FARGO, NORTH DAKOTA F5 TORNADO JUNE 20, 1957
HOW THE PUBLIC WAS WARNED: A PERSONAL ACCOUNT

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1. Introduction

Late in the afternoon on June 20, 1957, a series of 5 tornadoes sinuously twisted an eastward path through 64 miles of the Red River Valley in eastern North Dakota and Western Minnesota. The third tornado was the Fargo Tornado, and it struck the northwest and northeast sides of Fargo leaving in its wake a debris laden path of death and destruction. Following the tornado, Dr. Tetsuya Fujita of the University of Chicago was commissioned by the United States Weather Bureau to conduct a physical and meteorological analysis of the tornado, then the most photographed tornado in United States history. Dr. Fujita's research of the tornado family culminated in the publication of United States Department of Commerce, Weather Bureau, Technical Paper No. 42 entitled "A Detailed Analysis of the Fargo tornadoes of June 20, 1957". His pioneering paper on the characteristics of the June 20, 1957 tornadoes has become one of the foundation papers in tornado research and is widely quoted in publications.

For the 50th anniversary of the tornado, researchers subjected meteorological data associated with the tornado to additional analysis using recent tornado research and forecasting techniques to complement and further Dr. Fujita's work. There has also been interest in documenting the efforts of the Weather Bureau to warn the public on the fateful evening. Unfortunately, it appears that no formal documentation exists of the Weather Bureau's activity to warn the public of the approaching tornado. In this paper, I will reconstruct that process based primarily on personal recollection as the meteorological aid (observer-chartman) who was assigned the shift at the Weather Bureau that evening. I have also constructed a timeline of the tornadoes from the Fujita paper, the official Weather Bureau log of weather observations for that day, an account of Weather Bureau warning action as reported in the Fargo Forum through an interview with the station's principal assistant Mr. Vernon Hendrickson, and a sketchy letter I wrote to my parents a couple of days following the tornado in which I recounted some of the actions that fateful evening.

2. The Scenario

It was one of those days that most Dakotans would probably recognize as a possible thunderstorm day. It was not an excessively warm day as temperatures hovered in the middle 80s, but with dew points in the middle and upper 60s, the humidity was oppressive, although somewhat tempered by a southerly breeze. Still, there was something in the air that telegraphed significant thunderstorm activity in the next few hours.

We had begun experimenting at the weather station with issuing public severe thunderstorm warning bulletins for the local area at the urging of higher headquarters. The severe thunderstorm bulletins were to complement the efforts of the recently established Severe Local Storms (SELS) Unit of Weather Forecast Office at Kansas City, Missouri, which had the responsibility for issuing severe weather and tornado forecasts for the nation. It was our responsibility as well to relay their forecasts to appropriate media and emergency officials in our area of responsibility, which was poorly defined as Fargo-Moorhead and vicinity.

Our effort to issue local severe weather warnings was hampered by a sparse surface weather observation network, sketchy and inadequate radar observations from an air defense radar facility near Finley, ND, and lack of a storm spotter network. In essence, our warnings were based largely on a visual and meteorological assessment of the approaching storm and any storm reports that might have been phoned into the station by the public. There was no standardized format at the station to be used as guidance for issuing a public severe storm warning. Despite these inadequacies, several thunderstorm warnings were issued in the spring of 1957. Each person who issued the severe storm warning composed something "on the spot" that hopefully described the situation to the public.

Transmission of severe storm bulletins, weather forecasts and other meteorological information to the public, depended entirely on the oral communication of the text through our one line public telephone system, or on the direct telephone line that linked the weather station with most Fargo-Moorhead radio and television stations. This was a slow process since the person taking the message transcribed the information manually to paper. This system of oral communication was also somewhat prone to error as the person transcribing the information could misstate unfamiliar meteorological terms or incorrectly misinterpret their hastily written notes. A radio alert system, called Control of Electronic Radiation System (CONELRAD), provided a method for broadcasting emergency information to the general public directly from the Weather Bureau. It was used during the tornado event to broadcast information to the public concerning the impending tornado.

The direct two-way hot line that connected the Weather Bureau and several radio and television stations became a critical resource during the tornado warning process. I remember WDAY Fargo radio, WDAY Fargo television, KFGO Fargo radio and KVOX Moorhead radio being on the line. There were one or two others whose call letters have unfortunately been forgotten.

