wells newly operated by the county....at Christmas Lake and...Long Lake are operating at a rate that will raise Lake Minnetonka ten inches per year. With three other contemplated wells, Minnetonka can be raise one and one half feet per year...".

Surprisingly, September's excessive rainfall ended as abruptly as it started, most Minnesota stations recording only small amounts of precipitation after mid-month. Only 0.08 inches of rain was recorded at Worthington during the period, 17-30 September, prompting the 29 September edition of the Worthington Globe to note that "Thursday [29 September] was the eleventh day in the spell of perfect weather which followed the heavy rains of the first two weeks in September....Corn is drying up fast and farmers predict an early husking season...Although the grass is green and pastures are still growing, the landscape has rapidly assumed a fall coloring...". Other rainfall amounts recorded during the last two weeks of September included 0.05 inches at Albert Lea; 0.06 inches at Winona; 0.10 inches at Zumbrota; 0.08 inches at Morris; 0.06 inches at Wheaton; and 0.06 inches at Campbell (a station which, incidentally, had recorded 3.17 inches of rain on 6 September). Similar amounts were recorded during the same period at many northern and northwestern Minnesota stations (e.g. 0.01 inches at Gonvick; 0.02 inches at Fosston; 0.10 inches at Moorhead and Argyle; a trace [T] at Ada; and 0.00 inches at Roseau). This dearth of moisture exacerbated the dry conditions which had prevailed over much of northern Minnesota during the summer of 1938, creating the conditions which, as noted previously, fueled a serious outbreak of autumn brush, peat and forest fires. According to Minneapolis Weather Bureau officials the fire threat reached critical levels in late September with fires and "thick" smoke reported at several northern Minnesota locations during the closing days of the month. The fires intensified during early October, a month which, at least until its closing week, featured a combination of extreme drought and unseasonably high temperatures. Fanned by high winds and sustained by low humidity and lack of rain, the fires soon spread over a wide area, threatening towns, villages and farms and causing at least twenty one deaths. The seriousness of the situation was stressed by the 11 October 1938 edition of the Minneapolis Tribune in a story which told readers that "peat and brush fires [had] caused at least one death, destroyed several homes and menaced numerous others in northern Minnesota Wednesday [10 October] as strong winds, low humidity and high

temperatures combined to create a potentially dangerous situation. Several hundred men were fighting numerous fires in the vicinity of Warroad. Crews in the area were to work all night combating the flames. A jackpine ridge west of Warroad along highway no. 11 was burning. At least three danger spots were being watched closely. At International Falls, peat fires a few miles out of town drove families from their homes, destroyed at least two homes and filled the town with smoke and ashes. Large fires dotted an area fifteen miles square south of Baudette. More than one thousand men were called to service to fight the fires with additional plans made to call additional fire fighters Tuesday .A severe fire was reported a mile and a half north of Chisholm as flames roared northward into heavily timbered areas".

On the next day [12 October], the Tribune's account of the fires indicated a worsening, almost desperate situation. According to this report, state militia units had been sent into northern Minnesota to fight the fires which, at that point, had reportedly killed seventeen people. Troops, trucks and planes, it was said, had been dispatched to the fire area to aid the three thousand men already engaged in fighting blazes which had erupted in various parts of the Minnesota Iron Range and in regions on both sides of the Minnesota-Ontario border. The Tribune went on to explain that "alarmed by the situation, Governor [Elmer A.] Benson instructed Adj. General Ellard A. Walsh to supply the help of national guardsmen. General Walsh sent fleets of trucks, sixty officers and men and an airplane to the fire zone near the border. The blazes were in areas near Warroad, Baudette, International Falls, Virginia, Hibbing and Park Rapids. Timber lands were also flaming along a fifty mile front westward from Ft. Francis to the Rainy river in Ontario [Canada]. The fire was described as the worst in Canada since 1922. In the Black Bog district east of International Falls, all residents had their belongings packed and were ready to flee on short notice. At Warroad it was reported that most fires were under control...Park Rapids reported several bad fires which moved over 160 acres in Crow Wing township...".

The Tribune's account of the fires on the following day (13 October) opened with a headline stating that a number of northern Minnesota villages were "menaced as wind fans forest fires, that the efforts of 3,000 fighters had been "thwarted", that "no rain was in sight" and that the death toll stood at twenty. The story that followed reported that "rising and shifting winds coupled with a drop in humidity [had] fanned forest fires anew Wednesday night [12 October] on both sides of the Minnesota-Ontario border. Forest rangers said that some of the fires were spreading with rapidity despite the efforts of some three thousand men engaged in fighting the flames. The situation, believed to have been under control earlier, was menacing Wednesday night. Fires dormant since Monday night [10 October] were racing into the timber. And there is no sign of rain....The worst fires in Minnesota were reported west of Little Fork in Koochiching county with the west winds carrying the flames toward Ericsburg and the Rainy Lake summer colonies. Fire was threatening Gemmall, a small community in the southwest corner of Koochiching county, north of Blackduck. The fires were still some miles outside of International Falls and Fort Francis and hundred of men were working to prevent advance of the flames into the areas adjacent to those communities". Better news followed, the 14 October edition of the Tribune claiming that the fires had been "put under control". A threatening blaze, it was stated, had been stopped "within two blocks of the outskirts of International Falls". Moreover, the brush and timber fires that, according to the Tribune had taken twenty lives in the Minnesota-Ontario border

region, were reportedly under control on the night of 13 October. "Nearly exhausted fire fighters were cheered by occasional drizzles of rain. A large fire crossing the international boundary north of Warroad on the southwest shore of Lake of the Woods is expected to burn itself out when it reaches areas previously burned. Although all fires were under control, forestry officials said the situation is still potentially dangerous. The battle turned in favor of the fire fighters late in the day when the wind slackened and the humidity began rising...".

Similarly, the 15 October edition of the Tribune reported that "fire fighters along the Minnesota-Canadian border took advantage of a lull in the intensity of the flames to strengthen fire lines Friday night [14 October]. Numerous small blazes were still burning in the area. All were reported under control with no great difficulty anticipated in keeping them under control. Crews were still combating fires in the southwest edge of International Falls. Despite strong winds, fire lines were holding the blazes in check in the vicinity of Warroad.". The struggle to contain and extinguish the October fires was aided immensely on 15 October when what the Tribune (16 October) described as the "first rain in nearly two months" fell over much of northern Minnesota. Although amounts were generally light (e.g. 0.46 inches at Warroad, 14-18 October; 0.20 inches at Park Rapids, 16-17 October; and 0.38 inches at Baudette, 14-18 October), the rains, combined with cooler weather, were, in the words of the Tribune (16 October) sufficient to "enable fire fighters to make major gains in their fight against the blazes". This did not mean, however, that the fires had been totally extinguished: the Tribune noted, for example, that fire fighting crews consisting of about seventy five men were still at work near International Falls where, as in other areas, fires were yet to be brought completely under control. The Tribune also reported that the fires had burned "nearly one hundred miles of countryside". The forest fire danger was further reduced by a snow and sleet storm which brought light precipitation to many northern stations on 22-23 October. The worst effects of this storm, however, were felt in southern and eastern Minnesota where sleet, snow and high winds combined to cause damage estimated at \$100,000, principally to overhead telephone and electrical lines. According to the 23 October 1938 edition of the Tribune, the storm left behind a "trail of snapped communication and power lines", the worst damage occurring in the Red Wing area. In the Twin Cities, where the storm was said to have been "less intense" than in other parts of the state, twenty eight mile per hour winds "drove snow through the air. Snow and sleet stuck to automobile windshields, handicapping the sight of drivers and causing dozens of accidents". Some stations recorded several inches of snow during the storm (e.g. Maple Plain, 5.5 inches and Spring Grove, 4.5 inches) and, in several locations, precipitation exceeded one inch, a boon to areas suffering from the state's prolonged autumn drought. Heavy precipitation, moreover, was recorded in most areas of Minnesota during the opening days of November, effectively ending both the drought and the forest fire season. November precipitation was particularly heavy in parts of northern Minnesota (e.g. 5.38 inches at Grand Rapids; 4.64 inches at Pigeon River Bridge), covering much of the state's timber land with a generally thick layer of snow.

Heavy snow continued to fall in many areas of Minnesota, northern Minnesota especially, during December 1938, a notably foggy, cloudy month (with many stations recording twenty or more cloudy days). What Minneapolis Weather Bureau officials referred to as the

month's "only storm of importance" brought heavy snows and high winds to southern and eastern counties on 26 December, winds at the Duluth Weather Bureau station attaining a maximum velocity of fifty miles per hour on that date. December 1938 and the January which followed were notably warm months, so warm, in fact, that much of the precipitation that fell during January fell as rain. January 1939, like December 1938, was also cloudy and foggy, many stations (including the St. Paul airport station and the Minneapolis Weather Bureau station) recording three or fewer clear days and twenty or more cloudy days. January was also wetter than normal, several Minnesota stations recording monthly precipitation values exceeding two inches (e.g. New Ulm, 2.26 inches; Collegeville, 2.09 inches; and Pigeon River Bridge, 2.74 inches). Yet, despite its wet start, 1939 was, in Minnesota at least, one of the driest years of the 1930's, the driest for the state as a whole since 1936 and drier than either 1930 or 1931. Fortunately, however, the secular and geographic distribution of precipitation favored agricultural interests, crops yields in many areas exceeding those of any other year of the decade. Also, like many other years of the 1930's, 1939 was a year of climatic extremes, the most noteworthy of which included a wet, turbulent June, a warm, dry autumn and a springlike December, the warmest December recorded in Minnesota during the entire period, 1891-1939. June, which for the state as a whole was the wettest June since 1925, was preceded by three drier than normal spring months. Although significant amounts of precipitation fell at various stations on 14-15 March, 16-17 April and 6-7 May (e.g. 2.20 inches at Maple Plain on 7 May), much of the state, the Red River Valley area especially, suffered from an acute lack of spring moisture. Predictably, the dryness was accompanied by dusty conditions with light dust observed in portions of southwestern Minnesota as early as 28 February. Light dust was also noted in the far western parts of Minnesota on 31 March and in various unspecified areas on 4, 11, 20, 25 and 26 April; on 5, 9, 10, 14, 15, 18, 25, 29 and 31 May and on 4, 7, 8 and 18 June. The Moorhead area, moreover, was struck by a severe dust storm which began at about 0900 hours on 9 May, continuing until after nightfall. Visibility, according to Moorhead observers, was reduced to about a mile from 0900 until about 1230 hours and to less than a mile from 1230 to about 1700 hours. And, as late as 4 June thick, blowing dust damaged corn fields in the Tracy area, some of which were said to have been "stripped completely". As noted previously, May 1939 was also much warmer than normal, temperatures during the closing days of the month rising above the 100 F mark at several stations in the northwest corner of the state.

Fortunately, however, the spring drought ended abruptly during the last week of May. Beginning on 24 May, significant amounts of rain fell over much of the state, lighter amounts in northern sections and heavier amounts in central and southern sections. The central Minnesota community of Long Prairie, for example, received 3.60 inches of precipitation on 24 May, the greatest daily amount recorded at any Minnesota station during the month. Other comparable amounts were recorded at Mora (2.82 inches, also on 24 May); Maple Plain (2.02 inches on 26 May); Fairmont (3.04 inches, 25-27 May); Hinckley (3.06 inches, 24-25 May); Taylors Falls (2.24 inches on 24 May); Winnebago (2.70 inches on 25-26 May); and Bird Island (3.06 inches, 25-27 May). The late May rainfall, as it turned out, was a prelude to a five week regime of wet, stormy weather which, with a few exceptions, brought copious rains to all areas of the state (including 5.06 inches at far northern Ada and three to five inches to many other communities in the state's dry

northwestern counties). Heaviest daily amounts included 3.44 inches at Wheaton on 9 June; 3.27 inches at Beardsley on 10 June; 2.24 inches at Maple Plain on 2 June; and 2.19 inches at Grand Meadow on 26 June. Monthly totals at many stations (e.g. Wheaton, Morris, Collegeville, Hinckley, Chaska, Alexandria, Winona, Park Rapids and Mora) ranged from six inches to as much as nine inches.

June's heavy rains, although highly beneficial, were often accompanied by damaging wind and hail storms. As early as 3 June, the Minneapolis Star, for example, noted that "today's clear, cool weather succeeded heavy thunder showers that swept through Minneapolis and most of Minnesota Friday [2 June], bringing welcome moisture to growing crops and improving agricultural prospects". Rainfall, it was said, had totaled 0.56 inches at the Minneapolis airport station; 1.20 inches at the downtown Minneapolis station and 1.70 inches at Robbinsdale. Another outbreak of thunderstorms, more severe than the 2 June storms, struck Minnesota during the early morning hours of 7 June, causing extensive damage and producing hail which, at one location, was said to have been as large as grapefruits. According to the 7 June 1939 edition of the Minneapolis Star, the storm "snapped off" the top half off the aerial tower of radio station WDGY, smashed five airplanes at the Minneapolis airport and damaged many trees and homes in the Minnetonka area. The Star explained that "a rush of cool air from the west which [caused] warm air to rise high in the skies was responsible for the terrific winds that hit Minneapolis, winds which, according to the Minneapolis Weather Bureau office, reached fifty seven miles per hour. "The area within fifty miles of Minneapolis was lashed by the strongest winds in twenty seven years. The storm hit shortly after five a.m., breaking many plate glass store windows and blowing down trees, many of which landed on telephone and power lines. Some streets were impassible because of fallen branches and trees and, in St. Paul, approximately 1,100 telephones were reported as out of service".

The most memorable and destructive weather event of the month, however, was the tornado which devastated parts of the city of Anoka during the mid-afternoon hours of Sunday 18 June 1939. According to Minneapolis Weather Bureau officials, the "tornado crossed the northwestern portion of Hennepin county and entered southern Anoka county between three and four p.m. Several villages and the small city of Anoka were in the path of the awful funnel cloud and death, injuries and destruction were left in its wake.....The tornado was first observed southwest of Corcoran in Hennepin county and traveled in a northeasterly course through Maple Grove, Champlin, Anoka and Cedar, a distance of twenty five miles. The storm struck Anoka at 3:20 p.m. and its last fury was spent in Cedar at 3:38 p.m. These times indicate a motion...of thirty miles per hour.

"The airways map based on observations at 12:30 p.m. revealed atmospheric conditions that were favorable for severe thunderstorms in southeastern Minnesota. The center of the disturbance was in the lower Red River of the North Valley, the Pembina barometer reading 29.42 inches. Temperatures in central and southern Minnesota were high (above 80 degrees) and a marked wind shift line and cold front had penetrated into the western portion of the state. Thunderstorms were numerous in the east central counties and were attended by hail and excessive precipitation in many localities. The tornado was attendant to one of these....storms. Many eyewitnesses testify to the presence of the funnel cloud formation, its

horror, and the many miraculous escapes in and near the twister. To one observer the tornado roared like a thousand airplanes, to another it appeared like smoke, and to many the cloud danced along in a huge funnel, and when it struck a buildingthere seemed to be a violent explosion as the structures disappeared in a puff. Debris was carried as much as three hundred feet and small articles of furniture, clothing and papers were picked up in various places fifty to seventy miles distant. The first destruction and fatalities occurred near Corcoran where four dwellings were demolished and four persons met death when their automobile was thrown one thousand feet and smashed to pieces. In the Maple Grove district, seven farm houses were damaged or destroyed. The tornado continued its northeasterly course to Champlin where several houses were completely demolished: one death and thirty injuries resulted. The storm now crossed the Mississippi river and many witnesses saw the river 'dry up' as the waters were lifted and wind velocities were so great as to prevent the flow and return of water until the funnel cloud had reached the opposite bank. Entering Anoka at Second Avenue, the tornado cloud moved up Third Avenue and cut a diagonal swath three blocks wide through the city, leveling houses, trees and buildings. According to a survey by the Anoka Union newspaper, 240 families and 1,450 persons were affected by the disaster. The state militia took charge of policing Anoka and remained on duty until June 26th. Traffic was resumed through the city a week after the storm when 25,000 automobiles and 100,000 persons visited the scenes of destruction.....".

On 19 June, the Anoka Union reported that three Anoka residents had been killed and many injured as the storm swept through the city. "Two swirling masses" it was said, met shortly after three o'clock just outside of Champlin where they joined together, moved through the residence section of Champlin's riverbank where the twister hesitated briefly then struck boldly across the Mississippi river, up Third Avenue and cut a diagonal swath about three blocks wide through the city, leveling houses, trees and other buildings. The full force of the storm struck the Anoka armory, leveling the huge drill hall and carrying the iron roof supports to Main Street. It ruined the roof of the Masonic Temple.....and blew on through Anoka demolishing trees and wrecking houses from Third Avenue south to the outskirts of town at Seventh Avenue...Damage was greatest in north Anoka.....Anoka citizens were thunderstruck after the storm and it wasn't until Monday that [they] began to fully realize the extent of the damage. Cars parked along Main Street in front of the Anoka armory were turned over onto boulevards and lawns.....Other cars parked along the armory wall were demolished by falling bricks. Many cars in the Freeburg-Farrier garage were badly damaged.

"Traffic through the city was blocked many minutes by fallen trees, wires, poles and various debris. Nearly every street in the stricken area of forty blocks was impassable.....Visiting and local members of the American Legion took a hand in keeping the city under control until some means of organization could be put in charge. The visitors directed traffic and kept things moving while citizens and city crews as well as WPA workers labored to clear the Main Street of debris and trees. Temporary hospital service was set up at the Anoka high school in conjunction with the regular hospital service at the Anoka hospital where many were treated for cuts and abrasions. All local doctors worked with might and main giving attention and were finally helped by emergency doctors and nurses from the Twin Cities. Ambulances from the cities hurried to the scene and carried the badly injured persons to Minneapolis hospitals for further treatment. Governor Harold Stassen ordered the Second

Battalion of the 151st Field Artillery to mobilize and report to Anoka for duty with Col. Charles Green in command. The guardsmen arrived in time to get the damaged areas in control and prevent looting. Members of the Minnesota highway patrol rushed to Elk River and re-routed all traffic through Dayton and also policed roads into Anoka to keep sightseers from interfering with clean up work.....Anoka was in total darkness Sunday night with the exception of portable light plants used for emergency work. Candles, lanterns and oil lamps were also in use.....".

A week later, the Union reported that "with all streets cleared of debris from the storm, sightseers were allowed to drive through the devastated area...All streets were open and National Guardsmen patrolled only piles of wreckage to keep the more curious from looting. Rebuilding of the storm district has started with a vengeance and already many carpenters are busily engaged...Roofs have been repaired, windows reset...The second battalion of the 151st field artillery folded tents Monday noon [26 June].....Local members of battery B will be used for further duty if the occasion warrants. City attorney Allen Chambers who spoke for the Anoka Disaster Committee at a meeting in St. Paul Saturday morning told the state emergency legislative committee that the damage throughout Anoka and rural Hennepin county will total \$1,750,000 (1939 dollars) (emphasis added).

However tragic and devastating it was, the Anoka tornado had a lighter, freakish side. According to various sources quoted by Minneapolis Weather Bureau officials, a wedding ring was torn from a woman's hand; a family Bible lay on a table, unruffled, in a demolished house; a woman's purse was torn open and emptied of its contents, the keys being found later in a neighbor's yard; a berry box, doubled up, was driven into a two inch plank of a truck bottom to the depth of seven inches, causing an eighteen inch split in the plank; and a fur coat hung in a moth bag was found later, out of the moth bag and resting on rail tracks a block from the home of its owner. Also, in an interesting and inspiring story, the 1 July 1939 edition of the Minneapolis Tribune noted that sixty of the eighty two distressed families among the approximately four hundred hit by the Anoka tornado declined Red Cross help. "Available funds" they were reported as saying "could be directed to more serious causes. Some of the families were covered by insurance. Others considered their losses inconsequential. But all felt that other families were in greater need of assistance than themselves".

Nor was mid-June's storminess limited to east central Minnesota. The 23 June 1938 edition of the Morris Tribune reported, for example, that "a severe windstorm last Friday morning [16 June] wrought heavy damage throughout the county [Stevens], many barns and other farm buildings being either blown down or badly damaged...Trees in rural districts suffered heavily and considerable poultry and some livestock were reported killed..". Heavy rains, moreover, fell over many areas of the state on 21-22 June and again on 26-30 June (e.g. 2.19 inches at Grand Meadow on 26 June and 2.16 inches at Campbell on 28 June), continuing the wet regime which had established itself during the last week of May. On 30 June, the Tribune reported that "two heavy rains during the past week [have] added nearly two inches to the precipitation total for this community for June, boosting the total for the month over the six inch mark. Tuesday's [27 June] rain was accompanied by a heavy wind and a severe electrical storm...". And on 2 July, the Minneapolis Tribune commented that

"at Femco Farms, the Tribune's agricultural development institution near Breckenridge, an average of eight and one half inches of rain fell in June on fields and pastures. On one tract, 9.52 inches was recorded. As a result the soil is saturated and in depressions water is standing. Of the 519 acres of corn the Tribune is raising this summer all was knee high at the end of June..".

Although heavy rains were recorded at several stations during the month, July 1939 was generally dry. For the state as a whole, precipitation averaged about thirty percent below the then accepted July normal. Yet, as in July 1938, several stations experienced excessive, but generally isolated, downpours, the greatest of which occurred at Morris on 3 July. According to the 7 July edition of the Morris Tribune, "Morris and surrounding areas experienced a 'young flood' Monday afternoon when a cloudburst brought 3.88 inches of water in less than two hours. The storm did considerable damage throughout the city. Many basements flooded as storm sewers backed up. Many city streets [were] converted into veritable lakes. At the height of the storm it was almost impossible to see across the street. Street lights were turned on at three p.m. it was so dark..". Similarly, the Minneapolis Tribune (20 July) reported that heavy rains had drenched the southwest corner of Minnesota late in the day on 19 July, an unofficial report claiming that 1.8 inches of rain had fallen at Luverne in a period of twenty minutes. At Tracy, 3.85 inches of rain was recorded in less than three quarters of an hour on 27 July, a cloudburst which, according to the 28 July Minneapolis Tribune, caused "some crop damage" in that area of the state. The same edition of the Tribune also noted that much needed rains had recently fallen in drought stricken areas of the eastern United States. In sections of Pennsylvania, it was said, the first rain in twenty seven days had helped to extinguish "hundreds of woodland blazes". In Minnesota, other notable daily July rainfalls included 2.91 inches at Worthington on 24 July; 2.22 inches at Milan on 21 July; 2.20 inches at Mizpah on 3 July; and 2.16 inches at Montevideo on 21 July. And, although it was less stormy than June, July 1939 brought a number of severe hail and windstorms, including two small tornadoes which struck early in the evening of 5 July. One funnel touched down in Lyon county, the second in LacQuiParle county. Although several farm buildings were destroyed and some farm animals killed by the twisters, no human casualties were reported. July was also hot, many Minnesota stations recording maxima of 100 F or higher. On 7 July, the Minneapolis Tribune noted that a "heat wave had sent the mercury to 95 degrees at 1:30 p.m. in Minneapolis and to 97 degrees in St. Paul. One death in St. Paul was blamed on the heat". A few days later, in a story reminiscent of those appearing in area newspapers during the early 1930's, the Tribune (12 July) told its sweltering readers that temperatures had reached 111.4 F, a "new record high", at Sioux City, Iowa; 104 F at Bismarck, North Dakota; and 110 F at Hastings, Nebraska. More of the same followed on 13 July, the Tribune reporting maxima of 105 F at Moorhead; 100 F at Omaha, Nebraska; and 93 F in Minneapolis. On 27 July, temperatures at the Minneapolis Weather Bureau station reached 95.3 F, a day on which, according to the Tribune, the "sun beat down from a cloudless sky". One heat prostration victim, it was reported, had been treated after "collapsing at a Minneapolis restaurant".

August 1939, although warmer than normal, brought an end to the worst of the summer heat. The month also brought much needed and sometimes excessive rainfall to many regions of the state. The heaviest rainfall, as noted earlier, was recorded at Two Harbors

(6.50 inches on 8-9 August). Many other stations, however, recorded rainfall amounts of two to four inches in periods ranging from one day to three consecutive days (e.g. Ahgwahching, 3.20 inches on 8 August; Cloquet, 3.28 inches on 7-9 August; Duluth, 3.38 inches on 8-9 August; Argyle, 2.98 inches on 30 August; Virginia, 4.11 inches on 8-9 August; Windom, 2.45 inches on 8 August; Little Falls, 2.90 inches on 2 August; and Canby, 2.77 inches on 1 August). Also, on 10 August, severe thunderstorms passed through the Minneapolis-St. Paul area, causing damage estimated at \$5,000 (1939 dollars). At St. Paul, winds were said to have reached 54 miles per hour with higher gusts.

