

INTRODUCTION

At the end of one of his many famous poems, "The Hollow Men," the 20th century poet T. S. Eliot, in what was a probable reference to our civilization, said that the world would end not with a bang but with a whimper. Maybe. But this could not be said about the winter of 1887-1888, a notably frigid and stormy season, the last in a series of consecutive and devastating Upper Midwest winters, a series which has since been labeled "The Little Ice Age of the 1880's". This was a climatological interlude that, most emphatically, ended not with a whimper but with a bang, a very loud bang indeed.

Beginning in October 1887, the Upper Midwest experienced a series of intense, but intermittent invasions of Arctic air, bringing record low temperatures to many locations, record minima which, for many stations, have not yet been equaled or surpassed. The winter was also accompanied by heavy snowfall, much of which fell during December 1887. Apart from the cold and snow, however, the winter's iconic event occurred in mid-January 1888 when a disastrous blizzard swept across parts of Minnesota, Iowa, Nebraska and what was then the Dakota Territory (now the states of North and South Dakota). This storm, which, because it hit unexpectedly during the afternoon of a relatively warm January day, found many people – school children especially – unprepared for the white out conditions which engulfed the typically featureless Great Plains prairies. The human death toll mounted into the hundreds and economic losses were staggering.

Given the fact that brutal winters occur with disconcerting frequency in the Upper Midwest, the winter of 1887-88, although it marked the end of the Little Ice Age, was not, however, followed by an unbroken series of warm winters. Since that fateful season (i.e. 1887-88), the area continued to experience intermittent episodes of severe winter weather, one of the worst of which was the winter of 1935-1936. Nor was the winter of 1887-88 without parallel during the years prior to the onset of the Little Ice Age (e.g. winters at least as severe and as memorable as any of the winters of the 1880's occurred in 1842-1843, 1856-1857 and 1874-1875). The distinguishing feature of the winter of 1887-88, then, was not its extreme cold as such or even the blizzard of January 1888 (the disastrous impact of which was, in part, attributable more to the fact that the area involved was more densely settled/developed than it was when hit by earlier blizzards of comparable intensity and unpredictability). The last months of 1887 and the first months of 1888 are unique, rather, because, as noted, they marked the end of an unbroken six year reign of abnormally cold, miserable and ruinous winter weather.

The first of this series of winters, 1882-1883, was, ironically, preceded by one of the warmest winters (1881-82: average December-February temperature, 26F) on record in the Twin Cities area (and by inference probably in much of the upper Midwest as well). In addition, the winters (December-February) between the record cold winter of 1874-75 and the cold, snowy winter of 1880-81 (described by Laura Ingalls Wilder in her book, "The Long Winter") were also generally warmer than normal, a five year period which

included the record warm winter of 1877-78.

Any expectations of a continued trend toward warmer winters was, however, quickly dispelled by the onset of the Little Ice Age in the closing months of 1882. January temperatures during the next six years were exceptionally cold, averaging 1F, 9 F, 4 F, 1 F and 0 F at the St. Paul Signal Corps station in 1883, 1884, 1885, 1886, 1887 and 1888, respectively. Comparable January values of -3 F, 4 F, 1 F, 4 F, 0 F and -2 F were recorded by Minneapolis observer William Cheney during the six year interval, 1883-1888. Some of the extreme minima recorded during the same period included -31 F in January 1883 (St. Paul); -32 F in January 1884 (St. Paul); -36 F in January 1887 (St. Paul); -36 F in January 1883 (Ft. Snelling); -37 F in January 1885 (Ft. Snelling); -38 F in February 1886 (Ft. Snelling); - 42 F in January 1887 (Ft. Snelling); -25 F in November 1887 (Ft. Snelling); -31 F in January 1883 (Minneapolis); -33 F in January 1884 (Minneapolis); -38 F in January 1885 (Minneapolis); -30 F in February 1885 (Minneapolis); -34 F in January 1887 (Minneapolis); -41 F in January 1888 (St. Paul); -46 F in January 1888 (Ft. Snelling); -42 F in January 1888 (Minneapolis); -35 F in February 1888 (Minneapolis); and -39 F in February 1888 (Ft. Snelling).

The cause (or causes) of the Little Ice Age is at best elusive. Some climatologists attribute the six year cold regime to the dust and ash thrown into the upper atmosphere by the massive eruption of the Indonesia volcano Krakatoa in late August 1883. This, arguably, if not demonstrably, is a reasonable hypothesis. The particulate matter from the volcano, because it remained in the atmosphere for several years after 1883 (creating hazy conditions and spectacularly red sunsets in many parts of the world), undoubtedly blocked some incoming solar radiation, almost certainly causing significant climatic cooling. In fact, however, the anomalous cold, as noted, settled into the Upper Midwest during the winter of 1882-1883, some months before the culminating Krakatoa event (the main eruption having been preceded by earthquakes, smoke and less violent eruptions). This suggests that factors other than volcanic ash may have contributed to the 1880's cooling, further suggesting that Krakatoa was but one of several atmospheric phenomena (albeit an important one) which deepened the Little Ice Age, perhaps extending what may have been a short lived cold spell into a six year run of intense and persistent cooling. But however it might be explained, the Little Ice Age, as noted, was a singularly anomalous part of a climatic record which, for east central Minnesota at least, extends from 1820 to the present.

Yet, any speculation as to the cause of the Little Ice Age aside, the weather conditions which marked its final year (i.e. 1888) are, unlike those of most earlier years, extensively and fully documented. Accounts of the winter of 1880-81 are – insofar as they lack (with a few scattered exceptions) quantitative snowfall records – incomplete and partially conjectural. Worse, reliable, functioning weather stations were far and few between during most of the 1870's and early 1880's. This unfortunate shortcoming reflects both the distribution of Minnesota's pioneer era population and the policies of the Army Signal Corps, the agency which, from 1871 through 1890, was responsible for the collection and analysis of U.S. weather data. Prior to 1884, the Signal Corps network consisted largely of a few "first order" stations (e.g. St. Paul) and a few "volunteer"

stations (e.g. New Ulm). Most of the 1870's - early 1880's volunteer stations, moreover, were but remnants of a meteorological observer network established in the 1850's by the Smithsonian Institution: the policies which guided the Signal Corps during its early, formative years placed little emphasis on developing or maintaining a "dense" network of stations. As a result, many of the older stations were closed or abandoned.

The Signal Corps policy of benign neglect changed dramatically in the mid-1880's, partly as the result of an increased demand for weather data, a demand prompted to a large extent by the state's burgeoning agricultural economy. States, Minnesota included, were encouraged to establish new volunteer (or cooperative) stations, a task which was carried out with much effort and initial enthusiasm by Prof. William Payne of Carleton College, Northfield. Although this undertaking soon foundered, the result of conflicts involving the Minnesota business community, the Signal Corps and Payne, it did, nonetheless, result in the establishment of a number of quality stations in various parts of the state. By 1888, then, these stations, together with accounts of weather provided by the state's growing network of newspapers, provided a wealth of data (snowfall data especially) not previously available to weather historians, climatologists and others. This means, perforce, that the history of the winter of 1887-1888 is much more extensive and detailed than the history of most previous Upper Midwest winters, the previously compiled history of the winter of 1880-81 especially. Considering both 1887-1888's record setting cold and its significance as the apparent end of the Little Ice Age, we do, then, benefit greatly from the efforts of those who made such documentation possible. In addition, thanks are due to the staff of the Minnesota State Climatology Office and the Minnesota History Center. Their assistance was invaluable both in making the requisite documents available and in helping to interpret the data contained therein. Finally, a special note of thanks to David Laskin who has generously given permission to quote extensively from his book, "The Children's Blizzard," an exhaustively researched and well written account of the Great Plains blizzard of January 1888.

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WITH A BANG: NOT A WHIMPER
The Winter of 1887-1888

Many Upper Midwest residents undoubtedly looked forward to the winter of 1887-88 with apprehension, perhaps even fear. And for good reason. Anyone who had lived in the Minnesota and adjoining states since 1883 had survived an unbroken series of brutal winters: bitterly cold temperatures, blizzards and, at least in many prairie communities, weather related deaths and, more commonly, months of isolation and hardship. Perhaps, however, the area's pioneering residents were somewhat encouraged by the weather of the late spring and summer of 1887. May 1887 was unusually warm (e.g. 64 F in both St. Paul and Minneapolis); June 1887 was slightly warmer than average (e.g. 70 F in both St. Paul and Minneapolis); and July 1887 was hot (e.g. 75 F in Minneapolis and 74 F in St. Paul with temperatures of 80 F or higher on 28 days).

Any hopes for continued warmth were dashed by a cool late summer and a generally cold autumn. Area temperatures during August 1887 were decidedly autumnal (67 F in St. Paul with only eleven days with maxima of 80 F or greater). September 1887 was also cooler than normal (58 F in St. Paul with only one day with a maximum above 80 F). Although near normal temperatures prevailed during the early days of October, the latter part of the month brought winter like conditions, including snow and frigid late fall temperatures, both of which were often accompanied by gale force winds.

At the far northerly St. Vincent, Minnesota Signal Corps station, temperatures fell to -10 F on 25 October; to zero F on 26 October and to 1 F on 29 October. Argyle, Minnesota was nearly as cold with a reading of -9 F on 25 October. Winds at St. Vincent reached 42 miles per hour from the northwest on 12 October, probably raising a considerable amount of dust. Unlike other stations in Minnesota and elsewhere, St. Vincent observers, however, did not record any snow during October. Farther south, the Moorhead, Minnesota Signal Corps station recorded minima on 7 F on 24 October (with a maximum of only 18 F on that date); 6 F on 25 October; 11 F on 26 October; and 10 F on 29 October. Moorhead's October snowfall was negligible with only 0.1 inch recorded. Still farther south, D.T. Wheaton, the cooperative observer at Morris, Minnesota, recorded minima of 8 F, 6 F and 10 F on 24, 25 and 26 October, respectively. Like Moorhead, Morris escaped the October snowfalls, Wheaton's record indicating only a trace (T) of snow during the month.

October's wintery conditions also reached east central and southern Minnesota. According to Minneapolis cooperative observer William Cheney, [October 1887] "was in striking contrast [to] October of last year which was, with one exception, the warmest in twenty years. The past month was the coldest October since 1873 and we have had only two colder in the last 23 years. It was five degrees colder than the average of October for 22 years. The deposit of water [precipitation] was two inches in excess...of

last year. The first of the month was rainy.....[bu] no rain fell after the 16th. Snow on the 22nd and 23rd...Maximum was 67 degrees with a monthly minimum of 12 degrees on the 25th. Prevailing winds from the northwest with two inches of snow...”. Cheney further stated that the “first ice of the season” formed on 14 October and that no temperatures above 32 F were recorded on 24 and 25 October. St. Paul, similarly, recorded maxima of 33 F and 30 F, respectively, on the same dates. An even colder maximum of 24 F was noted at the Ft. Snelling post hospital station on 24 October (with a minimum of 9 F on the morning of the same day).

The late October cold was also noted in the 19 October edition of the New Ulm Journal: “winter is coming on and putting up stoves is part of the routine work in every well regulated household [here]...”. New Ulm’s October snowfall totaled 2.5 inches, most of which fell on 22 October. Lowest temperature recorded during the month was 9.5 F on 25 October. At Delano, Minnesota the Signal Corps volunteer observer (A.W. Wittman) recorded two inches of snow on 23 October and a chilly minimum of 8 F on 25 October. Like Delano, both the Mankato and Duluth stations recorded minima of 8 F on 25 October. It was slightly colder at Red Wing, a minimum of 7 F recorded there on the morning of 25 October. Mankato reported two inches of snow during the month (October) but the Duluth station, consistent with other northern Minnesota stations recorded only 0.2 inches of snow. Interestingly, St. Paul observers recorded a mere 0.4 inches of snow during October, a value seemingly at odds with the values recorded in Minneapolis and/or the amounts suggested by newspaper accounts.

Another perspective on the early onset of winter like conditions was provided by the 24 October 1887 edition of the St. Paul Dispatch. This report, indicating a widespread snowfall, stated that “the snowstorm of Saturday and Sunday extended over a large area. In St. Paul about one inch of snow fell but it has since disappeared, or nearly so.....In some parts of Wisconsin snow fell to a depth of a foot. In the Black Hills region, the storm was unusually severe.....on the [Great] Lakes a perfect gale raged and many disasters to shipping are reported, although attended by little loss of life...”.

Unlike October 1887, November 1887 was relatively warm with an average monthly temperature of 31 F in St. Paul and 30 F in Minneapolis. These averages, however, reflect a temporary, and deceiving, return to normal conditions during the first part of the month, deceiving because the closing days of the month were intensely cold and stormy. According to reports received from Minneapolis Tribune correspondents, “the first blizzard of the season was raging” at Sioux City, Iowa on 26-27 November. The Iowa report further noted that “a strong wind [was] blowing from the north and the storm has been blinding most of the day...”. Similarly, Morris, Minnesota reported snow and high winds on what was said to be the “roughest and coldest day of the season...”. A correspondent from Adrian, Minnesota, sounded an ominous note, stating that “it began snowing yesterday with a blizzard today and the thermometer falling...Farmers

are ill prepared as there has been a short supply of fuel and possible famine [presumably a fuel famine]...’.” At Yankton, Dakota Territory, the Tribune reported “a fierce storm of snow and wind” that had prevailed all day (27 November) “and giving indication that the blizzard will continue until Monday (28 November)...”. Trains, it was said, were “somewhat delayed, with “blockades anticipated by ...morning...”. Also, according to the same edition of the Tribune, at Watertown, Dakota., “snow commended falling at midnight and has fallen steadily ever since..”. And on 29 November the Tribune – relying on what may be exaggerated reports – reported a temperature of -30 F at Glencoe, Minnesota; six inches of snow with a 29 November reading of -30 F at Fair Haven, Minnesota; and -29 F at Wabasha, Minnesota. A report from Lake City, Minnesota, stated that the “cold snap had closed Lake Pepin entirely with ice nearly three inches thick..”.

In a parallel story, the 28 November 1887 edition of the St. Paul Dispatch stated that “at last the weather clerk has settled down to business and he proposes to make people a little livelier than usual and stop street loafing altogether. Yesterday was anything but a warm day and only those who are fortunate enough to possess fur overcoats.....were seen out of doors. The coal dealers are all smiling, while countenances of their poor victims bore a most woeful expression. The minimum temperature in St. Paul last night was 16 degrees below zero, and the highest point reached by the mercury was two below. At seven o’clock [today] the thermometer registered 16 below and within an hour afterwards had dropped to 22 below.....The temperature has gradually grown warmer until at two o’clock this afternoon the mercury stands at zero. Sergt. [Patrick] Lyons says this was the coldest November morning ever recorded at the St. Paul signal office, excepting one morning in November 1885, when the thermometer went down to 24 below. Weather reports received at the different railroads this morning indicate that the cold snap extended over Dakota, Minnesota and Wisconsin...”.

The same article reported, among others, readings of -28 F at Ft. Buford, Dakota Territory; -10 F at Des Moines, Iowa; and -24 F at Bismarck, Dakota Territory, all from official Signal Corps stations. Various railroad observers reported -22 F at Brainerd, Minnesota; -22 F at Dawson, Minnesota and -35 F at New Richmond, Wisconsin. At Moorhead, Minnesota, Signal Corps observers recorded minima of -21 F, -22 F on 27 and 28 November, respectively. Maxima of 5 F were recorded on 28 and 29 November with 42 mile per hour sustained winds from the north on 18 and 19 November. Farther to the north, the St. Vincent Signal Corps observer recorded minima of -23 F, -28 F, -29 F and -30 F on 26, 27, 28 and 29 November, respectively. The station’s maximum temperature on 27 November was a chilling -9 F. At Morris, temperatures dipped to -20 F on the morning of 28 November and at Delano, the late November cold wave brought a reading of -29 F on 28 November. At Argyle in far northern Minnesota, a temperature of -31 F was recorded on 29 November. In central Minnesota, G. M. Harvey, the observer at the St. Cloud Normal School recorded -23 F

while another observer at the St. Cloud College recorded -28 F at 0700 on the same date; and in south central Minnesota, Mankato and Red Wing recorded -21 F and , both on 28 November. Farther south, J. M. Hohzinger, the observer at Winona recorded -19 F on 28 November. At Ft. Snelling, the post hospital station recorded minima of -25 F on 27 and again on 28 November. Far northern Duluth, in contrast, reported a relatively “balmy” minima of -15 F on 28 November.

Overall, as noted previously, November 1887 was a comparatively warm month (e.g. with temperatures of 70 F and 72 F on 1 November in St. Paul and Litchfield, respectively), a fact which was overshadowed by the Arctic outbreak at the end of the month. In a meteorological summary printed in the Minneapolis Tribune on 2 December 1887, Minneapolis observer William Cheney emphasized the schizoid character of the month’s weather: “ this was a warm November, being more than three degrees warmer than November of last year and nearly one degree warmer than the average of November for the past 23 years. The first half of the month was unusually warm and pleasant. No day until the 17th had a mean temperature as low as freezing....A large proportion of these days (the first half of the month) were clear. The remainder of the month was colder with several snow storms. The storm of the 25-26 deposited six inches of snow and gave us our first sleighing. A minimum temperature of -20 degrees occurred on the morning of the 28th. The cold snap was accompanied by an usually high barometer. Temperatures moderated rapidly on the last day of the month...”.

Late November’s extreme cold, coming as it did after several weeks of warm weather, suddenly and understandably raised concerns regarding the adequacy and availability of winter fuel supplies. This concern was quickly and timely addressed by the St. Paul Dispatch on 28 November 1887. According to the Dispatch story, “John L. Lewis, vice president and treasurer of the Lehigh Coal and Iron company [stated that].....the coal received at that head of Lake Superior this season has been considerably in excess of the quantity arranged for by the coal companies. There have, however, been orders received for shipment on Lake Superior from places hitherto supplied from Chicago, and this will decrease the surplus for the ordering trade supplied generally from Lake Superior. There is no occasion for coal to be short at interior points, unless for want of a car supply, and I [Lewis] believe that at present all orders for the interior are pretty closely filled up. The fine weather experienced during November will materially decrease the quantity of anthracite used this season, and prevent any chance of shortage. We do not contemplate any famine of coal, and lake business being over will put a large number of cars into all rail supply. If, as stated in your telegram, Adrian is without coal, it is not owing to short supply at the head of Lake Superior, and fifteen or twenty cars would supply Adrian’s anthracite wants. Our orders generally over the Omaha road, on which Adrian is situated, are pretty well filled, and we are not aware of any considerable clamor for coal. The shortage generally in the interior is for all rail soft

coal from the mines direct and this has been caused by ostensibly reduced railroad rates, at which the railway company would not furnish cars, with the normal rates to take effect on the 5th of December.....Messrs. Griggs and Foster...stated that so far as they could see there was no danger of a famine.....The Northwestern Fuel company officials corroborated both the above statements as to the condition of the coal supply, and the manager stated that in localities where a shortage existed it was owing to the lack of car supply.”