3. The Storm and Warning Process

I arrived at the weather station at Hector Airport shortly before 4:00 PM CDT (3:00 PM CST) to prepare for my eight hour shift that I normally worked alone. I reviewed the latest surface weather charts and observed the local area was in the warm sector of a wave cyclone located east of Bismarck and that the adiabatic chart showed good atmospheric instability. The latest upper air charts for 7:00 AM CDT showed light

southerly winds advecting rich moisture into the area in the lower levels of the atmosphere. Light to moderate westerly wind flow was observed in the upper atmosphere above 10,000 feet. The surface cold front east of Bismarck, advancing eastward, seemed to be in the proper place to enhance any convective thunderstorm activity in the Fargo-Moorhead area that might form later that afternoon or evening.

That review of the latest weather charts convinced me that it was highly likely thunderstorm activity would occur during my shift. The early part of the shift was quiet and routine. There were the usual weather observations to be taken, the public phone and the direct line to the radio and TV stations to be answered , the late afternoon forecast to be prepared and disseminated, and an occasional pilot to be weather-briefed.

Since there was no guidance on station for the preparation of severe weather bulletins, I took advantage of the slow conditions to construct several severe weather bulletins for possible scenarios. They included severe thunderstorms with damaging winds, thunderstorms with hail, thunderstorms with damaging winds and hail, and even one for a tornado (I should make it clear that I was not forecasting a tornado to hit the Fargo-Moorhead vicinity, only to be prepared in the event one should occur). Parts of the draft warnings were left blank so that they could be filled in as needed with pertinent details such as time of event and location, source of report, hail size, and wind speed and wind damage reports. Having a draft outline on hand would save valuable time in composition of the bulletin and therefore in communicating critical weather information to the public in the event a severe weather situation should occur.

I also plotted and analyzed an area sectional surface chart shortly after the 4:00 and 5:00 PM CDT aviation weather reports crossed the weather teletype line. By doing so, I was hoping to obtain some clues through my primitive mesoscale analysis based on the sparse observation network to further define and track the position of the cold front east of Bismarck, the warm front between Fargo and Grand Forks and the location of the associated low pressure system. This task was no longer needed after 6:00 PM since my 5:58 PM CDT surface weather observation indicated a line of towering cumulus clouds extended from west of Fargo to north of Fargo. This defined for me the preliminary location of the line of thunderstorms which would likely move later through the Fargo area.

One of the priority duties for the person on duty on any shift was to maintain a constant weather watch. The Weather Bureau and the Federal Aviation Administration (The Civil Aeronautics Administration in 1957) had jointly specified requirements when a specialized aviation weather observation was to be taken in addition to the standard hourly surface observation. The weather observations I made and formally recorded in the hour following the 5:58 PM observation clearly reveal the rapidly deteriorating weather conditions as the line of towering cumulus clouds grew explosively into giant cumulonimbus clouds while moving slowly and relentlessly toward the North Dakota-Minnesota border. In the next paragraph, I will describe the formation and evolution of this line of severe thunderstorms as I saw and recorded it, as it sets the stage for the warning actions taken in subsequent paragraphs.

At 17:58 PM CDT, I completed and filed for transmission on the weather teletype circuit the regularly scheduled hourly surface weather observation. In that observation, I noted a line of towering cumulus clouds existed on the horizon from west of the station to the north of the station. Thunder was heard at the station a few minutes later at 6:06 PM CDT, as I reported in a 6:08 PM CDT special weather observation. That observation indicated that some of the towering cumulus clouds northwest of the station reported a few minutes earlier had quickly matured into cumulonimbus clouds and were now producing occasional cloud to ground lightning and thunder. It was not long after the 6:08 observation that a solid line of thunderstorms could be viewed from the weather station extending from some distance west of the station to some distance north of the station. According to Dr. Fujita's paper, the Wheatland tornado was in progress at the time of the 6:08 observation although I saw no evidence of it. It is apparent from the weather observations that the Wheatland tornado formed on the extreme southwest end of the line of thunderstorms, and at that time the southern end of the line of thunderstorms was about 30 miles west of Fargo. About 6:25 PM CDT, I spotted a tornado on the horizon which was estimated to be about 20 miles west of the station (It actually was about 25 miles west of the station, to be discussed later). It too was clearly on the extreme southwest end of the line of thunderstorms; so much so, it seemed to be coming from the base of a maturing towering cumulus cloud abutting the south end of the thunderstorm line. That line of thunderstorms on the western horizon shortly before the tornado was sketched and is shown as the Jensen tornado picture 28 I in the Fujita paper. The sighting of a tornado should have immediately triggered a special aviation weather observation, but this conflicted with what I perceived to be a higher priority task of warning the public of an impending tornado. The formal reporting of a tornado in the area was delayed until I filed a special weather observation at 6:46 PM CDT. That observation indicated the line of thunderstorms was still positioned some distance west of Fargo to north of Fargo. I also observed frequent cloud to ground lightning in the line and noted it was raining to the north of Fargo. At 6:54 PM CDT, I completed and filed the routine hourly aviation weather observation. A solid line of thunderstorms could be viewed from the weather station extending from west of the station to north of the station. By then, half of the sky from the western horizon to above the station was obscured by the ominous and slowly rotating cumulonimbus cyclone as it proceeded slowly toward the city of Fargo. The eastern half of the sky was obscured by altocumulus clouds. Thunder, accompanied by frequent in-cloud and cloud to ground lightning, could be heard at the station and it was raining lightly. It would not be long before the Fargo tornado would emerge from the rotating cloud.