The August rains, although coming too late to materially benefit crops in some of the driest parts of Minnesota (the Red River Valley especially), did significantly improve the condition of late maturing crops, thus fortuitously validating the generally optimistic crop reports which dominated much of the summer's agricultural news. The 4 July 1939 edition of the Minneapolis Tribune stated, for example, that "with the possible exception of oats, crop prospects in Minnesota, North Dakota and South Dakota are as good and in some instances better than average. The rains and warmer weather of the last three weeks have brought corn in southern Minnesota to nearly waist high". A week later (11 July), the Tribune quoted a United States department of agriculture report predicting (based on weather conditions as of 1 July) a total United States wheat crop of 716,555,000 bushels, a forecast which was said have been above that issued at the beginning of June.. The same report indicated an expected 1939 corn yield of 2,570,795,000 bushels. In another favorable report on 23 July, the Tribune predicted an "excellent" corn crop and a "fair to good small grain harvest". And on 27 July, the Tribune noted that the state's corn crop had "benefitted" from July's warm weather. In west central Minnesota, however, crop yields appear to have been uneven, evidence of which was provided by the Morris Tribune in a 4 August story stating that "farmers throughout this area are swinging into...threshing operations....reports received so far are too few on which to base any accurate yield predictions but it is likely that the crop in this county will be quite spotted. There are many fields of oats that will go fifty bushels to acre or more.....but there are areas throughout the county where the yields will be poor. Farmers...are optimistic over the exceptionally fine looking corn crop....". A week later, the Tribune (11 August) affirmed its earlier story, pointing out that "early threshing reports which indicated smaller grain yields in the county would be quite spotted continued to be borne out as the work of threshing progresses". Yet, as noted previously, 1939 crop yields, corn yields in particular, appear to have been among the best of the decade, evidence of which was provided by several fall 1939 reports published by the Minneapolis Tribune. On 12 September, the Tribune, quoting a 1 September 1939 release issued by the United States department of agriculture, stated that "with the nation's cribs and warehouses already filled with larger than normal surpluses from previous years...a bountiful harvest of most grain crops, vegetables, fruits, feed and fibers are in prospect....corn production [is] forecast at 2,523,092,000 bushels, an increase of about 63,000,000 bushels over the August forecast. The ten year (1928-1937) average is 2,309,674,000 bushels and last year's crop was 2,542,238,000 bushels,.....Although wheat production was estimated at 736,115,000 bushels or 21,520,000 bushels less than the ten year average the nation has an estimated surplus of 254,000,000 bushels from previous years.....Production of fruits and nuts [is] also expected to be well above average.....Oats production is indicated at 929,968,000 bushels compared with 98,026,000 a month ago and

1,053,839,000 last year.....Estimated barley production is 264,163,000 bushels compared with 252,139,000 last year...". In the second report (11 November 1939), the Tribune stated that Minnesota farmers had produced 204,570,000 bushels of corn during 1939, an average of forty five bushels per acre, the greatest in the state's history and thirty percent greater than in 1938. Nationwide, the corn crop reportedly was the third largest in ten years.

Beginning in early September 1939, Minnesota, together with much of the nation, fell into another deep and extended drought. According to the 11 November 1939 edition of the Minneapolis Tribune, the two month period, September-October 1939, was the driest on record in the vast area between the Appalachians and the Rocky mountains. Rainfall during this period was forty five percent of the then accepted normal in both North Dakota and South Dakota with the southern Great Plains area said to be in "urgent need of moisture". In Minnesota, September precipitation averaged fifty percent of normal. The month, however, was not without isolated heavy rainfalls, one of which deluged the Twin Cities on 11-12 September. Rainfall amounts ranged from 4.24 inches at the downtown Minneapolis Weather Bureau station to 1.6 inches at the Minneapolis airport station. In St. Paul, where 3.72 inches fell at the Holman Field station, "the heavy rain sent water boiling up in basements and did other damage.....about four hundred telephone lines were out at one time or another [on] Monday [11 September]. Hundreds of cars were stalled by wet ignition systems and in Minneapolis, a truck driver was...rescued by canoeists at Tenth and Como avenue in deep water under a railway underpass. An hour's delay was caused on the Snelling avenue cross town line between seven and eight p.m....by water under the railroad bridge at Marshall avenue. Destruction of paving was reported in many places. Rains were heaviest to the east, Eau Claire, Wisconsin, reporting four inches..." (St. Paul Dispatch, 12 September 1939). The 12 September edition of the Minneapolis Tribune began its account of the storm, stating succinctly that "Minneapolis had a flood last night". The Tribune story then went on to explain that "the flood resulted from the inability of storm sewers filled by the water than had fallen during the day to carry off the sudden downpour of the evening. All day yesterday [11 September], the rain fell almost without interruption and at 5:50 p.m. it measured 1.05 inches. Then the rain really started to fall. The nearly 0.75 inches that fell after six p.m. filled every low spot in Minneapolis, some...to depths of three or four feet. Minnehaha Falls also contributed evidence of the weight of the rainfall. Park police reported that the stream pouring over the falls was the heaviest in twenty five years. Wooden paving blocks on almost all streets still paved with the blocks were washed away. Among the worst spots were Nicollet avenue and Grant street and Chicago avenue and Lake street..."

October 1939, although bringing heavy rainfall to many northern and central Minnesota stations during the first ten days of the month, was, from a statewide perspective, drier than normal. The worst of the drought, however, occurred during November 1939, a month which, a very few favored areas excepted, was characterized by an almost total lack of precipitation. For the state as a whole, precipitation averaged about five percent of the then accepted November normal. Moreover, when taken together, the three autumn months of 1939 were the driest recorded in Minnesota since 1892. The autumn of 1939 was also unusually warm, featuring a late season heat wave which pushed temperatures into the 90's F and above at many stations on 14-15 September. The season's most aberrant warmth, however, occurred during a prolonged period of springlike weather which began in mid-

November, persisting well into December.

This combination of drought and warmth was, of course, the subject of extensive newspaper coverage. In this regard, the 18 November 1939 edition of the Minneapolis Tribune warned its readers that "shrubs, evergreens, vines and particularly newly planted things or those near houses where moisture evaporation is rapid need watering....[It] may be late on the calendar but it's summertime for the garden hose. That handy utensil is staging a comeback in Minneapolis...It's all because of the weather. For nearly a month...Minneapolis and the northwest have been parched. For the last week a most unusual condition the entire nation has been covered with high barometric pressure..with scarcely a shower anywhere....". (emphasis added).

Similarly, the New Ulm Daily Journal (23 November) emphasized the extent and depth of the drought, stating that "a slight rainfall last night, not heavy enough to provide measurement and intermittent drops of rain through the day lent hope today that the autumnal drought might be relieved....The rainfall situation is alarmingly serious not only in this region but throughout the Midwest where reports indicate an average precipitation for the year five inches below normal.....Farmers fear that wells and cisterns might run dry and that the ground may freeze before a soaking rain sets in....". An even more dour account followed, the 29 November edition of the Journal reporting that "a severe drought continues prevalent over a large area, the Weather Bureau said today in a summary which disclosed the driest September-October period in Midwest history...A shortage of water supplies for domestic use and for livestock is becoming serious....". Finally, on 1 December, the Journal reminded its readers that "New Ulm still continues in the dry belt while other sections were visited with copious rainfall last night. September-October-November will go down in weather history in New Ulm as being the driest ever experienced. Wells in New Ulm and Brown county are drying up and many cisterns in New Ulm lack water...The moisture is out of the ground to a depth of several feet, the ground being so dry it is almost like powder. Pastures were dried up before frost killed the grass...Many New Ulmites are sprinkling their lawns at this time...Trees have also been watered by many residents....".

Conditions similar to those chronicled by the Journal were also experienced by residents of west central Minnesota, a region of the state in which the drought began in late summer, continuing with little relief through the end of the year. Representative five month (August-December) precipitation totals recorded in this area included 5.16 inches at Alexandria, 4.02 inches at Fergus Falls and only 3.19 inches at Wheaton. And, according to the 24 November 1939 edition of the Morris Tribune, "figures released yesterday...give point to the general knowledge that the fall of 1939 has been unusually dry. With a total of only 0.64 inches of moisture recorded since September 12th, 3.77 inches since July 31st and none at all during the month of November, it adds up to one of the driest on record of these four months...A good rain or heavy snow would be of immense value in soaking up plowed fields, protecting grasslands and trees....". The severity of the drought was also stressed by the Wheaton Gazette (8 December 1939): "the past month was one of three months since records were first kept [here] in 1914 that showed no precipitation. In 1921, 1925 and 1939 the amount of moisture for the entire month of November was not enough to be measured." Similarly, the New London Times (21 December 1939) told its readers that

"weather statistics for the last month show the driest November in more than one hundred years. Rainfall was generally less than half the normal [nationwide] and less than one fourth of normal in considerable areas while [much of] the Midwest had no measurable precipitation during the entire month". New London itself recorded only 1.31 inches of precipitation in September; 2.24 inches in October; a meager 0.02 inches in November; and only 0.24 inches in December 1939.

Severe drought, as noted previously, also prevailed in southern Minnesota during much of the autumn of 1939. Only 0.01 inches of moisture (including a trace [T] of snow) was recorded at the Minneapolis Weather Bureau station during the entire period, 31 October through 30 November 1939. Observers at the St. Paul airport station recorded only a trace [T] of moisture during the same thirty one day interval, prompting the 1 December 1939 edition of the St. Paul Dispatch to describe November as the month of the "great drought" and the driest November "experienced in St. Paul since precipitation statistics started in 1837". Farther south, the Rochester Post-Bulletin (9 December 1939) noted that "the prolonged drought of the past weeks may cause the loss of many trees, shrubs and perennials if they are not given a good soaking before the freeze up, Ben F. Dunn, Rochester high school agriculture instructor warned. The ground around the roots of the plants, he emphasized, should be quite wet when the freeze comes". The Rochester area, like so many other regions of the state was abnormally dry during most of the fall of 1939, recording only 1.06 inches of precipitation in September; 1.56 inches in October; and 0.09 inches in November.

Its extreme dryness notwithstanding, November 1939 was relatively free of blowing dust: light dust was reported on only two days (the 9th and the 10th) during the month. Moreover, the 29 November edition of the New Ulm Daily Journal pointed out that "despite the loose condition of the topsoil in the southwestern plains region, no dust storms of consequence have occurred during the past week. There were some local dust storms in some central and northern states, however...". Dusty conditions were also reported at several locations, the Twin Cities included, on several days during December, 11, 12 and 16 December in particular. And, although numerous forest, peat and brush fires were reported during November, none appear to have been as large or as destructive as those which occurred during the earlier years of the decade. Fortunately, also, light to moderate precipitation fell in many locations on 19 December effectively checking any soil erosion (as well as grass fires) which had occurred during the prolonged autumn drought.

Surprisingly, however, November was a notably foggy month with "dense" fog noted at various Minnesota localities on 5, 14, 15, 20, 21, 22, 24, 25, 26, 27, 28, 29 and 30 November. The worst of the foggy conditions occurred on 26-27 November, the 27 November edition of the Minneapolis Tribune reporting that "fog blanketing the northwest caused grounding of airplanes and added [to] traffic hazards last night. In Minneapolis, the pall came in patches, thickly covering some areas of the city while shunning others....The fog moved in at the end of the day in which temperatures ranged below the freezing mark...Early today the visibility at the municipal airport in Minneapolis was reported at zero...So heavily were many highways blanketed that state highway patrolmen put flares at dangerous curves...". In a parallel account of the event, the 27 November edition of the

Minneapolis Journal stated that "a sharp drop in temperature which took the mercury to its lowest point of the season...was responsible for the heavy fog which overlay the city last night and continued today....Last night's fog blanketed much of the northwest, grounding airplanes and in many sections highways were lighted with flares to warn motorists of danger spots...".

Yet, however newsworthy they may have been, accounts of events such the 26-27 November fog and the record setting drought of November 1939 were overshadowed by newspaper coverage of the late fall-early winter "heat wave" which persisted over Minnesota and much of the nation from mid-November until mid-December 1939. Journalistic accounts of the anomalous warmth were often colorful, emphasizing the widespread wonderment which accompanied phenomena such as pussy willows and dandelions in December. Typical of such reports was a 7 December 1939 Minneapolis Tribune story which began by characterizing the unusual warmth as a "heat wave". Tribune writers then went on to point out that "December maxima of other years were pushed down into runner-up positions in some localities [yesterday]. In Minneapolis, the mercury reached 63 degrees at three p.m....shirt sleeved, some householders went out and sprinkled lawns. Sap came out of some maples...women [who] left home in fur coats, hustled back to change into lighter gear. Men reverted to top coat use....Private golf courses were overrun by foursomes....On playgrounds, the youngsters were engaged in football, touch ball...baseball...Tennis courts were in use....Only vestiges of thin ice remained along the shores of the city's lakes...". On the same day [7 December], the St. Paul Dispatch reported that St. Paul's previous record December maximum (58 F on 22 December 1888) was surpassed at 1330 hours on 6 December when the temperature at the St. Paul airport station reached 60 F. The mercury, however, continued to climb, reaching the day's official maximum of 62.8 degrees later in the same afternoon. At Rapid City, South Dakota, the temperature had reportedly risen to 79 F on the same date.

Several days later on 9 December, the Dispatch noted that many Twin Cities residents had seen "wiggling garter snakes" and other phenological evidence of the spring like weather. Lilacs began opening in some locations, prompting University of Minnesota plant specialists to reassure St. Paul residents, stating that the buds would not open enough to "cause harm to the bushes". The Dispatch also noted that swarming bees and blooming dandelions were reported in some parts of the state. Fergus Falls, it was said, was experiencing an ice shortage, the result of a depletion of the previous season's supply and the current season's warm weather (which, of course, had slowed the formation of new ice). Temperatures at the St. Paul airport station reached 50 F on 8 December and 57 F on 9 December, the result of another push of warm air which entered the area on 7 December. According to the Dispatch account, the front which brought the new round of warmth was accompanied by winds that reached thirty nine miles per hour at 0435 hours on 7 December, "tearing loose Christmas decorations on Earl Street and downing a power line on West Seventh Street, delaying streetcars...". Moreover, as early as 20 November, the Minneapolis Journal took note of the late season warmth, contending that "even the plants are being fooled. Summery weather has produced a crop of buds, the second of the year on lilac bushes at...1814 24th Avenue North..". In a humorous aside, the 29 November Journal discounted reports "from the north country saying its going to be a hard winter. The Indians are basing that prediction

on the fact that the muskrats have built their houses bigger and higher than ever. [This is] supposed to be a sure sign of a bitter winds blowing...Yesterday, the muskrats must have been sweltering in their snug bungalows. It got 46 degrees hot...". On 5 December, the Journal added birds to the list of things that had been "fooled" by the warm weather, noting that Mrs. William Haak, 2930 18th Avenue South reported that a "robin [had] arrived yesterday to make headquarters in an elm tree in her back yard....". Two days later (7 December) in a story parallel to that carried by the Minneapolis Tribune on the same date, the Journal noted that the "official high temperature at the Minneapolis airport was 63 degrees yesterday (64 degrees at the downtown Weather Bureau station), the hottest December day on record....Mrs. Leroy Squier, 5518 Vermont Avenue, St. Louis Park, was stung by a bee in the warm sunshine. Mrs. Helen Novak, 4531 Blaisdell Avenue picked strawberries in her garden.....". Also, like the St. Paul Dispatch, the Journal pointed out that winds had "hit a velocity of thirty nine miles per hour from the northwest" during the early morning hours of 7 December. And, on 9 December, the Journal opened its weather story of the day with a rhetorical question: "where is winter anyway?" The report that followed stated that "in Calgary [Canada] it was in the fifties yesterday...Winnipeg was in the forties...At Fergus Falls....farmers were plowing today and bees were swarming. Boxelder bugs are still bothering the trees...cherry trees were blooming in Almo, Missouri...the driest November in history has been succeeded by a procession of warm, dry days.....".

On the same day (9 December), the New Ulm Daily Journal posed a question essentially the same as the one put forward by its Minneapolis counterpart.: "Is there going to be a winter?" The remainder of the story noted that a maximum of 55 F had been recorded in New Ulm on 8 December and that "golfers roam the links with only ordinary golfing clothes...pussy willows, dandelions and snap dragons have been found by New Ulm residents and some lawns are still green...". Similarly, the 7 December edition of the Rochester Post-Bulletin emphasized that "yesterday [6 December] was Rochester's warmest December day in twenty seven years. The mercury...zoomed above the recent December mark or 54 degrees on the day after Christmas in 1936. Rochester temperatures did not [however] reach as high as record marks reported at other Minnesota and Dakota points....As temperatures ballooned yesterday over Minnesota, North Dakota, South Dakota and Wisconsin, sap was reported in trees, fur coats and overcoats were discarded...Even pansies and dandelions came out in South Dakota....at Rapid City, South Dakota, a mark of 79 degrees was a new high for the month. Minot, North Dakota's 66 degrees was the highest December reading ever recorded with Fargo's 64 degrees breaking a fifty year record...". The 10 December edition of the Post-Bulletin commented further on the geographical extent of the warm weather, pointing out that Denver, Colorado, like the Upper Midwest, was experiencing "wacky winter weather.....Instead of shoveling snow, the populace is playing golf, tennis and baseball and fishing in open water. Trees and flowers are blooming out of season...".

It was more of the same in west central Minnesota: on 8 December, the Morris Tribune announced a new December temperature record, stating that the "remarkable weather that has prevailed here this fall reached a climax Wednesday [6 December] when the temperature touched 69 degrees to establish a new record high for December". And on 15 December, the Wheaton Gazette told its readers that the "unusually warm weather has extended fall

into winter as signs of spring have been reported....J. Kieland and Charles Winchell this week brought into the Gazette office twigs from lilac bushes that were budding...from other parts of the state came reports that robins are wintering north and that flowers are blooming in many yards.....".

Besides providing material for numerous believe it or not stories, 1939's abnormal fall weather was the subject of several humorous digressions, one of which appeared in the 2 December 1939 edition of the Minneapolis Tribune. Noting the irony of a recent Minneapolis gathering of skiing officials," Tribune writers, obviously in a jocular mood, stated that "unless the weatherman gets more consistent than he appears to be this season, a certain group of sports leaders who met at the Curtis Hotel yesterday may propose a topsy-turvy arrangement of things just to offset his [the weatherman's] own freakish handiwork. They may decide to do their ice skating down south and take the sun tan baths in some beach up around the Arctic Circle. The group consists of the officials of the National Skiing Association of America. They came here primarily to discuss business affairs...but they thought they might do a little skiing on the side. And what did they run into in Minnesota? Spring time. Nice weather. But they hadn't brought along their maypoles". The same edition, more straightforwardly, reported that "December's debut yesterday was accompanied by a regular April shower (0.20 inches), the first in weeks...householders in Minneapolis reported some flowers blooming and lilac bushes budding.....".

In another humorous story on 10 December, the Tribune poked fun at what it called "amateur weather prophets," stating that "as another mild day rolled around in Minneapolis and the northwest yesterday, tempting all sorts of spring fantasies, the amateur weather prophets [were saying] just wait and see what you are going to get later. M. R. Hovde, government weatherman, explained that there is no direct relationship between the weather we are having now and what we will get next month.....meanwhile those residents who weren't too absorbed in dolorous prophecy, welcomed yesterday's mild weather...". The humor of the day was, however, mixed with much more serious news, the Tribune reporting that the Minneapolis fire department had "set a five year record by going to six grass fires in a short period yesterday". Moreover, according to the 12 December edition of the Minneapolis Journal, the fire department had been called to eighteen grass fires "in all parts of the city" on 11 December. The same source indicated that "there were a half dozen other rubbish fires blamed on the lack of moisture. December's wacky and dry weather today produced another of a long series of zeros in the precipitation column and in the fire department a large number of grass fires due to increasing dryness".

December's unusual warmth was temporarily interrupted by a brief invasion of cold air which brought near normal temperatures to most of Minnesota during the period 12-14 December. The 12 December edition of the Minneapolis Tribune announced the arrival of the colder weather, stating that "this season, which has been unusually mild in the past month, may step into a more wintry role today, with snow flurries and a drop in temperature...". On the next day, the Tribune reported that the cold was accompanied by "winds, in some instances of gale velocity [which] moved clouds of dust and some snow over Minnesota and the Dakotas yesterday. Temperatures dropped well below the freezing mark...In Minneapolis the wind blew almost steadily at more than twenty miles per hour...At

Bemidji...where residents were still boating on Lake Bemidji, there was a dust blizzard. Pipestone had a severe dust storm and some snow. A light snow fell in Duluth where there was a forty five mile per hour wind...Snow and dust were deposited at both Fargo and Pembina, North Dakota...".

The winds and cold were, however, followed by a rapid warm-up, temperatures at many Minnesota stations rising to levels near those experienced earlier in the month (e.g. Bemidji, 53 F on 17 December; Beardsley, 60 F on 16 December; Bird Island, 61 F on 16 December; Morris, 58 F on 16 December; Albert Lea, 63 F on 16 December; Minneapolis and St. Paul, both 58 F on 16 December; Rochester, 63 F on 16 December; and St. Peter, 65 F on 16 December). But, as noted previously, the early winter warm spell ended emphatically on 18-19 December, a transition which was marked by widespread light to moderate precipitation and a return to normal or near normal late December temperatures. Temperatures at most Minnesota stations did not, however, fall below zero until the closing days of the month, the Minneapolis and St. Paul stations recording their first sub zero reading of the winter on 30 and 31 December, respectively. For the state as a whole, the lowest December reading was -17 F at Park Rapids on 30 December, establishing a new record high statewide December minimum for the period, 1891-1939. Moreover, the snow which fell on 19 December was the first of the 1930-1940 winter season at most stations and, although generally light, was sufficient to "check" the soil erosion and the numerous grass fires which had accompanied the fall's extraordinarily dry weather. The mid-December snowfall was, of course, generally welcomed by Minnesota residents. The 22 December 1939 edition of the Morris Tribune commented, for example, that "the light mantle of snow which fell Monday night brought assurances of a white Christmas. The snow on Monday night followed by intermittent rains during the day heralded the end of the unusually dry weather that prevailed all of November and most of December. The combination of rain and snow was joyfully welcomed [emphasis added] for its beneficial moisture". As noted previously, the remainder of the winter of 1939-1940 featured a persistently cold and dry January, a month which, in yet another climatological turnaround, was followed by a warm, wet February.

It is likely, of course, that the extent and intensity of 1939's autumnal drought led many to think that drier than normal conditions would continue to plague the Great Plains and the Upper Midwest into the 1940's. However, as previously pointed out, the drought receded during the late 1930's, shrinking the size of the infamous Dust Bowl and reducing both the intensity and geographical extent of the dust storms which raged over much of the nation during the period, 1933-1937. Recovery continued into the early years of the 1940's with more normal temperature and precipitation patterns soon becoming predominate.. All of which raises a difficult and fundamental question: what combination of atmospheric, oceanic and ecological conditions caused the sudden onset of the drought and heat which began abruptly in 1930 and what changes took place when the drought waned and eventually dissipated a decade later? This question is, of course, an intriguing question a question which, during the 1930's and since, has aroused a great deal of curiosity and, more importantly, has inspired numerous theories which, then as now, seek to explain climatic change and to answer the question: could it happen again? Some of these theories and hypothesis were (and are) the results of research conducted by serious and qualified

scientists. Others, predictably, were (and are) the speculations of crackpots and hucksters, amusing at best and distressing at worst. Yet, whether scientifically credible or unscientifically ludicrous, the many attempts to account for the onset, duration and ebbing of the drought are of interest, not only to climatologists, but to historians interested in the psychological and intellectual moods of those who experienced the dust storms, the grasshoppers, the failed crops, the destitution and the suffocating heat waves of the 1930's. The ensuing discussion, accordingly, will focus on 1930's attempts to explain what happened, giving special attention to the impulsive, sometimes desperate, attempts to predict the end of the great drought. In addition, however, what follows will discuss current views of the drought and its causes, views which, although retrospective, take into account empirical data (upper air data, especially) and atmospheric models which were not available to past generations of meteorologists, climatologists and other scientists. This means, among other things, that data compiled by researchers, forecasters and observers during the 1930's can be interpreted (or reinterpreted) in the light of present day knowledge of atmospheric phenomena (e.g. various drought era upper air circulation patterns, although unknown to atmospheric scientists of the time, can be inferred from synoptic weather maps and other materials compiled during the 1930's). Finally, the ensuing discussion reveals that climate change and global warming, far from being concerns unique to the theorists of the early twenty first century, were very much a part of the scientific agenda of the 1930's. For, as indicated by studies which were undertaken at that time, climatologists and much of the lay public generally knew that the earth was then getting warmer. Consider in this regard a 7 November 1939 Rochester Post-bulletin story which noted that J. B. Kincer, Washington D.C. Weather Bureau researcher had told a "Symposium on Temperature" sponsored by the American Institute of Physics that "the world is getting warmer....there appears to be a trend toward higher temperatures...since the turn of the century [i.e. 1900] there has been a persistent trend to higher temperatures world wide in scope...".