Curiously, however, in another story appearing in its 28 November edition, the Dispatch emphatically contradicted the optimistic Lewis report. The second article stated, rather, that, although approximately one million tons of coal had been taken to Duluth (an amount which exceeded the corresponding 1886 total by about 200,000 tons), “it is already evident that there will be a great shortage in the supply this winter”. “The first blizzard has come and the towns of Western Minnesota and Eastern Dakota are even now showing signs of great anxiety....”.

Extant evidence suggests, however, that any fuel shortages which occurred during the remainder of the winter – unlike the widespread and disastrous “fuel famines” experienced, for example, during the winter of 1880-81 – were isolated and episodic. This change of fortune can probably be attributed to the fact that the railroads, the suppliers and the vendors, having been sobered by past calamities and debacles, were sensitized to the challenges posed by Upper Midwest winters and, accordingly, had improved the ways in which winter fuels, coal especially, were stocked and delivered. Newspaper accounts further indicate that improved technology also played a significant role: use of the then recently invented rotary snow plow allowed the railroads to open snow blocked routes more rapidly and effectively than in past winters, winters in which snow removal (often relying on manual labor) was inadequate to the task, leaving some roads blocked for much of the winter, delaying critical deliveries until spring.

Although December 1887 monthly average temperatures were, unlike November, generally somewhat below average, the month, taken as a whole -- in contrast to December 1886 and several other earlier Decembers – was not notably cold. Representative monthly mean temperatures included 3 F at St. Vincent in the far north, 6 F at Moorhead in the Red River Valley, 8 F at Morris in west central Minnesota and 16 F and 17 F, respectively, in Minneapolis and St. Paul in east central Minnesota. In the Twin Cities area at least, daily maximum temperatures during the first half of the month were mostly in the 30's F with extreme cold limited to the closing days of the month.

The distinguishing feature of the month, however, was excessive snowfall and frequent, widespread winter storms. Monthly snowfall values included 20.2 inches at Moorhead with an end of month snow cover of eleven inches; 6.0 inches at St. Vincent with a

month end snow cover of five inches; 39.5 inches at Morris with a month end snow cover of 36 inches; 24.0 inches at Delano with a month end snow cover of 20 inches; 26.8 inches at Duluth with a month end snow cover of 18 inches; 33.0 inches at Mankato with a month end snow cover of 22 inches; 33.2 inches in Minneapolis with a month end snow cover of 20 inches; 33.0 inches at Red Wing with a snow cover of 37 inches on 31 December; 26.0 inches at Tracy with a month snow cover of 26 inches; and 17.5 inches in St. Paul with a month end snow cover of 18 inches. Predictably, December 1887 was also an exceptionally cloudy month. Average daily sky cover values included 7.5 in St. Paul (with 10.0 indicating total cloud cover) and 17 cloudy days; 6.2 at Moorhead; 5.0 at St. Vincent; 7.6 at Ft. Snelling and 8.0 in Minneapolis.

Although early December, as noted, was relatively mild, the last ten days of the month were marked by an extended period of stormy, frigid weather. Morris's volunteer observer (D. T. Wheaton) recorded 17 inches of snow during a three day blizzard, 20-22 December. According to the 21 December edition of the Minneapolis Tribune, the same blizzard struck much of the Upper Midwest on 20-21 December. Watertown, Dakota Territory reported that "the worst storm of the season, commenced at a late hour last night and has continued with unabated fury all day...Trains are hung up in all directions...". Similarly, Adrian, Minnesota reported that "a blizzard began last night and it is snowing steadily today." Eastbound trains were reportedly running on time but westbound trains were said to be running late. Temperatures were noted as "falling rapidly..". Contrary to earlier reports, the Tribune's Adrian correspondent stated that "there is a big supply of fuel here," suggesting obviously, that coal suppliers had responded to earlier claims of an impending fuel shortage in that community. Like Watertown, Montevideo reported its "worst blizzard of the season," stating that several inches of snow had fallen since early morning, delaying train traffic and "suspending business".

Two days later (23 December), the Tribune reported that a "great blizzard" had caused the deaths of 60 people in Kansas with "scores of people frozen to death on the prairies...". The same edition of the Tribune stated that about 14 inches of snow had fallen at Wabasha and that temperatures at that location had fallen from two degrees at daylight (probably on 22 December) to -12 F at 0900. Country roads in that area were said to be "drifted full of snow". On the same date (23 December), the Morris Sun described conditions in west central Minnesota, stating that "sleighting has received a set back by drifting snow, hence business is dull. Prophecies of an open winter are not as abundant as a few days ago. The weather prophets have been snowed under. Christmas week is an unlooked for dull one owing to bad roads and severe weather. Farmers were compelled to stay at home to a great extent during the week and, of course, the Christmas trade suffered considerably."

More of the same followed: on 28 December, the Tribune reported that "another big

blizzard” had struck Kansas, Missouri, Nebraska and other Midwest states. At Council Bluffs, Iowa, a “heavy storm” was said to have “raged since midnight,” accompanied by a six hour temperature drop of twenty degrees and a nighttime reading of -10 F. Trains were delayed “on account of the heavy snowfall.”

Not unexpectedly, the pre-Christmas snowfall was followed by a period of bitter cold. Minimum temperatures at the St. Vincent station included -29 F, -25 F, -25 F, -35 F and -44 F on 21, 26, 27, 28 and 29 December, respectively. Winds of 38 miles per hour from the north were recorded on 23 December and the maximum temperature on 29 December was a frigid -19 F. At Moorhead, temperatures fell to -22 F, -24 F, -27 F and -36 F on 26, 27, 28 and 29 December, respectively. The maximum temperature on 28 December was -17 F and wind speeds “estimated” at forty miles per hour were noted on 23 and 31 December. At the Morris station, minima included -25 F, -23 F and -34 F on 27, 28 and 29 December, respectively, with a maximum of -18 F on 28 December. Similarly, the St. Cloud College observer recorded -30 F at 0700 on 29 December. Duluth, however, was relatively “warm,” with a minimum of -17 F on 27 December. In east central Minnesota, Delano recorded a minimum of -32 F on 30 December. Other notably low readings included -26 F at Mankato and Tracy, both on 29 December; -24 F at Red Wing on 29 December; and Ft. Snelling, -30 F on 28 December.

In the Twin Cities, both the Minneapolis and St. Paul stations recorded comparatively moderate December minima of -22 F. The cold was, nonetheless, newsworthy, prompting a lengthy, and somewhat lighthearted weather story in the 28 December 1887 edition of the St. Paul Dispatch. According to this account “this morning [28 December] was one when people looked in vain to find a thermometer that harmonized with their feelings. If there had not been an instrument in St. Paul, affidavits could have been secured to the effect that the thermometer was anywhere from 30 to 45 below. And yet the cold was less severe this morning than it was yesterday. The minimum reached was only 16 below zero as against 18 below yesterday, and at seven o’clock this morning it was only 14 below.the various Signal stations reported a temperature below zero, from two below at St. Louis to 28 below at Ft. Totten [Dakota territory]. At Leavenworth, Kansas, it was eight below...something remarkable for that place.

“In St. Paul this morning every person seemed to be possessed of the idea that it was an unusually cold day. They arose cold, they talked cold and they acted cold. If any office door was left open a minute there would arise a shiver....Men hustled around the city as if it were their last day of legal existence.. Even the newsboys acted as if they felt the blast.....The hotel rotundas were astir with visitors, who didn’t care to venture out. At the Merchants a ..politician from Bismarck walked around with a smile on his face. ‘You people make me tired,’ he said addressing a party seated around the stove. ‘You talk about this being cold. Why it’s nothing. If you want to feel the cold come out to Dakota some time’The indications are that the weather will moderate slightly, but

the chances are that the present cold snap will continue for a few days. A few degrees one way or the other do not make much difference, and while the mercury may rise to within a few degrees of zero the change will hardly be felt...”.

On a more serious note, the Dispatch story continued by noting that “nearly all trains into St. Paul were late today. The wind accompanying the cold wave blew the snow onto the tracks, and while some of the lines were blocked travel was very heavy. All of the Chicago trains were delayed from one to six hours. The Milwaukee felt the blow on all its divisions as did the Omaha. The Sioux City train was bulletined one and half hours late. Trains on the Manitoba and Duluth were also retarded, while the Northern Pacific more nearly approached schedule time.”

The 28 December account further emphasized the widespread extent of the cold, disruptive weather. A report received from Milwaukee (dated 26 December) stated that “trains on all roads running into this city were from one to five hours late this morning in consequence of the blizzard which raged...throughout the night. Snow fell to the depth of five and one-half inches, and drifted badly. The highest velocity of the wind was 36 miles per hour. The temperature at daybreak was two below zero, and at noon...four below. The zero line runs from Lake Superior south to Milwaukee and southwest to southern Wisconsin.....A wild snowstorm is raging today on the Upper Michigan peninsula...”. The same story noted -10 F at Dubuque, Iowa with “trains running late in all directions...”. Marshalltown, Iowa reported 18 below and, although snowfall in that region was said to be light, “high winds gave the railroads some trouble...”. Still another report told Dispatch readers that, at Springfield, Illinois, “a cold wave bore down on this city last evening from the northwest. The mercury had stood about ten degrees above zero during the day, and this morning it was ten degrees below...”. Still other reports of cold and snow dominated the news, the 30 December edition of the Rochester, Minnesota Post telling its readers that a snow storm had occurred as far south as Ft. Davis, Texas and that temperatures of -14 F and -30 F had been recorded at Denver and Ft. Totten, Dakota Territory, respectively.

Although the late December cold wave was followed by briefly moderating temperatures, perverse weather conditions persisted, featuring an intense snowstorm which brought excessive snowfall to many areas on 30-31 December. Snowfall during this storm – described by one St. Paul journalist “as one of the worst ever known” – included 15 inches at William Cheney’s Minneapolis station (where 10 inches of snow had fallen ten days earlier); 14 inches at another Minneapolis station maintained by J. H. Aschenbeck; and ten inches in Delano (adding to the 4.5 inches which fell at that location during the 20-22 December storm). Heavy snow was also recorded at Duluth, Litchfield, Northfield and many other Upper Midwest locations. St. Paul observers, in contrast, recorded only 4.7 inches of snow during the 30-31 December storm, a value which appears to have been derived from unrepresentative measurements,

measurements perhaps taken on a wind swept rooftop. Or a value obtained by measuring the snow “captured” by the station’s rooftop gage, a “catch” reduced by the high winds which, in all likelihood, would have blown much of the day’s snowfall over and/or out of the gage.

According to Minneapolis observer William Cheney’s meteorological report published in the Minneapolis Tribune on 2 January 1888, the storm began at about 1030 hours on 30 December and continued with only a “short intermission” until the evening of 31 December. The new snow, accompanied by high winds, drifted to a height of four to five feet in parts of the Mill City. Similarly, the St. Paul Globe stated that “more snow fell during...the last two days than at any time this season”. The snow, which was said to have been “light and dry” was “drifted badly by a high wind”, blockading railroad traffic “everywhere throughout the northwest”. Some trains were even said to have been “abandoned”. In the same vein, the 31 December edition of the St. Paul Pioneer Press reported that a blizzard had raged in the Mankato area, beginning during the forenoon of 30 December, a storm which it was further noted, had extended over a large portion of the Dakota Territory and the state of Wisconsin. Correspondents from Hastings, Shakopee, Northfield and Brainerd also reported a “heavy snowstorm”. On the following day (1 January 1888), the Pioneer Press commented that the “great” storm began in St. Paul on Friday morning 30 December with snow falling “steadily all day long...”. The same report emphasized, however, that the efforts of downtown street crews (who were described as being “actively at work”) had kept the storm from “materially” disrupting traffic in the city itself. It was further noted that the “snow blockades” on most of the railroads were “effectively broken” on New Year’s Day.

The center of the storm, as explained by Lt. Thomas M. Woodruff, the St. Paul Signal Corps station’s forecast officer, moved from Denver, Colorado to LaCrosse, Wisconsin during a twenty four hour period from 30 to 31 December, progressing eastward at a rate of about twenty five miles per hour. Snowfall in northern Minnesota, the Dakota Territory and Iowa was said to have “comparatively light” with heavier amounts falling in areas “east of the Mississippi”. Temperatures, as recorded at the St. Paul station, were relatively moderate during the storm, ranging from a high of 28 F to a minimum of 11 F on 31 December. Mean sea level (MSL) pressure was, however, notably low, dropping to 29.29 inches at Cheney’s Minneapolis station during the day on 31 December (following a reading of 30.77 inches on 29 December).

Somewhat surprisingly, however, newspaper reports suggest that 1887's cold, snowy and disruptive year end weather was not, so far as can be determined, accompanied by extreme or widespread hardship or loss of life. But, as contemporary press reports indicate, December’s severe weather took its toll nevertheless, particularly among farmers and others living in isolated areas. The 29 December 1887 edition of the Minneapolis Tribune reported, for example, that a St. Cloud area farmer and his children were “nearly frozen to death while traveling to the city [St. Cloud] from their

farm site about ten miles distant..”. Tragically, however, December’s casualties were soon dwarfed by monumental human and economic losses, the result of a series of calamitous weather events during the month that followed, preeminently the now infamous Great Plains blizzard of 12-13 January 1888.

Yet, the Great Blizzard, however historic, was but one of a succession of extreme weather events that plagued the Upper Midwest during January 1888. As early as 5 January, the Minneapolis Evening Journal reported, for example, that the Red Wing area was besieged by a “severe blizzard from the southeast, accompanied by hail (sleet?)...”. Worse, the 30-31 December snowstorm was followed by an outbreak of intensely cold Arctic air. Notable minima recorded during the early part of the month included -35 F, -29 F, -43 F, -41 F, -45 F and -54 F at St. Vincent on 2, 7, 8, 9, 10 and 11 January, respectively. Similarly, Moorhead Signal Corps station observers recorded -25 F, -27 F, -35 F, -27 F and -44 F on 3, 8, 9, 10 and 11 January, respectively. At Morris, temperatures fell to -31 F on 9 January and again on 11 January and at Delano, daily minima included -27 F on 2 January, -32 F on 9 January and -37 F on 11 January. Another bitterly cold minimum, -36 F was recorded by the St. Cloud College observer on 11 January. In the Twin Cities and surrounding areas, temperatures during the early January cold wave fell to -28 F at St. Paul on 11 January; to -39 F, -30 F, -33 F and -32 F at Ft. Snelling on 8, 9, 10 and 11 January, respectively; and to -30 F in Minneapolis on 11 January.

Although early January’s bitterly cold temperatures (which were often accompanied by brisk winds and blizzard conditions) undoubtedly caused significant economic and social disruption and physical stress, they were, as noted, soon eclipsed by the blizzard which – with little warning -- stuck much of the Great Plains and the Upper Midwest beginning in Montana early in the morning of Thursday, 12 January and continuing through Friday, 13 January 1888. According to weather historian David Laskin (in the prologue of his definitive account of the storm in his book entitled “The Children’s Blizzard”), “..... *[the] blizzard broke over the center of the North American continent. Out of nowhere, a soot gray cloud appeared over the northwest horizon. The air grew still for a long, eerie measure, then the sky began to roar and a wall of ice dust blasted the prairie. Every crevice, every gap and orifice instantly filled with shattered crystals, blinding, smothering, suffocating, burying anything exposed to the wind. The cold front raced down the undefended grasslands like a crack unstoppable army. Montana fell before dawn: North Dakota went while farmers were out doing their early morning chores; South Dakota during morning recess; Nebraska as school clocks rounded toward dismissal. In three minutes the front subtracted 18 degrees [F] from the air’s temperature. Then evening gathered in and temperatures kept dropping steadily, hour after hour, in the northwest gale. Before midnight, wind chills were down to 40 below zero. That’s when the killing happened. By morning Friday the thirteenth, hundreds of people lay dead.....many of them children who*

had fled – or had been dismissed from – country schools at the moment when the wind shifted and the sky exploded....”.

Predictably, most Upper Midwest newspapers were filled with accounts of the blizzard, focusing on the appalling loss of human life, the blizzard’s effect on railroad traffic and, in some instances at least, reports from communities which had experienced, or were expected to experience, fuel shortages. Much of the press coverage also indicated that most of Minnesota, as well as surrounding states, felt the wrath of the storm. The 12 January 1888 edition of the Minneapolis Evening Journal, for example, carried telegraphic reports from correspondents in various Minnesota communities and the Dakota Territory. Devils Lake, Dakota, noted that “the worst blizzard of the winter” was “raging” there: “all east bound passenger trains are abandoned...”. Pierre, Dakota, likewise reported a “a terrible blizzard” with winds “blowing 60 miles per hour, making “it impossible to see more than 100 feet...”. At Aberdeen, Dakota, the blizzard was said “to have set in about seven o’clock last night from the south, blowing furiously all night...This morning the wind shifted to the northwest and is now blowing a gale...”.

In Minnesota, a correspondent from Fergus Falls wrote that “the storm last night was fearful and continues unabated. Business is suspended. The mercury is at zero degrees with a heavy fall of snow...”. The Journals’ correspondent from the west central Minnesota community of Bird Island noted “the biggest snow and wind of the winter...The Hastings and Dakota [rail] line is snowed in tight...”. A similar report from St. Cloud stated that “a genuine blizzard has been raging since early morning. Considerable snow fell during the night and is now drift[ed] by a heavy wind...The thermometer registers minus ten degrees...”. The Litchfield correspondent, echoing the day’s predominate theme, reported that the “worst blizzard of the winter had prevailed since early morning” and that “all trains were abandoned and county roads [are] entirely blockaded...heavy winds from the southeast...”. Several inches of snow and a “heavy gale” was also reported from Montevideo. And at Owatonna in southeastern Minnesota, “a severe storm of snow and wind” “raged” all day. The snow, it was said, had “drifted badly” and trains had been delayed.

Also, in a retrospective account appearing in its 12 January edition, the Morris, Minnesota Sun stated that “late trains are an every day occurrence now...during the late bad weather (presumably a reference to inclement weather which had prevailed during the ten days following the 30-31 December storm) freight trains have great difficulty in moving at all...The night passenger [train] due at Donnelly at 2:50 a.m. was five hours late on account of the blizzard last Thursday night...”. In another retrospective story in its 19 January edition, the Sun’s editor stated that the “worst blizzard of a dozen years past prevailed during the past week, not in Stevens county nor in the state of Minnesota alone but in Dakota, Montana, Iowa and Nebraska did this terrible storm do more deadly work....It was bad in Minnesota but, from reports received, it was lamb like here

compared to what it was in other parts of the country....”.

However comparatively “lamb like” it might have been, the blizzard still did its deadly work in west central Minnesota. According to the Sun’s 19 January report, a couple, Mr. and Mrs. William Rixe, residents of a small west central Minnesota community attempted to return home from nearby Graceville, Minnesota during the afternoon of 12 January. They became lost in the storm and, at a point only a short distance from Mr. Rixe’s brother’s residence, they were forced to abandon their team and sleigh. They then attempted to reach their destination on foot but Mrs. Rixe’s clothes became so heavily laden with wind blown snow that she was unable to go on. The husband then attempted to carry his wife but, he, too, soon became exhausted. He did, however, reach his brother’s residence and the two set out to find Mrs. Rixe but, because the swirling snow almost totally obscured their view, they were unable to find her. Tragically, she was found the next morning, dead, but standing erect, frozen stiff.