Getting back to the warning process, the work pace at the station picked up quickly following the 5:58 PM CDT hourly weather observation. The peals of thunder and the darkening sky set off the public telephone line which begged answering as individuals sought information concerning the approaching thunder storm. The threat of quickly deteriorating weather conditions also increased the need to monitor weather conditions more closely. Routine duties such as clearing paper from the two teletype machines of weather observations, weather forecasts and other information and filing them in the appropriate place on the briefing console took place between telephone calls and eyeing

the western sky.

At 6:20 PM CDT, I received on the dedicated Weather Bureau Radar and Warning Coordination Circuit (RAWARC), a severe thunderstorm and tornado forecast for parts of North Dakota, South Dakota and Minnesota from the Severe Local Storms Forecast Center (SELS) Unit in Kansas City, MO. From an account in the Fargo Forum it read in part "Severe thunderstorms and tornado forecast for west central Minnesota and southeastern North Dakota with possibility of a tornado in west central Minnesota and southeast North Dakota until 11:00 PM CST Thursday night…approximate area bounded by 30 miles northwest of Jamestown to 10 miles south of Bemidji to 40 miles southwest of Redwood Falls, Minn. (sic), to 20 miles southeast of Pierre to 20 miles northwest of Jamestown". This severe thunderstorm and tornado forecast was immediately relayed to media and emergency officials. The severe thunderstorm and tornado forecast was received at the station at about the time the Wheatland tornado was ending and the Casselton tornado was reaching the ground.

Radio and television stations immediately began broadcasting the severe thunderstorm and tornado forecast. Even though there was no radio on station, I knew intuitively they were broadcasting the forecast as the public telephone began ringing incessantly. I answered a few calls trying to provide the information the caller sought. As soon as I answered a call and returned the phone to the cradle, it would ring again. Each caller desired about the same information which I was confident was being broadcast over radio and television. After answering a few calls in detail, I then simply picked up the phone and without identifying that they had reached the Weather Bureau, I tersely stated "Turn on your radio or television station for the information you desire" and hung up. I repetitively answered many calls that way. I suspect that the individual who heard my terse message had some unkind words to say about the services from the local Weather Bureau. A short time later I practically quit answering the public phone as more important developments were about to take place.

Shortly after disseminating the severe thunderstorm and tornado forecast from Kansas City, around 6:25 PM CDT, I was monitoring the sky through the west window of the weather station while answering telephone calls, when I saw a black conical shaped tornado on the distant horizon straight west of the station. I hung up the public phone and immediately grabbed the direct line phone to the control tower. The tower air controller, Wayne Grindeland, answered. He too had just observed the tornado and the two of us estimated the tornado on the horizon to be about 20 miles west of Fargo, approximately in the Mapleton, ND area. This tornado was the so-called Casselton tornado in the Fujita paper. (Based on the Fujita paper the tornado was actually about 25 miles west of Fargo and just north of Casselton). Although there are no known records to substantiate my next action, I distinctly remember going to my draft tornado warning bulletin and filling in the blanks with the pertinent information. The tornado warning bulletin for Fargo-Moorhead and Vicinity essentially said a tornado had been spotted from the Weather Bureau Office about 20 miles west of Fargo in the Mapleton area, that it was moving eastward, and residents should begin emergency preparations in the event the tornado was moving toward their area. I first read the tornado warning bulletin

simultaneously to the several radio and television stations on the direct hotline. I then telephoned other media and emergency officials. I also requested the North Dakota Highway Patrol to monitor the movement of the tornado. I quickly called my wife who was at home in Moorhead with our three month old daughter to tell her to turn on the television and to heed the weather warnings as I would be unable to talk to her again because of the ongoing emergency. Again, although there is no known record, I am confident that sighting of the tornado was transmitted on the RAWARC teletype circuit informing the SELS Unit in Kansas City of the tornado, and other weather stations on the circuit, as doing so would have been high priority. This is further substantiated as in my 18:46 PM CDT special aviation weather observation, I noted a tornado had been reported by the public at 18:40 PM 20 miles west of Fargo, not my own sighting a few minutes earlier as it had been already reported on RAWARC.