Yet, the climatological speculations of the 1930's notwithstanding, the essential questions remain: what atmospheric and oceanic anomalies triggered and sustained the drought of the 1930's? And, at least, insofar as Minnesota is concerned, when did the drought really begin? And is there reason to believe that droughts such as the ten year regime that prevailed mostly unbroken from 1930 through 1939 are caused by variations in solar activity (as some claimed at the time) or simply by causes which, at best, are only partially understood and, at worst, are understood hardly at all? These are questions, then, elusive answers notwithstanding, which must be addressed in any reasonably complete account of the Great Drought.

THE 1930'S
THE GREAT DROUGHT:
WHEN DID IT BEGIN?
WHO CAN TELL US WHEN IT WILL END?
AND WHY DID IT HAPPEN?

When viewed from a nationwide perspective, it is clear that the Great Drought began in 1930, developing suddenly and unexpectedly at the end of a series of relatively wet years. The climatological record suggests, however, that insofar as Minnesota is concerned, the drought started several years earlier, perhaps as early as 1917 and certainly in the 1920's. In this regard, Minnesota appears to have been unique, its relative dryness standing in contrast to the normal or above normal precipitation recorded in most surrounding states during the ten years, 1920-1929. According to the U.S. Department of Agriculture's 1941 yearbook (entitled "Climate and Man"), precipitation during the 1920's was 100 percent of the then accepted normal in Wisconsin; 101 percent of normal in Nebraska and Iowa; 104 percent of normal in both Dakotas; 105 percent of normal in Kansas, Illinois, Indiana and Ohio; 107 percent of normal in Colorado; 108 percent of normal in Missouri and Wyoming; and 110 percent of normal in Oklahoma and Utah. The corresponding Minnesota value was 94 percent, making it one of a very few states which, for the 1920's as a whole, generally received less than the normal amount of snowfall and rainfall.

Predictably, the relative wetness experienced in Great Plains states such as the Dakotas, Nebraska, Kansas and Oklahoma in the 1920's resulted in an increase in acreage under cultivation, particularly in areas such as western Kansas, western Nebraska, the Oklahoma and Texas Panhandles, the western and central regions of the Dakotas, parts of Montana and even portions of southwestern Minnesota. These, of course, were the areas that suffered the greatest ravages of the drought of the 1930's. According to the agricultural department's 1941 yearbook, average annual precipitation in the Great Plains states of North Dakota, South Dakota, Nebraska, Kansas and Oklahoma during the ten year period, 1930-1939 was, respectively, 85, 82, 86, 88 and 94 percent of normal. Much of the farmland which had been opened to cultivation during the previous decade was left uncultivated, even abandoned, the five states in question experiencing a net population loss of approximately 305,500 during the same ten year period.

Yet, whatever the situation in the areas favored by above normal moisture during the 1920's, much of Minnesota, as previous remarks have suggested, experienced endemic drought, particularly in 1923 and 1929. As early as June 1921, Minneapolis Weather Bureau officials noted that "unusual heat and drought" during the last half of the month had reduced the

yield of small grain. Hot, dry weather persisted into July 1921, the result of which was "greatly to injure nearly all crops except corn..". Similarly, Minneapolis Weather Bureau officials described the following year, 1922 as being "much drier" than normal, especially in central and southern portions of the state. July 1922 featured "unusual....drought over much of the larger portion of the state" while August was said to have been "generally unfavorable for the growth of crops..". The drought intensified in 1923, a year in which precipitation for Minnesota as a whole fell below twenty inches, a value almost twenty five percent below the then accepted statewide normal. With the exception of January and June, every month of the year was drier than normal, prompting Minneapolis Weather Bureau officials to emphasize that "the shortage of precipitation applied in general to all seasons, and crops suffered severe damage in many sections of the state. Fortunately there were quite heavy rains during June or the damage would have been much greater.....the yield of wheat was much below average, both in quality and quantity; but the corn crop was fairly good except on sandy soils and uplands where there was much firing due to the lack of moisture. The yield of potatoes was in general disappointing..."

Conditions improved somewhat in 1924, a year which, although somewhat drier than normal, featured generally normal to above normal growing season precipitation in most areas of Minnesota. According to the Minneapolis Weather Bureau office, "the dry weather of ...1923 persisted during the first two months of 1924, but fortunately a marked excess of moisture fell over the southern part of the state during March and over the northern half during April. This precipitation was very opportune, as the ground had become very dry and streams very low from the prolonged dry spell. During the summer the rainfall was generally ample in the southern half [of the state] but the northern half of the state was not so favored. The cool summer was very favorable for the growth and development of small grains and these crops were the best in years. On the other hand, corn did not thrive and much of it failed to mature..." . Drought returned to the state in 1925, a year which, with the exception of June and September, was consistently dry. August was especially dry, a number of stations recording less than 0.25 inches of moisture during the month. According to Minneapolis Weather Bureau officials, the August drought was "especially pronounced over the southern part of the state....The drought was especially damaging in that it occurred over the portion of the state where the bulk of the corn is raised, and this crop was badly damaged. From being in good condition at the opening of the month, it steadily deteriorated until at the close [of the month] much of the crop was a complete failure. Potatoes, too, especially the late planted were badly damaged by drought; and pastures were so dry in many localities that much feeding of livestock was necessary..."

Nor did conditions improve during the ensuing year (1926), a year that was described by Minneapolis Weather Bureau officials as being "decidedly unfavorable from a farming viewpoint. The persistent drought during the forepart of the year....became acute during April, retarding and, in localities, preventing the germination of grains. With heavy rains during June, conditions became more favorable, though over many areas drought continued during the remainder of the growing season...". April's weather was especially adverse, combining the dearth of precipitation with frequent high winds which raised numerous "disagreeable" dust storms. Much reseeded of planted crops was necessary, due to shifting soils. The drought ended abruptly, if temporarily, during August and September 1926.

August precipitation, although moderate at most Minnesota stations, was excessive at some locations during a rainy period which began on 11 August and continued until 20 August. Canby and Chatfield, for example, recorded 5.8 inches and 5.2 inches of rain, respectively, on 18-19 August. September was excessively wet in many areas, especially in central and southern Minnesota. Several stations recorded more than ten inches of rain during the month (e.g. St. Cloud, 10.72 inches; Little Falls, 10.59 inches; and New Ulm, 10.12 inches) while, at Albert Lea, a cloudburst on 18 September dropped 7.25 inches of rain, the greatest daily amount recorded during the month of September during the entire period, 1891-1926. For the state as a whole, September precipitation was approximately 180 percent of the then accepted statewide average. The last three months of 1926, like August and September, were also wetter than normal, establishing a pattern that persisted into the spring of 1927. The summer of 1927, however, was drier than normal and abnormally cooler than normal, the entire period May through August featuring temperatures about three degrees below normal. The cool weather, although favorable for the spread of crop damaging stem rust, mitigated the effects of the summer's dryness, making 1927 one of the few years of the 1920's when drought as such was not seen as a significant threat to the state's agricultural interests.

Although 1928 was, from a statewide perspective, slightly wetter than normal, moderate drought persisted in some sections, south central and extreme northwestern Minnesota especially. According to Minneapolis Weather Bureau reports, the "lack of sufficient moisture at the beginning of the growing season was decidedly unfavorable, much seed failing to germinate due to excessively dry soil; but with the occurrence of heavy rains during June this unfavorable feature was eliminated, and during the remainder of the growing season rainfall was ample except over limited areas...". August 1928 was especially wet and stormy, featuring a tornado which destroyed large portions of the city of Austin on 20 August. Many stations recorded six or more inches of rain during the month with amounts exceeding ten inches recorded at several stations (e.g. Albert Lea, 12.28 inches; Grand Meadow, 10.35 inches; New Ulm, 10.56 inches; and Reeds, 11.79 inches).

Drought returned in earnest during the last year of the decade (1929) and, incidentally, the last year of the economic prosperity which had prevailed since the post World War I recession of 1921-22. For the state as a whole, 1929 precipitation was about twenty percent below the then accepted statewide average. The growing season months were especially dry: June, with less than fifty percent of normal precipitation, prompted Minneapolis Weather Bureau officials to comment that "the outstanding feature [of the month] was the excessive dryness, few previous Junes being comparable with the present month in this respect. The first week was absolutely rainless, and while precipitation was well distributed throughout the remainder of the month, amounts were in general insufficient. The shortage of moisture was particularly severe over the central and central western counties of the state where vegetation in many localities was damaged beyond recovery.....". In its review of July's weather, the Minneapolis report noted that "the distribution of rainfall was the controlling factor in the disposition of the various crops, which in areas fortunately situated as to moisture was good as to grains and very good to excellent as to corn. Deterioration, however, was noted elsewhere, especially in the middle counties where the lack of sufficient rainfall, following a prolonged shortage of moisture during the preceding month [June], had

created an acute condition of drought. Many fields of small grain had to be abandoned, while even corn on some uplands was a total loss". Agricultural prospects continued to wane during August 1929, a month which, for the state as a whole, was about forty percent drier than the then accepted August normal. According to the Minneapolis Weather Bureau, precipitation shortfalls "were most pronounced in the western counties, as has been the case during the entire growing season....this paucity of moisture combined with excessively high temperatures so intensified the droughty conditions that vegetation suffered severely. Corn steadily deteriorated during that period to a poor condition even in the southern counties....while in the western counties and locally everywhere on light soils the crop fared badly and many fields were so poor as to be fit only for silage. Pastures dried up and in many sections afforded very little grazing., while late potatoes were badly damaged..."

As suggested earlier, the relative dryness of the 1920's was, at least in Minnesota, more than a prelude to the extreme drought which engulfed much of the United States during the 1930's. The endemic droughts which plagued Minnesota during much of the 1920's were, rather, part of a downward trend which followed a wet regime that began in the late 1890's, culminating during the early years of the twentieth century. Clear evidence of this trend is to be found in the annual statewide averages calculated by Minnesota Weather Bureau officials during the period 1886 through 1936, values obtained by taking the simple average of the total annual precipitation recorded at the state's various official stations. Following the drought of 1889, Minnesota's average annual precipitation dropped to approximately 23.5 inches, rising gradually thereafter, reaching 24.7 inches following 1896 (a wet year with a statewide average annual precipitation value of 31.02 inches). The average continued to rise steadily, reaching a peak of about 27.0 inches in 1909, while drifting lower thereafter. By 1913, the average had fallen to 26.4 inches, a drop which was temporarily halted by several relatively wet years (1914-1916). Beginning with 1917, another dry year (20.99 inches or, alternatively 21.46 inches), the decline proceeded without interruption, falling to 26.0 inches at the end of 1923, to 25.7 inches at the end of 1929, to 25.3 inches at the end of 1934 and to 25.2 inches at the end of 1936, reaching a nadir of about 25.1 inches at the end of 1940. Thereafter, the trend was generally upward, several intervening dry intervals (e.g. 1952-1955, 1958, 1969, 1976 and 1988-89) notwithstanding. Currently, average annual Minnesota precipitation (as calculated by the Midwest Climate Center from data collected during the thirty year period, 1971-2000) is 27.4 inches, a value exceeding the previous peak reached in the early years of the last century.

Unlike Minnesota, many parts of the country, as noted previously, were generally wetter than normal during the 1920's. Yet, there is evidence to suggest that many of these areas, too, were getting drier, a trend which, however, was masked by the persistence of normal or above normal precipitation. Evidence of this decline, albeit a decline which probably went unnoticed by Iowans of the time, is provided by Charles G. Reed, a Des Moines, Iowa Weather Bureau official, in an April 1930 Monthly Weather Review article entitled "Secular Trend of Iowa Precipitation". Based on his analysis of selected records from the period, 1873 through 1928, Reed concluded that precipitation in the state of Iowa had decreased on the average of 0.034025 inches per year over a fifty five year period, an aggregate decline of approximately two inches. He then went on to emphasize the seasonal aspects of this trend, noting that "for the summer months, June, July and August combined, the annual

decrement for the state as a whole is 0.034925 inches. This is a total of 1.92 inches, or fifteen percent in fifty five years. Apparently an appreciable amount of rain has been transferred from summer to fall. About half of this decrease is made up by a total increase of 0.95 inches in the fall months....when it is a positive detriment to the maturity and harvesting of Iowa's great corn crop. The spring seeding and planting months of March, April and May show almost no change, amounting to an increase of only 0.06 inches in fifty five years. Winter precipitation (December, January and February) shows a total decrease of 0.90 inches or 39 percent in fifty five years....Southwest Iowa has had the largest actual decrease. In the nine counties of the southwest district, the total decrease in fifty three years is 3.41 inches, ten percent, or at the rate of 0.064321 inches per year.....

"The records of the Weather Bureau in Omaha [Nebraska] had a marked effect on the trend in the southwest district, for they were continuous without a break through the fifty three year period considered.....A trend calculation of the Omaha record shows a remarkable decrease of 0.262168 inches per year, or a total of 13.89 inches in fifty three years, or 39 percent. The nearest station having a useful record for comparing [this] trend is Weeping Water, Nebraska, where, with a few interpolations, fifty one years [of data], 1878 to 1928 are available. Here the total decrease is 4.48 inches, fourteen percent, or at the rate of 0.087867 inches per year. For the state of Nebraska as a whole in the fifty three years, 1876-1928, inclusive, the total decrease is 1.56 inches, six percent, or 0.029439 inches per year. The only station actually in the southwest district [of Iowa] warranting a trend calculation is Clarinda. Including interpolations.....it is possible to make a fifty three year trend, 1876-1928, inclusive which shows an annual increase (emphasis in the original) of 0.035030 inches, or a total increase of 1.86 inches, or 5.8 percent, instead of a decrease. Either there must be an area centering about Omaha where there is an abnormal long time downward trend or else some sort of unfavorable conditions not readily apparent are developing and progressing in connection with the exposure of the rain gage. The rainfalls of the eighties were very heavy at Omaha, which gives the trend line a steep downward slope.

"The averages for the west central district [of Iowa] were but slightly influenced by the Omaha records, yet the total decrease in that district in fifty three years is 2.35 inches, seven percent or about 0.044318 inches per year. Next stand the east central and northeast districts, each with a decrease of 2.29 inches. At Independence, Buchanan county in the northeast district, the total decrease in rainfall is 4.66 inches, or fourteen percent in fifty nine years, 1869-1927. This is at the rate of 0.07915 inches per year. At Dubuque, Dubuque county, also in the northeast district, the total decrease is 4.89 inches or fourteen percent in seventy seven years. This is at the rate of 0.063550 inches per year. The least decrease is in the northwest district, where it amounts to only 0.20 inches.....".

In a similar but geographically more comprehensive study, Alfred J. Henry, a Washington D.C. Weather Bureau researcher claimed that annual precipitation values had decreased in many parts of the United States during the fifty year period, 1871-1920 (an interval which, because it is not coterminous with Reed's time series, precludes any strict correlation of the two studies). Henry's research, the findings of which were published in the June 1930 issue of the Monthly Weather Review appears to have been done in response to what was termed "a prolonged drought in southeast Virginia and northeastern North Carolina". For

purposes of his analysis, Henry "arbitrarily" divided the period of record into halves, the first half including the years 1871-1895 and the second, the years 1896-1920. "The differences between the means of the two periods," he explained "served to show whether precipitation had increased or diminished" during the five decades involved. Not surprisingly, these comparisons showed sharp declines in the amount of precipitation recorded by observers at stations such as Charleston, South Carolina; Wilmington and Hatteras, North Carolina; and Cape Henry and Norfolk, Virginia (areas at the center of the aforementioned drought). More surprisingly, however, large decreases were noted at such disparate locations as Memphis, Tennessee; Palestine, Texas; Manitowoc, Wisconsin; Boston, Massachusetts; Portland, Oregon; Buffalo, New York; and Shreveport, Louisiana. In contrast, comparison of the two twenty five year periods showed significant increases in precipitation at such stations as Union Springs, Alabama; and Rome, Georgia with modest increases noted, among other places, in parts of Utah and in southeastern Minnesota. Finally, the findings of the Reed and Henry studies were supplemented by and partially corroborated by a graph which displayed five year moving precipitation averages for two representative Dust Bowl stations, Las Animas, Colorado and Dodge City, Kansas for the period, 1872-1935. According to this display, published in the June 1936 issue of the Monthly Weather Review, these two stations experienced drought during the late 1870's, the five year average annual precipitation dropping to fourteen inches, a value about two inches below the long term normal. This dry period was, however, followed by a number of notably wet years, the five year average reaching approximately nineteen inches by 1885. The 1880's wet regime was following in turn by a long period of drought beginning at the close of the decade, persisting until the late 1890's. Average annual precipitation for the five year period ending in 1894 reached a low of twelve inches, a mark not equaled until the mid 1930's. By 1899, average annual precipitation had again reached the nineteen inch level and with the exception of a few brief periods of relative dryness during the early years of the 20th century, remained at or near average levels through much of the 1920's. Predictably, the graph showed another sharp decline beginning in the late 1920's, average annual precipitation again falling to the twelve inch mark during the five year period ending in 1935.

Although much of the climatological research conducted during the 1930's focused on changes in precipitation patterns, the decade's extreme heat also attracted considerable attention, stimulating interest in long term national and even world wide temperature trends. One of the most comprehensive studies of this sort was done by J.B. Kincer, a widely acclaimed (and widely quoted) 1930's U.S. Weather Bureau researcher whose analysis of long term temperature trends was published in the September 1933 edition of the Monthly Weather Review. Not surprisingly, Kincer's article opens with a question, a question which was often asked during the 1930's, not only by climatologists but the public at large: is the world getting warmer? He then went on to emphasize that the "phase of weather, or climate, that is attracting attention at the present time is not [a]...short period change from warm to cool and vice versa...but rather an apparent longer time change of cooler periods that seem to be less frequent and of shorter duration and warm periods that are pronounced and persistent.....It appears from the data presented with this study that the orthodox conception of the stability of climate needs revision, and that our grandad was not so far wrong, as we have been wont to believe, in his statements about the...old fashioned winters 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...change in climate, may be cited. When we examine the winter temperature records for Washington [DC], for example, it is found that of the last twenty one winters, 1917-1918 to 1932-1933, inclusive, eighteen have been warmer than normal; that every one of the last thirteen of these has been mild, and that the warmest winter of record, going back considerably more than a century, was that of 1931-1932. This is in marked contrast with 'grandad's day,' for the nineteen winters of 1854-1855 to 1872-1873, fourteen of which were colder than normal, with 1855-1856 the coldest in more than one hundred years. The record for New Haven, Connecticut, may be cited as another example. Here every one of the last ten winters has averaged warmer than normal; so also have eighteen of the last twenty one, and thirty three of the last forty five. 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 thirteen of the last fifteen 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 twenty of the last twenty four springs down to and including the spring of 1933, have had above normal temperatures, which contrasts sharply with the ten 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, Minnesota, more than seventy five percent of the fall seasons for the last forty three years previous to 1933 have been relatively warm, in contrast to the thirty seven year period from 1840 to 1876, inclusive, during which only nine were warmer than normal. In Washington, D. C. only three of the twenty five falls since 1907 have had below normal temperatures, while fifteen of the last seventeen 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 1917-1918 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 degrees F below zero occurred in the Yellowstone National Park in February 1933.....

"This study shows....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.....into long

time trends (the longest available covering more than one hundred 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 indicate that the winters are the most erratic, with up and down trends of greater frequency and of shorter duration than in other seasons. For the spring and fall, the trend has been more uniformly upward with fewer interruptions by short cold spells. The curves for the fall season show a remarkably steady upward trend....for nearly a hundred years, our fall seasons have been trending progressively to warmer.....For the fall, winter and spring seasons the averages in temperature for the twenty years to an including 1933 are from 2.5 to four degrees high than similar averages sixty or seventy years ago.....a very definite upward temperature trend for the northern and eastern United States, from the record at St. Paul, Minnesota and St. Louis, Missouri, for the former and Washington, D.C., for the latter. These cities show a nearly uninterrupted upward temperature trend since 1875, or for more than half a century....the summation for St. Paul for the twenty years ending with 1876 being lower...an average of 2.6 degrees a year, then for the twenty years ending in 1933.....

".....seasonal curves for two long records in the eastern United States New Haven, Connecticut and Washington, D.C., the former beginning in 1781 , and the latter with 1817, offer interesting and corroborative testimony.....the similarity of the trends [for these two stations] 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 [based on] trend concurrences, that the fundamental observational data are trustworthy, and are of such character as to afford complete confidence in their integrity.....The records for both stations show [that] in the early seventies [1870's] the winters for twenty years up to that time averaged three degrees or more colder than for a like period ending with the winter of 1932-1933....The trends for the spring months for the two stations show close agreement since about 1845, actually for more than one hundred years.....An interesting feature....is the recent comparatively cool summers.....following 1880, while the winters, springs, and falls were becoming definitely warmer, the summers were becoming cooler. More recently, they too show a recovery, the trend lines corresponding with the other seasons. The fall months show the most remarkable [similarities]. Beginning with Washington in 1848 and New Haven in 1850.....there is a very definite upward trend in temperatures up to 1932. In other words, the eastern United States has been getting definitely warmer in the last one hundred years....[This] is confirmed by average temperatures from all stations within the state of Iowa, based on average temperatures for a period of sixty one years, 1873 to 1933.....

"It has been suggested that these tendencies to abnormally high temperatures noted in recent year may be more apparent than real. The data cited are nearly always from large cities whose thermometers may have been unduly affected by influences that do not obtain in the open country. We have examined this phase of the matter and find that this suggestion is not well taken. It so happens that continuous, dependable cooperative records [kept] in open country, or small communities are available for comparison with nearby city records. Among these are Dale Enterprise, Virginia, near Lynchburg and Easton, Maryland, near Baltimore, which afford excellent comparison between city and country exposures. The records...from

these points...[show] an even more pronounced upward trend evident in the cooperative data than in those for the nearby city station.....a much longer cooperative record made at West Chester, Pennsylvania, near Philadelphia, covering seventy eight years from 1855 to 1932 [shows] the same trend, just as pronounced, as that for the Philadelphia station. These showings definitely dispose of the city influence argument.....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 the number of days in the winter with certain low temperatures.....the length of the winters.....etc. All confirm the general statement that we are in....a period of abnormal warmth, which has come more or less gradually for many years.....the general trend of the number of days with freezing weather in the fall and spring at Washington, D.C. [for the period of sixty years, 1873-1933] shows that for the twenty years ending in 1892 there were a total of 354 spring [March-May] days with minimum temperatures of 32 degrees or lower, and for the twenty year period ending with 1933, this had dropped to 237 days....an average [decrease] of six days per year.....".

Inevitably, studies such as those done by Kincer, Reed, Henry and others, appearing as they did during the climatological anomalous 1930's, piqued public interest, provoking a great deal of speculation, scientific and otherwise. Newspapers, accordingly, featured numerous climate change stories, some of them serious, some amusing, but all reflecting the concerns and anxieties of their readers. Kincer's findings, for example, were widely but often incautiously quoted, undoubtedly leading many newspaper readers to assume a hot and dismal climatic future for the earth and its inhabitants.. The 1930's unusual siege of heat and drought also spurred interest in climatic cycles, giving prominent, if undeserved, credence to scientists (and not a few crackpots) who thought that they had discovered recurring (and predictable) patterns in the behavior of the earth's weather. Many meteorologists and climatologists (including Kincer) were, however, much more cautious, downplaying their ability to comprehend, much less predict the weather, whether in the short term but especially in the long term (including the end of the drought, a matter which provoked extensive speculation during the height of the Dust Bowl era).

In this regard, the 6 August 1936 edition of the Minneapolis Tribune carried an article written by Washington [D.C.] correspondent Paul Mallon debunking what he called "drought delusions". In Mallon's words "weather men have probably been wrong as often as politicians, but the best of them hereabouts will guarantee that current popular notions about the drought are mostly dry propaganda. For one thing they do not believe there is the slightest chance of the great plains area becoming the great American Sahara. For another, they do not believe that the plowing of that area had anything important to do with the drought. That great movie, produced by Professor Tugwell, depicting these theories, they say, bear a few birthmarks of a Hollywood studio scenario. That is, it certainly did, when it implied that the plowing of the great plains had anything to do with the weather beyond increasing the severity of dust storms. Loose talk now current in the drought areas is subject to the same classification, they say.