Blizzard stories gathered from various points in Minnesota and the Upper Midwest also dominated the front page of the 12 January edition of the St. Paul Dispatch. The day’s headlines told readers that the blizzard was “general all over the northwest” and that all railroad traffic would probably be blocked by six o’clock that evening. A report from Jamestown, Dakota, sounded a familiar refrain, telling Dispatch readers that the “worst blizzard of the season is raging here. It is not cold, the thermometer indicating four degrees above zero, but the snow is flying in circles and a strong wind is blowing from the northwest. All the roads are blocked. No trains are expected in..from ten to twenty four hours. The storm is general all through Dakota and Montana, and it reached here from Glendive, Montana, in about three hours...”. Bismarck, Dakota, further reported that “the worst blizzard known so far this season has been raging here since early morning....Children started for school but were obliged to turn back on account of the severity of the storm. Railroad traffic is interfered with and the westbound passenger train left Sterling, thirty miles east of here, eight hours late....”.

In Minnesota, a Fergus Falls correspondent reported the “worst blizzard of the season,” noting that “Wednesday night’s train from the north is snowbound at Barnesville [Minnesota], and the train from the south due here this morning is stalled in Alexandria. There is a very heavy fall of snow”. Still another report stated that at Rochester, Minnesota “a terrible blizzard set in today, the wind blowing from the southeast. All trains are blocked”. And at Red Wing, a Dispatch correspondent complained that a “cold wave culminating yesterday morning is today followed by a blinding snowstorm...Trains are all late”. In still another report, the Dispatch touted “today’s storm [as] the worst that has been experienced by the various Northwestern railways this winter. Reports at the general offices of the St. Paul roads show that snow is general along the lines.....A heavy wind accompanied the storm, and it is a perfect blizzard at some western points. If the wind and snow continue until six o’clock tonight every road

out of St. Paul will be blocked and all trains will have to be temporarily abandoned.....”.

However downbeat, even alarming, they may have been, most 12 January newspaper reports provided only a preliminary account of the blizzard. Beginning on 13 January, in contrast, press accounts began to focus on the devastating effects of the storm, its horrible death toll in particular. On 13 January, the Minneapolis Evening Journal provided extensive coverage of the storm, stating that “the most terrible storm ever known in the Northwest has been prevailing for the past 24 hours. The railroads have never suffered so much. There have been times when the blockade has continued for a great number of days, but then the roads did not have the facilities for fighting the snow that they have now....If the storm continues, and the signal service says that it will, there will be no trains to speak of out of Minneapolis or in until Sunday night. Three inches of snow fell in Minneapolis yesterday and that was the average fall throughout the northwest. With it came a cold wave which aggravates the situation greatly. At six o’clock last night it was 14 degrees above zero. At seven o’clock this morning it was 17 below zero...The storm has been raging since Wednesday night at seven o’clock but did not reach the state until last night. The storm swept along at a rate of 40 miles per hour....The wind has laid the ground bare in some places....”. The Journal further noted that at 1000 hours temperatures at various locations impacted by the storm had fallen to dangerously frigid levels: -35 F at Grand Forks and Neche, both in Dakota;; -36 F at Minot, Dakota; -28 F at Fergus Falls; and -20 F at St. Cloud. By 0600 the following morning (13 January), the Journal claimed that temperatures at these and other locations had dropped another 15 to 20 degrees with an early morning reading of -52 F (probably an exaggerated, unofficial reading) at Grand Forks.

The same edition of the Evening Journal further noted that rail traffic had been suspended at St. Cloud, Wabasha, Winona, Duluth and other points. Redwood Falls, Minnesota, reported a “terrible blizzard” with a temperature of 32 below zero. At Moorhead, where southerly winds of 50 miles per hour had been recorded on the morning of 12 January, several plate glass windows had been blown out. Interestingly, also, the Journal carried a report from DeSmet, Dakota, the setting for Laura Ingalls Wilder’s account (“The Long Winter”) of the winter of 1880-81. According to telegraphic reports from that community, “the worst blizzard [in] years struck...at one o’clock yesterday. Snow was so thick that buildings but a few rods away could not be seen. J. N. Tervey started south with a team just before the storm. He got a mile out and tipped over. The team broke and he stayed under the box all night. A party found him this morning all right and not frozen, though it was 30 below and there was a high wind.....”.

Like the Journal, storm stories dominated news coverage in the 13 January edition of the St. Paul Dispatch. A telegraphic report from Huron, Dakota, reminded Dispatch readers once again that “central Dakota has never seen such a storm as came howling

down upon us just before noon [12 January]. A high wind had blown from the south for twenty hours, when it whipped into dead north, and has blown from fifty to sixty miles an hour ever since.....All the snow drifts in the country appear up in the air, making it nearly impossible to go out on the street. It is not safe to venture out, for objects cannot be distinguished twenty feet distant. Business men who attempted to go home this afternoon lost their way at street crossings. Many others are not attempting to go home tonight, as it is not safe. Some teachers, who had never seen a first class zephyr, dismissed their children this noon and sent them home in the storm. Nine or more of these were soon lost on the open space of two blocks around the school house and ordinary attempts to find them were unavailing.....”.

Numerous other messages reported delayed, stalled and abandoned trains; a temperature of -25 F accompanied by winds of 56 miles per hour (Grand Forks, Dakota); temperatures of -53 F and -56 F (Neche, Dakota); a temperature of -25 F “and falling” with thirty mile per hour winds (Bismarck, Dakota); a temperature of -47 F (Fargo, Dakota). A report from Tracy, Minnesota stated that the barometer there “fell very rapidly during last night and the storm has been raging west all day.....The thermometer fell eight degrees in ten minutes when the storm struck”. In St. Paul “the snow fell all day yesterday and the wind piled it in huge drifts wherever it could. The street car company kept snow plows busy and the cars were run on all lines, though progress was slow. Pedestrians didn’t seem to mind it much, however,.....”. And in Minneapolis, “the disagreeable storm...raged all day yesterday.....The temperature had moderated to some extent, but a cold blustering wind careened around the street corners all day, [making] it difficult for pedestrians to get about and [causing] the street car and motor people to ‘hump’ themselves to keep the lines clear...”.

A week after the storm, the St.Cloud Daily Times published an account of the personal experiences of a St. Paul resident (P.W. Smith) who had been a passenger on a train which became stalled at Aberdeen, Dakota, forcing Smith to “wait out” the storm, presumably at an Aberdeen hotel (or perhaps in the train itself). He stated that “it [the blizzard] came up very suddenly and [it] was one of the worst storms that I ever witnessed....On Wednesday morning [11 January] the weather was warm and calm....But the blizzard came when we least expected it. The wind blew a perfect hurricane and the snow was blinding.....[An] exciting incident was that of Mr. McLaren who drove a quarter of a mile to a school house for his two children.....and Miss Kittie Reeves, the school teacher. The party started for home and lost their way. They were out in the storm for eighteen hours. Miss Reeves kept the children and herself from freezing with a buffalo coat.....”.

On Monday 14 January, the storm had abated,, leaving in its wake the frozen bodies of numerous hapless prairie dwellers, school children especially (hence the title of Laskin’s book, “The Children’s Blizzard”). Newspaper accounts, expanding on

previous, but obviously fragmentary reports of fatalities, now displayed an increasing awareness of this aspect of the storm. "Died In the Storm" for example headlined an extensive blizzard story in the 14 January edition of the Minneapolis Evening Journal. The article that followed told readers that "telegraphic reports....from northwest correspondents...indicate that the storm has subsided, although it is yet cold and the highways are so blockaded that travel is impossible. There has been much suffering and some loss of life and it is likely that more will be reported within a few days when communication with the country districts...have been re-established....At Omaha, Nebraska, Fred Eiler, a cigar maker, froze to death within a block of his boarding house....Two children....at Inwood, Iowa, perished on their way home from school. Within 40 miles of Sioux Falls, Dakota, an unknown man was found frozen near a barn....[At Watertown, Dakota] Thursday forenoon....just before...the blizzard struck...a party of seven farmers.....started for their homes.....The report comes that bodies of four of them have been found dead....A farmer....living four miles north of Mitchell, Dakota was caught in the storm and his little son froze to death...A freight crew has been blockaded since Wednesday with nothing to eat...John Loy, a farm hand at Luverne, a veteran who served in the Fifth Minnesota, lost his way and was found dead". At Adrian, Minnesota, "several farmers living 12 to 15 miles north started home about three o'clock and cannot be accounted for.....". And in the Red River Valley, the Fergus Falls Weekly Journal (26 January) reported that the "remains of Mrs. John Front who was lost in the storm were found Friday [20 January], eight days after she had been seen to [leave] a neighbor's to find her home one half mile away. Her body was found in the snow on the prairie..." The same edition of the Journal further reported that the Indian agent at Browns Valley "states that a large number of Indians on the Sisseton, Dakota reservation are destitute of provisions and are starving to death..."

The same edition of the Journal also emphasized difficulties encountered by the crews that were attempting to clear the area's badly blocked railways. According to the Journal correspondents, "the greatest difficulty which the railroad men have to contend with is the cold. Instead of moderating it grows colder and the temperature ranges from 20 to 40 below in northern Minnesota and Dakota and in western Minnesota....the snow drifts are packed so hard that they are like piles of sand. It is almost impossible for a snowplow to get through. The storm began to subside about six o'clock yesterday and since then all the roads have been busy trying to clear the tracks.... Snow plows were run all night on the Manitoba.....".

Moreover, increasingly disheartening news continued to pour into Upper Midwest newsrooms during much of the week immediately following the storm. The Tuesday 17 January edition of the Minneapolis Evening Journal reported that the storm had claimed 153 lives [sic], 124 in Dakota, 16 in Minnesota and 20 in Nebraska. Temperatures reportedly had fallen to -40 F at several communities in Iowa with the "fatal" cold reaching as far south as Tennessee. Blizzard conditions were reported at Memphis in

that state. It was more of the same on the following day, the 18 January edition of the Journal reporting that “the blizzard which last week swept the country from the Manitoba boundary to Texas probably numbers more school children among its victims than of any other class. The storm in all its severity came unannounced late in the afternoon just as innumerable school children started or [were] about to start for their prairie homes... Drifts of five to ten feet high [have been] reported at Dakota locations....”.

Similar accounts appeared on the pages of the Rochester Post. In its 20 January edition, the Post reported that at “Yankton, Dakota, the terrible effects of Thursday’s storm are already manifested by the discovery of frozen bodies on the prairies....[there were] at least 100 fatalities within a radius of 50 miles....Three hundred may suffer the loss of arms or legs. Loss of farm animals is expected to be about 2,000....At Aberdeen, Dakota, a teacher and 16 pupils were lost and frozen during the storm.....”.

Human casualties, extensive and tragic as they were, were not the only theme of the newspaper accounts published in the wake of the storm. Many of these stories, rather, emphasized disruption of rail traffic and the economic effects of the blizzard (as well of the effects of the bitter cold that followed). In this regard, the 18 January edition of the St. Cloud Daily Times noted that “the Willmar [Minnesota] train, which has been snowed up for the past week.....arrived here this morning at ten o’clock....The train was blockaded about four miles this side of Willmar, about 10:30 p.m. The storm raged all day Thursday...at times during the storm the cars rocked as though they were about to be overturned, the cold was intense....passengers were huddled in one corner of a car to keep warm...”. Several days later (21 January), the Times noted that “the heavy snows and severe weather of the past few days has had a quieting effect upon trade and sales,[which] as a rule, are light....”. And on 24 January, the Times reported that, at Morris, “the Manitoba railroad company has opened the Browns Valley branch....and will have thirty cars of fuel in Graceville on Wednesday and a trainload in Browns Valley. Morris is short of fuel but the [railroad] company has authorized...the delivery of coal from their sheds until the Northern Pacific company opens up the Little Falls and Dakota branch...”.

Additional information regarding the weather related distress experienced by Morris residents (and probably by many other west central Minnesota residents as well) was provided by the 26 January edition of the Morris Tribune: “the intense cold and snow has caused suspension of business in many parts of the northwest. Excessive cold makes iron brittle and likely to break. This fact will account for the number of broken rails and railway accidents now being reported (one such accident having occurred on 21 January near the town of Donnelly, northwest of Morris). A fuel famine is threatened here. Many families are already out of wood and some were out of coal. Last Saturday morning, the mercury went down as far as the length of the tube would permit...”. A parallel blizzard story (but with no suggestion of an impending fuel shortage) was

featured in the 18 January edition of the New Ulm Review: “full reports from all points affected by the blizzard which began on the twelfth, show it to be the worst storm ever witnessed in the northwest. Railroads are blockaded in every direction and many reports of people losing their lives comes from various parts of Minnesota and Dakota....very little attempt was made to run trains except between St. Paul and Chicago and the wind in Minnesota and Dakota was still blowing hard, filling up the cuts as fast as it cleared out.....the temperatures so low that neither men nor engines could work to advantage. On the whole Manitoba system no trains were run except between St. Paul and Minneapolis and between Barnesville and Neche, the latter being a piece of track on the level prairie that is scarcely ever troubled by snow. Trains out of St. Paul were all abandoned.....The train out of St. Paul at four p.m. Thursday...got only as far as Clear Lake....”.

Although they provide a wealth of essential information relative to the Great Blizzard of 1888 (as well as to other weather events), newspaper accounts are typically episodic, fragmentary and, in some instances at least, inaccurate or misleading. Fortunately, however, press reports of this historic event are augmented and contextualized by two books, one written by David Laskin who, as noted previously, is an experienced, meticulous weather historian and the second of which, “In All Its Fury” consists of stories and reminiscences of people who experienced (and survived) the swirling, wind driven snow and the bitter cold of 12-13 January 1888. Accordingly, then, this account of the blizzard and its tragic legacy cannot be considered complete without recourse to the evidence provided by these two works.

According to Laskin’s account, “Even in a region known for abrupt and radical meteorological change, the blizzard of 1888 was unprecedented in its violence and suddenness. There was no atmospheric herald. No eerie green tinge to the sky or fleecy cirrus forerunner. One moment it was mild, the sun was shining, a damp wind blew fitfully out of the south – the next moment frozen hell had broken loose. The air was so thick with find ground wind lashed ice crystals that people could not breathe. The ice dust webbed their eyelashes and sealed their eyes shut. It sifted into the loose weave of their coats, shirts, dresses and underwear until their skin was packed with snow. Farmers who had spent a decade walking the same worn paths became disoriented in seconds.....The blizzard of January 12, 1888, known as the ‘the Schoolchildren’s Blizzard’ because so many of the victims were children caught out on their way home from school, became a marker in the lives of the settlers, the watershed event that separated before and after. The number of deaths – estimated as between 250 and 500 – was small compared to that of the Johnstown Flood that wiped out an entire industrial town...the following year or the Galveston hurricane of 1900....But it was traumatic enough that it left an indelible bruise on the consciousness of the region. The pioneers were by and large a taciturn lot.....Yet their accounts of the blizzard of 1888 are shot through with amazement, awe,

disbelief.....The blizzard literally froze a single day in time. It sent a clean, fine blade through the history of the prairie....”.

From a meteorological and/or climatological viewpoint, the blizzard of 1888 was, however, not a unique occurrence. In this regard, Laskin’s [op.cit.] comments, while describing the atmospheric conditions that come together to create the Great Blizzard, further note that: *“An evil genius could not have devised a more perfect battleground for clashing weather fronts than the prairies of North America. When conditions are right, which they frequently are, vigorous fronts unleash the worst weather in the world over this region – super-cell thunderstorms spawning tornadoes in late spring, huge globes of hail falling from anvil topped cumulonimbus clouds in summer, blizzards in winter. On the prairie cold fronts can come through so rapidly that standing water ices up in ridges, small animals literally freeze to their tracks, people whose clothing is wet find themselves encased in ice. When a strong cold front is accompanied by the blowing ice dust of a blizzard, the punishment inflicted on human and beast is unimaginable...”.*

Specifically, on 12 January 1888, what Laskin [op.cit] describes as a “ferocious” cold front dropped southeast through Montana at a speed of about 45 miles per hour. He then points out that *“With the advance of the cold front, all of the elements of the storm suddenly began to feed off each other, bloating up hugely with every bite. As the contrasting air masses slammed together, they caused the upper level winds to strengthen, which served to strengthen the low [pressure system]. As the low deepened, the surface winds increased, causing the temperature differences between the air masses to spike. The greater the temperature difference, the faster the low deepened. The deeper the low, the stronger the front. It was a self-reinforcing and accelerating cycle. When a storm becomes gradually organized, high wispy cirrus clouds usually appear a day or two ahead of the cold front, followed by a low bank of stratus cloud stealing across the sky. But by the first hours of January 12, this storm was spinning up so quickly that there was no time for an atmospheric herald. The cold front was now so strong and so well defined that it was like a curtain of ice separating two radically different climates, a curtain that was hurtling in two directions simultaneously – down from the sky and horizontally across the surface of the earth. At the same time that the curtain swept down from the north, a warm spongy mass of air was ascending from the opposite direction. The intensifying low forced the two air masses to converge with ever increasing speeds. When they collided, the atmosphere erupted. The warm air slid up and over the curtain, rising about three feet every second. As soon as it hit an altitude of about 5,000 to 7,000 feet, the air instantly surrendered its vapor into infinitesimal droplets of supercooled water – liquid specks colder than freezing but prevented from turning to ice by the surface tension of their ‘skin’. As many as a billion cloud droplets swarmed around every cubic meter inside the ballooning clouds. Even smaller particles of airborne debris roiled alongside the*

cloud droplets – pollen, dust, salt crystals.....and these particles.....served as the nuclei around which the supercooled cloud droplets coalesced and turned to ice. The instant the cloud droplets froze, they began to grow..by fixing other droplets onto their crystalline facets.

“Behind the front, where the air was much colder, ice production inside the clouds happened at significantly lower altitudes, as low as 3,000 feet , and the condensing vapor spat out a different kind of crystal.....what was being manufactured inside these frigid clouds was a myriad of nearly microscopic hexagonal plates and hollow columns and needles – hard slick surfaced crystals that bounced off each other as they swirled around.....The newly manufactured snow crystals, smashed and ground into....fragments....mixed with older crystals that had settled at the surface after previous storms.....New snow is not necessary to boost a winter storm into the category of a blizzard. All that is required is wind of at least 35 miles an hour, airborne crystals and temperatures of 20 degrees or colder (the National Weather Service recently dropped the temperature requirement).....

“The disturbance rippled southeast....By midnight, the leading edge of [the] cold air had reached Poplar River in northeastern Montana. By 2 A.M., it had engulfed Medora in western Dakota....By 4 A.M., January 12, the cold front was poised just west of Bismarck. At six o’clock in the morning....the temperature at North Platte, Nebraska, stood at 28, fully 30 degrees warmer than the previous day; while in Helena [Montana], 670 miles to the northwest, observer E.J. Hobbes.....noted that the mercury had fallen 49.5 degrees in the past four and a half hours.....Omaha was 23 above and so was Yankton in southern Dakota.....The report from Huron, northwest of Yankton [had] 19 above at 6 A.M....nearly 40 degrees warmer than the previous day. More fuel for the approaching storm.....”.