Around 6:30 PM CDT, Mr. E. Vernon Hendrickson arrived at the station to assist me. He was the Principal Assistant at the weather station, and at the time was Acting Meteorologist In Charge, as Mr. Ralph W. Schultz was on vacation. I do not know what prompted Mr. Hendrickson to return to the station after his day shift to assist me as he had a house full of company. Without a doubt, as a veteran weather man, he had been observing the sky and more than likely had heard about the SELS Unit thunderstorm and tornado forecast and knew I would need help. In any event, I was elated to see him as the weather conditions were deteriorating rapidly and my ability to respond promptly and properly to events was being overwhelmed.

The Mapleton tornado retreated back into the base of the cumulonimbus clouds about the time of Mr. Hendrickson arrival. Although the tornado had disappeared from the horizon, the line of thunderstorms continued to advance steadily toward the Fargo-Moorhead area. A few minutes after spotting the Mapleton tornado and relaying the tornado warning to the public and around the time of Mr. Hendrickson‘s arrival, approximately 6:35 PM CDT, I became aware of the now classic cloud signature of a potential tornado event. I could clearly see the wall cloud pouch on the bottom of the cumulonimbus cloud which was associated with a rather circular cloud tail that stretched for a mile or so northwestward from the bottom of the wall cloud. I learned later that many people thought it was the tornado itself. Immediately above the wall cloud, another well defined cloud characteristic was visible that was wider than the wall cloud below it. It was labeled as a collar cloud in Fujita’s paper. These two features exhibited a great deal of turbulence which I might describe as a “rolling boil“. Above the wall and collar clouds, the base of the cumulonimbus cloud widened rapidly with height and the rotation of the cloud complex was clearly evident there. Spiral rings with seemingly helical features encircled the outside edges of the huge cloud. Folds in these rings appeared to be illuminated with a greenish fluorescent radiant glow. The meteorological phenomena inadequately described above became an awesome, ominous and unforgettable sight as it and the associated line of thunderstorms slowly moved toward the North Dakota-Minnesota border.

I remember no discussions with Mr. Hendrickson on who was to do what since we both knew the job and what had to be done. Sensing the urgency of the situation, we both did

what we could to accomplish the highest priority tasks as they arose. As it turned out, I absorbed most of the internal operations. I made most of the weather observations as time allowed and kept in nearly constant contact with the radio and television stations on the direct telephone line relaying to them my eyeball assessment of the approaching storm. Mr. Hendrickson presided mostly over public liaison operations. He answered the telephone when time permitted and called media and emergency officials to pass on updated information. He also activated the emergency broadcast network as the tornado was taking dead aim at Fargo.

Shortly after Mr. Hendrickson arrived at the station, he received a call at 6:40 PM CST from Mr. Ronald Harness of Casselton saying a funnel cloud had touched ground four times northeast of Casselton and then went back up into the clouds and it was moving east or northeast. (In the confusion, Mr. Hendrickson thought he heard Mr. Harness say there were four funnel clouds instead of four touchdowns). This likely was the same tornado I had seen about 15 minutes earlier although I had not seen the skipping action. In any event, this information was immediately relayed to all the usual outlets mentioned above as well as to a Wahpeton radio station.

At about 6:45 PM CDT, I began a nearly continuous two-way dialogue with radio and television personal on the direct hot line reporting on what I observed as the line of severe thunderstorms moved toward Fargo. This dialogue continued for nearly an hour until all power and communications were lost at the Weather Bureau at 7:40 PM CDT. The dialogue was interrupted on occasion for short periods of time to take a weather observation or to accomplish some important task that had to be done.