"These fair and warmer fellows have records to show that for years after the plains were plowed up, there was more rain than usual. At that time the cry was 'rain follows the plow'. This notion was just as false as those now current. Likewise they can show you there were

droughts in the plains long before the first plow caused the first wrinkle.....Or, consider the record of the dust bowl. It shows the rainfall for the five years ending in 1894 was exactly the same as for the five years ending in 1935. And the drought there in the late 1890's was as severe as this one. The truth, as they see it, is [that] these middle western areas get such a small amount of rain in their best years, that a slight curtailment of rainfall causes suffering. But the law of averages indicates it will all even up in the end; that when one country fails to get its rain, another country gets the deficiency (reports from Europe now indicate the rainfall is so heavy it is interfering with the harvesting) (emphasis added); that over a period of years rainfall history everywhere repeats itself.

"Nor do the cloud surveyors take any stock in the theory that because lakes and rivers have dried up, future rains will be any lighter in the drought area. They say that all the moisture absorbed by the sun in the west in a year would not make more than one good shower. They note that West Virginia, a wooded and humid state, was the worst drought state in 1930 but has not had a severe one since; that suffering Iowa's rivers were rather full before the drought hit....the midwest moisture, they say, comes long distances, mostly from the gulf of Mexico. As long as the gulf has water in it, the midwest will average up in rainfall over a period of years.....".

A similar view was expressed by Kincer himself, who, according to the 4 January 1935 edition of the Morris Tribune, contended that the "recent drought in the interior of the United States is not a sign that the climate has basically changed" (a view arguably at odds with his 1933 study of worldwide temperature trends). "The drought of 1934 was merely a periodic dry phase. In Minnesota there were two extremely dry periods in the last century, one culminating about the middle of the century and the other in the early 1890's. St. Paul's dry time came during the five years ending in 1856 and during the five years ending in 1891". Approximately four years earlier (2 August 1930), the Minneapolis Star published an article which, although using much more forceful language, presented views essentially identical to those held by Mallon and Kincer. The Star story which began with an arresting sub-head stating that "scientists discard fanciful theories of sun spots and moon cycles" explained that "it's hot because, well, because there hasn't been anything to cool the country off with". "And that's about as far as scientists will go in trying to explain the reason for the unprecedented heat wave which has burdened the middle west this summer. Gulf streams, sun spots, lunar cycles, changes in the depth of the earth, fluctuations in wind direction all these have been discarded by learned men as possible causes for the excessive heat. It just happens to be hot, and there isn't much that can be done about it. The meteorologists make their forecasts on reports of conditions throughout the country. Taking them by and large, they aren't very far wrong. But why conditions arise is a scientific mystery. (emphasis added)

"Long distance prognostications are mostly luck, bad or good, as the subsequent developments prove. Henry Janvrin Browne of Washington sees a scrap between the sun spots and the moon spots as the cause, but he gets no confirmation or backing from the men of science. A St. Paul man, William H. Mears, does a little predicting on the basis of government weather reports and the theory that history repeats itself. He finds a ten year weather cycle and a forty year cycle, and according to his studies of the statistics, we are

now at the end of the last ten year period in the forty year cycle, which he predicted a year ago would bring excessive temperatures and short crops.

"Next year we will enter the first of another cycle and moderate weather and good crops, bringing general prosperity to the country, will be the rule for the next twenty four years, Mr. Mears says. As evidence of his position, he points out that forty years ago, in 1889 and 1890, drought caused widespread damage, while in 1887 and again in 1927, the precipitation was above normal. All of which does nothing to remedy the present situation. Minnesota had only a fraction of its normal rainfall in July, while Indiana and Illinois had less than half of normal precipitation, and Iowa and Michigan, less than a third. Wisconsin fared a little better with about two thirds normal rainfall. Crop damage has been severe, livestock and pastures have suffered, and already the corn crop, has been cut 300 million bushels, according to government estimates. More warm weather is in prospect for next week, but there probably will be some recession of temperature.....".

Views parallel to those expressed by the Star were featured in the 15 August 1930 edition of the Minneapolis Tribune in a story quoting C. F. Marvin, then chief of the U.S. Weather Bureau. Marvin, it was said, "believes that there has been no permanent change in climate for whole centuries on end. There may be trends of hotter or cooler weather or drier or wetter weather but on the whole weather balances out". Similarly, the 29 June 1934 edition of the Brown County Journal (New Ulm) asserted that "scientists taking cognizance of the [reasons for the] drought that [has] overspread vast regions of the United States agree that the best answer is that nobody knows. There is no single connection between sun spots and drought. Perhaps it is only because the current drought has gotten more publicity [that we forget that it is] perhaps no worse than dry spells of the past...".

In what must be one of the greatest ironies of the 1930's, the bitterly cold winter of 1935-1936 seems to have raised the specter of a new ice age, temporarily turning the public's attention from drought and heat to snow and cold. At least one bit of evidence suggesting that prospects of a cooling earth had, at least in some quarters, replaced fears of a warming earth is to be found in the 21 February 1936 edition of the Brown County Journal. According to this source, the "freezing blasts of Minnesota's sub zero winter have little portent for another ice age according to Dr. Reginald Daly, professor of geology at Harvard who spoke Friday in Minneapolis. Although the mean temperature of the last ice age was probably not much lower than present day readings, the essential condition for the formation of another ice cap is completely lacking. The likelihood of the excessive precipitation necessary for an ice cap is too remote even for consideration...". And, in a follow up story, the 20 March 1936 edition of the Journal offered its readers a scientific explanation of the winter's cold, quoting R. Hanson, described as a "weightman" at the U.S. Weather Bureau's Washington, D.C. office. According to Hanson "the bowlful of northern polar cold air has a way of overflowing by way of Iceland, by way of Labrador and Hudson Bay and by way of the MacKenzie River Valley. After a heavy overflow down the MacKenzie Valley, the polar reserve of cold seems for a while to lose its pep. The passing winter [i.e. 1935-1936] has been peculiar in that the MacKenzie and Labrador overflows have both been liberal. Our northern plains states have felt the MacKenzie Valley waves in their full force. We don't know what causes polar air to spill out so eccentrically. We [simply] don't

know....".

Yet, as noted previously, the skepticism of meteorologists such as Hanson, Marvin and others did not prevent many of their fellow scientists (as well as others) from searching for long term atmospheric patterns and cycles which, they thought, would allow them to understand and, more importantly, predict future weather events. One of the less reputable of this group was the aforementioned Henry Janvrin Browne, an obvious charlatan whose dramatic but specious theories appear to have attracted extensive public attention. In its 15 August 1930 edition, the Brown County Journal, for example, noted that Browne's long range forecasts had brought him "into conflict with the Weather Bureau from time to time". He was quoted nonetheless, saying that the "present break in the heat wave was only temporary and that there will be no definite end until Labor Day". Browne was further quoted as contending that "a sun spot cycle coupled with a lunar cycle had destined the summer of 1930 to be hot and dry". "Records," he asserted, "indicate that hot and dry summers come every fifty six years. Similar conditions to those of this summer prevailed in 1874 and 1818. The moon has traveled so far north it had pulled the waters of the Atlantic Ocean westward, dragging with it the heat of the Gulf Stream under which the Mississippi Valley has sweltered...". Confirmation of the Weather Bureau's antagonism toward Brown's theories was provided by the Minneapolis Star on 1 August 1930. According to the Star, U.G. Purssell, Minneapolis Weather Bureau meteorologist emphatically stated that if Browne is "an educated man, he's just another charlatan". Browne's "alleged reasoning" (a reference to his theory that drought and heat are caused by an "argument between sun spots and spots on the moon") was, in Purssell's words, "all wet". "Browne's long range forecasts are about as far off as the moon and the moon is a little too far off to change our weather". Another theory, demonstrably more preposterous even than Browne's sun-moon conflict, was advanced by a Brown county Minnesota farmer who, according to the 12 January 1934 edition of the Brown County Journal, thought that the earth "was slowly tipping southward". This individual (whose name was prudently omitted from the Journal story) supported his view by claiming that his measurements showed that the shadow cast by his windmill onto his house had gotten progressively lower each December, evidence of a change in the tilt of the earth and the reason for the then perceived warming of Minnesota's climate.

Although the fanciful speculations of Browne, New Ulm's unidentified farmer, Mears and others were easily dismissed and discredited, weather cycle research done by credible scientists appears to have been widely publicized and widely accepted during the 1930's. One such researcher was Dr. C. G. Abbott, secretary of the Smithsonian Institution in Washington, D.C., who, it was said, had predicted the 1934 drought "with a high degree of accuracy". According to a story which appeared in the 23 August 1935 edition of the Brown County Journal, "weather forecasts years in the future are now possible," the result of Dr. Abbott's work. Devastating droughts, it was claimed, "may be predicted in the future years ahead as accurately as tomorrow's weather is forecast. Dr. C. G. Abbott....an outstanding authority on radiation of the sun, announced new results of his studies of the effect of variations in the sun's rays on the earth's weather, which holds great promise for long range weather forecasting.....He has established a definite twenty three year cycle of weather changes which apparently [are] dependant on a double sun spot cycle in solar radiation. In

this cycle, temperature and rainfall at numerous points over the earth's surface approximately duplicate conditions at the same point twenty three years before.

"Tall, scholarly Dr. Abbott was quick to point out that the repetition would not follow exactly from month to month each twenty three years but that in general normal or abnormal weather could be expected to recur at approximately that interval. Thus another major drought may be expected in 1957. His conclusions were reached after a study of two sets of data. One was composed of daily records of solar heat reaching the earth obtained at lonely stations of the [Smithsonian] institution on Table mountain, California; Montezuma, Chile; and Mt. St. Katherine in Egypt.

"These showed there were twelve recurring periods in solar radiation, which were almost identical at the three widely separated points. Dr. Abbott was then able by mathematical analysis to work out the twenty three year cycles. The second set of data consisted of weather records, some going back millions of years. The water levels of the Great Lakes reflecting precipitation in the drainage area during the past one hundred years showed a regular twenty three year cycle. Analysis of tree rings, going back to 1306 B.C. also demonstrated the cycle. One of these rings is added each year and its thickness depends on the amount of water available."

Another, but seemingly less credible (or perhaps misrepresented), version of Dr. Abbot's twenty three year cycle theory was presented in November 1933 at Cambridge, Massachusetts. According to the 23 November 1933 edition of the Marshall County Banner (Argyle), Abbott, in a presentation to the national academy of science cited evidence indicating that "electricity controls weather all over the world". The "electric control," it was said, "runs in a definite cycle, causing rains, droughts and heat spells to repeat themselves once every twenty three years, with comparatively minor variations for individual localities. This electric cycle comes from the sun. Spinning like a big top, the sun's northern and southern hemispheres are electrically charged the opposite of each other, one positive, the other negative. These charges reverse from north to south, taking twenty three years for the change.

"Dr. Abbott gave records to show that the rainfall of central India followed this cycle from 1865 to date with three complete repetitions, and that study of Bismarck, North Dakota records from 1875 showed the same thing so strikingly that the weather from 1921 to 1932 was predicted 'very well' from the previous twenty three year cycles. If the weather of 1911 is repeated in Grand Forks next year [1934] there will be 23.18 inches of precipitation according to figures at the United States weather observatory at the University [of North Dakota]. That is 3.69 inches above [the] normal of 19.49 inches for a year. The recent dry years have reduced the normal considerably below what it was then, and the 1911 figure was just slightly above the average of those times. The highest yearly precipitation ever reported for the city [Grand Forks] was in 1901 when 26.4 inches were reported."

Still another (but more nuanced) weather cycle hypothesis was featured in the 18 February 1936 edition of the Minneapolis Tribune, an account which quoted Kincer as asserting, contra Abbott, that, the climate "hops, skips and jumps: it does not swing like a pendulum".

The Tribune story, nonetheless, opened by stating that "there are strong indications that the present abnormally cold winter over most of the United States marks a climatological turning point". "Since 1914" it was claimed, "the mean annual temperature of the country has been rising and the mean annual rainfall declining. Henceforth, it is likely that [that] this trend will be reversed. There will be colder, snowier winters and cooler, wetter summers.

"Such is the belief of Joseph B. Kincer, chief of the climatological division of the United States Weather Bureau. Kincer does not, he emphasizes, make this as a prediction. (emphasis added). The data are too tenuous and elusive to form the basis of any sort of forecast. The fact is, however, that twice before in the past 125 years, when the cumulative ten year temperature and precipitation average reached about the point they had reached in 1935, there was a quick turn in the reverse direction. Betting is in favor of a recurrence of the same phenomenon.

"During the last twenty years of increasing warmth there have been ups and downs, with some of the coldest winter weather on record. The fact remains that by treating the mean temperatures statistically, the accumulation of temperatures above normal and the deficit of rainfall below normal have been greater year after year. It is practically certain, Kincer's figures show, that climate moves in cycles. He has been unable, however, to find any time factor in these cycles (emphasis added). It cannot be said that a warmth accumulation period will change to a period of increasing deficits after running a definite number of years.....so the statement that the world has come to a climatological turning point doesn't necessarily mean that next winter will be colder than this one, or as cold. It may be very warm, just as the winter of 1918 in the period just passed was very cold. But the average for the next twenty years, it is likely, will be colder than that for the last twenty years, with warm winters, normal winters and abnormally cold winters all bunched together.

"The United States Weather Bureau is a cooperating member of an international organization which collects and publishes the records for 500 stations scattered over the world. These records, extending from 1910 to 1927, have just been published by the British Meteorological Office. They show clearly, Kincer says, that these alternating trends are world wide. They might not be apparent at any one place. Strictly local conditions have a profound effect on climate. But taken over a period of twenty years or more, almost any station tends to fit itself into the world picture. There is doubtless, Kincer says, some world wide factor involved. Meteorologists can come to no agreement as to the nature of this factor. It is something sufficiently powerful to dominate widely different local conditions and may have a definite time swing. Records are too short to determine whether this is true.

"Superficially, meteorologists can give a reason why the winter is abnormally cold. An excess of cold air has been piling up somewhere in the Arctic basin. Very likely it has been accumulating there for twenty years. Now it is spilling over. Great masses of it are rushing down the MacKenzie river, just east of the Canadian Rockies, over the Central Plains areas of the United States and then eastward through the Central states to the Atlantic. It is as if somebody had pulled out a plug to let out the cold air. But what that plug is, where it is, or what pulls it are completely unknown. Physically the MacKenzie valley has been just as clear for the last twenty years as it is today but for some reason or other, it hasn't been letting the

cold 'highs' through in such quantities."

On 16 July 1936, the Tribune introduced its readers to yet another weather prophet, one who foolishly [stupidly?] predicted an early end to the drought then ravaging much of the Upper Midwest and the Great Plains. This account featured Shelby Maxwell, described as an astronomer-meteorologist, who based his forecasts on "wobbles" in the moon's orbit and who, it was claimed, had anticipated 1936's hot, dry weather six months before it occurred. According to the Tribune report, Maxwell had predicted an "immediate end to the drought, with its crop damage and threats of rising food prices.....There [will] be no more damage from the drought after Thursday [15 July], he asserted, although it may take the nation ten days to accept the fact. By July 26...there will be so much rain that everyone is going to see that the drought danger has ended.....Maxwell predicted the drought's end with the same air of confidence with which he warned of its coming around Christmas time in 1935.

"At that time he glanced at his long range forecasting charts based on the distances the moon wobbles in its orbit and opined that January and February [1936] would have heavy snow and that drought would develop during March, April and May and do its worst in June and July [1936]. All that came to pass. Wednesday night Maxwell looked at his charts again. They showed, he said, that the end of the drought began with last week end's rains the ones the Weather Bureau expected would break the heat wave. When the break failed, Maxwell said, the cool wave did not dissipate as some weathermen believed, but had shot northward over the uninhabited wilds of Canada and looped back Wednesday from the Hudson Bay region. His maps, made months before, outlined the loop clearly. Wednesday night and Thursday, Maxwell predicted a 'considerable drop' in temperature perhaps twenty to twenty five degrees accompanied by rain from the Great Lakes to Alabama, Georgia and the Carolinas and bringing rains and colder temperatures to the lower half of the corn belt, he declared."

Interest in climatic cycles and the attendant yearning for reliable long range weather forecasts was not, however, an exclusively 1930's phenomenon. The search for the recurring and predictable patterns which, it was assumed, lay hidden behind the seemingly random changes in day to day weather can be traced back to the ancient world. This search, predictably, become more rigorous and systematic in the 19th century, an epoch characterized, inter alia, by an increased confidence in the ability of modern science to predict and control nature. An instructive summary of these efforts was provided in an address delivered by Sir Richard Gregory to the Royal Meteorological Society [United Kingdom] on 15 January 1929. This address, which was published in the December 1930 issue of the U.S. Weather Bureau's Monthly Weather Review and is quoted in part as follows:

"Speculations and explorations relating to cycles of natural phenomenon have always been of popular interest; and even when the evidence relating to them is tested by statistical standards of correlation coefficients their study is of value, however discouraging the results may be. It seems worthwhile, therefore, to devote my address this year to a general description of some weather recurrences and weather cycles which have at various times been accepted as

articles of belief or derived from rigorous examination of evidence. From a strictly scientific point of view, it may be thought that no cycle is of substantial interest unless the proximate or ultimate cause of it is understood. Such a view can not, however, be maintained, particularly in meteorology, in which purely empirical knowledge may be the basis of methods of forecasting weather. The waxing and waning of solar activity in a period of about eleven years can be used to predict variations of solar radiation with fair precision, yet we do not know the cause of this cycle any more than we know the cause of gravitation which determines the movements of the planets. The first duty of science is to collect facts, and if these lead to a hypothesis, to test by observation and predictions suggested by it. When prediction is confirmed by sufficient experience, the hypothesis may be raised to the dignity of a theory, or even a law of nature.

"With the generous aid of our encyclopedic secretary, Dr. C. E. P. Brooks, I am able to present a general survey of some studies or cycles or periodicities of weather from the point of view of possible forecasting. He has, however, himself remarked that the search for the golden cycle in weather is similar in its history to the search for the philosopher's stone it has not been found, and we are more and more compelled to the belief that it does not exist. Periodicities in weather there undoubtedly are, but they are usually either so small in amplitude as to be of academic interest only, or they show baffling changes of phase and amplitude.

"If in what I say I may seem to deal too critically with some beliefs which are still cherished by many amateur meteorologists, as well as by the general body of the public, my excuse must be that in these matters there is a very real danger of misconception. In judging the work of an official meteorological service there is a tendency to forget the successes and remember only the failures; whereas the prognostications which depend on wise saws and cycles receive more lenient treatment from the public. The failures are forgotten while the occasional successes are proclaimed from the housetops. Perhaps it is our habit of treasuring rarities which is responsible.....

"The monthly cycle of changes of the moon is believed by many people to be associated with changes of weather. As the moon is chiefly responsible for the rise and fall of the tides, it would seem reasonable to suppose that the earth's atmosphere is affected in the same way, and that there are air tides which may vary through the lunar month, like the spring and neap tides of the sea. Such atmospheric tides have indeed been detected, but they represent a difference at Greenwich of appreciably less than one-thousandth of an inch in a barometric reading, and are, therefore, scarcely worth considering as a sign of any change in the weather or a factor in forecasting. As on average our weather changes every fourth day, it is not surprising that such changes should occasionally coincide with changes in the moon which occur every seven days. Any success achieved by weather prophets who base their predictions upon the time of day

when the moon enters one of its four quarters must, therefore, be attributed to the laws of chance and not to any actual relationship. Even when weather does change with the change of moon, there is no regular cycle of weather conditions corresponding to the monthly cycle of moon phases.....

"Though weather is independent of the moon's movements or aspects, the same kind of weather tends to occur at definite dates annually on account of the successive changes in the sun's position. Each year the seasons summer and winter come round with the same approximate regularity, while spring and autumn also have similar characteristics. In addition to the four seasons, a cold spell has been stated to occur regularly early in May and has been associated with the so-called 'Ice Saints.' Various explanations have been offered to account for this cold spell, the most popular being that in the course of the regular annual series of pressure changes which results from the sun in spring, an anticyclone develops over northern Europe at this time and causes a period of northeasterly winds. Another cold spell is supposed to occur in June, caused by the development of monsoon winds blowing into the interior of Europe. The chief explorer of these regular spells was Alexander Buchan who defined them as follows: 'deductions from all observations hitherto made show that there are certain periods more or less well defined when the temperature, instead of rising, remains stationary or retrogrades instead of falling, stops in its downward course, or even rises.....These...periods were deduced from observations taken in Scotland during a period of ten years in the middle of the nineteenth century. In spite of this limitation, however, they have been assumed by many newspaper correspondents to be equally valid for the temperature of London in the twentieth century. Such an assumption is quite unwarranted.....No scientific evidence has ever been adduced that cold or warm periods have any tendency to occur in London on Buchan's dates.

"From these considerations of belief and evidence in weekly, monthly and annual recurrences of similar weather we may pass to cycles having periods of several years. A lunar cycle which may have suggested weather cycles is that which determines eclipses. The Chaldeans and the Egyptians knew that eclipses recur after an interval of a little more than eighteen years, and this cycle, known as the Saros, formed the basis of their very successful eclipse predictions. The cycle was discovered thousands of years before the astronomical movements which determine it were understood, but it was established as the result of observation.; and no similar evidence is available upon which a related weather cycle can be based. It is true that H.C. Russell in 1896 concluded from an inquiry into droughts extending over a period of a thousand years, particularly those in New South Wales in a period of 108 years, that the records fitted into a cycle of nineteen years, but this cycle does not stand the test of critical examination.

"Dr. Russell suggested that the ancient Egyptians knew of the nineteen years' cycle and that Joseph was versed in the wisdom of the priests and therefore able

to predict Pharaoh's drought. He regarded Elijah's prediction as a repetition of this drought 49 X 19 years after it and Elisha's as nineteen years after Elijah's, but the factor might just as well have been fourteen instead of nineteen, as this was apparently the cycle upon which Joseph based his long range forecast.....As we know from Biblical writ this forecast was successful, and the probable basis for it was a weather periodicity of about fourteen years. The periodicity could not have been very highly developed, or it would have been common knowledge, but it must have been sufficiently well marked to influence the general character of the succession of years.

"Since that time many attempts have been made to discover weather cycles which can be used for long range forecasting, but in none are prediction and fulfilment combined so dramatically as in the story told in Genesis. This cycle and some others already mentioned have received much popular attention; and most of them are in a different category from those which have merged from close meteorological inquiry. Every year the weather is in some sense abnormal, but the past twelve months have given us rather more than our fair share of extremes, beginning with the most severe winter since the famous frost of 1985, continuing through several long periods of drought to the rainiest November and stormiest December on record. Unusual weather always leads to much discussion in the press of the time honored subject of weather cycles, and 1929 was no exception. The point that the interval of thirty four years since 1895 was within a year of the famous Bruckner cycle was not missed.....

"Alone among modern weather cycles, that of thirty five years has a background of tradition, for it was described by Sir Francis Bacon before 1625. Many of you are familiar with the passage from his essay 'On Vicissitudes of Things:' 'there is a toy which I have heard, and I would not have it given over, but waited upon a little. They say it is observed in the low countries (I know not in what part) that every five and thirty years the same kind and suit of years and weathers comes about again, as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like and they call it prime; it is a thing I do the rather mention, because, computing backwards, I have found some concurrence.'

"This weather cycle was rediscovered and carefully investigated by the late Dr. Eduard Bruckner, then professor of geography at the University of Bern, and it is now known generally as the Bruckner cycle. His great work 'Klimaschwankungen seit 1700, nebst Bermerkungen uber die Klimaschwankungen der Diluvialzeit,' published in 1890, has become a classic for the patient collection and analysis of material from a great variety of sources. He studied all the long records of rainfall, pressure, and temperature available at the time, and carried the record back into earlier centuries by utilizing the variations of level in the Caspian Sea and other lakes in inclosed basins and in the great river systems of the world, the historic variation of ice conditions on the rivers of Europe, the dates of the wine harvest and the

frequency of severe winters. From all this material he deduced the existence of a long succession of cycles [a] series of generally warm and dry years alternating with [a] series of generally cool and rainy years. From 1020 to 1890 A.D. he found twenty five cycles, giving an average length of 34.8 years, but the individual cycles varied between twenty and fifty years. With this in mind we must not expect too much from the Bruckner cycle, for so great is this variation that only one cycle out of five comes within two and one half years of the expected length. When in addition one remembers that the amplitude of the variations is so small that in meteorological statistics the existence of the cycle can only be seen at all as the result of extensive smoothing, it becomes obvious that the Bruckner cycle is useless for the purpose of making long range forecasts of weather, and the interval of thirty four years between the cold winters of 1895 and 1929 takes its proper place as a mere coincidence.