Another description of the storm’s genesis and progression was included in a book of blizzard reminiscences entitled “In All Its Fury” and compiled by a Nebraska historian, W. H. O’Gara. This account, written by Ray A. Dyke, a meteorologist at the Lincoln, Nebraska Weather Bureau (now the National Weather Service) office, stated that *“at 2 p.m. on January 12, 1888...the counterclockwise windflow around [a] low in Nebraska and [a] clockwisewindflow around [a] high over western Canada together [drew down] the cold arctic air from the interior of Canada over the North Central States.....a cold air mass was over the Canadian Northwest in the early part of January 1888. We have the records from a number of western Canadian stations which show the lowering of temperature. In Northwest Territory.....we find that on the third [of January] some places recorded temperature averages for the day as low as 35 degrees below zero.....the movement of the colder air was at first slow....only awaiting the development of a low to initiate a rapid movement. While the cold air was present over the interior of western Canada, a trough or tongue of low*

pressure extended on January 11 from southwestern British Columbia to Montana and bent southward along the eastern slope of the Rockies.....at 9 p.m. a center of low pressure had formed over eastern Montana within the trough, while pressure to the north was considerably higher. The innermost isobar of the low showed a pressure of 29.6 inches. High pressure, with 30.7 inches at the center, was centered over the region between the Ohio River and the Great Lakes.....

“At 6 a.m. of the 12th, the low pressure center over eastern Montana had moved southward in nine hours to western Nebraska and eastern Colorado with a pressure near 29.5 inches. At 2 p.m. of the 12th the typical cold wave development was shown by the isobars, with the low pressure 29.5, while pressure increased northwestward to 30.7 inches.....This gave a gradientfor northerly winds of gale velocity over the Plains, rapidly transporting the cold air of interior Canada southward. The 17 hour movement of the cold front had then brought it from northern Montana to southeastern Nebraska. In 17 hours the front had moved about 780 miles, or at an average rate of 45 miles per hour. In the following seven hours the low pressure moved to Wisconsin while the circulation around the low pressure center swept the cold air farther southward.....In the eight hours to 2 p.m. of the 12th the front of cold air had almost crossed Nebraska and extended along the western boundary of Minnesota to near Sioux City, Iowa.....The effect of the movement is shown at Valentine, Nebraska where the temperature had risen to 30 above zero by 6 a.m. of the 12th and fell to six below by 2 p.m.....By the morning of the 13th temperatures were 20 to 30 below zero in Dakota, 15 to 20 below in Nebraska and 20 to 30 below in Montana. On the 14th, 42 below was recorded at Ft. Custer, Montana and around 40 below in parts of Dakota.....

The snowfall in Lincoln [Nebraska]....is recorded at seven inches, which is more than other places.....Four inches was recorded at Omaha.....Farther east, in Iowa, the snowfall was heavier. Under high wind conditions the amount of snow caught in gages is deficient and the depths on the ground are highly irregular.....”.

Dyke's summary also included reports submitted by observers at various Signal Corps stations in Dakota, Minnesota and other adjacent states. At Huron, Dakota, for example, observer Samuel Glenn noted that on 12 January, the “southerly gale of yesterday and last night continued, with light snow until 6 a.m., when the gale began to abate. At noon the velocity was 24 miles per hour; between 12:35 and 12:40 p.m. it had subsided to 12 miles with a light snow and damp atmosphere; at 12:42 p.m. the air was perfectly calm for about a minute; the next minute the sky was completely overcast by heavy black clouds and the wind veered to the west and blew with such violence as to render the position of the observer on the roof unsafe. The air was immediately filled with snow as fine as sifted powder. The wind veered to the northeast, then backed northwest in a gale of 40 miles per hour. These conditions continued steadily all day

until 4 a.m. of the 13th, when the gale began to abate and the snow soon after ceased.....At noon the temperature was 20 above and at 10 p.m. 17 below zero, and fell to 28 below during the night. The wind averaged from 45 to 50 miles per hour and attained an extreme velocity of 60. The number of lives lost in this county is 11....”.

At Moorhead, Minnesota, the station’s Signal corps observer recorded “extremely violent” winds during the early morning and forenoon of 12 January, the highest winds, as noted previously, reaching 50 miles per hour. It was further noted that “there was a sudden change of the wind from the south to the north at 1:45 p.m. Heavy blinding snow at intervals”. Minnesota’s then northernmost station, St. Vincent, reported “a low barometer rising rapidly” [on 12 January] with a “36 mile per hour gale from the south, ending at 5:25 p.m. The blizzard struck at 1 p.m. [and] beginning at 2:40 p.m. the wind blew a terrific gale, attaining a velocity of 36 to 48 miles per hour from 3 p.m. on the 12th to 2 a.m. on the 13th. Lowest temperature 40 below zero”.

Other descriptions of the blizzard’s ferocity included a report from the Lisbon, Dakota postmaster: “on the 11th the thermometer stood at seven above zero while the wind with a blinding snowstorm came from the south. At 11 a.m. on the 12th the wind changed to the north and the temperature dropped to zero. The wind continued at 30 to 40 miles per hour until 11 p.m. and the snow flew so that no one could see across the street with a bright light burning. At daylight next morning the wind was still blowing very hard and the temperature was 18 degrees below zero”. And at Bismarck, Dakota, Signal Corps observers noted a “rapidly falling barometer” on 11 January accompanied by “rapidly rising temperature and a high east wind veering to the southeast”....On 12 January, the station received an order “to hoist the cold wave warning [flag] at 1:20 p.m”. [A] “northwest gale began at 6:30 a.m. and continued all day, highest velocity 54 miles per hour, northwest.....drifting the snow that had already fallen, and which was falling, to depths of five to twenty feet.....”.

Dyke further noted that “the cold wave and blizzard swept over Iowa and the wind caused heavy, deep snowdrifts. The blizzard conditions in Iowa were mainly in the latter part of the afternoon of the 12th and the following night and late enough so that in general the schools were closed and the children safely home. Two days after the blizzard in the Missouri valley, the cold wave reached Texas.....At several places the weather was described as the coldest experienced up to that time..... In noting the fact that greater intensity has been shown in some other storms there is no...minimizing the severity of the January 1888 blizzard. Caught in the open, in the piercing cold whose freezing power for living things was increased by the gale, and unable to see because of the snow filled air, the individual regarded his early arrival at a place of safety as a matter of life and death.....”.

As a matter of life and death, indeed. The history of the January 1888 blizzard is filled

with stories of great tragedy, heroism and bewilderment, several of which have been cited previously. Most previously noted incidents are, however, second hand accounts taken from newspaper reports, reports which, besides providing “filtered” accounts of individual experiences, tend to emphasize the economic and meteorological rather than the “personal” aspects of the storm. The Laskin and O’Gara books, in contrast, provide numerous first hand accounts which, unlike most newspaper descriptions, more fully capture the harrowing sense of fear, the often paralyzing sense of danger and the encounter with death experienced by people who survived the blizzard’s wrath. Following, then, are two personal accounts, one with a “happy” ending taken from “In All Its Fury” [op.cit.] and a second with an unhappy ending taken from “The Children’s Blizzard” [op.cit].

The first account is from Emily Vail who, at the time at which she wrote it, was a resident of Berkeley, California: *“I was teaching in a little frame schoolhouse perched upon the windswept prairies of Stanton county [Nebraska]. The attendance was small and so were the pupils with the exception of one girl fourteen years of age. There was nothing except an unusual mildness and calm to give warning of [an] approaching storm. Just after the opening of the afternoon session I glanced at the windows and could see nothing but a white wall. I rushed to the door and opened it. The air was so full of snow that the view was completely obscured as though a sheet had been stretched before me.*

“I was alarmed but knew I must not let the pupils know it. With some careless remark about the sudden breaking of the storm, I resumed my work.....So the afternoon passed and it became time for dismissal. Then the children became uneasy...They gathered around me, asking if I did not think it ‘an awful bad storm’. I admitted that I did and told them as calmly as possible that we would have to wait at the schoolhouse until someone came for us.....I suggested such amusements as came to my mind and they entered into the spirit of the occasion. All but one little fellow of four who wanted his mama and let it be known

“I had gradually disclosed to the children that we might have to stay at the schoolhouse all night, and had given them the impression that it would be a very novel and exciting experience if we did. They shared my view, until it came to the matter of substituting a few dry crusts, left in their dinner pails, for a warm supper.....However, the self sacrifice of the older children was pathetic as they divided their meager scraps with the younger ones. It became quite dark and we had no means of lighting the room except by opening the stove door. We made the best of this situation by playing hide and seek and when they tired of this I suggested story telling. Grouped about the stove we passed the time very pleasantly. The little four year old visitor had fallen asleep and forgotten his troubles.

“Then another problem developed. The children were thirsty and there was no water in the house. We decided to melt snow to drink, and opened the door to get the snow. When we tried to shut the door we discovered what a mistake we had made. The snow had driven in around the casing and we could not close the door. The more we tried to remove it, the more it came in and the larger the obstruction became. So we pushed the door as far shut as we could, and braced blocks of wood...to hold it. But there was a gap about four inches wide, through which the snow drifted in, thawing as it settled on the floor, forming a pool of water in the only cheerful spot in the room. About this time, we discovered that the room was filling with smoke, and found that the stovepipe was unjointed at the rear of the room. I climbed up on a table and tried to rejoin it, but.....had to give it up.

“It was nearly midnight and the children were getting sleepy. by using wraps to the best advantage I succeeded in making resting places...on the seats and soon they were all sleeping peacefully.....The responsibility of keeping fires burning kept me awake but it was a weary watch with a howling blizzard outside and smoke and gloom inside. However, I was profoundly thankful for the generous cord of wood which had been stacked in one corner of the room.....

“Toward morning the storm began to subside and by four o’clock it was comparatively calm. About that time the children began to wake and discuss the night’s adventure. They were in agreement that it had been a jolly time.....Soon parents began arriving. Every family had attempted to reach the schoolhouse the night before but had been obliged to give it up. We can only guess with what fear and anxiety they had waited for the morning, not knowing where or how their children were being cared for. After all, their night had been harder than my own”.

Like Vail’s story, the second account (as related by Laskin) also began in a schoolhouse. But tragically, it did not end there: *“The school.....was the simplest, starkest building possible—four rectangles capped by two triangles and a roof laid over the top.....at the front of [the classroom], Mr. James P. Cotton, the American teacher.....When the blast rocked the north wall of the school at around 11:00 in the morning, the [seven boys in attendance] and their teacher all turned to look at the north windows as if they had been summoned by a trumpet call. As everywhere the wind and darkness came almost simultaneously. The school windows went from pearl to charcoal as the cloud of snow enveloped them, not so much falling as slamming sideways. Within minutes the wind had sucked the warm air out of the uninsulated building. Powdery snow began sifting in through every crack in the walls and around the window frames and spraying against their faces. Soon there was fine snow hanging in fringes from the maps on the wall and eddies of snow snaking across the floor boards. Even a few feet away from the stove it was so cold that the snow didn’t melt.....*

“Instinctively, the younger boys looked to their older brothers to see what to do. Heinrich and Elias Kaufmann knew that Johann [Graber] would take care of them.....He and Peter Graber were practically men. They would know what to do....probably better than Mr. Cotton. Johann Albrecht, with no brother at school, turned to Mr. Cotton. But the teacher would not meet his eyes. He just kept looking over at the rattling windows and shaking his head.....But what should they do?.....now Mr. Cotton was asking the two older boys for advice and then arguing with them. [The boys said] they must stay in school and wait for their fathers to come for them.....”

“But no. Mr. Cotton had made up his mind. They must leave the school and go to the nearest house, where they would find food and warmth. All of them would go together to the Grabers’ place – less than a quarter of a mile away, a few hundred paces.....Mr. Cotton ordered them to get their wrapsand get ready.....The two older boys went out first, each one wincing as if slapped when he stepped into the wind. When all eight ...were outside they huddled for a minute behind the south wall of the schoolhouse, which was the only place they could stand up straight.....Then they set out, one by one, into the wind.

“As soon as they were outside, Mr. Cotton’s authority vanished.....Within a few paces, the boys had split into two groups.....Andreas and Johann Graber got separated from their older brother...and ended up with Mr. Cotton.....It all went so fast and it was so difficult to see anything with the wind.....One moment [one group was] there, ghostly shapes a few paces ahead. The next moment they were gone and there was nothing where they had been but the stinging white. The drifts were already too deep for Andreas [Graber] [He] began to flounder in the snow. He couldn’t see Mr. Cotton or his brother Johann any more.....Andreas panicked and shouted for Peter to come and help him. But instead of Peter, Mr. Cotton and Johann appeared. As they loomed out of the snow, Andreas heard Mr. Cotton calling ahead to the five other boys to wait for them. But there was no answer that Andreas could hear over the wind.....So they staggered on – Mr. Cotton in the lead and the two younger Graber brothers behind.....It was a row of spindly trees that saved them. Andreas’s father had planted the trees soon after he settled in Dakota.....For an instant, the air cleared enough for them to see the end of the row of [trees].....All they had to do was follow the line of saplings back to the house.....The fear came first, but the cold followed so hard on its heels that it was impossible to tell the difference. The two smaller boys.....felt it first. They were lost.....Mr. Cotton and Peter Graber’s two younger brothers were gone. There was no sign of the Graber’s farmhouse at the end of the field. No sign of a barn or a haystack or a fence in the blinding snow. They were lost, five of them together.....[they] had worn no hat or gloves or heavy woolen coats in the mildness of the morning.....In an awful

way, the five Schweizer boys who had wandered off when the blizzard struck had become factors, very small and frail, in the immense equation of the weather.....When the Schweizer boys left school late in the morning, the windchill was about five degrees above zero. At 9 p.m. four hours after the sun had set , the windchill had dropped to 40 degrees below zero. In conditions like that , exposed human flesh freezes in ten minutes.....

“ For a while the shivering kept them warm.....As darkness fell, Maria and Johann Albrecht took some small consolation in the fact that the teacher, Mr. Cotton, hadn’t come back either.....Mr. Cotton, who was boarding with them must have stayed at the schoolhouse with their son Johann and the other children.....Shivering is a very demanding way of warming the body. But the body shivers as long as it’s able to because the alternative is much worse.....Once shivering stops, the chilled body falls quiet and then shuts down rapidly.....The functions of their vital organs slowed.....Hallucinations and delusions set in. Starved of oxygen, unhinged by stress and fatigue, the brain fabricates its own reality.....People freezing to death sometimes find they are unaccountably happy and relaxedAs the mind and the body amicably part company, the freezing person looks down on himself as if he is hovering overheadHe’s gazing at this corpse and walking on.....For the five Schweizer boys, the end was probably peaceful.....As their internal body temperature dropped below 85 degrees, the hallucinations lost their grip.....They just wanted to go to sleep.....The younger boys gave out first. At some point [they] fell and couldn’t get up again.....the five Schweitzer boys hung together until the end,.....in the end that’s what they did. One by one they collapsed.....As the snow conducted heat away from their bodies, their heartbeats slowed to an occasional twitch. The boys lost consciousness. Beyond both hope and fear, they felt nothing at all.....”.

Both of the foregoing stories, one happy, one tragic, together with most other accounts of the January 1888 blizzard, raise several unavoidable questions: why were Upper Midwest residents not warned of the impending storm? Why were so many taken by surprise, seemingly oblivious to the lurking danger until the moment the “monster” erupted? These questions can, of course, be answered on several different levels. First, there is the beguiling warmth that spread over much of the area on the morning of 12 January. As a result, people – school children especially – ventured out when they should have stayed home or, when they did venture out, they dressed for what they thought would be a relatively warm winter day. Second, and more importantly, there are the shortcomings of the 1880’s national weather service’s limited ability to collect and interpret relevant weather data and/or its then rather rudimentary understanding of atmospheric dynamics.

According to Laskin’s account (op.cit.), the central figure in the service’s failure to

issue timely blizzard and cold wave warnings was Signal Corps Lt. Thomas M. Woodruff, then the officer in charge of the St. Paul indications (forecasting) office, an entity which had been established only several months earlier and which was, therefore, still in its formative stages when confronted by the challenging weather events of January 1888. In Laskin's words, *"The person charged with the job of predicting the origin and movements of this spiraling atmospheric disturbance was a thirty nine year old career officer.....The fact that so many people died when the potential energy of this disturbance was released over the Dakotas, Nebraska, Minnesota and Iowa....was by no means Woodruff's fault. Given the state of the art of weather forecasting in 1888, Lt. Woodruff did the best he could. He simply didn't know enough to do any better – and he didn't have the means to make effective use of what knowledge he had.....Lt. Woodruff's failure, if one can speak of human failure in the face of a storm of this force and scale, is that he lacked imagination. A common failing in a person trained and drilled all his adult life in military discipline.....A common failing in any age, perhaps....."*

"It was nearly midnight on Wednesday, January 11, before Lt. Woodruff reached a decision about the indications, the term then in use for the weather forecast, and was satisfied to make it final. He knew that once he handed the slip of tissue paper to his assistant.....there was no going back.....He picked up his pen, filled it with black ink, and scrawled out the forecast for the following day.....For St. Paul, Minneapolis and vicinity: warmer weather with snow, fresh southerly winds becoming variable. For Dakota: snow, warmer, followed in the western portion by colder weather, fresh to high winds generally becoming northerly. The snow will drift heavily in Minnesota and Dakota during the day and tonight; the winds will generally shift to high colder northerly during the afternoon and night....."

"Woodruff had decided not to issue a cold wave warning. Instructions from acting chief Signal Officer Brg. Gen. Adolphus W. Greely were extremely clear in this regard. 'The exact meaning of the term cold wave, Greely had written, implies that the temperature will fall below forty five degrees, and that in twenty four hours an abnormal fall of fifteen or more degrees will occur'.....As he [Woodruff] well knew, the overwhelming majority of cold waves that hit the Upper Midwest originated east of the Rockies and swept east or southeast down from Montana. Temperatures would plunge first in Helena, then Bismarck.....then Huron and Yankton in southern Dakota and so on until the cold air reached....St. Paul. But after studying the 10 p.m. (Eastern time) observations telegraphed from Signal Corps stations to the west, Woodruff concluded that a cold wave warning was not warranted....Caution was called for, not alarm, especially given how tenuous his position in St. Paul was. Greely himself had sent Woodruff west to open the office in St. Paul as part of an experiment in decentralizing the government weather service. Though he had only been forecasting from St. Paul since October...Woodruff had issued many more cold

wave warnings than his counterparts at the Signal Corps headquarters in Washington.....Better not cry wolf.

“At a few minutes before midnight of January 11, 1888, Woodruff handed the slip of tissue paper with the indications [for the following day to his assistant] and instructed him to encode the message and then transmit by telegraph to the St. Paul Western Union office, from which it would be distributed to the office of the chief signal officer in Washington; to the St. Paul District Telegraph Company; to the Associated Press and the major newspapers in Minneapolis and St. Paul; to the Signal Corps observers in Milwaukee, Bismarck, Rapid City and Ft. Custer; and to....the Minnesota State Weather Service [which] would see that it was distributed to sixty seven volunteer observers in Minnesota and the Dakotas.....