Nearly and hour after I observed the Mapleton tornado from the weather station, Mr. Hendrickson and I watched at 7:28 PM CDT the Fargo tornado emerge from the wall cloud on the south end of a line of thunderstorms about 4 miles west southwest of the station. The tornado emanated a short distance south of the center of the wall cloud and the attendant tail cloud. As it emerged, it was a sharply pointed black cone, and as it rapidly descended toward the ground, it retained its conical structure. Immediately after touchdown three to four miles west of Fargo, the tornado quickly became much wider, losing its conical point, and became nearly vertical and cylindrical as it began its easterly move toward the Golden Ridge area of Fargo. From the time the funnel began its descent from the cloud until power was lost at the station , I maintained constant contact on the direct line with the media describing to them what I was observing. Mr. Hendrickson further increased the coverage of the tornado warning coverage by implementing the procedures to activate the CONELRAD system at about 7:28 PM CDT. Broadcasting directly from the Weather Bureau over all area radio and television station, he warned the Fargo-Moorhead populace by radio that a tornado was approaching Fargo from the west. I do not remember or know if Mr. Hendrickson read from a prepared script or spoke extemporaneously. If he did not use a script, all he had to do was glance over his shoulder through the west window to witness and report the tornado march toward Fargo.

As the tornado touched down, it immediately began to wrap a huge swirl of dust and debris around the base of the funnel which soon extended about one third of the way up

the funnel. It retained that feature until it began its trek through the Golden Ridge residential area. At that time, the debris field surrounding the funnel moved upward until it nearly reached the cloud base. Now, the most distinguishing characteristic of the debris field surrounding the funnel was that it was laden with discrete particulate matter that was being slung out from the rotary field of the funnel. In a letter to my parents I described it this way, "I could see whole sides of houses being thrown 3-4 hundred feet into the air and out-just like when you are twirling something and the string breaks". It was a most extraordinary spectacle that continued until I lost sight of the tornado over northeast Fargo.

The tornado moved slowly eastward and as it did so, we could distinctly hear the intrinsic audibles emitted by the tornado. The noise associated with the tornado seemed to be a whining, whistling, roaring sound which I can not accurately describe because of its distinctiveness. When the tornado was south southeast of the station near North Dakota Agricultural College, it appeared to be veering northward, and it seemed that it might be heading toward the airport and the station. This change in direction was brief and it again began its eastward movement into Minnesota. It was also near the time that electrical power and communications were completely lost at the station. Prior to the total loss of power at the station, I had been losing stations on the hot line for a minute or two as the tornado moved across the 13th Street area taking down telephone lines. Heavy rain accompanied by a few hail also began at about this time which obscured the tornado. A few minutes later, the tornado was observed from the Weather Bureau as a white rope funnel east of the station in Minnesota, probably east of Moorhead. I did not observe the eventual end of the tornado and its retreat back into the base of the cumulonimbus or its disintegration.

4. Some observations and personal comments

The Weather Station on the second floor of the Hector Airport passenger terminal building was a prime location to view the thunderstorms and associated tornadoes. Nearly continuous windows on the south and west sides of the office provided an unobstructed view of the approaching mesocyclone and the tornadoes. Mr. Grindeland, the FAA air traffic controller in the tower about 65 feet above the ground, no doubt had the premier viewing seat in Fargo.

Through the direct line to the radio and television stations, I was able to describe the approaching storm, its movement, and some tornado safety rules in existence at the time to the people, mostly radio announcers, on the other end of the line. Most of them, maybe all, were broadcasting live to the public. They would listen to what I was telling them and I could hear them in the background paraphrasing my comments and passing them on to their audience. In one sense, our initial severe thunderstorm and tornado warning was being orally updated continuously from the time a tornado was spotted around Mapleton, through the visual tracking of the mesocyclone toward Fargo, and eventually the touchdown of the Fargo tornado and its movement through Fargo. It was a great system that night for communicating warning and other critical information. As the telephone system was two-way communication, it also gave the radio and television

personnel a chance to ask brief questions or ask for clarification on some matter. It was all very orderly and professional on that crowded telephone line during the warning process.

I do not remember precisely when I first became aware of the rotation of the mesocyclone, or the Mother Low, at it was also called in those days. As I noted earlier I believe it was about 6:35 PM CDT or shortly thereafter, not long after the sighting of the "Mapleton" tornado, or about 50 minutes prior to the formation of the Fargo tornado. In any event, the rotation was observed over a period of tens of minutes. As the mesocyclone moved nearer to Fargo-Moorhead, its rotation could be seen by residents, even by those whose visibility was restricted to the west; all they had to do was look up to see the rotation. I suspect that not many residents understood the meaning of such a cloud, but its threatening existence served as a warning process in itself. In any case, it certainly communicated visually the storm threat they were hearing over radio and television.