"Bruckner himself was far from claiming the mathematical regularity for his cycle that such exact recurrences would require, for he wrote; 'This is no single periodical meteorological phenomenon, which must fulfil itself with mathematical exactitude from one occurrence to another. Of the reality of a marked annual period of temperature or of rainfall there can not be the slightest doubt, and yet we see the epochs from year to year fall not exactly on the same months, but now on the one, now on the other month, owing it may be to the influence of disturbing factors, which enter differently from year to year, or it may be to certain accidents. It would be very remarkable, if such accidents did not enter into our secular variations.'

"The true value of Bruckner's work lies in a different direction. Although the amount of rainfall may vary widely from one year to the next, the quantity of water which is stored up on the land areas, in the soil, in lakes and in glaciers, varies far more slowly. This stored water is not so closely related to the rainfall of the one preceding year, as to the average rainfall of the ten preceding years, and if these ten years fall in the wet half of a Bruckner cycle, the quantity of stored water will be great. Again, in the dull, rainy countries of northwest Europe, warm, dry years are favorable for crops and vegetation, and on the whole the dry warm half of a Bruckner cycle will yield better crops than the cool, wet half, although there may be wide variations from one year to the next. An agricultural community must take the bad years with the good, and trust to the surplus from a rich harvest to tide over a year of dearth, but at the end of the warm half of the cycle the community will be prosperous, while at the end of the cold half it will be poor. Hence waves of emigration and the movements of peoples are closely related to climatic cycles such as Bruckner's, which in this way leave their mark on history. That, and not long range forecasting, is the role of the weather cycle. This view of its [the Bruckner cycle's] importance in economic life was in fact taken by Bruckner himself.....

"This idea was further elaborated in the United States by Henry Ludwell Moore, a professor of political economy, who turned meteorologist.....he

summarized his conclusions as follows: 'The rhythm in the activity of economic life, the alternation of buoyant, purposeful expansion with aimless depression, is caused by the rhythm in the yield per acre of the crops, while the rhythm in the production of the crops is, in turn, caused by the rhythm of changing weather which is represented by the cyclical changes in the amount of rainfall.....'. Moore discovered two periodicities in the rainfall of the Mississippi Valley from 1839 to 1910, one of eight years and the other of thirty three years, and the latter may reasonably be identified with the Bruckner cycle. Its exact length is a matter for dispute, different authorities giving various values ranging from thirty three to thirty six years, but this uncertainty need not disquiet us. The non-instrumental records, like severe winters and fluctuations of water level, are by their nature somewhat vague; even the records of the annual rings of tree growth have not the exactitude of good observations with meteorological instruments. On the other hand, trustworthy instrumental observations go back little more than a hundred years, and cover only three or at most four cycles, a period which is not sufficient for determination of length. The general average of all the estimates, however, can not be far from Bruckner's original figure of 34.8 years, which thus gains in probability from attempts to improve or supplant it.

"Further inquiries, however, reveal departures from this estimate. The Bruckner cycle has received a great deal of attention, but this is probably due more to the fact that it has a name and a history than to its intrinsic importance. Brunt's elaborate examination of long meteorological records in western Europe did not display the thirty five year periodicity as any more noteworthy than several others; in fact, it could only be found at all in six of the twelve long records examined. Bruckner took his material largely from the records of severe winters in Europe, but the late Dr. C. Easton, who reexamined the periodicity of winter severity, using data far more complete than Bruckner's, found no evidence of a thirty five year cycle, giving his vote instead to a periodicity of eighty nine years with a well marked half cycle of 44.5 years. He summarized his conclusions as follows: 'within each interval of 44.5 years, to begin with 759.5 A.D. the first half is colder than the second. To this rule there have been no exceptions since 1200. Within each interval of eighty nine years, to begin with the year 759.5 the first half is colder than the second.' Since 1116 there has been only one exception. It should be noted that both these rules would give a period of cold winters commencing in 1917.

"In the rainfall of Great Britain, the Bruckner cycle is far less important than one of fifty years. The authoritative pronouncement made by the council of the Royal Meteorological Society in the matter of the supposed influence of broadcasting on weather contained a passage pointing out that groups of wet years in England have occurred about 1770, 1821-1830, 1871-1880 and 1922-1928, four recurrences at intervals of about fifty years separated by groups of dry years in 1741-1756, 1801-1810, 1851-1870 and 1891-1910, the inference being that the wet years since 1922 were due to some natural period of

oscillation of the rainfall, and not at all to the relatively small electrical disturbances of the ether by human agencies.

"Before leaving the subject of the thirty five and fifty year weather cycles, mention may be made of one feature of Bruckner's results which is not without interest. He found that the length of his cycle varies from twenty to fifty years, but it does not seem to have occurred to him that this variation most probably came about because he was actually dealing with two periodicities of about the same amplitude but of different lengths.....

"There is another cycle which has claimed great attention in relation to weather, namely, the sun spot cycle of eleven years. The literature on this subject is enormous, but critically examined, it may be reduced to very little. Sun spots are a useful index of the activity of the sun and they go through a not very regular cycle with an average length of 11.125 years. Taking account of the change of polarity discovered by Dr. G. E. Hale, it is more accurate to say that sun spots go through a double cycle of 22.25 years. In terrestrial phenomena, these changes of solar activity are accompanied or closely followed by fluctuations in the elements of terrestrial magnetism and by variations in the frequency of auroras. E. J. Lowe, after an elaborate investigation of the dates of all droughts and frosts of historic times in Britain of which he could find mention, concluded that there was an eleven year cycle of the seasons with maximum variability at the end of each century. Writing in May 1880, he stated that the drought which had begun in October 1879 could be expected to last three years, and that the 'the intensity of the winters about 1896 will be greater than those we have just experienced'. Actually, the drought ended at the close of the month in which he wrote, but 1896 might be taken as a fairly close estimate for the cold winter of 1894-1895.

"In matters of weather, a connection with temperature was first suspected by Riccioli as early as 1651 and was clearly demonstrated, for tropical regions, by W. Koppen in 1873. There also appears to be a fairly close relationship between the sun spot number and the rainfall in certain parts of equatorial Africa, especially the plateau of Lake Victoria; and the eleven year cycle in the level of this lake which rises and falls with the rise and fall of solar activity, is one of the best known and most striking illustrations of the connection between solar and terrestrial phenomena.....A similar relationship is found in Lake Albert and further south in Lake Nyasa, though in the latter it is somewhat obscured by the large annual variation in the level of the lake, and by other factors. In Great Britain, the eleven year sun spot cycle, like the Bruckner cycle, is of little importance. Although we are undoubtedly governed in the long run by solar influences, these find their way from equatorial to [temperate] latitudes by many and sometimes devious routes winds, ocean currents, etc. so that their unity becomes lost and they appear as an irregular series of changes following no apparent law. For example, it was found by Dr. G. Hellmann that the rainfall of Europe has two maxima and two minima in each sun spot period,

and he explained this as due to the combination of two causes, the direct effect of the solar variations on the weather of Europe and the indirect effect due to changes at the equator extending their effect northwards.....".

In many respects, of course, Dr. Gregory's comments now appear quaint, even erroneous, reflecting as they do the state of scientific knowledge in the 1920's. Yet, even though our understanding of atmospheric phenomena has increased exponentially in the past eighty years, his skepticism regarding regular, recurring and predictive climatic cycles has withstood the test of time. As regards sunspot theory, Dr. Gregory's dismissive attitude may, however, be unwarranted (or at least overstated). Although climatologists and others appear to have given up the view that there is a direct and immediate cyclical correlation between the number of sunspots and the earth's weather, they have, nevertheless, developed an increased appreciation for the meteorological and climatic significance of changes in solar radiation (as indicated, among other things, by the number and size of sun spots). An example of science's continued interest in this phenomenon was reported on 6 July 2004 by Dr. David Whitehouse, online news editor for the British Broadcasting Corporation (BBC). According to this report, "a new analysis shows that the sun is [now] more active than it has been at anytime in the previous 1,000 years. Scientists based at the Institute for Astronomy in Zurich [Switzerland] [have] used ice cores from Greenland to construct a picture of our star's activity in the past. They say that over the last century the number of sunspots rose at the same time the earth's climate became steadily warmer. The trend is being amplified by gases from burning of fossil fuels, they argue. Sunspots have been monitored on the sun since 1610, shortly after the invention of the telescope. They provide the longest running direct measurement of our star's activity. The variation in sunspot numbers have revealed the sun's eleven year cycle of activity as well as other, longer term changes. In particular, it has been noted that between 1645 and 1715 few sunspots were seen on the sun's surface [the so-called Maunder minimum]. This coincided with a spell of prolonged cold weather often referred to as the 'Little Ice Age'.

"Solar scientists strongly suspect that there is a link between these two events [i.e. the dearth of sunspots and reduced planetary temperatures] but the exact mechanism remains elusive. Over the past few thousand years there is evidence of earlier Maunder like coolings in the earth's climate, [as] indicated by tree ring measurements that show slow growth due to prolonged cold. In an attempt to determine what happened to sunspots during these other cold periods, Dr. Sami Solanki and colleagues have looked at concentrations of a form, or isotope, of beryllium in ice cores from Greenland. This isotope is created by cosmic rays, high energy particles from the depths of the galaxy. The flux of cosmic rays reaching the earth's surface is modulated by the strength of the solar wind, the charged particles that stream away from the sun's surface. And since the strength of the solar wind varies over the sunspot cycle, the amount of beryllium in the ice at a time in the past can therefore be used to infer the state of the sun and, roughly, the number of sunspots.

"Dr. Solanki is presenting a paper entitled 'Cool Stars, Stellar Systems and the Sun' on the reconstruction of past solar activity at a conference in Hamburg, Germany. He says that the reconstruction shows the Maunder minimum and the other minima that are known in the past thousand years. But the most striking feature, he says, is that looking at the past 1,150 years the sun has never been as active as has been during the past sixty years

(emphasis added). Over the past few hundred years, there has been a steady increase in the number of sunspots, a trend that has accelerated in the past century, just at the time when the earth has been getting warmer. The data suggest that changing solar activity is influencing in some way the global climate causing the world to get warmer. Over the past twenty years, however, the number of sunspots has remained roughly constant, yet the average temperature of the earth has continued to increase. This is put down to a human produced greenhouse effect.....This latest analysis shows that the sun has had a considerable influence on the global climate in the past, causing the earth to warm or chill.....".

Yet, despite the extensive and often intense public and scientific interest in the reality and predictive value of Bruckner cycles, sunspots, wobbles in the moon's orbit and the like, not everyone in the 1930's was willing to wait for nature to bring an end to the decade's drought and heat. There were, rather, a number of individuals and groups individuals and groups with questionable motives who told distressed farmers and others that it was possible to control the weather, coaxing rain out of the 1930's dusty skies. Rainmakers, then, were undoubtedly able to get many people to pay for rainmaking services services which produced no rain but which left the payee richer and the payer poorer. In a scathing article written by Dr. Frank Thone and published in the 1 August 1936 edition of the Minneapolis Star, rainmaking was, with ample justification, called a racket which produced "rich harvests" for the rainmakers and regrets for their victims. Thone, described by the Star as a specialist in agriculture, biology, geology and "allied sciences," began his comments with a pair of rhetorical questions: "Can't we do anything about the weather? Must we just sit still and let the rain come when it gets good and ready?" His answer was that "we can't and we must." "For in spite of the old and often quoted complaint of Mark Twain, there is as yet nothing that can be done about the weather". He then went on to state that "the usual crop of weather making proposals has been harvested of the drought. These pseudo-scientific suggestions always flourish when all useful growth is scorched with sun and perishing of thirst. They grow when even the cactus wilts. Rainmakers need only one kind of fertilizer money. They invariably make the modest proposal: you pay my expenses while I do the work, and a bonus for every tenth of an inch of rain that falls. No rain, no bonus. Only my living and travel expenses and the cost of the secret chemicals used in my formula. If rain falls, they take the credit and the cash. If no rain falls, they still take considerable cash for the 'secret chemicals' are invariably expensive. Heads I win, tails you lose: what could be a sweeter racket for a smooth talking professor with a Van Dyke beard?

"Older rain making methods are simpler and less expensive for their practitioners. The magicians of primitive tribes imitate the sound of thunder with rattles and drums, or they throw water in the air, or they nick a vein in the chief's arm and let a little blood or go through some other 'sympathetic' procedure. But like their more cultured colleagues of our own land, they still get their expenses paid. There is just one drawback for the racket among at least some of the tribes. If the magic doesn't work, the medicine man may get a synthetic lightning stroke in the shape of a war club on the cranium. So he usually waits until the wind is in the right quarter before he goes into his dance".

Thone's article also ridiculed long range forecasting, calling it "a less expensive civilized racket which some practitioners manage to make quite remunerative". These, he scathingly

described as "quasi-astrological long range forecasters who undertake to predict the weather months or even years in advance". "Such gentry show impressive looking charts of lunar and planetary positions or terrific tables of world weather statistics, such as to deceive, if possible, even the elect. One trouble about scotching this particular tribe of charlatans is that some honest efforts are being made by real scientists to extend the range of forecasting from the present couple of days to two weeks or more. The U.S. Weather Bureau is looking into half a dozen various methods, none of which at present professes even an approach to infallibility yet all of which might conceivably turn up something worth while. Probably one safe touchstone is to find out whether the hopeful forecaster is vending his prophetic wares for cash. If he is, you are privileged to look on him with a very, very skeptical eye."

Yet, no doubt to the disappointment of their often desperate patrons (victims?), most of the rainmakers and others who claimed that they could alleviate the 1930's drought by artificial means (e.g. with "secret chemicals") turned out to be, hucksters and, worse, swindlers. Moreover, those who relied on climatic cycles, whether to explain the cause of the drought or to predict its end, their scientific pretensions notwithstanding, were typically misguided or worse, often relying on theories which, when closely examined, were little more than the concoctions of charlatans, defying both empirical verification and common sense. Thus, the fundamental scientific question "what caused the drought?" either went unanswered or was answered with what, in most instances, were non-answers dressed up as answers. We are, then, left with a question which, even in the light of early twenty first century knowledge of atmospheric cause and effect (e.g. our knowledge of upper air phenomenon such as the jet stream and our increased understanding of the interactions between the air, the oceans and the sun) still seems to lack a definitive answer. But even if it does not provide definitive answers, current knowledge of atmospheric phenomena is sufficient to provide retroactive, proximate answers answers which eluded our 1930's ancestors (meteorologists included) whose knowledge of the dynamics of weather was largely limited to surface observations and/or to observations taken by instrument carrying balloons or propellor driven aircraft flying in the lower levels of the atmosphere. Or, to put it differently, there are enough data available from ground and tropospheric observations to permit description of the atmospheric configurations which caused and accompanied the dust storms, heat waves and other climatic events of the 1930's. More importantly, however, there are data sufficient to support reasonable inferences concerning the upper air and oceanic conditions which, on some level, can be said to have "caused" the climatic anomalies of the period.. And, finally, there are obvious, commonly recognized secondary factors which, although they do not cause drought, act to sustain, reinforce and intensify drought once it occurs (i.e. the tendency of drought to reinforce and prolong itself, the result of reduction or sometimes even the practical elimination of the rain stimulating evaporation which occurs when the soil is wet and vegetation is lush).

One of the most persistent and in retrospect one of the least surprising features of the atmospheric circulation during the 1930's was, as noted previously, the westward extension of what is now called the Bermuda High. Much of the United States, the Midwest especially, was thus deprived of its normal supply of Gulf of Mexico moisture, the result of an anticyclonic "block" situated at various times over the southeastern United States and/or the Gulf itself. This pattern was particularly pronounced during the summer of 1930, a

period of entrenched and extreme drought extending from the south central United States through the Ohio Valley and into the mid-Atlantic states. In this regard, atmospheric circulation maps published in the September 1933 edition of the Monthly Weather Review, featured a "high level" anticyclone which was centered over Louisiana, Mississippi and Arkansas during July 1930 and over Louisiana, Arkansas, Texas and Oklahoma during August 1930. The result was an outflow which moved hot, dry air from the southwest over the "top" of the high, spreading abnormal heat into the Midwest and much of the eastern seaboard. In addition, the summer of 1930 was marked by a high pressure ridge extending eastward from the Bermuda High into the mid-Atlantic states (which, as noted in previous discussion, were then experiencing unprecedented heat and drought). The U.S. Weather Bureau's daily weather maps for the summer of 1930 also indicate the relative persistence of an anticyclonic pattern over the Great Lakes. Undoubtedly, also, the subpolar jet stream was far to the north of its normal path during much of 1930, a pattern which, as early as February 1930, produced what the September 1933 Monthly Weather Review described as an "unusually large crop of cyclonic storms, most of which entered the continent north of fifty degrees north latitude and moved eastward at or north of the Canadian boundary...".

Although high pressure "blocks" continued to dominate the southern United States during much of 1931 and 1932, the Monthly Weather Review's September 1933 maps suggest that the center of anticyclonic activity sometimes migrated westward, centering itself over Texas, Oklahoma, New Mexico and parts of Kansas and Arizona during August and September 1931 (and again in September 1932). As a result, warm, dry air continued to flow into the middle sections of the country, producing record warmth during September 1931. More moist air, however, was able to reach some areas along the eastern seaboard, thus ameliorating the drought which had ravaged that area during the summer of 1930.

Obviously, however, the general patterns (blocking high pressure, shifts in the jet stream, etc.) which prevailed during much of the 1930's do not specifically document the atmospheric conditions associated with events such as the May 1934 and July 1936 heat waves, the warm winter of 1930-1931, etc. Any adequate explanation of such events must, then, go beyond generalities, describing (to the extent possible, given the limitations of 1930's data) the atmospheric phenomena which accompanied and which caused (or at least contributed to) the decade's most noteworthy weather events. During one such episode, namely the 1930-1931 winter without a winter, January 1931 weather maps indicate, for example, that a persistent high pressure regime was entrenched over much of the contiguous forty eight states, diverting cyclonic activity to the north and the south and east and establishing a pattern which undoubtedly reduced cloudiness and kept most of the country free of significant snow cover. Moreover, the polar jet stream, it can be inferred, was far to the north of its normal winter position, thus sharply reducing the number and intensity of Canadian generated winter cold waves.

In June 1933, a month which brought extreme heat and drought to many areas of the country (including Minnesota), the northern jet stream was displaced far to the north of its usual summer position, a high pressure ridge dominated much of the central part of the country and a persistent blocking high over the southeastern United States (as in so many

summer months during the 1930's), diminished the northward flow of moisture from the Gulf of Mexico. The result was a stagnant air pattern which reduced cloudiness (and, of course, rainfall), allowing the sun to further bake the increasingly dry soil, thus intensifying the drought. Interestingly, also, the June 1933's hot, dry weather was preceded by an active pattern which brought ample rainfall to many areas of the country during May 1933.

Also of interest are the atmospheric patterns which generated two of the 1930's most noteworthy events, namely the great dust storm of 9-10 May 1934 and the heat wave at the end of May 1934. On 8 May 1934, the day preceding the first of the two events, a moisture starved low pressure system (29.8 inches) was centered over the Dakotas with high pressure over the Great Lakes and parts of the eastern United States. The low pressure system intensified (29.45 inches) and moved into northwestern Minnesota on 9 May 1934, high pressure remaining over the mid-Atlantic. On 10 May, low pressure was centered over the Hudson Bay region, dragging a sharp cold front behind it, making way for a cold anticyclone (30.3 inches) which settled over Minnesota on 11 May. On 12 May, however, the high pressure system (still at 30.3 inches) had moved to the eastern Great Lakes while a new low pressure system (29.6 inches) dropped out of Canada, reaching South Dakota and Nebraska. On the same date (i.e. 12 May) portions of Minnesota experienced a second dust storm, a storm which, however, was much less severe than the 9-10 May storm. On 29 May 1934, one of the first days of the record setting May heat wave, Weather Bureau maps showed high pressure over northern Minnesota, low pressure in the Hudson Bay region and high pressure over the southwestern United States. On 30 May, an intense low pressure system (29.35 inches) had moved into North Dakota with high pressure over the eastern Great Lakes. And on 31 May, a day on which temperatures in Minnesota and elsewhere reached unprecedented heights, low pressure (29.4 inches) had moved into northwest Minnesota, drawing hot southern air along the leading edge of an apparent cold front (a front which was accompanied by an apparent warm front on the easterly side of the low pressure system, a front which had been pushed as far north as southern Canada). It is probable that the same southerly flow brought more humid air to the Upper Midwest, providing the moisture which fueled an outbreak of rainy weather during the first days of June 1934.

During the famous (infamous?) winter of 1935-1936, atmospheric patterns were virtually opposite those which characterized the warm winter of 1930-1931. Daily weather maps drawn during 1936 clearly indicate that the northern jet stream had sagged far south of its normal position, pulling bitterly cold Canadian air into much of the northern, central and even southern United States. More specifically, February 1936 maps published in the Monthly Weather Review show a succession of cold anticyclones moving out of Alaska and western Canada, then shuttling southward along the eastern edge of the Canadian Rockies and into the Dakotas before moving in a southeasterly direction across Iowa and northern Missouri. January 1936 maps appearing in the same publication show a similar pattern but suggest that the jet stream had not dipped as far south as it did during the subsequent month (i.e. during February 1936). Maps for both months suggest, however, that the winter's cold air originated not in Alaska and northwestern Canada but in Siberia, being drawn across the Arctic ice cap before entering North America. In Minnesota, the coldest days of the winter included 23 January and 16 February 1936, the latter date effectively marking the end of the bitter cold which had first engulfed Minnesota and surrounding states in mid-January.

Maps for the first of these two dates show the core of a dense (30.4 inches) and extremely cold high pressure system sliding down over Minnesota. And on 16 February, the maps show an enormous high pressure ridge extending from Canada to the Gulf coast. Temperatures on that date fell to the forties and fifties below zero at many Minnesota and Dakota stations with numerous below freezing readings in the Gulf coast states. Two days later (18 February), temperatures of 36 F and 16 F were recorded at 0800 hours at New Orleans, Louisiana and Vicksburg, Mississippi, respectively. Moreover, as noted in previous discussion, the winter of 1935-1936 featured several severe blizzards, the worst of which were produced by low pressure systems (popularly known as Panhandle Hookers) which entered North America in the Pacific northwest, passed over the Rocky Mountains, reformed in the Texas-Oklahoma Panhandle region and "hooked" northeastward, bringing heavy snow and strong winds to the Dakotas, Minnesota, Iowa and Wisconsin.

The winter of 1935-1936 was followed by a summer which, from one point of view, marked the beginning of the end of the 1930's drought or which from another point of view was the worst climatic event of the decade (perhaps even of the century). As in the other dry years of the 1930's, the summer of 1936, July in particular, featured an anticyclonic block (an extension of the Bermuda High) which lingered over the southern and southeastern United States. The resulting outflow, combined with a displaced polar jet stream, favored development of a southwesterly circulation pattern which pumped hot air into the Midwest, raising temperatures to 100 F or higher each day at many locations during a torrid heat wave which began on 6 July and ended on 14 July. In addition, the resulting stagnant weather pattern suppressed precipitation, leaving much of the country without significant rainfall during a two month period extending from mid-June to mid-August 1936.

Predictably, high pressure was predominate over much of the Great Plains area during the peak of the July 1936 heat wave. On 14 July, however, the weather maps also indicated an approaching cold front, a front which, although obviously moisture starved, did bring cooler weather to Minnesota and surrounding areas. Specifically, the Weather Bureau's 14 July map showed a weak low pressure center (29.9 inches) in northern Minnesota, creating a pattern similar to the one that brought record heat to much of the area on 31 May 1934 (i.e. a warm front which had pushed far to the north as the low pressure system approached, allowing extremely hot air to move northward along the advancing cold front). After passage of the cold front on 14-15 July, temperatures in Minnesota (and the Upper Midwest generally) returned to more seasonal levels, weather maps now indicating a predominance of dry, but more temperate, Canadian Pacific air. So far as can be determined, however, the southern anticyclonic block remained in place during much of the remainder of the summer, preventing any significant amelioration of the drought until late August.