“On the morning of January 11.....Woodruff and his assistantarrived at the indications office....at 9 a.m. The men got to work at once. They had an hour and a half before the morning indications were due to be telegraphed to Western Union, and then there were five daily maps to prepare.....and distribute to the main local railroads, newspapers and hotels.....Woodruff noted that the atmospheric pressure had dropped sharply at Ft. Assinniboine in northern Montana – from 27.31 inches of mercury at 10 p.m. the previous night to 27.06 at that day’s 7 a.m. observation with wind out of the east and barely any temperature change....Helena and Ft. Custer were both reporting a slight rise in temperature and light winds. Cold and clear in the Dakotas–20 below in Bismarck and Huron – though still not as cold as it was in St. Paul.....Woodruff [and his assistant] began entering the 7 a.m. data on blank maps of the United States – for every station in their network, some forty six stations in all.....Woodruff could see clearly that the huge elongated high centered just north of the Dakotas that had materialized on the previous night’s map was shifting southeast. A low seemed to be nudging down from the north behind the high, hence the falling barometer at Ft. Assinniboine, but Woodruff did not have readings from far enough north in Alberta or Saskatchewan to get a clear picture of what was happening upstream. The high over the Dakotas was nothing out of the ordinary for this time of year, so it was unlikely that anything really violent was pressing behind it.....Woodruff decided to be cautious. Central Montana stations were reporting slightly warmer conditions, and it was a good bet that this mild weather would spread south and east as the high pressure center continued to move eastward...He wrote out the afternoon forecast by hand: indications for 24 hours commencing at 3 p.m. today. For St. Paul, Minneapolis and vicinity: slightly warmer, fair weather, light to fresh variable winds. For Minnesota and Dakota, slightly warmer fair weather, light to fresh variable winds.....Woodruff would keep an eye on those Montana pressures when he issued his next set of indications at midnight.....Woodruff and young Alexander McAdie [his assistant] broke for lunch as usual at 1 p.m. on January 11 and were back in the office at 2:30 p.m.....It was approaching 5 p.m. in St. Paul

before Woodruff got a clear picture of what had happened in the course of the day. The readings from Ft. Assiniboine were startling. The pressure had fallen dramatically since the 7 a.m. observations – from 27.06 to 26.76, a drop Woodruff had rarely seen.....while the temperature had risen 11 degrees.....Bismarck was also reporting a rapidly falling barometer and rising temperatures. Farther south in Huron, a stiff southeast wind had kicked up and the temperature had jumped 18 degrees.....As Woodruff inked the isobars in red on the map, a distinct oval bowl of low pressure took shape around Medicine Hat in southern Alberta, just north of Ft. Assiniboine: the first faint shadow of the coming storm.

“Woodruff and McAdie left the office at 5:45.....the temperature was still rising in St. Paul, odd for this time of day in winter, though with readings remaining in the double digits below zero, they hardly noticed.. The men.....returned to [their office] at 10:15 p.m. to await the arrival of the nighttime observations from Chicago. Again there was the time lag due to the backlog at Western Union and then the tedious process of translation and transcription. Woodruff worked quickly on the charts.....He saw at once that the Alberta low from the afternoon chart had moved quickly to the southeast and was now centered over Ft. Keogh, the eastern Montana army post where he had [once] been stationed.....But still no outbreak of truly frigid air over the U.S.....Helena was 33 above, Bismarck 7 above and the Huron station.....was reporting a slightly falling barometer, stiff southeast winds and a temperature rise of five degrees in the past seven hours.....The reading that stood out most starkly was.....at North Platte in southwestern Nebraska: 22 degrees above zero at 10 p.m., a rise of 20 degrees since the 3 p.m. observation.....The rise [at] Helena was a bit puzzling, because according to Woodruff’s own formulation, a ‘fall of temperature succeeds or follows an area of low barometer’ and the center of the low had already passed well to the south and east of Helena.....

“But there was one critical bit of data right there in front of him, if only he knew it. That 20 degree spike in temperature at North Platte was like an arsenal packed with explosives. The meaning of this reading was lost on Woodruff.....It was one more piece of data that didn’t fit what Greely termed the ‘principles of philosophy’ that he insisted were ‘sufficient to explain the intricate and varied phenomena of the atmosphere.’ By 11:45 p.m. on January 11, the indications for the following day were obvious to Woodruff. The Montana low would bring snow and rising temperatures to Dakota Territory during the day, followed by colder temperatures and northerly winds spreading over the region from west to east. The tight rings of isobars bunched together over southeastern Montana.....and western Dakota indicated that pressure differences were particularly marked in this region – a clear sign of high winds.....

“When Woodruff....left the St. Paul Signal Office a few minutes before midnight, E. J. Hobbs, the Signal Corps observer in Helenawas still on duty.... Word had

reached him of severely cold weather bearing down from the north.....Strangely, temperatures continued to rise through the first hours of January 12. At 2:30 a.m. Hobbs recorded 38 above and the mercury hit 40.5 before dawn. Meanwhile 173 miles to the northeast.....the Signal Corps observer on duty [at Ft. Assinniboine] was observing something he had never seen before. The telegraph wires that connected the station's receiver to the endless loops of wire strung over the plains were emitted strange flashes of light.....and were so charged with electricity that they could not be handled. Even inside the station the air fairly crackled with electricity. And outside the weather was turning fiercer by the minute. The warm chinook wind that had blown out of the southwest....was now howling out of the northwest at a velocity approaching 50 miles an hour. It was like a hurricane approaching over the empty plains of Montana in the dead of winter.....

“At six o'clock in the morning....when the telegrams bearing Lt. Woodruff's midnight indications began to arrive on the desks of weather observers and newspaper editors, the temperature at North Platte...stood at 28, fully 30 degrees warmer than the previous day.....The report from Huron.....was late – but eventually this bit of data got entered on the map: 19 above at 6 a.m.....nearly 40 degrees warmer than the previous day. More fuel for the approaching storm. Of course, nobody in Nebraska or Dakota saw it that way. The tragedy of that day was that the fuel came disguised as welcome relief from the weeks of bitter cold, a spell of softness and relative ease in lives that had too little of either.....

“[On the morning of January 12]. Woodruff arrived at his office in downtown St. Paul....[He] and McAdie got to work immediately on the morning indications.....Woodruff was gratified to see that his indications from the previous night had [been] ‘verified’.....Temperatures had indeed risen in advance of the low, just as he anticipated. And behind the low, up in Montana, cold air was spilling out of Canada....There was no question now in Woodruff's mind: a cold wave warning was warranted for Dakota and for Nebraska later in the day.....Woodruff took a fresh sheet of tissue paper and quickly covered it with black ink: Indications for 24 hours commencing at 3 p.m. today. For St. Paul, Minneapolis and vicinity, warmer weather with snow [and] fresh easterly winds. For Minnesota: snow, warmer followed by colder with a cold wave, fresh to high northerly winds. For Dakota: snow, warmer, followed by colder with a cold wave, fresh to high northerly winds. A cold wave is indicated for Dakota and Nebraska tonight and tomorrow: the snow will drift heavily today and tomorrow in Dakota, Nebraska, Minnesota and Wisconsin.

“The words cold wave in the indications triggered a set of special procedures. The instructions were clear and exact.....Newspapers and the Associated Press wire service received the daily indications as a matter of course, but now extra telegrams must go out to the Signal Service stations in Minnesota, Dakota, Nebraska, Iowa,

Wisconsin and Chicago, some twenty two stations in all, as well as to the principal railroads serving the region. Prof. William Payne [director of the Minnesota State Weather Service] had also arranged with Woodruff to have cold wave telegrams sent to sixty 'flag stations' that he had set up through his Minnesota State Weather Service; although as Payne noted sourly, 'the service as rendered by the Western Union Telegraph Company, in many instances, is very poor,' with the result that his volunteer[s]frequently did not receive Woodruff's indications or received them late. In any case, when and if, the messages arrived, display men at the flag stations and observers at the Signal Corps observation stations were immediately to hoist...black and white cold wave flags.....and keep them flying until Woodruff instructed them to take them down. This was the procedure and on January 12 it worked as well as it was expected to. The forecast was substantially correct. The messages.....were duly received.....But by the time the procedure went into effect, it was too late to matter.....

"As January 12 drew to a close, it was becoming clear that this was shaping up to be one of the most intense cold waves ever seen in the United States. A sign of the fierceness – and strangeness – of the storm was the eerie electricity that crackled through the air as the temperature began to drop.....In effect, the storm had created a kind of horizontal thunderstorm.....the driving force behind these static discharges was the extreme difference between the various currents of air that were screaming past each other....

"The storm was just grazing St. Paul with light, dry snow and bursts of wind when Lt. Woodruff returned to the Chamber of Commerce building from his evening meal at 10:15 p.m.....The temperature in St. Paul had been rising all day.....But Woodruff could see at a glance on the afternoon maps that the cold was coming his way fast.....Shortly before midnight, Woodruff issued his indications for the following day.....indications for 24 hours commencing at 7 a.m. today. For St. Paul and Minneapolis, snow, colder with a cold wave, fresh northerly winds. For Minnesota, colder with a cold wave, snow followed in northern part by fair weather, fresh northerly winds. For Dakota, local snows, colder with a cold wave, fresh, northerly winds becoming variable. In a few hours it would become clear how inadequate the word colder was to describe the air that was pouring down over the prairie...."

In reality, of course, the massive outbreak of frigid air that followed in the wake of the departing blizzard was but a continuation of the bitter cold which had prevailed in much of the Upper Midwest since late December 1887. It was, however, more intense than the early January cold, bringing record low temperatures to many localities, including some as far south as Texas and Louisiana. Consistent with Woodruff's forecast, temperatures dropped rapidly when skies cleared and winds slacked off during the late hours of 12 January and the early morning hours of 13 January. The waning blizzard

and the eerie scene which followed is colorfully described by Laskin (op.cit.): *“Before dawn on Friday, January 13., the blizzard had pretty much blown itself out over the Dakotas, Nebraska, and southwestern Minnesota. The last gusts put the final touches on drifts and hollows, and then the atmosphere subsided in a deep sigh of high pressure. Over a thousand miles of prairie, from central Canada down to Oklahoma, the air grew pure and dense and dry with intense cold. Twenty nine below zero at 6 a.m. at Ft. Assinniboine. Twenty five below at Huron.....As the light came up, the dome of the sky seemed to lift and expand like a balloon filling with air. The colors of the most delicate alpine flowers flushed the sky from east to west – first graying pink, then powder blue, then azure. The last bits of moisture condensed and fell glittering in tiny crystals from the cloudless sky.....the hills which had been sharply outlined were now rounded knolls.....Everywhere there was perfect whiteness....”*

As indicated previously, the departing storm also left Upper Midwest residents with the task of clearing snow blocked railways. The 14 January edition of the Minneapolis Evening Journal reported, for example, that railroads remained blocked in the Brainerd area and, in Minneapolis itself, normal rail traffic was not expected to resume until Sunday night, 15 January. Similar disruptions were reported from Mandan, Dakota (where railroading had been at a standstill for 30 hours); Carrington, Dakota (where it was said that there had been no train service for ten days); and Bird Island, Minnesota (where blockading winds had reached a peak of 70 miles per hour). Moreover, the 1 February 1888 edition of the New Ulm Journal suggests that, at least in some areas, continued drifting of the windswept snow (perhaps accompanied by new snowfall) delayed opening of some railways until late in the month. According to the Journal, “the blockade of last week continued from Monday evening until Friday afternoon. The railroad company did not make an effort to open the road between Kasota and New Ulm until Friday. One reason of their not doing so sooner was because they wanted to test the rotary snowplow. By means of a series of paddles fastened to a hub the snow is cut and thrown to the side of the track. These paddles revolve very fast and throw the snow maybe from 50 to 200 feet. The best feature of the plow is that it does away with the dangerous ‘backing’ of snow. The rotary movement of the paddles pulverize the snow and at the same time clear the track without causing any but a slight jar....”.

The cold wave which accompanied – or, more accurately, was a major cause of – the Great Blizzard remained entrenched for about ten days, reaching its peak in some sections, east central Minnesota in particular, on 21 January 1888. At far northern St. Vincent, Signal Corps observers recorded a minimum of -34 F on 13 January, a reading probably attributable in part to the clear skies and the relative calm which followed the subsiding blizzard. Even colder conditions followed with minima of -41 F on 14 January and again on 15 January. The already frigid air mass was reinforced by more Arctic air with temperatures at the St. Vincent station dropping to -38 F, -45 F, -38 F

and -35 F on 19, 20, 21 and 23 January, respectively. Similarly, the Moorhead Signal Corps station recorded minima of -28 F, -36 F, -27 F, -29 F, -37 F and -41 F on 13, 15, 17, 19, 20 and 21 January, respectively. The station's maximum was -23 F on 20 January, yielding a daily average of -30 F, a value about 40 degrees below the station normal for that date. Interestingly, also, the Morrhead station recorded southerly winds of 48 miles per hour at 0700 hours on 24 January.

In west central Minnesota, D.T. Wheaton, Morris's volunteer observer recorded minima of -27 F, -37 F, -38 F, -27 F, -30 F, -35 F and a record -40 F on 13, 14, 15, 16, 19, 20 and 21 January, respectively. Daily maxima included bone chilling readings of -25 F on 14 January; -23 F on 19 January and -24 F on 21 January. Also, the 26 January edition of the Morris Sun noted an unofficial reading of -42 F on 21 January, a value probably obtained from a thermometer exposed on the side of one of the city's businesses, perhaps on the newspaper's office itself. At another west central Minnesota location, the Fergus Falls Weekly Journal reported numerous unofficial readings which, so far as can be determined, were taken from a thermometer mounted on the wall of that city's Grand Hotel. Readings from this instrument included -34 F at 0600 hours on 11 January, the day before the blizzard struck; -28 F at 0600 on 14 January; -32 F at 1800 hours on 14 January; -36 F at 2400 hours on 14 January; -38 F at 0600 on 15 January; -36 F at 2400 on 19 January; -36 F at 0600 on 20 January; -36F at 2400 on 20 January; and -32 F at 0600 on 21 January. Even colder minima were recorded in central Minnesota, the St. Cloud College station with readings of -36 F at 0700 hours on 11 January; -42 F at 0700 on 15 January and a record shattering -50 F at 0700 on 21 January. In contrast, G. M. Harvey, the observer at the St. Cloud Normal School recorded a minimum of -44 F on the morning of 21 January. Curiously, the worst of the January cold appears to have bypassed the port city of Duluth: the lowest temperatures of the winter included -34 F on 15 January and -31 F on 21 January, values which, for that location, were not especially noteworthy.

Although the cold wave which accompanied the 12-13 January blizzard spread rapidly across most of the Upper Midwest on 13-15 January, a number of stations in central, east central Minnesota and western Wisconsin recorded the lowest temperatures of the season, not immediately after the storm but, rather, on 20-21 January. This lag suggests, of course, that a large core of reinforcing cold air drifted slowly southward, entrenching itself over a large, more southerly area about ten days after the blizzard had exited the Upper Midwest. The Signal Corps observer in the east central Minnesota community of Delano, for example, recorded minima of -25 F, -31 F, -43 F and -30 F on 13, 14, 15 and 16 January, respectively (with an MSL pressure reading of 30.86 inches on 15 January). On 20 January, however, the Delano temperature fell to -35 F and, on the morning of 21 January, to a record shattering minimum of -52 F, a value 14 degrees lower than St. Vincent's minimum of -38 F on the same date. Delano's maximum temperature on 20 January was a frigid -20 F: on the following day, however,

the temperature rose 45 degrees to a “warm” maximum of -7 F.

Minimum temperatures recorded at the Ft. Snelling post hospital station followed a similar pattern. Although Fort observers recorded minima of -43 F on 14 January and -31 F on 15 January, similar or lower readings occurred on 19 January (-34 F), on 20 January (-46 F, the lowest official temperature yet recorded at a Twin Cities station) and 21 January (-45 F). In Minneapolis, that city’s veteran observer, William Cheney, recorded -38 F at 0700 hours on 15 January, -32 F at 0700 on 20 January and -42 F at 0700 on 21 January. At a station several miles from the Cheney station, Minneapolis observer J. H. Aschenbeck recorded -42 F, -36 F and -43 F at his 0700 fixed time observations on 15, 20 and 21 January, respectively. Similarly, both Mankato and Red Wing recorded their coldest temperatures of the month on 21 January: Mankato with -37 F and Red Wing with -41 F (compared to -34 F at Mankato on 16 January and -34 F at Red Wing on 15 January). Like stations farther north, Winona also recorded its lowest temperature (-40 F on 20 January) during the second of the two cold waves that followed the 12 January blizzard (but with the St. Paul Dispatch later reporting a 21 January Winona minimum of -44 F). The Tracy, Minnesota station, however, recorded its lowest temperature of the month (-33 F) on 15 January (compared to -30 F on 21 January). At St. Paul, minimum temperatures between the 15 January reading of -37 F and 21 January included -29 F, -10 F, -15 F, -18 F and -32 F on 16, 17, 18, 19 and 20 January, respectively.

Inevitably, January 1888’s intense ten day cold wave was the topic of numerous newspaper stories, one of the most extensive of which was featured in the 21 January edition of the St. Paul Dispatch. Headlines on that date told readers that St. Paul had experienced its coldest day on record. The story that followed emphasized the winter weariness of St. Paul residents (and Upper Midwest residents generally) asserting that “.....It is getting very monotonous and no one is going to deny the assertion. Last Sunday [15 January], Lt. Woodruff gave it out cold – very cold – that it had been the coldest day [with one exception] since the establishment of the U.S. Signal Service station in St. Paul....This morning the same stereotyped information was thawed out....with the statement that the lowest point reached was only 41.2 degrees below zero and with a freezing smile noted that it was good ice palace weather.....”. (The maximum temperature on 21 January was a frigid -17 F.) The Dispatch further noted that the “new invoice of cold....arrived during the night [of 19 January] and the stock at hand is sufficient to answer for ordinary purposes...the worst feature of the weather last night was the cutting wind.....”. Fortunately, however, wind chill was not a significant factor on the morning of 21 January. The St. Paul station reported calm conditions at 0548 hours CST on that date with a temperature of -37 F and light ice fog. Maximum wind speed during the day was five miles per hour from the east with calm conditions prevailing throughout the following day (i.e. 22 January). Light winds also prevailed on the day preceding the record cold: on 20 January, the St. Paul station anemometer

registered sustained wind speeds of four miles per hour at 1348 hours, one mile per hour at 2048 hours and a maximum daily wind speed of 14 miles per hour from the northwest. Besides being relatively stable, the cold air was, of course, very dense: average daily MSL pressure, as recorded by St. Paul observers, was 30.61 inches on 20 January and 30.67 inches on 21 January. Individual readings included 30.50 inches at 2048 hours on 19 January; 30.61 inches at 2048 hours on 20 January and 30.64 inches at 2048 hours on 21 January. Interestingly, the barometer at North Platte, Nebraska, rose to a record level of 30.94 inches on 21 January (with a temperature of -35 F), another indication of the extent and depth of the late January cold air mass.

Ironically, as Woodruff noted in his 21 January comments to the St. Paul newspapers, the unprecedented cold proved to be a boon of sorts to the St. Paul winter carnival. According to Laskin (op. cit.), “.....*the cold wave [provided] ideal weather for building a rock hard ice palace for the upcoming Winter Carnival [festivities], the high point of the winter social season in St. Paul. Though Thursday’s blizzard had forced city officials to postpone the ceremonial laying of the corner block, the occasion took place with all due pomp on Saturday evening – a bit of luck, as it turned out, since this just happened to be the day Woodruff celebrated his thirty ninth birthday. When it was finished a few days hence, the ice palace would rise to 120 feet at its highest turret, with some 55,000 22 by 33 inch ice blocks covering an acre of ground and weighing in at 6,000 tons – all of it frozen solid by the subzero weather and glittering like diamonds*”.

Like the St. Paul Dispatch, the 22 January edition of the Minneapolis Tribune focused on the record cold with emphasis on the extreme temperatures recorded – or purportedly recorded – at various Minnesota and Wisconsin locations. According to the Tribune, an observer at Chippewa Falls, Wisconsin had recorded a minimum of -65 F on the morning of 21 January with a reading of -50 F as late as 1000 hours on the same day. Other notable minima included -46 F at Red Wing; -58 F at St. Cloud; -60 F at Tower [Minnesota], a value which, if accurate, equaled the state’s official record low minimum of -60 F recorded in 1996; -45 F at Northfield; -56 F at Shell Lake, Wisconsin; -41 F (with heavy fog) at Winona; -58 F at Zumbrota; and -43 F at Owatonna. Regrettably, however, many of the values cited in the Tribune story are suspect. Some, undoubtedly, were unofficial readings taken from poorly calibrated and/or poorly exposed thermometers while others may have been fabricated by the newspaper’s correspondents or, alternatively, are values which may have been erroneously changed by the newspaper’s typesetters or editors. (At least one piece of evidence casting doubt on the validity of the Tribune’s reports is the discrepancy between the -58 F value reported from St. Cloud and the more plausible readings (i.e. -50 F and -44 F) reported by observers at the stations operated by the city’s then existing colleges. But a word of caution: it is possible that the -58 F reported by the Tribune was a reading taken from a self-registering thermometer which, in contrast to the

college's fixed time readings taken at 0700, recorded the "true" overnight minimum on the date involved).

Surprisingly – or at least surprisingly to 1888's winter beleaguered Upper Midwest residents – temperatures moderated rapidly within days after the record setting cold of 15-22 January, bringing above freezing readings to many areas during the closing days of the month. At the St. Paul Signal Corps station, daily maxima included a relatively warm 7 F on 22 January, followed by maxima of 25 F, 23 F, 28 F, 34 F, 34 F 35 F, 37 F, 38 F and 37 F on 25, 28, 29, 30, 31 January and 1, 2, 3, 4 February, respectively. Notable minimum temperatures included 19 F on 22 January, 22 F on 2 February and 29 F on 3 February. In Minneapolis, William Cheney reported "mild weather during the last four days of January": temperatures at his location included 1400 hour readings of 22 F, 26 F, 32 F, 34 F, on 28, 29, 30, 31 January and 34 F, 35 F and 32 F on 1, 2, 3 February, respectively. Predictably, the warmer weather caused some thawing, evidence of which included a Minneapolis Tribune report of "slushy, muddy streets...during the latter days of the 1888 St. Paul Winter Carnival...".

Nor were the moderating temperatures –which occurred when warmer air flowed into the area behind the departing cold air mass – limited to east central Minnesota. The 31 January edition of the Minneapolis Journal reported, for example, that "Saturday was an unusually busy day in Rochester [Minnesota], it being the first time that people with teams [of horses] from any distance could come in [to town] since the big storm. Similarly, the 4 February edition of the Journal noted that, at Watertown [Dakota], "the weather for the past two days was quite favorable to the ground hog.....". At Moorhead, late January and early February daily maxima included 23 F on 29 January; 31 F on 30 January; 29 F on 31 January and 1 February and 32 F on 2 February. In west central Minnesota, the Morris observer recorded maxima of 27 F, 31 F, 32 F, 35 F, 31 F and 30 F on 28, 30, 31 January and 1, 2, 3 February, respectively. (In contrast, the same station recorded a maximum of -24 F on 20 January). At Fergus Falls, the previously noted Grand Hotel thermometer registered 32 F at 1200 on 1 February. Farther south, Delano recorded 37 F on 31 January and at Mankato temperatures reached 33 F, 37 F, 39 F and 37 F on 30, 31 January and 1, 2 February, respectively. Although it did not feature any quantitative values, the editor of the 1 February New Ulm Journal humored his readers, providing a sanguine (and probably exaggerated) report of the warmer weather: "I wonder what C. H. Ross [probably a New Ulm resident who was then on an out-of-town trip] would have said about the climate of Minnesota had he been here Monday and seen people walk around bareheaded and in their shirt sleeves. The manager of the city telegraph office is thankful that the season of snow blockades is a thing of the past, thanks to the rotary snowplow...". And even at St. Vincent, not far from the Canadian border, temperatures reached 36 F on 30 January.

The month end warmth, although fortuitous, was not sufficient, either in duration or

intensity to soften the reputation of January 1888 as one of the most severe, disastrous winter months in the climatic history of the Upper Midwest. The warmth did, however, raise the average temperature of the month, making it somewhat warmer – at least at several locations – than some of the Little Ice Age Januaries that preceded it. This fact was emphasized by, among others, the Morris observer D.T. Wheaton. In remarks published in the 8 February 1888 edition of the Morris Tribune, he noted that “contrary to general expectations, the mean temperature for the month [January] was nearly two degrees warmer than January of last year. From the third to the sixth and from the twenty seventh to the end of the month, the temperature was unusually mild.....”. What Wheaton considered to be “unusual” mildness notwithstanding, the average daily temperature for the month, according to his calculations was a frigid -5.65 F. Like Morris, January 1888's average temperature at William Cheney's Minneapolis station, although below the corresponding value for January 1887 (-1.7 F vs. 0.2 F), was not the coldest of the decade. According to the Cheney record, January 1883 was the coldest month of the decade (-2.6 F). Moreover, as a matter of historical record, no winter monthly average recorded at Minneapolis during the 1880's was colder than January 1875 (-5.0 F). At St. Paul, however, January 1888 (-0.4 F) was the coldest January in the 1880's series but, as in Minneapolis, it was considerably “warmer” than January 1875 (-3.4 F).

But whatever its ranking when compared to other frigid Little Ice Age Januaries, January 1888 was singularly cold. Monthly averages at representative Minnesota stations included -7.8 F at Moorhead (with an average daily minimum of -18.6 F); -13.5 F at St. Vincent; 2.3 F at Duluth; 0.6 F at Mankato; -1.7 F at Delano; -3.3 at Glenwood; -2.3 at Ft. Snelling; 0.3 F at Excelsior; and 0.2 F at LeSueur. Corresponding values at various Dakota stations included -5.5 F at Ft. Lincoln; -6.8 F at Ft. Sisseton; -12.4 F at Ft. Totten (a value which the January 1888 edition of the Signal's Corps Monthly Weather Review suggests may have been derived from an incomplete record); -1.4 F at Huron; 4.6 F at Yankton ;and -3.3 F at Garden City. In Iowa, January 1888 monthly averages included 6.5 F at Des Moines (with a monthly minimum of -32 F); 9.2 F at Cedar Rapids; -0.8 F at Cresco (with a monthly minimum of -43 F); 0.5 F at Ames; and 7.0 F at Dubuque. In Wisconsin, LaCrosse recorded a monthly minimum of -42 F with a monthly average of 2.6 F. And at Omaha, Nebraska, the month minimum was -25 F and the monthly average was 8.0 F.

Although there is no one, simple explanation for January 1888's intense cold, a major contributing factor was the extensive and heavy snow pack which had accumulated in many areas during the early winter of 1887-88, particularly as a result of the previously noted heavy snowfalls which occurred during December 1887. Moreover, moderate to heavy amounts of snow fell at many locations during January, adding to the snow cover, a snow cover which, despite short periods of moderating temperatures, remained substantially intact through the entire month of January (and beyond, persisting in some

areas well into April 1888).

Specifically, January snowfall values included 12.8 inches at Cheney's Minneapolis station, 7.0 inches of which fell during the 12-13 January blizzard; 8.1 inches at St. Paul (4.0 inches of which was recorded during the 12-13 January blizzard) with a month end snow cover of 17 inches; 5.4 inches at Mankato with a month end snow cover of 15 inches; 10.0 inches at Tracy with a month end snow cover of 32 inches; 10.0 inches at Winona with a month end snow cover of 12 inches; 10.0 inches at Red Wing with a month end snow cover of 27 inches; 15.3 inches at Duluth with a month end snow cover of 20 inches; 25.5 inches at Delano with a combined December-January total of 49.5 inches and a 31 January snow cover of 26 inches; 12.1 inches at Moorhead with a month end snow cover of ten inches; 9.6 inches at St. Vincent with seven inches on the ground at the end of the month; and 5.0 inches at Morris with a month end snow cover of 30 inches. Other month end snow cover values included 24 inches at Richardton, 15 inches at Huron, 10 inches at Ft. Totten, nine inches at Bismarck and four inches at Yankton, all in the Dakota Territory; 26 inches at Cresco, Iowa; 24 inches at Ames, Iowa; eight inches at Cedar Rapids, Iowa; two inches at Des Moines, Iowa; 40 inches at Fredonia, Wisconsin; 35 inches at Green bay, Wisconsin; 17 inches at Madison, Wisconsin; and 14 inches at Prairie du Chien, Wisconsin.

Apart from the official statistics, various newspaper reports provided interesting anecdotal--albeit sometimes dubious -- accounts of January snow cover. The 19 January edition of the Minneapolis Evening Journal noted, for example, that at Mandan, Dakota "much of the prairie that was covered with snow to a depth of two feet on the level a week ago is now bare, blown so by the recent storm. There is much less snow on the ground [there] than there was a year ago...". In a somewhat different vein, the 22 February edition of, the Morris Tribune reported that the "unusually severe weather and well nigh impassible roads of this winter has had a disastrous effect on business. There have been few days since the middle of December when it was possible for farmers to get far from home....". And on 20 January, a St. Paul Pioneer Press correspondent -- in a seemingly exaggerated report -- claimed that snow in the Aberdeen, Dakota area had drifted to a height of 50 feet.

One of the most detailed accounts of January 1888 snow cover was provided by the Fergus Falls Weekly Journal, several editions of which carried winter weather reports from the villages and townships in the immediate Fergus Falls area. On 12 January, the Journal reported that "wood chopping and hauling at Oak Valley is almost suspended on account of the deep snow....twenty two inches of snow at Eagle Bend in Todd county with a fresh supply every day or two...". A similar report from Rothsay noted that "there is some danger of a wood famine in this vicinity if the roads do not improve. Farmers report them [the roads] almost impassible on account of the drifts...". At Maplewood, the Journal correspondent claimed that the snow cover there had reached a depth of 37

inches. In still another report, a Campbell correspondent stated that, there “[is a lot] of snow on the flats [a reference to the lower Red River Valley’s extremely level terrain, a topography attributable to that area’s past geological history, it once having been covered by water from glacial Lake Agassiz]....the trains that have been off a few days are just beginning to run on time again.....wood and coal are both scarce and [expensive]...rotten, sour and poorest of poor wood is being palmed off as number one hard....”. And in the 2 February edition of the Journal, the Campbell correspondent noted “that quite a number of boys report frozen feet and hands and plenty with ears, faces and noses frozen are to be seen. This has been the worst winter for storms witnessed by the people on the flats. School in district 13 has closed until more favorable weather for children to get out...”.

Nor were the effects of January 1888's adverse weather felt only by residents of the Upper Midwest. The January 1888 edition of the Signal Service’s Monthly Weather Review noted deep month end snow cover in many areas in the northeastern, mid-Atlantic and central portions of the country with winds reaching velocities of 50 miles per hour or more at locations in New York and New England. The same source noted floating ice in the Mississippi river at Cairo, Illinois from 17-21 January. Navigation on the Ohio River at Louisville, Kentucky was said to have been suspended from 21-25 January and again on 27-28 January. Further, a number of eastern harbors were reported as either completely “frozen over” or, as at Baltimore, Maryland, were said to have been obstructed by chunks of ice which “rendered navigation difficult” at times during the month.

The widespread incidence of January’s extreme winter weather was, of course, featured in Minnesota newspapers, partly perhaps in an effort to counter the Upper Midwest’s presumed reputation as the ice box of the nation. The 23 January issue of the Minneapolis Evening Journal told readers that the Lampasas, Texas area had been struck by “another blizzard.” The same edition further noted that “reports of the disastrous effects of the unprecedented cold spell of last week continue to arrive from distant sections...”. Several days later (27 January), the Journal featured a story which claimed that “there was one of the biggest blockades known on the New York Central.....the snow blew upon the tracks as fast as it could be shoveled away and the wind was so bitterly cold that the laborers could not stand up against it...the storm of the night before last and yesterday was most severe in the Mohawk Valley. The wind ... blew 60 miles per hour.....”. On 30 January, the Journal reported that “yesterday at Rochester, New York...the fury of [a] three day blizzard was obtained on the New York Central Road between Buffalo and Syracuse.....The fury of the storm which began Thursday and which swept the railroads of northern and eastern New York with snow was not spent until Saturday afternoon...”. And on 31 January, the Journal noted that the “ice gorge” which had formed on the Mississippi River “in front of St. Louis, Missouri began to move last night,” wrecking several steam boats and causing damage estimated

at \$1.5 million....". Likewise, the 1 February edition of the New Ulm Journal carried a story stating that "reports from various points in Maine, New Hampshire and Vermont state that the heaviest snow storm [in] years prevailed [there]...Snow fell from 15 to 18 inches. [The] storm was described as the worst there in thirty five years...". And the 26 January issue of the Fergus Falls Weekly Journal told its readers that cold weather had "closed the Patapsco River at Baltimore, Maryland with ice..."

Reports emphasizing the severity and extent of January's weather were, not surprisingly, amply corroborated by statistics compiled by stations throughout the country and published in the January 1888 Monthly Weather Review. Average monthly temperatures ranging from eight to ten degrees below the then accepted normals were reported at several Iowa stations. Moreover, Dr. Gustavus Hinrichs, (relationship to the Signal Corps not specified) wrote that "the continued extremely cold weather that has prevailed during the past days [prior to 22 January] is very.....fortunately a rare feature in Iowa climatology. During the entire middle decade of January 1888, the temperature has been zero or below on every night, on two of which it reached to within one and two degrees of the lowest temperature recorded by me in almost twenty years. The mean temperature of the second decade of January 1888 is minus 4 degrees. Only once during the twenty eight years for which we have an unbroken series of reliable observations at Iowa City has any winter decade been as cold, namely the first decade of January 1864, which had a mean temperature of minus seven degrees.....During the first 18 years only one winter decade was so extraordinarily cold, but during the last ten years we have had four such instances.....This is another indicationthat in Iowa the winters are colder than formerly."

According to the same edition of the Monthly Bulletin, January 1888 temperatures at Signal Corps stations in many other states including Illinois, New York, Michigan, Massachusetts and even California, averaged nine to four degrees below normal. At Salt Lake City, Utah Territory, a minimum temperature of -17 F was recorded on 15 January, the lowest reading at that location since January 1883. The "extremely cold weather of the second decade resulted in the loss of large numbers of sheep in the western part of the [Utah] Territory...". In Texas, the Abilene station reported an 0700 hour reading of -5 F on 15 January, "the coldest of which there has been any record and colder than the oldest residents have ever known it". The Bulletin also noted a minimum of -2 F at Portland, Oregon, the lowest recorded there "during the past sixteen years". And at Rosebud, Oregon, "unusually low temperatures" occurred on 14, 15, an 16 January, temperatures which were said to have "caused great suffering of [live]stock".

Although, as documented previously, area temperatures moderated markedly during the last days of January and the first days of February 1888, the Upper Midwest soon felt the sting of another bitter cold wave, a cold wave which, in some respects was more severe than its January counterpart. The frigid air, accompanied by blizzard conditions,

began to filter into the area on 3-4 February. The 4 February edition of the Minneapolis Journal emphasized the changing conditions, noting that “a stiff wind set in and quite a breeze prevailed all night accompanied by considerable falling snow. Today, the telegraph wires are reported down and trains [are] late....” At the St. Paul Signal Corps station, temperatures on 4 February fell from a high of 37 F to a low of 9 F, a low which, in turn became the maximum for the following day. The downward trend continued for the next five days with minima of -7 F, -7 F, -12 F, -22 F and -33 F on 5, 6, 7, 8 and 9 February, respectively (with a maximum temperature of -15 F on 9 February).

Like St. Paul, most other Minnesota stations reported their lowest February temperatures on the ninth of the month. Minneapolis observer William Cheney recorded -35 F at 0700 hours and -14 F at 1400 hours, respectively, on that date. Other 9 February readings included -30 F at Red Wing; -36 F at J. H. Aschenbeck’s northeast Minneapolis station; -32 F at Mankato; -33 F at Duluth; -42 F at 0700 at St. Cloud College ; -37 F at the St. Cloud Normal School; -34 F and -40 F at Morris on 8 and 9 February, respectively (with a maximum of -20 F on 8 February); -43 F and -50 F at St. Vincent on 8, 9 February, respectively; and -38 F and -47 at Moorhead on 8, 9 February. At Fergus Falls the Weekly Journal reported unofficial readings of -30 F at midnight on 7 February; -34 F at 0600 on 8 February; -38 F at midnight on 8 February; and -42 F at 0600 hours on 9 February. Also, on 9 February, the Minneapolis Journal noted readings of -30 F at Duluth; -40 F at Montevideo; -32 F at Huron, Dakota Territory; and -62 F at Pembina, Dakota. So far as can be determined, however, the Pembina reading was an unofficial value, perhaps an exaggeration attributable to an imaginative Journal correspondent or, more likely, a reading taken from a poorly exposed or poorly calibrated thermometer (a conclusion buttressed by the fact that the official minimum recorded at the nearby St. Vincent Signal Corps station on the same date was, as noted, a more credible -50 F [officially recorded as -49.9 F]). Had the Pembina reading been taken from a reliable, official thermometer it would, interestingly, have been the lowest temperature yet recorded in what is now North Dakota, exceeding that state’s now officially recognized low of -60 F recorded during the winter of 1935-1936.

Exhibiting a pattern similar to that following the 21-22 January cold wave, area temperatures rose rapidly after 9 February, rising to 45 F at the St. Paul station on 13 February. Another brief period of cold weather followed on 15 February (with a minimum of -18 F and an MSL pressure of 30.91 inches at St. Paul on 15 February). In Minneapolis, Cheney noted a 50 degree drop in temperature between 1400 hours on 13 February and 0700 hours on 14 February followed by a rise of 57 degrees between 0700 hours on 15 February and 1400 hours on the ensuing day. At St. Paul, daily maxima of 40 F or higher were recorded each day from 16 through 19 February with a surprisingly warm maximum of 50 F recorded at the Duluth Signal Corps station on 16

February. The 23 February edition of the Fergus Falls Weekly Journal noted a temperature of 36 F at the Grand Hotel on 18 February, complaining that “the thaw is spoiling our sleighing for hauling....”. The Journal also noted in passing that “there are a good many wolves around this winter and they are getting bold and ravenous...”. According to the 24 February edition of the Rochester Post, the “springlike” weather was general throughout much of the upper Midwest: temperatures from 30 to 60 degrees were reported in parts of Montana “with grass sprouting and buds swelling...at Mandan, Dakota, over two feet of water [had accumulated] on the ice [presumably in the river] and is thawing rapidly....very little snow in the country north of here.....(On 29 February, however, the Post reported that “a storm nearly approaching a blizzard [had] raged all day in Montana...snow badly drifted and packed [with] trains delayed...”).)