As noted previously, another episode of extreme drought engulfed the United States during the closing months of 1939, bringing one of the driest November-December periods on record. With but a few breaks, high pressure was predominate during the entire month of November, the apparent result of a split jet stream pattern which left much of the country in a meteorological "no man's land". Weather maps drawn on 26 November, for example, showed strong high pressure (30.7 inches) over Minnesota and on 29 November high pressure was stretched across the country, extending from the west coast to the eastern

seaboard. In addition to drought, several weeks in late November and early December 1939 were marked by abnormal warmth. In Minnesota, temperatures during the first ten days of December rose into the 60's and 70's F, the apparent result of a combination of high pressure centered over the Dakotas, a lack of snow cover and the warming effects of prolonged dryness. At the peak of the December "heat wave" (6-7 December 1939) circulation around the north side (or "top") of a high pressure ridge over the Dakotas brought then record December maxima to many parts of Minnesota (e.g. 73 F at Marshall, Milan and Beardsley), the warm air being ushered into the state on strong northwesterly winds.

The displacement of the northern branch of the jet stream, the westward migration of the Bermuda High and other anomalous weather patterns characteristic of the Dust Bowl years were, of course, only proximate causes of that era's heat and drought. Inevitably then, such phenomena raise the further question: what more fundamental causes caused the proximate causes? Many have attempted to answer this question, formulating theories of various sorts (e.g. cycle theories) some of which, as noted previously, can claim limited validity and others of which can be dismissed as the speculations of crackpots. There is, however, at least one such attempt which, although it raises further "why" questions (and, therefore, cannot be said to provide ultimate or definitive scientific answers of the type sought by cycle theorists and others), does provide a credible account of the causes of the atmospheric patterns characteristic of the 1930's. This explanation, published in the 19 March 2004 edition of "Science", is the result of a study conducted by several researchers (Siegfried Schubert, Max Suarez, Philip Pegion, Randal Koster and Julio Bacmeister) at the Goddard Space Flight Center. According to this source, cooler than normal sea surface temperatures (SST's) in the tropical Pacific combined with warmer than normal temperatures in the tropical Atlantic to cause shifts in large scale weather patterns and low level winds, the effect of which was to reduce the normal supply of moisture from the Gulf of Mexico, inhibiting 1930's rainfall throughout the Great Plains. More specifically, this combination of cooler Pacific temperatures and warmer Atlantic temperatures weakened the low level jet stream, changing its course. The low level jet stream, it was pointed out, normally flows westward over the Gulf of Mexico, turning northward to pull up moisture, bringing rains to the Great Plains. However, when it was weakened by the SST anomalies of the 1930's, it traveled farther south than normal, causing the Great Plains to dry up.

Relevant sections of this study (entitled "On the Cause of the 1930s Dust Bowl") are quoted as follows:

"In the United States, the 1930's were characterized by a decade of rainfall deficits and high temperatures that desiccated much of the land surface of the Great Plains. The drought and its associated dust storms created one of the most severe environmental catastrophes in U.S. history and led to the popular characterization of much of the southern Great Plains as the 'Dust Bowl'. While progress has been made in understanding some of the important processes contributing to drought conditions, the mechanisms by which a drought can be maintained over many years are not well established. A number of studies have used the historical record of meteorological and oceanographic observations to identify statistical relations between slowly varying Pacific

Ocean sea surface temperatures (SST's) and precipitation over the Great Plains. The record of observations, however, is too short to provide definitive results for long term drought. Understanding the causes of the 1930's drought is particularly challenging in view of the scarcity of upper air meteorological observations prior to about 1950.

"Several recent studies using state of the art atmospheric general circulation models (AGCM's) have shown how SST anomalies can produce prolonged drought conditions over much of the northern middle latitudes, to drought in the Great Plains, and to drought conditions in the African Sahel region during the 1970's and 1980's. The importance of the Pacific SST's (the pan-Pacific pattern) in forcing long term precipitation variations in the Great Plains led us [the researchers] to expect that this pattern would be an important factor during the Dust Bowl when drought was most severe. SST anomalies, however, were surprisingly weak throughout the tropical Pacific during the 1930's. This prompted a much closer look at the relationship between SST anomalies and the generation of the Dust Bowl. Our study is based on a number of century long simulations carried out with the NASA [National Aeronautics and Space Administration] Seasonal-to-Interannual Prediction Project (NSIPP) atmospheric general circulation model.....the basic model simulations are an ensemble (emphasis added) of fourteen 100 year (1902-2001) runs forced by observed monthly SST's.....The runs differ only in their initial atmospheric conditions. As such, the degree of similarity in the runs (the 'signal') provides us with an assessment of how much the SST's control Great Plains climate variations, while the disagreement among the runs (the 'noise') provides us with an estimate of the of the unpredictable component of the climate variability.....the time series of the observed and simulated anomalies show considerable variability with extended periods of both above and below normal conditions throughout the century.....While there is considerable scatter among the ensemble members, there are periods during which all curves tend to follow one another. In particular, during the 1930's almost all of the runs show a tendency for dry conditions, consistent with the [actual] observations. The dry conditions of the 1930's are followed, in the early 1940's, by a rapid transition by all ensemble members to wetter conditions, again consistent with the observations. In general, the simulations agree with the observations to the extent that all observed anomalies fall within the scatter of the ensemble members.....

"To understand the importance of each...feature of the 1930's drought, we carried out a number of idealized experiments in which SST anomalies, averaged over the 1932 to 1938 Dust Bowl period, were applied to particular subregions.....Our aim was to separate the contributions to the drought from each of the tropical basis, Indian, Pacific and Atlantic and the extra tropics. We first examined whether forcing the model with the 1932 to 1938 time-mean SST anomalies produces the same time mean response in the Great Plains precipitation as that obtained in the original...ensemble.....In addition to the

dry anomalies, the idealized forcing also reproduces some of the wet anomalies in the Pacific northwest and along the southeast coast. There are some discrepancies between the runs.....Despite...minor differences....it appears that the basic drought conditions simulated by the model in the Great Plains during the 1930's can be explained as a response to the time mean global SST anomalies and that the year to year variations of the SST's in that decade played a most secondary role in shaping the drought (emphasis added).

"We next tried to distinguish between tropical and extra tropical effects. The results of the tropical run...show that the main features of the drought are reproduced with the tropical SST forcing alone....Extra tropical anomalies tend to broaden the region of drought conditions, especially to the east and south of the central Great Plains. They also increase the region of wet anomalies in the Pacific northwest. The precipitation anomalies from the different model runs, including the contributions from the different tropical basins and the extra tropics averaged over the core of the Dust Bowl region.....show that the contributions from the tropical Pacific and tropical Atlantic are significant, while those from the tropical Indian Ocean and the extra tropics are not.....land-atmosphere interaction appears to be responsible for much of the drought severity.....without soil moisture feedbacks, precipitation variability is greatly reduced, consistent with previous studies.....showing that the Great Plains region is particularly sensitive to soil moisture changes.

"The results presented so far have been for annual mean conditions. It is well known, however, that most of the rain in the Great Plains tends to fall during the spring and summer seasons.....The largest deficits occur during the warm season, with about half the deficit occurring during the summer months. Somewhat surprisingly, the fall season has larger deficits than the spring season. The winter season precipitation anomalies are by comparison rather small; in fact the observed winter anomaly is slightly positive.....These results suggest that we must look to the summer and fall seasons to understand the mechanisms linking tropical SST anomalies to the Dust Bowl region. An analysis of the summer circulation changes...suggests that the role of the cold Pacific SST anomalies was to generate a global scale response in the upper troposphere (negative height anomalies in the tropics and a tendency for positive height anomalies in the middle latitudes) that suppressed rainfall over the Great Plains. The warm Atlantic SST anomalies produced two upper level anticyclonic circulation anomalies on either side of the equator, with the northern anomaly extending across the Gulf of Mexico and the southern United States. In the lower troposphere, the response to the warm Atlantic SST anomalies was a cyclonic circulation anomaly positioned to suppress the supply of moisture entering the continent from the Gulf of Mexico. It is noteworthy that the Atlantic response is confined almost exclusively to the summer and fall season.

"While the severity, extent and duration of the 1930's drought was unusual for

the 20th century, proxy climate records indicate that major droughts have occurred in the Great Plains approximately once or twice a century over the past four hundred years. There is evidence for multidecadal droughts during the late thirteenth and sixteenth centuries that were of much greater severity than those of the twentieth century. For example, tree ring analyses in Nebraska suggest that the drought that began in the late thirteenth century lasted thirty eight years. An analysis of the other major central U.S. droughts of the twentieth century suggests that a cool tropical Pacific is common to all. Only the dust Bowl drought, however, combined cool Pacific SST's with a warm Atlantic Ocean.....Since the early 1980's (with the exception of 1987 to 1989), the Great Plains generally experienced above normal precipitation. On the other hand, much of the western (especially the southwestern) United States, including some parts of the Great Plains, experienced below normal precipitation during the past five years, leading to moderate or extreme drought conditions. The cause of this most recent drought is unclear, although a preliminary look at the relation between SST's and long term precipitation variations over the southwestern United States....from our runs suggests a strong link to the pan-Pacific pattern discussed earlier. One difference compared with the Great Plains is that the southwestern United States appears to have a stronger link to the Indian Ocean SST's".

Although the Goodard study does provide a credible explanation of the weather patterns which prevailed during much of the 1930's, it does not, of course, address the causes which, in turn, caused the Atlantic to warm and the Pacific to remain cool. Did the Gulf Stream or some other ocean current or currents shift course? Was there a change in solar radiation which, in some complex way, affected ocean temperatures? Or was it all caused by some scientifically incomprehensible (random?) atmospheric and oceanic permutation, something which happened by "chance" and which may or may not be repeated (or even approximated) in the future? If past failures are any indication of future failures, attempts to answer such questions may well turn out to be an exercise in futility. In any event, any serious consideration of such issues lies beyond the scope of this discussion which, as has been emphasized, is primarily historical and secondarily scientific. Yet, there are other pertinent factors to be addressed factors which, although they cannot be said to have caused the drought, certainly intensified it, making it much worse than it otherwise would have been.

Chief among these factors is, of course, the agricultural practices of those who, beginning in the 1860's settled the Great Plains. According to statistics compiled by students in the school of natural resources at the University of Nebraska, Lincoln, crops were harvested on about ten million acres of land in the eight Great Plains states in 1879, on about fifty million acres in 1899 and on about 105 million acres in 1929, a tenfold increase in fifty years. Initial impetus for settlement of this area is attributable to the Homestead Act of 1862, a federal government initiative which promised title to 160 acres of land to anyone who was willing to clear it and farm it. Most of these early settlers misunderstood the climate of the Great Plains, assuming that there would be ample rain for pasturage and for crops such as wheat. Unfortunately, however, normal precipitation in many portions of the Great Plains was marginal at best (e.g. Goodland, Kansas, 18.0 inches; Greeley, Colorado, 13.3 inches;

Gillette, Wyoming, 15.5 inches; Aberdeen, South Dakota, 19.2 inches; Minot, North Dakota, 16.6 inches; Lamar, Colorado, 15.1 inches; and Scottsbluff, Nebraska, 15.5 inches), a fact which, in many instances, was obscured (forgotten?) during wet years. Many other settlers, moreover, were beguiled by a then popular slogan ("rain follows the plow"), encouraging the belief that cultivation of the land would, in itself, create a wetter, less harsh climate. As a result, many Great Plains farmers adopted tillage and cultivation practices that were suitable to a wetter climate, blithely unaware of the dangers of the wind and soil erosion that would accompany any prolonged drought in relatively dry regions such as western Kansas, the Dakotas and other similar regions.

During the 1920's, Great Plains farmers experienced a combination of above normal precipitation and falling wheat prices. Pressed by the need to compensate for falling commodity prices, many farmers, encouraged by adequate rainfall, brought more and more land under cultivation (hoping, of course, to maintain the profitability of their farms by selling more grain, albeit at lower unit prices). The cultivation of additional acreage, much of it marginal, together with the need to maintain profitability by reducing production costs, led to widespread use of the so-called one way disc plow. This implement, although more efficient than the older plows, left the soil more exposed, increasing its vulnerability to wind erosion, helping to set the stage for the disaster that followed. And follow it did. After several years of below normal precipitation, the combination of drought and improper land management created conditions which allowed exposed topsoil to be blown about by the high winds which swept the largely treeless plains. The result was massive wind erosion in an area stretching from the Texas Panhandle through much of western Oklahoma, western Kansas, Nebraska, Montana, the Dakotas and western Minnesota. Thus the choking dust storms which spread across many areas of the United States during the period, 1933-1938.

One of the best and most complete accounts of the disastrous consequences of the poor, and often heedless, farming methods which set the stage for these dust storms is provided by Worster (op. cit). Although much of his analysis of the follies which led to the Dust Bowl are tinged with ideologically leftist biases, he has, nonetheless, written an historical commentary which, given its depth and completeness, is an invaluable resource for those who wish to understand what has been called one of the "three worst ecological blunders" in human history. It is appropriate, therefore, to end any historical discussion of the Dust Bowl with quotes from his previously cited work, the "Dust Bowl: The Southern Plains In The 1930's":

"The southern plains are a vast austerity. They sprawl over more than one hundred million acres.....Nothing that lives finds life easy under their severe skies; the weather has a nasty habit of turning harsh and violent just when things are getting comfortable. Failure to adopt to these rigors has been a common experience for Americans, so that the plains have become our cultural boneyard, where the evidence of bad judgment and misplaced schemes lie strewn about like bleached skulls.....Yet the plains have had their place in American dreams, back when the West was new and the grasslands offered unexplored possibilities.....When we look at the plains today, we are amazed that previous generations could have found so much excitement in so bare a

country.....But remote and unappealing as they may be, the plains are still important to us all. They remain, after much abuse, one of our greatest agricultural treasures.....The Dust Bowl was the darkest moment in the twentieth century life of the southern plains.....the Dust Bowl took only fifty years to accomplish.....It came about because the culture was operating in precisely the way it was supposed to. Americans blazed their way across a richly endowed continent with a ruthless, devastating efficiency unmatched by any people anywhere. When [they] came to the plains, they talked expansively of 'busting' and 'breaking' the land. And that is exactly what they did.....The Dust Bowl.....was the inevitable outcome of a culture that deliberately....set itself to the task of dominating and exploiting the land for all it was worth.....

"During the spring and summer of 1930, little rain fell over a large part of the eastern United States. A horizontal band on the map, from Maryland and Virginia to Missouri and Arkansas, marked the hardest hit area of wilting crops, shrinking ground water supplies and uncertain income. Over the summer months in this drought band the rainfall shortage was 60,000 tons for each one hundred acre farm, or 700 tons a day. Seventeen million people were affected. In twelve states the drought set record lows in precipitation and among all the eastern states only Florida was above normal. Three years earlier the Mississippi river had overflowed its banks and levees in one of the most destructive floods in American history. Now captains wondered how long their barges would remain afloat as the river shrank to a fraction of its average height. During the thirties serious drought threatened a great part of the nation. The persistent center, however, shifted from the east to the Great Plains, beginning in 1931, when much of Montana and the Dakotas became almost as arid as the Sonoran Desert. Farmers there and almost everywhere else watched the scorched earth crack open, heard the gray grass crunch underfoot....Around their dried up ponds the willows and wild cherries were nearly leafless, and even the poison ivy drooped. Drought, of course, is a relative term: it depends on one's concept of 'normal.' But following the lead of climatologists of the time, we can use a precipitation deficiency of at least fifteen percent of the historical mean to qualify as drought. By that standard, of the American states only Maine and Vermont escaped a drought year from 1930 to 1936. Twenty states set or equaled record lows for their entire span of official weather records...Intense heat accompanied the drought.....In the summer of 1934, Nebraska reached 118 degrees, Iowa, 115.....Two years later, when the country was described by Newsweek as 'a vast simmering cauldron,' more than 4500 people died from excessive heat, water was shipped into the west by diverted tank cars and oil pipelines and clouds of grasshoppers ate what remained of many farmers' wheat and corn.....

"Droughts are an inevitable fact of life on the plains, an extreme one occurring roughly every twenty years, and milder ones every three or four. They have always brought with them blowing dust where the ground was bare of crops or

native grass. Dust was so familiar...that no one was surprised to see it appear when the dry weather began in 1931. But no one was prepared for what came later: dust storms of such violence that they made the drought only a secondary problem storms of such destructive force that they left the region reeling in confusion and fear.....Explaining why these storms occurred requires a excursion into the history of the plains and an understanding of the agriculture that evolved there. For the 'dirty thirties'....were primarily the work of man, not nature.....The storms were mainly the result of stripping the landscape of its natural vegetation to such an extent that there was no defense against the dry winds, no sod to hold the sandy or powdery dirt.....The day after Black Sunday [14 April 1935] the Dust Bowl got its name. Robert Geiger, an Associated Press reporter from Denver, traveled through the worst hit part of the plains, and he sent a dispatch to the Washington Evening Star, which carried it on 15 April 1935: 'Three little words,' it began, 'achingly familiar on a western farmer's tongue, rule life in the dust bowl (emphasis added) of the continent if it rains'.....Within weeks the southern plains had a new identity, one that they would never be able to shake off. The label came spontaneously into the speeches of the region's governors, into the pressrooms of city newspapers and into the private letters of local residents to their distant friends.....The SCS [Soil Conservation Service] [later used the term, defining the Dust Bowl as] 'the western third of Kansas, southeastern Colorado, the Oklahoma Panhandle, the northern two thirds of the Texas Panhandle, and northeastern New Mexico'. But the SCS's region VI also covered an extensive fringe that made a total of almost 100 million acres, stretching 500 miles from north to south, 300 from east to west about one third of the entire Great Plains.....The difficulty in making the Dust Bowl more fixed and precise was that it roamed around a great deal it was an event as well as a locality.....

"By 1938, the peak year for wind erosion, ten million acres had lost at least the upper five inches of topsoil; another 13.5 million acres had lost at least two and one half inches. Over all the cultivated land in the region, there were 408 tons of dirt blown away from the average acre, in some cases to the next farm, in others to the next state or beyond.....The dirt that blew away, one Iowa deposited sample revealed, contained ten times as much organic matter and nitrogen the basics of fertility as did the sand dunes left behind in Dallam county, Texas.....

"'The meaning of the dust storms,' wrote Archibald MacLeish, 'was that the grass was dead.' An old and unique ecological complex had been destroyed by man, leaving him with no buffer against the elements, leaving the land free to blow away. It was not the first time some large part of the natural vegetation had died, but it was the only time that it had happened because of a deliberate strategy carried out by human beings. Before the coming of the Europeans to the plains there had been long cycles of drought and rainfall, following, like summer after winter, a continual building up and tearing down by the

inanimate forces that control life on this planet. Against these powerful forces organic nature had struggled over millions of years, determining by trial and error what would flourish best in this dry corner of the good earth.....For the Great Plains the most dramatic....upheavals had come with the Laramide Revolution of sixty million years ago, which had created the Rocky Mountains. In a geological instant the immense trough through which Pacific and Arctic waters had once invaded the North American interior was plugged. The Rockies had also fundamentally altered the climates east of them, distilling out the moisture that air currents brought from the ocean and leaving the plains lying in a wide rain shadow. The heavy rains and snows that had fallen on the mountain tops now washed away the softer, sedimentary layers and redeposited them in a broad apron, or alluvial fan, at the base. Year by year in the Tertiary period, that apron spread eastward from the mountains, covering the old seabed of shale and sandstone with loose, unconsolidated silt and smaller quantities of sand and gravel as much as five hundred feet thick. Irregularities in the old surface were smoothed away to produce one of the most monotonously level land forms on the face of the earth: the soft tableland of the High Plains, ranging from 3000 to 4000 feet in elevation. There was not enough rain on the plains to erode the smoothness; the rivers that flowed through eventually carried less new sediment and stayed roughly in their courses, having little more regional effect.

"During the past million years, the so-called Pleistocene epoch, massive ice sheets formed and they crept down from mountain valleys and south from Hudson's Bay. On four occasions the glaciers spread into the plains, but they never reached the southern latitudes of the continent. Then, with the retreat of the ice, large sections of land lay bare and dry. Winds began to pick up the soil, and interglacial dust storms occurred far greater and more protracted than those of the 1930's leaving behind them deposits we call loess. In Nebraska some 42,000 square miles of loess were laid down, sometimes twenty or more feet thick; much of the fertile farmland of Iowa, Illinois, Wisconsin and Indiana also originated in the days of prehistoric wind erosion, gaining a gift of rich soil from the plains to the west. There was potential good in blowing dust then, but at the immediate and severe cost of transforming parts of the Great Plains into areas of Martian sterility, swept by tyrannic tidal winds.....From those chaotic, erosive forces soil patterns emerged.....The first was a dark surface layer containing organic matter, ranging in color from black in the east.....to shades of brown as one approached the Rocky Mountains. The second was a zone of alkaline salt accumulation, usually lime carbonate, created by the leaching effect of limited rain. On the extreme eastern edge of the Great Plains there was no alkaline zone because the rain was heavy enough to wash the salts down to groundwater level. But farther west it appeared first at a depth of sixteen to twenty inches, then only thirteen or fourteen inches down. This calcereous material under the loose surface formed a hardpan, or, more technically, a caliche deposit, beneath which the earth stayed dry. Soils with this layer were called 'pedocals,' indicating that they had

lost less mineral matter than those of humid climates. Give them rain and they would support a rich vegetation but then the same rain would eventually leach away their soluble nutrients. So little moisture falls on the southern plains today that they are classes as semi-arid: not quite a desert, but very dry, receiving an average of twenty inches or less of precipitation a year.

"But the most important fact about the climate....is its unpredictability. There are years when the Oklahoma Panhandle enjoys Iowa weather; then it will get a year or two of Utah skies of dry crackling air that can turn the bare earth to powder. Most of the moisture falls during the spring and summer growing season, but high temperatures can quickly evaporate it before there is much penetration to plant roots. The land is not one of steady deficiency that men can count on, as is the true desert, but one of the sharp extremes heat and cold, floods and droughts, cyclones and blizzards. It is an unreliable, intractable place, wildly oscillating around an almost meaningless mean. The only certainty is that droughts will come, and that in 'normal' years the region lies at or below the rainfall margin for most farming.

"Why the climate should be so volatile is clear enough when one understands the peculiar meteorological situation. The high level winds of three powerful weather empires meet and clash here. Mild, dry air moves across the cordillera; cold, dry fronts roll heavily down from the Arctic; and warm, moist currents flow up from the Gulf of Mexico. Where and how they meet determines what the plains will be like from week to week as well as from century to century. The sudden encounter of polar cold and tropical warmth, sometimes with hail and thunderous eclat, can produce in a single day a torrential downpour of one third the average annual precipitation. Over the years a rough balance of power emerges in this warfare: a series of rainfall zones shades from north to south and from east to west. The Dust Bowl lies most fully under the power of the desiccated westerlies that flow over the mountains: rain makes it way from the Gulf on only a few unguarded occasions. All of this takes place as a grand upper atmospheric drama. Down at ground level, however, the winds usually blow out of the southwest; their average velocity in mid-afternoon is fifteen miles per hour. They are the one steady ingredient in plains weather always ready to tear away whatever is not firmly rooted or nailed down.....

"There were not many kinds of plants that had sufficient resilience for such conditions. In particular, almost all trees needed more soil moisture than the plains could offer, except along river bottoms, where cottonwood, hackberry, willow and wild plum found a wetter, less wind blown refuge. For the most part, the plains had to be given over to grasses. In the post-Mesozoic era the grasses began to appear on the earth, some of them destined to furnish man with important cereal foods, such as wheat, rice and corn. Eventually, the grasses covered one quarter of the earth's total land mass. Out of some 4,500 species of grasses....the Great Plains became the home of several hundred. As many as fifty to seventy five species could be found in a single area. Together they

created a series of ecological communities or ecosystems that were nowhere duplicated in the world. Those communities could be disrupted by drought, silting or Ice Age climate shifts; and their boundaries were never rigidly fixed, but expanded or contracted with yearly weather patterns. Even so, the grasses endured those trials. They created a new, living inland sea that lasted for millions of years. They helped preserve the soft plateau from further erosion by wind and water.....They came as a pacifying force, unable to tame the elements, but moderating their effect and creating a more benign world for other forms of life.