The warmth was, however, short lived. A cold wave, although more moderate than the earlier February outbreak, settled into the area on 25-27 February, once again bringing below zero readings to east central Minnesota. In northwest Minnesota, Moorhead and St. Vincent recorded minima of -21 F and -29 F, respectively, on 27 February. At Moorhead, the 27 February reading was accompanied by winds of 50 miles per hour, producing what must have been a day of singularly unpleasant weather. At Morris, observer D.T. Wheaton recorded -22 F on 27 February, near the end of a month which he described as featuring “high winds and blizzards...”. Similarly, the Fergus Falls Journal reported an unofficial reading of -22 F at 0600 hours on 27 February. And at the St. Cloud College station, the temperature dropped to -20 F on the same morning.

Considered as a whole, February 1888 was colder than normal, its relatively mild interludes notwithstanding. According to Prof. William Payne, then director of the Minnesota State Weather Service, the month was, in fact, marked by “....abnormally low temperatures...” In a summary of the month’s weather (published in the February 1888 issue of the Monthly Weather Review), Payne wrote that the “the [February] average for the state [of Minnesota] was 9.0 F, “.....4.1 F colder than that of the corresponding month of 1886 and 2.3 F warmer than that of 1887. In the southern portion of the state, the temperature was from four to five [degrees] below the normal of fifteen years, while there [was] a gradual decrease in the departure until the northern boundary is reached, where it was only one [degree] below the normal. The lowest monthly mean was -0.1 F, reported from St. Vincent; the highest monthly mean was 15.6 F, reported from La Crosse [Wisconsin]. The warmer portions of the month were: 1st to 3rd, 13th, 16th to 19th, 22nd to 24th. The maximum for the state. 50 F, reported on the 16th from Duluth; the next highest 48 F, on the 18th at La Crosse. The coldest periods of the month were: 7th to 10th...14th, 15th, 26th, 27th. On these days the mean daily temperature over the entire state were generally below zero. The minimum for the month occurred during the passage of the cold wave in the first of these periods. The lowest registered was -50 F on the 9th at Rush City, while on the same day at St.

Vincent it was -49.9 F; Pine River Dam, -48 F; Moorhead, -47 F; Princeton, -44 F; Alexandria, -43.5 F; Glenwood and Morris, -40 F. Monthly mean temperatures (in addition to those reported by Payne) included 4.4 F at Moorhead; 13.1 F at St. Paul and 11.5 F at Minneapolis.

Fortunately, February 1888, although generally cold, was relatively dry. According to Payne's report, February precipitation "was fairly well distributed.....the average for the state [was] 0.48 [inches]....respectively 0.17 and 0.66 below the amounts of the corresponding months of the two preceding years. The greatest deficiency was in the vicinity of Lake Superior, where it was over three quarters of an inch below the average. In the southern counties [of Minnesota] the deficiency amounted to half an inch while in the northern counties it was only a quarter of an inch. Precipitation was general throughout the state on the 3rd to [the] 7th, 10th to 13th, 19th, 22nd, 24th and 25th. The heaviest fall occurred during...the storm on the 19th and 20th. The greatest total monthly precipitation was 0.91 at Mankato and Red Wing, while some of the smallest amounts were Morris, 0.11; St. Vincent, 0.22; Duluth, 0.24. At the close of the month from three to ten inches of snow remained on the ground in the northern portion of the state, while elsewhere there was from ten to twenty inches.....the snow drifted badly on the 26th, so that trains from the west were delayed several hours. Logging operations proceeded uninterrupted during the month and conditions were generally favorable for a full cut...".

Specific February snowfall values included a monthly snowfall of 6.1 inches at Red Wing with a month end snow cover of 23 inches; 8.5 inches of snow with a month end snow cover of 24 inches at William Cheney's Minneapolis station; 3.4 inches of snow with a month end snow cover of ten inches at the St. Paul Signal Corps station; 6.8 inches of snow at Mankato with seven inches on the ground at the end of the month; 2.6 inches of snow at Duluth with a month end snow cover of fifteen inches; a 15.5 inch end of month snow cover at the St. Cloud Normal School station; 3.5 inches of snow at Morris with a month end snow cover of twenty inches; 2.0 inches of snow at St. Vincent with a month end snow depth of twelve inches; and at the Moorhead station, 4.7 inches of snow with a month end snow cover of only four inches.

Upper Midwest residents no doubt looked forward to the end of February and the beginning of March, the first meteorological spring month, hoping for warmer weather and an end to the winter's disheartening series of snowstorms and blizzards. Any such hopes were, however, soon dashed: March 1888, like the winter months that preceded it, was severe, featuring several notable cold waves and, in some areas, heavy snowfalls. The month opened with a snowstorm which, according to the 2 March edition of the Minneapolis Evening Journal, brought up to eighteen inches of snow to parts of Michigan's Upper Peninsula. At Duluth, 40 mile per hour winds, combined

with fresh snowfall, blocked “all” rail traffic in that part of Minnesota. Predictably, the 1 March storm was followed by bitterly cold temperatures: on 3-4 March, temperatures fell to -27 F at Argyle; -18 F at Fergus Falls (an unofficial reading); -27 F at St. Vincent; -20 F at Moorhead; -14 F at Tracy; -12 F at Mankato and -8 F at St. Paul. Although the early March cold wave was followed by a brief period of moderate temperatures, cold air invaded the region again at mid-month, accompanied by strong winds which, for example, reached 50 miles per hour at Moorhead on 14 March. Many stations, however, recorded their lowest temperatures late in the month, values which, given the dates (21-22 March) on which they occurred, added yet another extreme event to the winter’s already remarkable but dismal list of such events. Representative minima, all of which occurred on 22 March included -17 F at Moorhead; -29 F at St. Vincent;(preceded by winds of 54 miles per hour on 20 March); -16 F at Morris (with a maximum of -4 F on 20 March);-14 F at Farmington;-15 F at the St. Cloud Normal School station; -18 F at the St. Cloud College station; -14 F at Duluth; -8 F at Mankato;-14 F at St. Paul; -16F at Ft. Snelling; and -13 F at 0700 hours at William Cheney’s Minneapolis station. Other notable late season readings included an unofficial -21F at Fergus Falls at 0600 hours on 21 March and zero F at 0600 on 28 March; Also, on 28 March , the St. Cloud College station recorded -8 F and the St. Paul station recorded 1 F.

According to Prof. William Payne’s monthly climatic report (published in the March 1888 issue of the Monthly Weather Review), Minnesota’s March 1888 weather was “unusually severe for an initial spring month.....the average for the state, 15.8 F, [was] 9.7 below that of the corresponding month of 1887, 11.0 below that of 1886, and 8.4 below that of 1885. At St. Paul, it was 9.8 below the normal of fifteen years; LaCrosse [Wisconsin], 8.1 below; Duluth, 7.9 below; Moorhead, 6.4 below; and St. Vincent, 5.9 below. This [was] the lowest mean temperature recorded for the month of March since the stations were established at LaCrosse and St. Paul. The highest mean temperature was reported [at] LaCrosse where it was 22.2 F, while the lowest was 7.8 F at St. Vincent.....the warmer portions of the month were [the] 8th and 9th, 13th to [the] 15th, 17th to [the] 20th, 26th to [the] 31st.The highest temperatures generally occurred during the third of these periods. The maximum for the month was 50 F, reported on the 18th at Rolling Green and Pine river Dam....[Minimums were generally below zero on the days during the colder portions of the month]. The greatest cold was experienced during the last of these terms [i.e. 21-22 March], when the temperature fell to -30 F at Pokegama Falls Dam and Pine River Dam. On the same data at St. Vincent it was -29.3; Leech Lake Dam, -29.0; Argyle, -26.5.....”.Monthly mean temperatures other than those published in Payne’s report included 12.5 F at Moorhead; 19.6 F at Mankato; 17.8 F at William Cheney’s Minneapolis station; and 18.8 F at St. Paul. Also, consistent with the abnormal cold, March monthly maxima were unseasonably low (e.g. 42 F in Minneapolis; 42 F in St. Paul and 41 F at Winona and Moorhead).

Prof. Payne's comments were, of course, echoed by other observers. In his monthly report to the Signal Corps, D. T. Wheaton noted that, at Morris, March 1888 was a "very stormy month" with "frequent blizzards" and an "unusual depth of snow at the close of the month...". And in the 3 April 1888 edition of the Minneapolis Tribune, Minneapolis observer William Cheney stated that "it will probably afford some satisfaction to a great many people to know that their impressions of an unusually cold March are confirmed by the records. It was in fact the coldest March on record [here] with the exception of March 1867.....The first half of the month was colder than the latter half, but the minimum temperature was not reached until the 22nd. Five of the 7 a.m. observations showed a temperature below zero and on one day, the 21st, [the] mean temperature was below zero...".

To make matters worse, March 1888's record or near record low temperatures were accompanied by moderate to heavy amounts of snow, adding to the winter snow pack and leaving what Prof. Payne termed "an unusually large amount of snow...on the ground at the close of the month...". Individual monthly values included 16.5 inches of new snow at Delano with a month end snow cover of twenty inches; twelve inches of snow with a month end snow cover of 22 inches at the then newly established Farmington station; 11.4 inches of snow at Morris; sixteen inches of snow at the St. Cloud Normal School station with a month end depth of eighteen inches; eight inches at Duluth with thirteen inches on the ground at the end of the month; fourteen inches at Mankato with a month end snow cover of six inches; 10.4 inches at St. Paul with a month end depth of seven inches; 21.2 inches at Cheney's Minneapolis station with a month end depth of 36 inches; nineteen inches at Winona with 24 inches on the ground at the end of the month; eighteen inches at Red Wing with a month end depth of 25 inches; 11.1 inches at Moorhead with eight inches on the ground on 31 March; and 9.6 inches at St. Vincent with a month end snow cover of nine inches. At Fergus Falls, the 5 April edition of the Weekly Journal claimed that, on 1 April, the nearby town of Western "reported snow banks higher than the windows with no sign of a thaw....".

In his monthly report to the Signal Corps, Prof. Payne stated that the March snowfall "was unevenly distributed, the greatest amount having fallen in the southeastern portion of the state, while the least fell in the northwestern and south central portions.....At the close of the month from 18 to 36 inches of snow remained on the ground in the region of the 'Great Woods' [a probable reference to the then "forested" region to the west and north of the Twin Cities] while in the southeast portion of the state it averaged 24 [inches] and in the southwestern from six to 14 [inches]. At the close of the corresponding month of the preceding three years snow had almost entirely disappeared, except in localities where there had been severe drifts....". Payne further noted that "high winds were of frequent occurrence [during March], but without frequent gales. There was a comparative absence of serious snow blockades [on the railways], although the drifting of snow on the 1st, 25th and 26th caused alight

delays...The unusually large snowfall was not generally very favorable for logging operations....”.

Although focused on Minneapolis and surrounding area, William Cheney’s 3 April meteorological report included comments similar to Payne’s description of March 1888 snowfall patterns. In Cheney’s words “another unusual feature [of the month] was the large snowfall, the largest in March since 1872. The sleighing was nearly worn out in the city on the 20th but the storms of the 23rd and the 26th replenished it so that sleighs were running until the 31st....There is still an abundance of snow in the country and better sleighing than wheeling.....The total snowfall for the season up to March 31, inclusive, is seven feet, one-eighth inches. The first sleighing for the season was November 28 so that up to March 31, inclusive, there were 127 days of continuous sleighing.....”. Cheney’s record also show March to have been an unusually gloomy month with an average daily cloudiness of 8.7 (on a scale of zero to ten with ten indicating complete overcast).

March 1888's disagreeable weather did not, however, feature any major blizzards nor, as Payne’s report indicated, did not seriously hamper rail traffic or otherwise seriously disrupt the Upper Midwest’s social and economic life. The month did, nevertheless, bring widespread death and destruction to another part of the country, namely the Eastern seaboard, the city of New York especially. In what the 13 March edition of the Minneapolis Evening Journal described as a “terrible blizzard” pummeled that region on 11, 12, and 13 March, coincidentally (and ironically), exactly two months after the devastating “Children’s Blizzard” which swept through the Upper Midwest on 11,12 January. The Journal’s account of the eastern storm, headlined “Their Turn Now”, claimed that, in comparison, the January storm was a “little one”. As of 13 March, the Journal continued, “There has been only partial resumption of traffic in [New York]. Elevated trains are running at intervals but they are wholly inadequate for the requirements. Most business men who have come down this morning were forced to walk. Sleighs and carriages were in great demand. The wind is still blowing furiously and the snow is badly drifted, being piled in many places six and eight feet high. Several persons are reported to have perished in the city last night [an understatement: storm related loss of life was, in fact, great, probably as great that attributed to the Children’s Blizzard]. Communication with Washington and all points south of New York is still entirely cut off.....The snow is frozen so hard that plows cannot be used, and gangs of men with shovels and picks are endeavoring to clear the roads. The East River is frozen hard this morning and many Brooklinites walked across to the New York side.....Many trains are stalled.....The hospitals report a great number of patients who were severely bruised and overcome by yesterday’s storm....The bodies of two men and one woman found on the streets were taken to the morgue.....At Saratoga, New York, the snowfall which began Sunday night has continued for 36 hours and at 7 a..m. [on 13 March], the measurement was exactly 40 inches.....”. In contrast, the Journal

noted that “the severe weather New York and the East are now complaining of” was dramatically different from mid-March weather conditions in Huron, Dakota. The weather there, in what was probably an embellished report, was said to be “as calm and clear as in May. The sun is starting the buds on the maples and tints of green can be seen in the fields...”.

As noted previously, the winter of 1887-88, brutal as it was, does not (apart from the January and March blizzards) seem to have caused widespread suffering and deprivation comparable to that experienced – at least by Upper Midwest residents – during previous severe winters, the winter of 1880-1881 especially. Press reports suggest that, although some areas experienced episodes of what, in the terminology of the time, were called “famines”, there were no prolonged or widespread fuel and food shortages, except perhaps among the area’s Native American population. Several Minnesota newspapers reported, for example, that there was “terrible distress” among the Indians in [the Winnipeg vicinity] of Canada. In Minnesota (as noted previously), the Indian agent at Browns Valley [Minnesota], in a statement published in the 26 January edition of the Fergus Falls Weekly Journal, contended that a large number of the Indians on the Sisseton [Dakota] reservation [were] “destitute of provisions and are starving to death...”. This, in turn, triggered an investigation which reportedly supported the agent’s contention, finding that “quite a number of Indians [on the Sisseton reservation] are almost destitute of the necessities of life...”. However, according to the 10 February edition of the Minneapolis Tribune an investigating committee told Minnesota Gov. McGill that “complaints of suffering in the Browns Valley area [which, it can be reasonably assumed, included the Sisseton reservation] were due to the blockade on the Manitoba Road....and that reports of coal and wood shortages were exaggerated...”, a conclusion which may or may not have been warranted by the facts. Other reports, again as noted previously, indicated that, at various times during the winter, a number of communities (e.g. Morris, Rothsay, Campbell, Adrian) experienced temporary fuel shortages, shortages caused by disruption of rail traffic, deep snow which impeded the ability of farmers and others to cut and haul firewood and/or the unusually high demand for fuel, obviously attributable to the extreme cold. Newspaper reports and other anecdotal evidence indicate, also as noted previously, that fuel and food supplies were generally adequate, partially because improved snow removal technologies prevented prolonged obstruction of rail traffic, allowing the railroads to deliver needed supplies to outlying communities on a timely basis. Undoubtedly also, Upper Midwest suppliers, having learned from the hardships of earlier winters (1880-81, especially), prepared for the worst by laying in generous stocks of coal, wood, food and other necessities during the late autumn months.

Upper Midwest residents, Native Americans especially, who, during March, were still reeling from the effects of an unduly prolonged winter, no doubt breathed a sigh of relief when the cold gave way to a short lived late March warm up. At St. Paul, for

example, the closing days of March brought above freezing temperatures, followed by a 50 F reading on 4 April. Disappointingly, however, both April and May 1888 were, like March, notably cold months, a cold which was compounded by heavy rains (in southeastern Minnesota and Iowa, especially), local flooding and many cloudy, gloomy days. Minneapolis observer William Cheney, for example, recorded 2.8 inches of snow on 29 April with minima in the 20's F every day from 26 through 29 April, inclusive. The average April temperature at his station (an average derived from fixed time observations taken at 0700, 1400 and 2100 hours), was a chilly 40.2 F. At St. Paul, temperatures during April averaged 41.6 F, with a maximum temperature of 70 F or above on only one day. As in Minneapolis, St. Paul experienced unusually cold weather during closing days of April with 1.5 inches of snow and temperatures ranging from a high of 36 F to a low of 30 F on 29 April. Significantly, also, the ice on Lake Minnetonka in western Hennepin county did not disappear until 25 April. Moreover, locations in northern and western Minnesota experienced winter like temperatures during early April: 7 F at Moorhead on 2 April; 6 F at St. Vincent on 2, 6 April (with an average monthly temperature of 34.8 F); and 4 F at Morris on 2 April.

Although some areas experienced an extremely wet April (e.g. 5.14 inches in St. Paul and 5.13 inches in Minneapolis), snowfall was generally light. Monthly totals included Red Wing, 1.1 inches; Minneapolis, 3.1 inches; St. Paul, 2.0 inches; Tracy, 3.0 inches; Mankato, 1.2 inches; Duluth, 3.0 inches; Morris, 0.5 inches; St. Vincent, 3.1 inches; and Moorhead, 0.3 inches (a station which, incidentally, recorded winds of 54 miles per hour on 24 April). And with the exception of Duluth (with a trace of snow on the ground at the end of the month), all of the foregoing stations were snow free at the end of April, Morris observer D. T. Wheaton noting that the “snow disappeared gradually with no high water in the streams...”.

Unlike the Morris area, however, numerous localities, including areas in southeastern Minnesota, Iowa, and Illinois did experience high water, the result of a combination of heavy rainfall and snow melt. On 30 April, the St. Paul Pioneer Press reported heavy rainfall and the implied threat of flooding: “the heavy rainfall of the last four days has not materially affected the [Mississippi] river thus far, the water remaining stationary yesterday...Ortonville reported 2.07 inches, Tracy, 1.27 inches. The fall will probably average about two inches throughout the watershed of the Minnesota River...”. The following day, the Pioneer Press told readers that the Upper Mississippi at Aitkin was rising at the “rate of about six inches in twenty four hours. The total rise so far is eight feet, [the] highest in four years...”. On 4 May, the Minneapolis Evening Journal reported that the “water in the Mississippi River [at Winona] [was] still rising. It rained hard all day yesterday and the river rose seven inches. The levee is flooded and a number of houses are under water...A six inch rise was reported at LaCrosse [Wisconsin]”. Similarly, the 3 May edition of the St. Paul Daily Globe stated that, at Red Wing, “the river is again rising and is now higher than at any time since 1881. Today the

government gauge registered 13.4 feet and the water was still rising...". In still another flood story, the 3 May edition of the Minneapolis Evening Journal stated that, ".....the Mississippi River at Quincy, Illinois now shows sixteen feet above [the] low water mark. A vast amount of bottom land is inundated and experienced river men say the river will reach the high water mark of 1851. The Burlington and Northern road bed opposite Winona has a washout and at LaCrosse the [river] has risen over a foot during the past twenty four hours.....". On 3 May, the Pioneer Press, in an article written by P.F. Lyons, St. Paul Signal Corps observer, emphasized April's wetness, pointing out that the month had been the wettest April recorded at St. Paul since 1870. Lyons also reminded Pioneer Press readers that, as noted previously, the excessive rainfall was accompanied by "considerably below normal temperatures", making it the third coldest April recorded in St. Paul since 1870. "The months's rainfall, he wrote "was very evenly distributed during the month up to the 20th but from that [date] to the end of the month the fall was excessive.....The ice dam on the Mississippi [at St. Paul] moved out on the 9th. There was a minimum stage of three feet of water in that stream on the 6th and a maximum of 14.4 feet on the 14th. The river records of the Signal Service office date from April 1872 and show that higher water occurred in 1873, 1875, 1880 and 1881 but they don't show anything to compare with the sudden rise of April 1888.....". And on 4 May, Pioneer Press headlines featured the flood at Winona: "Winona in a Swim, People in Minnesota's Venice Sleeping on Tables and Visiting in Skiffs, Elevators and Flour Mills Shut Down". The same edition further stated that "heavy rains for the past two days have raised all [the] streams in the vicinity of Little Falls.....The water in Lake Pepin [is] higher than since June 1880...[the Minnesota] river is rising at Shakopee....". By 5 May, however, the Pioneer Press announced that the river was "falling" at Winona.

Although 1888's spring flooding was undoubtedly serious--particularly in river communities like Winona, which, at the time, did not seem to have had flood control facilities adequate to protect them from unusually high waters -- it was much less damaging, overall, than the floods which followed the spring snow melt in many previous years (1881 especially) and in many subsequent years (e.g. 1927, 1951, 1965, 1969, 1997). Yet, flooding aside, May 1888 was, like the spring months that preceded it, a singularly disagreeable month. The 5 May Pioneer Press reported, for example, that "recent rains in the southern part of the state have stopped seeding...the season has been backward and cold...". The early part of the month featured heavy rains and a late season snow storm which, according to the 3 May edition of the St. Paul Daily Globe had been "raging all day at Aitkin [Minnesota]: "it has snowed three inches on the level and is still snowing...". The same article indicated the four inches of snow had fallen at Superior [Wisconsin]. Other snowfall amounts -- all recorded on 4 May -- included 1.5 inches at Cheney's Minneapolis station, 1.0 inches at St. Paul, 0.5 inches at Farmington; and 0.1 inches at Mankato. A "little snow" reported by the Red Wing observer on 2, 3 May with a trace (T) of snow at Farmington on 12 May. Stations such as Morris and

Moorhead recorded no snowfall during May, suggesting obviously, that, in Minnesota, the 3-4 May snowstorm was confined to the eastern and northeastern parts of the state.

Many localities also experienced what was described as a “hard freeze” on 12-13 May. St. Paul Signal Corps observers recorded minima of 29 F on both 12 and 13 May with a chilly maximum of only 40 F on 12 May. In Minneapolis, Cheney recorded 30 F at 0700 on 12 May (suggesting an overnight minimum in the mid to high 20's F). He further noted that ice formed to a thickness of one fourth inch and temperatures at 1400 hours (35 F) had barely risen above the freezing mark. At Morris, minima included 26 F on 12 May, 27 F on 13 May, 28 F on 14 May and 32 F on 31 May. Also, at both the Morris and St. Paul stations– and probably at many other stations as well -- 19 of the month's days 31 days were recorded as cloudy, that is having a sky cover of 8.0 or greater. May's average temperature at the St. Paul station was a chilly 50.2 F with only three days on which temperatures rose to 70 F or above. (The stations's first 80 F reading of the season did not occur until 8 June.) In his monthly meteorological summary published in the 2 June 1988 edition of the Minneapolis Tribune, Minneapolis observer William Cheney described May as being an “exceptional month in two respects”. “It was with one exception, the coldest May [49.8 F] in the last twenty three years. The exception was May 1867.The rainfall [6.21 inches] was the largest of which I have any record for twenty three years. Another unusual feature of the month was the snowfall of 1.5 inches on the 4th. This makes the total snowfall for the season commencing with the first snowfall on October 22nd, seven feet, five and five-eighths inches. This with the excessive [precipitation] of April [5.13 inches]...has thoroughly soaked the ground and given a high stage of water in the rivers and lakes. Vegetation is backward...”. Cheney further noted that the lilacs in his vicinity did not bloom until 7 June.

Unlike May, June 1888 was relatively dry with only 1.95 inches of precipitation recorded in St. Paul. But like May, it was a cool, cloudy month, St. Paul observers recording sixteen cloudy days and a monthly minimum of 41 F. In contrast, July, at least at St. Paul, was warm (73.1 F). Like so many of the preceding months, August 1888 was cooler than normal, undoubtedly raising the specter of another long, bitterly cold winter. Although September and October were somewhat cooler than normal (St. Paul recording 36 F on 13 September and 31 F on 29 September), November 1888, in marked contrast to November 1887, was warm and dry, dramatically – and no doubt surprisingly – reversing the cold weather pattern that had prevailed during most the preceding twelve months. St. Paul, for example, experienced a notably warm November (36.2 F) with maxima of 66 F on 1 November and 62 F on 13 November. The low for the month was 6 F, a value which, although chilly, stood in stark contrast to the record cold of late November 1887.

More significantly, however, November's late autumn warmth intensified in December,

reversing T.S. Eliot's famous line, ending 1888's prolonged cold not with a whimper but with a bang. Moreover, as it turned out, December 1888 marked the end of the Little Ice Age's series of sub-Arctic winters. Although numerous episodes of extreme winter cold occurred after 1888 (e.g. January 1893, February 1899, February 1904, January 1912, January-February 1917, January 1918, January-February 1929, January-February 1936, January 1966, January 1977, December 1983), the Upper Midwest has, at no time since, experienced sustained "ice age" conditions like those that prevailed from 1882-1883 through 1887- 1888. At St. Paul, December 1888 temperatures averaged 25.2 F with maxima of 53 F on 4 December, 54 F on 9 December and a record setting pre-holiday reading of 58 F on 23 December. Snowfall during the month (following a meager 0.8 inches in November) was only 2.2 inches with an end of month snow cover of one inch. Other 23 December readings included 56 F at 1400 hours in Minneapolis; 57 F at the University of Minnesota's school of technology station; 58 F at Mankato; 56 F at Delano; 58 F at Farmington; 55 F at 1400 hours at the St. Cloud College station; 59 F at Ft. Snelling; and 54 F at Red Wing. Other unseasonably warm temperatures included 43 F at St. Vincent; 51 F at Morris; and 55 F at Moorhead, all on 9 December.

Consistent with its unusual warmth, December 1888 was marked by an absence, both of snowfall and extreme minimum temperatures. At Moorhead, temperatures during the month averaged about 20 F with a monthly minimum of only -5 F, that occurring on the last day of the month. Snowfall totaled only 1.2 inches with no month end snow cover. The month was also relatively cloud free with a mean monthly sky cover value of 3.9. At the St. Vincent station, snowfall was considerably greater (5.6 inches) but with only a trace [T] on the ground at the month's end. As at Moorhead, mean cloudiness was low (4.4). In west central Minnesota, the Morris observer recorded a monthly minimum of -3 F on 31 December. Snowfall totaled on 1.5 inches with a snow cover of only 0.5 inches at the close of the month. Similar December values were recorded in east central and southern Minnesota: Delano, 4.0 inches of snow with a month end snow cover of 1.5 inches; Farmington, month end snow cover of 0.5 inches; Mankato, only one inch of snow recorded with a trace [T] remaining on the ground at the close of the month. And at St. Paul, the monthly minimum was 5 F, giving December 1888 the distinction of being one of a very few Minneapolis-St. Paul Decembers without a subzero temperature.

Curiously, Twin Cities newspapers had little to say about December's warm weather, the 22 December edition of the St. Paul Dispatch, for example, noting only that the "weather proves more favorable for croquet parties than [for] tobogganing". And on 24 December, the St. Paul Daily News commented that "perhaps the weather clerk is tapering off with a view to New Year's resolutions and has forgotten the kind of weather he should serve up for Minnesota....". The News further reported that several skating drownings had occurred on city lakes, presumably because of thin ice, the result

of a lack of cold weather. An expanded account of December 1888 weather was, however, provided by Minneapolis observer William Cheney. Writing in the 2 January 1889 edition of the Minneapolis Tribune, he emphasized that what he called an “exceptional” month, [had] “entirely broken the records...The two respects in which it [was] entirely unprecedented [was] in having the highest maximum temperature in record here [Minneapolis] in December and also this being combined with almost [an] entire absence of snow and very little rain. [There was] an entire absence of sleighing and uniformly good wheeling throughout the month. On the whole, December 1888 will long be remembered as a most delightful winter month...”. Notably, also, December’s dry weather continued a drought which had settled into many areas of the Upper Midwest beginning in the late summer of 1888 and which, as it turned out, persisted through much of 1889, a year with only 16.96 and 18.38 inches of precipitation at the St. Paul and Minneapolis stations, respectively.

A brown Christmas. Croquet weather. Record warmth. Impending drought. Such were the hallmarks of the Upper Midwest weather which, very emphatically, marked the end of the “little ice age,” a climatic episode which began, quite unexpectedly, following the warm winter of 1881-1882 and which ended with a bang during the closing weeks of 1888. Or, if not with a bang in the literal sense of the word, at least with a heartfelt (if not loud) collective sigh of relief. Yet, a sigh of relief no doubt tempered by a sense of apprehension. Is this really the end of the bitter cold? Is our climate getting colder in the long run and is this, then, but a fleeting respite? But what of these apprehensions? Well over one hundred years have now passed and, despite the periodic occurrence of severe winters – including a pattern of colder than average winters during the 1960's and 1970's – the Upper Midwest, Minnesota specifically, has not, at least up to this point, experienced sustained, extreme periods of cold comparable to those of the “little ice age”. Quite the opposite. In recent years, attention has focused on what is thought (whether warranted or not) to be a long range, perhaps ominous, trend toward warmer weather, a perception bolstered by a consecutive series of warm winters which began in the late 1990's, continuing (with a few exceptions) until the time of this writing. And continuing until when? Who knows? Maybe for decades or centuries to come? Maybe until such time as another massive volcanic eruption like Krakatoa triggers a period of global cooling. Maybe until some unanticipated, random blip in our dynamic, unpredictable, erratic “weather machine” brings back the “little ice age” (or worse). Maybe this. Maybe that. Again, who knows?

WITH A BANG: NOT A WHIMPER

TECHNICAL NOTES

□ Average monthly and/or annual temperature values included in the ensuing history are averages as originally calculated by volunteer observers and/or Signal Corps officials. Some are averages derived from fixed time observations taken at 0700, 1400 and 2100 hours. Others, although obtained by adding daily maximum and minimum temperature values and dividing by two, are from “observation days” which – often depending on the preferences of the station’s observer -- routinely began and ended at various times of the day, usually the early morning, the late afternoon or the late evening. The resulting averages, because they are “raw,” unhomogenized averages, may either exaggerate or, alternatively, understate the differences between and among the average monthly temperature values cited in the ensuing narrative. Despite their statistical or climatological shortcomings, the values cited do, nonetheless, reliably document the extreme cold experienced during the winter of 1887-88.

□ Many of the extreme temperature values (e.g. the 9 February 1888 reading of -62 F at Pembina, Dakota Territory) cited in the ensuing narrative are unofficial readings taken from thermometers which, extant evidence suggests, were often either poorly calibrated or, improperly exposed (or both). Moreover, official Signal Corps readings were taken at various heights, typically from rooftop sites at first order stations (e.g. St. Paul) and at ground level at most volunteer/cooperative stations (e.g. Morris, Delano, Ft. Snelling, etc.). Inasmuch as rooftop readings are typically warmer than comparable readings taken at ground level, some extremes (e.g. the -41 F recorded at St. Paul on 21 January 1888) are probably “warmer” than the extremes which might have been recorded at a ground level station at the same site. In addition, it is also important to note that 1887-88 readings taken in cities such as St. Paul may have been modified by air pollution (caused by the then widespread use of coal fired stoves and boilers), by urban heating in general and/or by environmental factors such as lack of ambient vegetation, the color and composition of the rooftops on which such stations were situated and/or the influence of surrounding buildings (especially buildings which may have shadowed the station at certain times of day, may have altered the air circulation in the vicinity of the station or which may have exposed station instruments to radiation from nearby smokestacks, etc.).

□ Although most 1887-88 Signal Corps observers -- whether at first order or volunteer stations – routinely measured daily snowfall, measurement methodologies appear to have varied greatly. Extant evidence suggests that some observers derived snowfall values by melting the snow captured in the station gage and multiplying the result by ten while others, in contrast, probably measured actual snow depth, whether

from a gage accumulation or from separate, representative ground measurements. It is also likely that snowfall values -- at least at some first order stations (e.g. St. Paul and Moorhead)-- were probably obtained from rooftop measurements. In addition, of course, measuring snowfall is a daunting task for any observer, however conscientious. New fallen snow is often drifted badly, often mixed with snow from previous snowfalls, often partially melted upon reaching the ground (particularly during the autumn and spring months when the descending flakes fall on relatively warm ground), etc. Differences in observation methodologies, combined with difficulties inherent in measuring snowfall combine, then, to compromise, even invalidate, comparisons of snowfall measurements taken at different locations, whether taken simultaneously or at different times during a snowfall event (e.g. the large, inexplicable discrepancy between the amount of snow recorded in St. Paul vs. the amount recorded in Minneapolis during the blizzard of 30-31 December 1887).

□ Besides the record cold recorded at many Upper Midwest stations during the third week of January 1888, the distinguishing meteorological event of the winter of 1887-88, as noted previously, was the Great Blizzard of 12-13 January 1888. Interestingly, David Laskin's book, "The Children's Blizzard [op.cit] provides abundant technical detail documenting the factors which eventually came together to produce the atmospheric "explosion" which claimed several hundred lives, most of them in the Dakotas and Nebraska and, although fewer, also in Minnesota. According to Laskin's research "all of these conditions came into alignment over the Canadian interior during the first days of January 1888. Take out a map of Canada and run your finger along the 60th parallel – the line that runs from the Gulf of Alaska to Hudson Bay.....This is one of the world's perfect breeding grounds for cold. At this latitude on the day of the winter solstice [i.e. on or about 21 December], the sun remains above the horizon for a total of 5.6 hours.....[But] even if rises into a perfectly clear sky, the winter solstice sun [there].....provides essentially no solar energy.....Ft Simpson, which sits.....hundreds of miles and two mountain ranges away from the moderating influence of the Pacific Ocean, has an average daily temperature of 11 degrees below zero in December and slightly over 16 below in January. But at the start of January 1888, it was considerably colder than the average. With high pressure bearing down on western Canada, surface winds were light. Nothing disturbed the vast shallow pool of cold air that settled over the snow covered plains and lakes. The longer the atmosphere stagnated, the colder it became. On January 3 the temperature hit 35 below zero east of Ft. Simpson. Gradually, over the next few days, the cold air mass expanded and flowed southward like a glacier of sluggish gas. By Sunday, January 8, the lobes of cold air had pushed as far south as Medicine Hat in Alberta, about 70 miles from the Montana border.....And there it sat, a pool of dry, stagnant and exceedingly cold air, too heavy to rise into the warmer air above it, too inert to mix with the middle air masses around it.....Shortly after Christmas 1887, a ripple developed in the flow about six miles above the surface

that would in time dislodge the frigid air massing over interior Canada.....The ripple that shoved the cold air out of Canada was born of the interaction between the masses of contrasting temperature and pressure, and so, in a larger sense, was the upper level flow of air that swept up the ripple and carried it down the spine of the continent. That upper level flow, commonly known as the polar jet, circles the globe from west to east at altitudes of six to nine miles. The jet stream is a natural boundary marker, an atmospheric river flowing between the region of warm subtropical air to the south and cold polar air to the north.....On Tuesday January 10, the jet stream with its embedded jet streak, having crested the ridge somewhere up in the northern reaches of British Columbia.....began diving southeast into western Alberta. It was here that the flow encountered the immense irregular wall of the Rocky Mountains.....The mountains squeezed and deflected the current, altering its temperature and pressure. As the flow descended the eastern flank of the Canadian Rockies, the air warmed, and as it warmed it dropped the air pressure at the surface.....As the upper flow crested the jagged obstacle of the mountain range and soared over the great flat expanses of the North American plains, it sent an immense vortex spinning counterclockwise all the way down to the surface.....Propelled by high pressure building in behind it, the low worked its way southeast down the tapering lower half of Alberta on Tuesday, intensifying as it moved. The air was so cold that it had very limited capacity to hold moisture, so not much snow fell. That would come later, when the vortex fastened onto a stream of moist air coming up from the south. The stronger the low became, the more surface air it pulled toward the center of the vortex. You'd think that the low would eventually 'fill' by pulling enough air to raise its pressure and thus fizzle...out. The reason this didn't happen was because of the way the jet streak was roiling the flow six miles up.....The diverging flow aloft acted like a pump.....Sometime during the first hours of Wednesday, January 11, the advancing low crossed the U.S. border and began to cause the air pressure over northeastern Montana to fall. All that day it continued to churn southward until by nightfall on Wednesday there was a well defined trough of low pressure.....By itself, the strengthening low would have kicked up some stiff wind on the Great Plains, blown the snow already on the ground into drifts, maybe spat out a few inches of snow.....But as it dug deeper into U.S. territory, the low uncovered a source of highly explosive fuel that boosted its power exponentially. To the north of the low, up in central Alberta, that pool of arctic air had hardly budged for a week...and the longer it stagnated the colder it got. To the south, a mass of unseasonably mild and humid air from the Gulf of Mexico was beginning to stream up over Texas and Oklahoma. The potential energy in the temperature differential between these two sharply contrasting air masses was enormous. In order for that potential energy to be converted into the kinetic energy of violent weather, something had to bring the two air masses together – the more sudden their encounter, the more violent the weather would be. That something was the intensifying low.....”.

□ It is probable that anyone who may read the ensuing account of the winter of 1887-88 will discover at least several – perhaps even numerous – typographical, spelling or even grammatical errors. Although unfortunate, such errors are seemingly inevitable, particularly when one is one's own proofreader. So, whether few or many, I can only apologize in advance, then, for the errors that will undoubtedly be discovered by future readers.