"Before [the Europeans] appeared, the North American grassland extended from the oak openings of Ohio all the way to the Rockies, and beyond in isolated pockets. Its most impressive domain, however, was what became the Great Plains states. On the eastern edge of that country, where the rainfall was twenty five to thirty inches annually, grew the tall grasses.....some...eight feet high with roots going six feet into the ground. That was the true prairie of black chernozem soil. But the Dust Bowl, lying hundreds of miles southwest of the prairie and beyond the twenty inch isohyet, was a world of brown soils and short grasses. Not one, however, but four major plant associations were widely established on these southern plains: grama buffalo grass, wire grass, bluestem bunch grass and sand grass-sand stage. Ofthese the first was the most common, forming a tough fibrous mat that looked precisely like a well grazed meadow.....These were only the ecological dominants of the short grass country. A miscellany of other grasses sprouted too.....There were bright colored plants such as the yellow sunflower, butterweed, tetraeneuris and sundrop.....Complexity, adaptation and loveliness were all parts of organic nature's way of meeting the challenge of the plains. One effect of the grasses was to keep the dirt in one place; another was to transform the sun's energy into foodstuffs on which other organisms could subsist. As the grasses evolved, so did animals equipped to eat them, the most important of these animals being the hoofed herbivores.....As long as the grasses flourished, the plain was no silent, empty wasteland. It could still be a hard demanding world, but in most years.....it provided abundantly all the conditions that make for success in nature's economy. The first men to come into this short grass ecological community had neither the means nor the intention to change it substantially.....ancient man devoted himself for the most part to collecting berries, seeds and roots, and to hunting small game. But he continued to go out for bigger animals, too.....All along the Rocky Mountains....man camped and hunted; it is clear, however, that his environmental impact was far less than that of the bison or the prairie dog.....Just fifty years after Columbus arrived in the New World the Spanish conquistador.....Coronado[crossed] in 1540-42 from Santa Fe into the panhandle area and northwest to present day Great Bend, Kansas, where he....located about twenty five wretched villages of the Wichita Indians.....The Indians Coronado visited were among the most backward on the continent. But two centuries after his expedition, and a full century after the founding of Jamestown, the grasslands

were the scene of an incredible explosion: the birth of the Plains Indian culture, which eventually came to symbolize for the entire world the aboriginal man of North America.....Because it was so vivid, straightforward and heartfelt in its violence, this Plains culture became the most familiar of all the primitive cultures in the world.....Hunting the buffalo, for example, was once again made the basis of human economics; agriculture had never been dependable enough. The horse, however, gave unprecedented locomotion to the hunt.....By 1775 this culture was in full maturity with tepees spotted over the landscape, horses tethered and hobbled, haunches of buffalo meat roasting on sticks, and a rich, imaginative mythos sung around campfires. For the first time in its history, the grassland began to experience the presence of man. But for all their creative, exuberant force, these Indians did not drastically alter the ecological order.....From the beginning of their occupancy there was a limit on these Plains people's potential due to their full acceptance of the natural order, but at the same time that acceptance enforced a pattern of ecological restraint in their behavior.....

"Much of what was to become the Dust Bowl first came into American hands with the Louisiana Purchase of 1803. President Thomas Jefferson, who promoted that real estate deal, wanted land as an insurance plan for his democracy of small farmers.....Justice and equality, Jefferson's theory suggested, require continual economic expansion, which to his mind meant simply more farmland for the nation.....Later that view would take on extravagant proportions.....Those Americans who did not take up the expansionary attitude were frequently accused of being elitists.....One of Jefferson's own army officers, Lt. Zebulon Pike, was an anti-expansionist, and apparently no elitist.....His 1806 report on the southern plains (he was the first American ever to visit the area) began a century long dispute over the region and its value for the new nation. Pike followed the Arkansas river west up into the mountains. What he saw on that part of his explorations were for the most part the extensive riparian dunes that had blown out of the river bed in dry seasons. If that was what all the plains were like, he concluded, then the nation had purchased a veritable desert.....Having a wide desert on the western side and an ocean on the eastern, the United States would be more politically cohesive and safe. It was an appealing prospect for others who came after Pike, too. 'Great American Desert,' they began to write on maps of the interior plains, and what they usually meant was that Americans had better stay put and tend their gardens rather than go adventuring westward.....Neither Pike nor other 'desert' proponents had the slightest effect on the pace of plains settlement.....If the plains were not all that Jefferson had hoped they would be, the farmer could remedy their deficiencies.....Turn the grasses under and the skies would fill with clouds.....

"Under the Homestead Act of 1862, any person who settled on 160 acres of shortgrass, stayed there for five years, made 'improvements' and paid a filing fee became part of the landed gentry. But farmers were slow to go that far west,

having rich black prairies to take up first, and when they did arrive they found the country in the hands of the cattle barons. Even before the Indians and the bison were out of the way, the cattlemen had come in, seeking to exploit the grass.....The world of cowboys, round-ups and cattle drives has been recalled many times, but not the ecological story. Whether they held title or not, the cattlemen pushed the land as far as it would go and then pushed it some more.....In some areas they ran four times as many cattle as the grass could carry, resulting in depletion and long lasting damage.....The winter of 1885-86 proved to be the harshest in the recorded history of the region, and with severely diminished buffalo grass for forage, it was a fatal blow. Eighty five percent of the cattle perished on some ranches, and their carcasses lay black and stinking across the spring landscape.....Now, in the face of collapse, the beef entrepreneurs retreated right and left, their industry bankrupted by weather and, more, by over expansion.....

"Into the post-1886 vacuum poured the waiting farmers, armed with iron plows to 'break the land' and establish a more democratic tenure. Unlike the cattlemen, they came without much capital as little as a team of oxen and a dollar gold piece.....Out of the sod itself they made their houses, with walls two feet thick, dirt roofs that leaked muddy water, and straw filled mattresses that swarmed with bedbugs and fleas.....It was as hard a life as any that Americans have made for themselves, yet they liked it well enough.....By 1890 there were six million people on the Great Plains.....the Dust Bowl was boom country, doubling its numbers in less than a decade.....In the majority of cases [the newcomers] came wanting not a place to stay forever, but simply cash a stake to take with them someplace else.....Consequently, the mobility of the soddy entrepreneur was phenomenally high. The sod house era did not even last as long as the cattle bonanza had. Beginning in 1889, drought scorched the plains for most of the next six years, at times it was as severe as in the 1930's. Luckily, there was little dust blowing, for most of the grassland still remained in sod. But in some cases the economic hardships were worse than those in the Dust Bowl years.....[there] was a massive exodus. In [some] counties of the region, the decline was as much as sixty and even ninety percent.....The cattlemen, chastened by their failure, began to reacquire the land.....

"In the wake of the 1890's debacle a new technique called 'dry farming' began to appear.....deep plowing in the fall, packing the subsoil, frequently stirring up a dust mulch, and summer fallowing leaving part of the ground unplanted each year to restore moisture. Corn had been the chief crop on the plains before 1890; now farmers put their fields into more drought resistant grains, especially Turkey Red, a hard winter wheat, and the sorghums. In 1909, to satisfy dry farming agitation, Congress passed an Enlarged Homestead Act which gave each settler 320 acres. Once again the plains became a feverish scene as thousands rushed to get their share....It was in this latest surge of settlement, from 1901 to 1930, that a dust bowl was prepared.

"The most important new wrinkle was the machine. Neither the cowboy nor the sod house farmer knew much about technology; their methods were almost as old as agriculture itself herding animals by horseback, walking behind a plow and team.....The grassland was [now] to be torn up to make a vast wheat factory: a landscape tailored to the industrial age. Specialized, one crop farming became the common practice, and business economics the standard of success or failure. Above all, the new style sodbuster was expansionist, feeling all the old land hunger of an opportunity seeking democrat, but adding an intense desire to make his new machines profitable.....Under the new homestead policy, land entries skyrocketed nationally, especially after 1912, when Congress reduced the proving-up time from five to three years....A study of twenty tow High Plains counties in Kansas, Colorado and Texas suggest the magnitude of population ebb and flow and the emerging scale of modern agriculture. In 1890 there were 5,762 farms in those counties, and the average size of a unit, including a few ranches, was 256 acres. By 1900, with the swing back to cattle, there were only 4,087 farms, and the average holding was up to 1,730 acres. The year 1910 found 11,422 farms, averaging 520 acres, as crops once more replaced pastures. The enlarging size of these wheat belt farms was clear evidence that, despite what the public land laws indicated as best, Americans on the frontier always wanted and got more. In 1920 the average unit in these counties was 771 acres, and in 1930, 813. These were the halcyon days for all the nation's farmers, setting a standard of prosperity against which subsequent experience would always be measured. A growing urban population at home and bigger markets abroad meant high prices, substantial profits and more money to expand. Wheat fetched from \$1.04 per bushel in 1909 to \$0.93 in 1914 on the southern plains: these were the so-called 'parity,' years when agriculturalists stood on a roughly equal footing in purchasing power with manufacturers. But it was World War I that put the American farmer into a happy dither. As the Turks cut off wheat shipments from Russia, the largest producer and exporter in the world, Europeans turned to the Great Plains. The effect of this new and heavy demand was that in 1919 the price of American wheat reached 2.5 times its 1914 level.....

"Under the wartime Food Control Act of 1917, the government guaranteed wheat prices of over \$2.00 per bushel. Americans that year harvested 45 million acres of wheat, down (due to droughty weather) from 60 million in 1915, and providing only 133 million for export. When the war ended Europe still needed food imports, and by 1919 the nation, under government set goals, harvested 74 million acres yielding 952 million bushels in all, a thirty eight percent increase over the 1909-13 period, and providing 330 million bushels for shipment abroad. Most of this gain came in winter wheat, which was the standard variety grown on the southern plains.....Kansas, Colorado, Nebraska, Oklahoma and Texas had expanded their wheat lands by 13.5 million acres by 1919, mainly by plowing up eleven million acres of native grass.....

"One of the most important facts of the period was that more acres in wheat did not mean more work in man hours. In the twenty years after 1910 the labor needed to plant and harvest the nation's wheat fell by one third, while the acreage jumped by almost the same amount. The reason for this disparity lay, of course, in mechanization: an industrial revolution, supplanting men and animals with fossil fuel power had come to American agriculture.....The wide flat lands of the Dust Bowl were especially suitable for mechanized farming.....As early as 1900 the southern plains witnessed the arrival of the monstrous Reeves machine a miniature locomotive weighing several tons.....The steam tractor, which had actually been around for fifty years before that date, was late in reaching the plains: not so its lighter, gasoline powered replacement. By 1917 there were two hundred companies manufacturing these new, small tractors.....Seated on one of these rumbling machines, small or large, the wheat farmer was a very different man from the old style sodbuster.....Now he had a marvelous machine that could be used to break the land and hold it firmly under his control.

"Another new mechanical innovation was the one way disk plow, which resembled a series of concave plates set vertically on a beam. In the nineteenth century, Western farmers had used a moldboard plow to kill the grass. It dug deep, sliced through the roots, and laid the sod over practically unbroken. The new disk contraption did not go as far down into the earth: it moved along faster, chopped the ground up more roughly to increase water absorption, killed weeds efficiently and, when used often enough, left a finely pulverized surface layer. Under the dry farming program, farmers were told to haul their disk plows out after every shower and stir up the dust for moisture conservation. But in droughty years they disced their fields so much that some observers blamed the dust storms of the 1930's on the misuse of this single implement. There was one more apparatus that completed the industrialization of the grassland: the combined harvester-thresher, or, as it was called more simply, the combine. By the end of the twenties more than three fourths of the farmers in the winter wheat section owned such a machine. Instead of hiring ten or twenty bindle stiffs seasonal harvest laborers coming in on the railroad who drank heavily, frightened the children, required the wife to feed them, and sometimes demanded higher wages, the farmer bought a combine that he or one or two others could manage. Pulled by a tractor, the combine could cut a sixteen foot swath through the wheat, and in two weeks could harvest five hundred acres.

"Machines made money, but they cost money, too far more than small farmers could afford.....But, as in every instance where new technology has entered, there were hidden, unanticipated effects, not the least of them being, especially in the early twenties, a severe economic squeeze for many marginal farmers. The war left them with huge machinery debts to pay. For a while overseas markets remained good, prices stayed above \$2.00 and there was no worry. But as the Europeans restored their own agriculture to full productivity.....the Great Plains farmer lost some of his world outlet and

found himself in a tighter and tighter bind. In every county there were those who could not survive the crunch and went under.....

"There were a few enterprising wheat farmers who welcomed the postwar competitive race to see who could mechanize fastest and shave their production costs.....to Plainview, Texas came the Hollywood mogul Hickman Price in 1929 to show the plainsmen what modern farming was really like.....His factory farm stretched over fifty four square miles 34,500 acres and required twenty five combines at harvest time. In every part of the plains there were pacesetters like these men and women who fervently believed that the methods of industrial capitalism were what the land needed.....The mobility of the new machines allowed not only large scale enterprises but also widely dispersed holdings.....the machine made possible, and commonplace, an exploitative relationship with the earth: a bond that was strictly commercial, so that the land became nothing more than a form of capital that must be made to pay as much as possible. All across the flat open spaces the tractors steadily plowed away, especially in the second half of the 1920's and on up until the very eve of the dust storms.....During the same period farmers tore up the native vegetation on 5,260,000 acres in the southern plains.....Most of the freshly plowed ground went into wheat, so that over the 1920's the production of that cereal jumped three hundred percent, creating a severe glut by 1931.....When the black blizzards began to roll across the plains...one third of the dust Bowl region thirty three million acres lay naked, ungrassed and vulnerable to the winds. The new style sodbusters now had their turn at facing disaster.....

And face it they did. And endure they did. And learn from it they did. Things got better, the result of improved conservation practices, improved land management, a newfound, if belated, respect for the temperamental, but often hostile climate of the Great Plains and, perhaps most importantly, good luck at the climatic roulette table. Although the Great Plains, as noted previously, experienced episodes of severe drought in the 1950's and again in the 1970's, there was no repetition of the ecological disaster of the Dust Bowl years. Still, there is no reason to believe that a prolonged, severe drought (the droughts of the 1950's and 1970's were of relatively short duration) might not bring back the Dust Bowl (or something very much like it). But that concern, however real it might be, lies beyond the scope of any historical account of Great Plains and Midwestern droughts: anyone seeking prophecy must look elsewhere. But if prophecy is irrelevant to this discussion, perspective is not. In concluding, then, it is important to provide additional climatological data, both to underline the extent and depth of the drought of the 1930's and to contextualize the Dust Bowl experience by noting evidence of previous droughts of greater or equal intensity. And, finally, to compare 1930's temperature and precipitation patterns with the climatic events and trends of the last sixty years.

THE 1930'S
A POSTSCRIPT:
THE GREAT DROUGHT IN PERSPECTIVE

As indicated previously, the great drought of the 1930's began abruptly in 1930, a year in which extremely dry and hot conditions were experienced, not only in the Great Plains, but in the mid-Atlantic (e.g. Virginia, Maryland, West Virginia), south central (e.g. Arkansas) and north central (e.g. Illinois, Indiana, Ohio) sections of the country. Although the drought in some regions was mercifully short lived, severe to extreme dryness persisted over other areas until the end of the decade. According to a composite 1930-1939 Palmer Drought Severity Index map prepared by the National Drought Mitigation Center, the most severely stricken regions included northwestern and west central Minnesota, Nebraska, northeastern Colorado, central and western Kansas, western Iowa, southern and central Montana, southern Idaho and much of North and South Dakota. Specifically, areas such as central and southern Montana, central North Dakota, the Oklahoma Panhandle, most of Kansas and Nebraska, central and northeastern Colorado and northwestern and west central Minnesota were shown as having experienced severe to extreme drought at least fifty percent of the time during the ten years ending in 1939.

During the same period, extreme to severe drought prevailed thirty to forty percent of the time in southwestern Iowa, some parts of Pennsylvania and New York, southeastern Colorado, portions of North and South Dakota and southwestern, north central and east central Minnesota. Areas classified as severely to extremely dry twenty to thirty percent of the time included much of Illinois, Ohio, Indiana, northern Iowa, the Arrowhead region of Minnesota, eastern Michigan, most of Wisconsin and central Oklahoma. Despite the drought of 1930, most of the mid-Atlantic was relatively drought free during the 1930's, experiencing severe to extreme dryness only ten to twenty percent of the time. Surprisingly, also, most of Texas was relatively free of extreme drought during the 1930's (e.g. western Texas, ten to twenty percent and eastern Texas, zero to ten percent). Other relatively drought free areas (twenty percent or less) included most of Arkansas (indicating a rapid and sustained recovery from the drought of 1930), southern and central Missouri, California, Arizona and much of New England.

Predictably, the Drought Mitigation Center's composite Palmer Drought map for the six years, 1934-1939 displayed a pattern similar to that for the full ten years, 1930-1939. All or virtually all of North and South Dakota, Kansas, Nebraska, northwestern Minnesota, eastern Colorado, south and central Montana were shown as being severely dry at least fifty percent of the time during the entire six years. West central Minnesota, which for the decade as a whole was shown in the fifty percent plus category dropped to the forty to fifty percent category during 1934-1939 (reflecting, no doubt, intervals of above normal rainfall during 1935, 1937 and 1938). South central Minnesota, however, was somewhat drier, moving into to the Palmer Index's forty to fifty percent severe drought category. During the same period, the Texas Panhandle was shown as having experienced severe to extreme drought twenty to thirty percent of the time. Moreover, date specific Palmer Drought Index maps show, for example, that much of central and western Minnesota was, as of 1 April 1934, in the grip of an extremely deep drought, ranking three points below the line of demarcation distinguishing moderate from severe drought. By 1 July 1934, the same area had fallen even deeper into drought, now ranking five points below the severe drought mark. And on 1 October 1934, the Index showed that although drought had retreated from eastern Minnesota, western Minnesota (as well as the Dakotas and Nebraska) remained extremely

dry.

In marked contrast, the Palmer Indices confirm that most of the United States was drought free during the 1920's, the Great Plains states included (an area which, in stark contrast with the 1930's, had a zero to ten percent incidence of extreme to severe drought during much of the period, 1920-1929). Notable exceptions to the general wetness of the ten years ending in 1929 included central Minnesota (thirty to forty percent incidence of severe to extreme drought), east central Minnesota (twenty to thirty percent incidence), west central Minnesota (ten to twenty percent incidence) and parts of southern and eastern South Dakota (twenty to thirty percent incidence).

Insofar as Minnesota is concerned, the 1920's Palmer Index, of course, confirms earlier allusions to the fact that, as noted previously, the state's drought began at the end of the second decade of the 20th century (and, in some respects, even earlier). According to statistics compiled by the Midwest Climate Center, precipitation for Minnesota as a whole exceeded thirty inches in 1903 (31.6 inches) and 1905 (32.3 inches), remaining well above average in most years through 1909 (28.2 inches). Although the following year (1910) was extremely dry (14.8 inches), statewide precipitation levels rebounded in 1911, remaining ample (but modest) during most years during the period, 1912-1920. The last notably wet year was 1919 (27.1 inches), a year which marked the beginning of a twenty year regime of moderately dry to extremely dry years. Average annual precipitation for the state as a whole was about 24.3 inches during the 1920's, a value significantly below the then accepted long term Minnesota normal. The Midwest Climate Center's numbers further indicate that, during the eight year period beginning in 1929, the annual statewide average fell precipitously to 21.6 inches while the average for the 1930's as a whole (1930-1939) was 22.8 inches. As indicated in previous discussion, the last years of the decade marked the beginning of the end of the drought, featuring one notably wet year (1938 which, according to the Midwest Climate Center's statistics, was the wettest year recorded in the state since 1919).

Although statewide precipitation during 1939 averaged only 21.7 inches (giving it the dubious distinction of being one of Minnesota's driest years of the 1930's), the early 1940's brought a sustained and rapid recovery. Statewide averages jumped to 29.0 inches in 1941, the state's wettest year since 1906. Moreover, the average rose above thirty inches (30.1 inches) in 1944, the first such occurrence since 1905. More significantly, however, the upward trend persisted throughout much of the rest of the century, the statewide average exceeding the thirty inch mark in 1951 (31.0 inches); 1953 (30.5 inches); 1965 (33.3 inches); 1968 (33.2 inches); 1977 (a record 33.9 inches); 1985 (30.8 inches); 1986 (31.7 inches); 1991 (32.5 inches); and 1993 (31.6 inches). Interruptions in this trend, although sometimes dramatic (e.g. 1976, 15.8 inches) were relatively short (e.g. 1948, 22.8 inches; 1952, 22.5 inches; 1958, 20.3 inches; 1967, 21.2 inches; and 1980, 21.7 inches) and, typically, were followed by notably wet years (e.g. 1952 by 1953, 1967 by 1968 and 1976 by 1977). Significantly, the longest sustained drought during the entire period lasted a mere three years, 1987 -1989 (1987 and 1988 each with a statewide average of 22.2 inches and 1989 with an average of 22.7 inches). And, although the opening years of the 21st century were generally wet (2000, 28.1 inches; 2001, 29.8 inches; and 2002, 28.7 inches), precipitation levels dropped sharply in 2003 (22.5 inches, the lowest since 1989) perhaps

hinting at a return to a drier period.

Although Minnesota's rendezvous with drought can credibly be said to have begun in the early 1920's, average annual temperatures during the twenty year period, 1920-1939 were, with a few exceptions, near the then accepted statewide normals. Average annual temperatures for the state as a whole (as calculated by the U.S. Weather Bureau in the 1930's) averaged 42.0 F during this twenty year interval, a value only slightly higher than the then accepted 1891-1939 statewide average of 41.6 F. As noted previously, the warmest years during this period occurred mostly in the 1930's: 1931 (46.9 F); 1938 (43.5 F); and 1939 (43.6 F). The warmest years of the 1920's, in contrast, were 1921 (44.4 F); 1928 (42.4 F); and the drought year of 1923 (42.4 F). Several years during the 1920's were, in fact, notably cold, featuring a preponderance of cool, if often dry, summers. More recent climate statistics, specifically those compiled by the Midwest Climate Center (at the University of Illinois) show a similar pattern. According to the Illinois source, Minnesota's average annual temperature for the periods, 1895-2003 and 1920-1939 are 40.7 F and 40.8 F, respectively, statistically indistinguishable values. In contrast, corresponding values calculated by the Minnesota State Climatology Office are 40.8 F for the period, 1920-1939 and 40.1 F for the period, 1891-2003 values which unlike the Weather Bureau and Climate Center averages -- suggest that the state's two drought decades were, on the whole, significantly warmer than average.

It is important to note, however, that comparisons based on 1920-1939 values and/or annual averages tend to mask some of the most significant differences between Minnesota's long range temperatures and the temperature patterns of the 1930's. In this regard, comparisons which exclude the 1920's record, focusing instead on the 1930's alone, do show that the latter were, on balance, considerably warmer than average. As indicated in appendix figure 1A, annual statewide average temperatures for the ten years, 1930-1939 were approximately one degree higher than the Weather Bureau's then accepted long term average. More importantly, summer temperatures during the 1930's exceeded the long term June-August averages by differences ranging from about 1.5 F to 2.5 F (e.g. the Weather Bureau's then accepted long term July average for Minnesota was 70.1 F, a value almost three F lower than the 1930's ten year July average of 72.6 F). Midwest Climate Center values are similarly striking, showing that average temperatures for every summer during the ten years, 1930-1939, were at least 0.5 F warmer than the Center's 1895-2003 Minnesota meteorological summer average (66.7 F). Individual warm summers included 1933 (70.3 F, a value nearly four F higher than the Center's long term summer average); 1936 (69.6 F); 1937, (69.1 F) and 1931 (69.0 F). With several exceptions, however, the winter, spring and autumn temperatures recorded during the 1930's were not significantly different than the long term averages for those seasons.

Nor do 1930's average annual temperatures appear particularly noteworthy when compared to corresponding values in the decades that followed. According to the Climate Center's calculations, annual temperatures during the period, 1930-1939 averaged 41.3 F, or 0.6 F above the state's long term average. On a statewide basis, the 1940's (41.1 F) were almost as warm as the 1930's. And, although the three decades beginning in 1950 witnessed a marked cooling trend (1950-1959, 40.6 F; 1960-1969, 40.3 F; and 1970-1979, 40.1 F),

annual averages returned to, and quickly exceeded 1930's levels in the 1980's and 1990's. Minnesota's average annual temperatures (again, as calculated by the Midwest Climate Center) reached 41.5 F in the 1980's, 41.6 F in the 1990's and 42.3 F during the first four years of the twenty first century. In contrast to the 1930's, however, the warmth of the 1980's and 1990's was largely attributable to warmer winters rather than to warmer summers. According to the Climate Center's statistics, Minnesota's winter (December-February) temperatures averaged 11.6 F during the 1930's, rose to 12.7 F during the 1940's; but fell sharply to 11.7 F, 10.7 F and 9.2 F, respectively, during the 1950's, 1960's and 1970's. During the next two decades, however, the trend of the previous thirty years was emphatically reversed, average winter temperatures increasing to 13.1 F and 14.1 F, respectively, in the 1980's and 1990's. During the four years, 2000-2003, winter temperatures average 15.8 F, value which, although derived from a scant set of data, suggests a continuation, perhaps even intensification, of the trend toward warmer winters. The Midwest Climate data further show that Minnesota's winter temperatures for the thirty year period, 1970-1971 through 1999-2000 averaged 12.4 F, a value 0.7 F higher than the long term (1895-1896 through 2002-2003) December-February average.

Average summer temperatures, in contrast, averaged 68.5 F during the ten year period, 1930-1939, a value higher than the averages recorded in any decade since. Midwest Climate statistics indicate, for example, that summer temperatures averaged only 66.7 F during the 1940's, a decade which otherwise was essentially as warm as the 1930's. The 1950's summer average was also 66.7 F, the corresponding value declining to 66.3 F during the ten year period, 1960-1969. Warmer summers prevailed during the 1970's (66.8 F) and the 1980's (67.4 F) with a return to cooler conditions during the summers of the 1990's (66.5F). The opening years of the present century, however, suggest a trend toward warmer summers, the average June-August temperature rising to 67.7 F during the four years, 2000-2003. Midwest Climate Center calculations, moreover, indicate no significant statistical change in Minnesota's long term summer temperatures. Unlike winter temperatures which, as noted, have risen markedly in recent years, summer temperatures have remained essentially unchanged: the statewide summer average for the thirty year "normal" period ending in 2000 was 66.9 F, virtually the same as the corresponding value (66.7 F) for the entire period, 1895-2003.

Comparisons based on Minnesota averages as calculated by the U.S. Weather Bureau during the 1930's provide yet another perspective from which to gauge the extent and intensity of the heat and drought during the period, 1930-1939. These values indicate that for the state as a whole and for the decade as a whole, precipitation was about nine percent below normal and annual temperatures about one degree F above the then statewide normal. The precipitation shortfall, when viewed month by month, included a twenty two percent deficiency in July; a fifteen percent deficiency in September; a thirteen percent deficiency in June; and an eight percent deficiency in August. Surprisingly, however, decadal precipitation averages for several other months of the year were either normal (May) or above normal (January, February and November). Yet, as the appended charts show, departures from the 1891-1939 means varied significantly from individual station to individual station. Specifically, average annual decadal temperatures, depending upon the station involved, ranged from about 0.5 F to 2.0 F above the Weather Bureau's long term (1891-1939)

normals. Decadal station by station precipitation averages were even more varied ranging from a deficiency of about thirty three percent at Moorhead to slight surpluses (about one percent) at locations such as Chaska and Rochester. Other individual station departures all of them negative -- included fourteen percent at Minneapolis; twenty percent at Argyle; twenty two percent at Alexandria; thirteen percent at Albert Lea; twelve percent at Morris; nine percent at Virginia; and only four percent at New Ulm.

A quite different pattern emerges, however, when individual station values for the 1930's are compared with the thirty year (1971-2000) station normals now used by the state climatology office. This pattern which, of course, reflects recent tendencies toward a wetter, warmer Minnesota climate typically reduces (or even eliminates) the positive temperature anomalies while increasing the negative precipitation anomalies indicated by the earlier Weather Bureau values. Normal average annual temperature values at the New London station, for example, have changed from 42.3 F (1891-1939) to 43.4 F (1971-2000), the new normal approximating that station's actual 1930-1939 annual average of 43.8 F. Annual mean precipitation has changed even more dramatically, increasing from 22.6 inches (1891-1939) to 31.7 inches (1971-2000), a forty percent increase. Other illustrations of the same trends include Brainerd (25.5 inches, 1891-1939 and 27.7 inches, 1971-2000; 39.9 F, 1971-2000, 39.0 F, 1930-1939 and 38.4 F, 1891-1939):Collegeville (23.1 inches, 1891-1939 and 29.3 inches, 1971-2000; 44.3 F, 1971-2000, 43.4 F, 1930-1939 and 43.0 F, 1891-1939): Crookston (20.6 inches, 1891-1939 and 20.7 inches, 1971-2000; 39.8 F, 1971-2000, 40.4 F, 1930-1939 and 39.0 F, 1891-1939): Duluth (27.9 inches, 1891-1939 and 31.0 inches, 1971-2000; 39.1 F, 1971-2000, 39.5 F, 1930-1939; and 38.0 F, 1891-1939): Milan (24.7 inches, 1971-2000 and 23.2 inches, 1891-1939; 44.3 F, 1971-2000, 45.0 F, 1930-1939 and 42.9 F, 1891-1939): Minneapolis (29.4 inches, 1971-2000, 27.7 inches, 1891-1939 and 45.4 F, 1971-2000, 46.3 F, 1930-1939 and 44.5 F, 1891-1939): Morris (25.4 inches, 1971-2000 and 23.8 inches, 1891-1939; 42.5 F, 1971-2000, 44.0 F, 1930-1939 and 42.0 F, 1891-1939): New Ulm (29.5 inches, 1971-2000 and 29.3 inches, 1891-1939; 46.2 F, 1971-2000 and 44.7 F, 1891-1939): Virginia (27.1 inches, 1971-2000 and 26.5 inches, 1891-1939; 38.0 F, 1971-2000, 39.2 F, 1930-1939 and 38.0 F, 1891-1939); and Wheaton (22.5 inches, 1971-2000 and 20.3 inches, 1891-1939; 44.7 F, 1971-2000 and 42.9 F, 1891-1939).

Interestingly, however, some Minnesota station records seemingly defy the overall trend toward warmer temperatures and in increased precipitation. Average annual precipitation values at Argyle, for example, are lower for the period 1971-2000 (19.8 inches) than for the period, 1891-1939 (21.0 inches). Average annual temperature values for the same station, moreover, are essential unchanged: 38.7 F, 1871-2000; 39.0 F, 1930-1939; and 38.4 F, 1891-1939. The Rochester record, although indicating a large increase in average annual precipitation (28.2 inches, 1891-1939 to 31.4 inches, 1971-2000) shows little change in annual temperatures (43.7 F, 1891-1939 and 43.4 F, 1971-2000). Similarly, although Waseca station statistics show a significant increase in precipitation (34.7 inches, 1971-2000 compared to 29.3 inches, 1891-1939), average annual temperatures values decreased from 44.7 F, 1891-1939 to 43.9 F, 1971-2000. Conversely, as indicated above, average annual temperatures at the Crookston station increased from 39.0 F (1891-1939) to 39.8 F (1971-2000) while average annual precipitation remained virtually unchanged (20.6

inches, 1891-1939 and 20.7 inches, 1971-2000).

Despite these and other exceptions to the general pattern, it is clear that Minnesota has become warmer and wetter in the decades since the end of the Great Drought. This trend, of course, has led many to think that prolonged severe droughts are a thing of the past. And although, as noted earlier, this discussion has studiously avoided speculation concerning future climatic conditions(whether drought, global warming or otherwise), it is obvious that droughts as severe or more severe than the drought of the 1930's could occur in the future. In this regard, extant evidence suggests (perhaps even proves) that the central United States has experienced extended drought at various times prior to or during the early phases of European settlement of the Upper Midwest and the Great Plains. According an article written by L. Dean Bark, a Kansas State University climatologist and physicist and published in the AAAS symposium's discussion of North American Droughts (op. cit.). "droughts have plagued man for centuries, undoubtedly causing some of the famines referred to in the Bible. On our continent, tree rings indicate many early droughts including the 'Great Pueblo Drought' from 1276 to 1299.....The earliest records of drought in North America are those painstakingly derived from analyses of the growth rings of trees. A. E. Douglass and his followers at the Laboratory of Tree Ring Research at the University of Arizona have done pioneering work in this area. H. Fritts, from that laboratory, has suggested a model for the physiological relationship causing ring width growth to correlate with variations in climate, and has provided a statistical evaluation of the relationship. Chronologies of tree rings that extend back as far as 500 A.D. have been constructed in some locations. Fritts presents these data as departures from average for ten year periods for locations in the western United States. Although there is evidence of many localized droughts, he reports [that] widespread droughts occurred in 1576-1590, 1625-1635, 1776-1785, 1841-1850, 1871-1880 and 1931-1940.

"Tree rings have also been studied in other parts of North America. However, these studies are not as extensive in the drought prone mid-continent region. R.A. Weakly identified prehistoric droughts from studies of tree rings in Nebraska.....He reported that twelve droughts lasted for ten years or more, and three of them for more than twenty years (emphasis added).The drought that began in 1276 lasted thirty eight years. It is staggering to contemplate just what effect such a drought would have today. Douglass also identified droughts in the Pueblo region at about that time (from 1276 to 1299) that were catastrophic to many of the Pueblo civilizations. Weakly did not find sufficient regularity in his wet-dry patterns to define a drought cycle. However, it seems that droughts have been a feature of our climate for thousands of years.....Since the establishment of observational networks, climatic records have provided a more objective method of identifying droughts. Droughts have occurred in the mid-continent region at approximately twenty year intervals since weather records were started in the United States. They have also occurred in other regions of North America, but not as frequently nor with the regularity that they do in the mid-continent region.....".

Bark, quoting American weather historian D. M. Ludlum, also noted that droughts of varying length and severity had occurred in various parts of the country in more recent times. Among these were droughts (or apparent droughts) in New England (1621, 1623,

1749 and 1761-1762), a general drought over much of the eastern United States (1805 and again in 1822), a drought in California (1850-1851 and again in 1862-1864), a general drought extending from Missouri to New York (1854), and a drought in Minnesota, Wisconsin, Illinois, Kansas, Missouri and Iowa in 1860. Not mentioned was the severe Civil War drought which parched Minnesota (and probably other parts of the Midwest) from 1863-1864.

Worster's history of the 1930's Dust Bowl (op. cit.) also discusses evidence of early Great Plains droughts. According to this source, "in the thirties a number of archaeologists also began to take up the analysis of tree rings, hoping that these might furnish a calendar of droughts for at least the last few centuries. Such a calendar could tell how often these droughts had come and how long they lasted. The tree ring technique was the invention of Andrew Douglass, director of the University of Arizona's Steward Observatory. Back in 1901, he began measuring the thickness of rings on stumps as a clue to rainfall cycles. With the added help of old Pueblo beams he discovered that there had been a major drought in the southwest from 1276 to 1299, forcing the Anasazis to abandon their Mesa Verde cliff dwellings. Could the Great Plains have been affected by this disaster, too? It is impossible to say; there were few trees to analyze here, especially trees of any real antiquity. But one student, Harry Weakly, did manage to find enough plains trees to construct a drought calendar for Nebraska; the narrowest rings (indicating, of course, low precipitation) were those of 1439-1454, 1459-1468, 1539-1564, and 1587-1605, all well after Douglass's great southwestern drought. Undoubtedly, dry spells of such duration one of them lasting twenty six years must have killed not only crops but sometimes the grasses too, so that dirt was laid bare and began to blow, though nowhere so seriously as in modern times. The conclusion of those researches was that agricultural man had long faced severe tests on the Great Plains, and that there were a few exodusters even before the Europeans came. Wherever farming has been tried, in fact, it eventually had failed. A settled village life, depending on its own introduced crops, could not survive the ancient cycle of aridity.

"In the light of this record of human failure, it was ironic that European man's first venture into the Dust Bowl was a quest for Gran Quivira, a great city supposedly built on the plains and paved with gold. Just fifty years after Columbus.....the Spanish conquistador Francisco Vasquez de Coronado made a futile search, crossing in 1540-42 from Santa Fe into the panhandle area and northwest to present day Great Bend, Kansas, where he at least located about twenty five wretched [Indian] villages.....that was all he had to report: no wealth, no cities, a tiny handful of humans lost in the immensity of grass. To make the impression even worse, Coronado arrived during one of Harry Weakly's worst droughts. Thus, four hundred years before the dirty thirties, civilization came to the southern plains and left in disappointment along essentially the same route as the Okies [of the 1930's] took west.....".

The Great Plains are now, of course, one of the major breadbaskets of the world, a generally prosperous region providing a home and livelihood for millions of people. Despite droughts, depressions, insouciant agricultural practices and the misuse (overuse?) of technology, the grasslands are no longer the Great American Desert, an area once so barren and unattractive as to send the likes of Coronado scurrying off to better climes. Yet, skeptics such as Worster (op.cit.) notwithstanding, settlement on the Great Plains has, in

the long run, proved to be a success, a success which has vanquished the views of those who, in the nineteenth century were called "gloomers" (e.g. Pike and others). Some, of course, would argue that, in the even longer run, the "gloomers" might yet be vindicated. Could the area's present culture, strong and ingenious as it is, withstand a drought of the magnitude of the one that appears to have occurred in the late thirteenth century? Will present water intensive farming methods eventually bring about ecological collapse? These, to repeat, are questions to be debated and answered (if meaningful answers are, indeed, possible) by futurists, not by historians. All that can be said in conclusion, then, is that the Great Drought of the 1930's, although an unprecedented disaster, a major setback, did not destroy the hopes and dreams of those who saw better times ahead, not only for the Great Plains but for mid-continent America as well. Drought, in other words, was not ultimately victorious. It did not totally sap the resolve of those who survived the dust storms, the sand dunes, the ruined crops, the depleted herds and suffocating heat. Nor did it let the "gloomers" dissuade those who, despite their many mistakes, tragedies and follies, were able to turn Coronado's wasteland into a flourishing plain. Yet, the vast expanses of the Great Plains and Midwest were not, contrary to his expectations, destined to become the seed bed for Jefferson's utopian democracy of small, self-sufficient farms. Far from it. What emerged (or which, at the least, is now emerging) was a system of technological, industrialized farming combined with a degree of urbanization which bids fair to turn the Jeffersonian dream into a Jeffersonian nightmare. But Jeffersonian or not, the taming of the drought prone mid-continent is a triumph (perhaps a temporary triumph) of the dynamic, expansionist spirit which, although challenged by Worster and many others, has transformed a "desert" into one of the great granaries of the world.

-ENDNOTES-

DECADE OF DISCONSOLATION:
ACKNOWLEDGMENTS, CAVEATS,
APOLOGIES AND EXCUSES.

A special note of thanks to the Minnesota History Center and the Minnesota State Climatology Office, Minnesota Department of Natural Resources. The assistance provided by the staff of these two agencies and the access to their respective records and files was essential to the framing, writing and successful completion of this project.

Although each page of this project was carefully proofread, it is certain, nonetheless, that the ensuing narrative contains a number of typographical, punctuation, spelling and even syntactical or grammatical errors. These, although seemingly inevitable are nevertheless regrettable, the subject of an advance apology to any reader unfortunate enough to come across them.

Many of the quotations appearing in the ensuing narrative particularly quotations taken from Minnesota newspapers have been modified as necessary to correct grammatical, spelling and syntactical errors. In other instances (to the extent required by the context in which the quotation is framed and/or to extent required to clarify the meaning of the original quotation), word order has been altered or conflated and verb tense has been changed. Quotations may also include author's interpolations (indicated by brackets [...]). In all instances, however, the essential meaning and flavor of the original quotation has been maintained.

Unless otherwise indicated, all towns, cities, counties and other geographical entities noted in the ensuing narrative are located in Minnesota.

In some instances, the same or similar data or comments appear in several different sections of the ensuing narrative. Given the way in which the history of 1930's climate has been presented (a general overview of 1930's weather followed by detailed accounts of the most noteworthy climatic events of the decade), some repetition is, unfortunately, unavoidable, even necessary.

All ensuing temperature values are expressed in degrees Fahrenheit (F) and all precipitation values are expressed in inches (in).

Temperature and precipitation values taken from Minnesota newspaper accounts of 1930's (or other) weather events are sometimes different than the corresponding values appearing in official National Weather Service/Weather Bureau publications. These differences are attributable to differences in observation time, typographical errors and/or reporting errors.

During the 1930's some Minnesota observers (as some still do) took readings in the early morning hours, typically at 0700 or 0800 hours central standard time. Consequently, some ensuing temperature and precipitation values are shifted from the day of actual occurrence to the following day. More specifically, (because daily temperatures typically peak at about 1500 hours) daily maximum temperatures recorded at some Minnesota stations are often "moved" to the day following the day on which they actually occurred. Similarly, precipitation which fell during the late morning, afternoon or evening would under an early morning observational regime be measured and recorded on the day following the day on which it actually fell.

Monthly and annual average temperature values cited whether in the ensuing narrative or in the appendix which follows are from thermometers which were read and re-set at various times during the day, ranging from the early morning hours (as

indicated above), to the early or late evening hours or, as in the instance of first order Weather Bureau stations, at midnight (2400 hours). No attempt has been made to homogenize these averages by adjusting them to the 2400-2400 observation day now considered standard by the National Weather Service.

During the 1930's, the United State's official meteorological service was known as the U.S. Weather Bureau, an agency which was then part of the United States Department of Agriculture (and later a part of the U.S. Department of Commerce). The term U.S. Weather Bureau, accordingly, is used consistently throughout the ensuing narrative. The Weather Bureau, of course, is the agency which, in the 1970's, was renamed the National Weather Service and which is now part of the National Oceanic and Atmospheric Administration (NOAA) in the United States Department of Commerce.

As noted in the ensuing narrative, the way in which statewide average precipitation and temperature values were calculated have changed several times since the U.S. Weather bureau was established in 1891. For a number of years subsequent to 1937, statewide averages were computed differently than they were previous to 1937. Moreover, newer and more sophisticated averaging methods have been adopted in recent years by the Midwest Climate Center, the source of some of the values cited in this study of 1930's weather. As an example, statewide average annual precipitation for the year 1929 was initially shown as 20.56 inches. Beginning in 1937, the same annual average was "adjusted" to 21.27 inches. Further adjustments were made by the Midwest Climate Center, the statewide average annual precipitation cited by that source for 1929 now being shown as 21.03 inches. Similarly, statewide average precipitation for 1936 was calculated variously as 18.23 inches (pre-1937); 18.31 inches (post-1937); and 18.08 inches (Midwest Climate Center method).

The ensuing account of the drought of the 1930's, it must be emphasized, is a historical survey which focuses on the perceptions and responses of the people who were unfortunate enough to experience first hand the decade's suffocating "dusters," scorching summer heat and economic adversity. Thus, although "Decade of Disconsolation" necessarily contains a great deal of climatological and meteorological data, it is -- as an account of the climatological events of the 1930's -- neither exhaustive nor technically rigorous. It does not, for example, provide a detailed analysis, much less a critique, of the causes of the drought which ravaged much of the nation during the ten year period ending in 1939. Nor does it provide an exhaustive analysis of the many weather cycle theories which flourished, not only during the 1930's, but in the decades which both followed and preceded the great drought. Rather, it mentions a few such theories, mostly as they were understood and interpreted by the journalists and the lay public. And, to the extent that it does include scientific discussions of these theories, it does so from the standpoint of their historical significance and interest and not so much from the standpoint of their climatological merits and failings. In conclusion, then, it is hoped that what follows will be viewed as a good historical "read," not as a scientific treatise.

Apart from spelling, grammatical and other similar errors, the ensuing narrative may contain errors of fact, some of them perhaps serious. Such errors, to the extent that they occur may, of course, be attributable to errors in the newspaper reports quoted herein. In other instances, however, they are probably the fault of the author, either through misinterpretation of the welter of data collected during the course of this project and/or as a result of the author's failure to fully collect and exhaustively examine material related to some of the topics discussed in the ensuing document.

The word "drought" is used herein in a manner suggesting that its meaning is obvious, unambiguous, perhaps even self-evident. In reality, however, "drought" is a complex concept. It can, of course, be (and usually is) defined simply and objectively as a period of time (usually prolonged) with significantly less than the amount of precipitation considered normal for any given area or ecosystem (or, alternatively, a period featuring a combination of abnormal warmth and deficient precipitation). In reality, however, "drought" is a somewhat subjective term, involving the interplay of a number of qualitative (as opposed to scientifically quantifiable) elements, economic and sociological elements, particularly. Thus, the drought of the 1930's would have been perceived quite differently than it was had the Dust Bowl area not been given over to farming in the 1860's and after (i.e. if the area had remained in its natural, pre-settlement state). Which is to say that a 17th century drought of the same extent and magnitude as the 1930's drought would probably have been thought of as an interesting, but insignificant event (inasmuch as it would have affected relatively few people and would probably not have stirred up suffocating dust storms, etc.). Use of the term "drought, moreover, depends to some extent on the secular distribution of precipitation: years with a dry spring and summer (e.g. 1934 in Minnesota) are typically thought of as drought years while an otherwise dry year with generally adequate summer precipitation (e.g. 1952 in Minnesota) is thought of as a meteorologically "normal" year, its autumn, winter or early spring dryness largely forgotten or ignored.

The ensuing narrative and the charts which accompany it contain a number of abbreviations. These include: F (Fahrenheit); Jan (January); Feb (February); Mar (March); Apr (April); Jun (June); Jul (July); Aug (August); Sep (September); Oct (October); Nov (November); Dec (December); Ann (Annual); Win (Winter); Spr (Spring); sum (Summer); Aut (autumn); Avg (Average); Hghst (Highest); and Lowst (Lowest).

DECADE OF DISCONSOLATION TABLE OF CONTENTS

TITLE	PAGE
Introduction	i
Acknowledgments, Caveats, etc.	vii
The 1930's: A Climatological Overview	1
The Nationwide Drought of 1930	48
The Winter That Wasn't	59
Warm, Warm and Warmer	71
The Grasshopper Summer	79
1933: Prelude To Disaster	97
1934: As Bad As It Gets	115
Hiatus: August 1934-August 1935	145
The Winter From Hell	166
The Summer From Hell	187
The Winter Of 1936-1937	220
Recovery: 1937-1939	229
When Did It Begin? What Caused It?	264
Postscript	312
Endnotes	321
APPENDIX	
Minnesota Precipitation, 1930-39	Figure 1
Minnesota Temperatures, 1930-39	Figure 1A
Minnesota Extreme Maxima, 1930-39	Figure 1B
Minnesota Extreme Minima, 1930-39	Figure 1C

Albert Lea Precipitation, 1930-39	Figure 2
Albert Lea Temperature, 1930-39	Figure 2A
Alexandria Precipitation, 1930-39	Figure 3
Alexandria Temperature, 1930-39	Figure 3A
Argyle Precipitation, 1930-39	Figure 4
Argyle Temperature, 1930-39	Figure 4A
Brainerd Precipitation, 1930-39	Figure 5
Brainerd Temperature, 1930-39	Figure 5A
Chaska Precipitation, 1930-39	Figure 6
Chaska Temperature, 1930-39	Figure 6A
Collegeville Precipitation, 1930-39	Figure 7
Collegeville Temperature, 1930-39	Figure 7A
Crookston Precipitation, 1930-39	Figure 8
Crookston Temperature, 1930-39	Figure 8A
Duluth Precipitation, 1930-39	Figure 9
Duluth Temperature, 1930-39	Figure 9A
Maple Plain Precipitation, 1930-39	Figure 10
Maple Plain Temperature, 1930-39	Figure 10A
Milan Precipitation, 1930-39	Figure 11
Milan Temperature, 1930-39	Figure 11A
Minneapolis Precipitation, 1930-39	Figure 12
Minneapolis Temperature, 1930-39	Figure 12A
Moorhead Precipitation, 1930-39	Figure 13
Moorhead Temperature, 1930-39	Figure 13A
Morris Precipitation, 1930-39	Figure 14
Morris Temperature, 1930-39	Figure 14A
New London Precipitation, 1930-39	Figure 15
New London Temperature, 1930-39	Figure 15A
New Ulm Precipitation, 1930-39	Figure 16
New Ulm Temperature, 1930-39	Figure 16A
Orr Precipitation, 1930-39	Figure 17
Orr Temperature, 1930-39	Figure 17A
Pipestone Precipitation, 1930-39	Figure 18
Pipestone Temperature, 1930-39	Figure 18A
Redwood Falls Precipitation, 1930-39	Figure 19
Redwood Falls Temperature, 1930-39	Figure 19A
Rochester Precipitation, 1930-39	Figure 20
Rochester Temperature, 1930-39	Figure 20A
Roseau Precipitation, 1930-39	Figure 21
Roseau Temperature, 1930-39	Figure 21A
Virginia Precipitation, 1930-39	Figure 22
Virginia Temperature, 1930-39	Figure 22A
Waseca Precipitation, 1930-39	Figure 23
Waseca Temperature, 1930-39	Figure 23A
Wheaton Precipitation, 1930-39	Figure 24
Wheaton Temperature, 1930-39	Figure 24A

Worthington Precipitation, 1930-39	Figure 25
Worthington Temperature, 1930-39	Figure 25A
Snowfall, Winter 1935-1936	Figure 26
Snowfall, Winter 1930-1931	Figure 26A
Snowfall, Winter 1936-1937	Figure 26B
Statewide Precipitation, 1891-2003	Figure 27A
Statewide Temperature, 1895-2003	Figure 27B