It was the first and only sighting of a tornadic mesocyclone in my life time. From the literature and from my use of a primitive weather radar while in the Air Force Weather Service, I was aware of what I was observing, and if we had radar, I knew I would likely have been looking at the classic "hook" echo associated with tornadoes. I was fascinated by the sight of the slow rotation of the huge cloud and the helical spirals, striations, colorations and folds in the cloud in the mid and upper levels of the mesocyclone.

The broadcasting of the SELS Unit forecast for severe thunderstorms and a possible tornado, and especially the sighting and warning associated with the Mapleton tornado, brought many visitors and onlookers to the weather station. It was rapidly filled by people who came into the station for various reasons: some to ask questions, some to get advice, some to observe the warning actions in progress, some to crowd around the observer's console to observe the instruments, and others to get a good view of the approaching storm through the spacious windows lining the western and southern walls. By the time of Mr. Hendrickson's arrival, they had became so numerous that we loudly declared an "authorized personnel area only" zone on the south side of the briefing console which divided the room. This was the area where the public and direct line phones and the weather observing console was located. Sometime later during the warning process and around the time of the descent of the Fargo tornado, I became aware that the room was empty except for Mr. Hendrickson and myself!

There was a mass exodus of Fargo citizens as the tornado bore down on the city. Out of the south window of the station, I could see cars streaming north on 13th street which was then US Highway 81. A few blocks north of North Dakota Agricultural College, the highway curved to the west for about a mile along the south edge of the airport before turning north again on its path to Grand Forks. In spots, the cars were two abreast on the two-lane highway. I have often wondered what the casualty number would have been if the tornado had veered from its eastward path and crossed the highway, or assumed a path parallel to the highway. There were no escape exits that I was aware of other than the ditch. It suffices to suggest the casualty figures could have been enormous.

In the days following the tornado, I informally wrote about our actions during the tornado event and commented at length about the physical characteristics I had observed. Unfortunately, these personal notes and comments have been lost, probably during one of the many moves made during my weather service career or moves since then. They would have been invaluable to supplement and support the observations and actions in this report.

5. Conclusion

The June 20, 1957 tornado episode has become a classic in the annals of tornado research. It also was an event that unfolded in several dramatic and classic ways that enhanced the effectiveness of the timely warnings, which arguably greatly reduced the number of deaths and injuries. Consider the following:

1. Timing. The Fargo tornado struck the city in the early evening hours at about 7:28 PM CDT, about 3 hours before dark. Businesses with normal day time hours had closed and evening activities had generally not yet begun. It was around the time of the supper hour and most families were at home. This facilitated making decisions concerning family reactions to the impending danger.

2. Nature's Warning. Mother Nature gave Fargoans advance warning by knocking on Fargo's door an hour before striking the city by exhibiting two tornadoes in rural areas west of Fargo. The second tornado was seen from the Weather Bureau Office which triggered tornado warnings for the area. She also produced a highly visible, long-lasting, ominous, rotating cloud (mesocyclone) which signaled her intentions to produce more tornadoes.

3. Storm Movement Speed. The parent storm of the tornadoes moved steadily eastward at a relatively slow speed of less than 20 miles per hour. This provided ample time to produce, disseminate and broadcast severe storm and tornado warnings, considering existing communication technology.

4. Adequate Communications. Although available communications are antiquated by today's technology, they proved adequate to effectively disseminate warnings and storm information. A radio broadcast system (CONELRAD) linked to the Weather Bureau Office provided a rapid means of disseminating emergency information directly to the public. Perhaps more effective at the time, was a two-way telephone system between the Weather Bureau Office and several radio and television stations in Fargo-Moorhead. It was used not only as a means to simultaneously communicate the severe thunderstorm and tornado warnings to them, but as a means of instantly reporting observations and descriptions of the mesocyclone and the Fargo tornado.

5. Public Reaction. Fifty years ago, educational programs teaching the public how to react to weather emergencies were limited, and in the case of tornado preparedness, some of the information was in error. Using survivability as a measure, Fargoans seemingly

responded appropriately and responsibly. This may have been due, in part, they had sufficient time between warnings and the event to consider and activate survival strategies. It also may have been due, in part, that there was some discussion on the Weather Bureau-radio and television hot-line concerning existing tornado safety rules which were broadcast to the public.

6. APPENDIX

A chronological timeline for reconstruction of events at the weather station on June 20, 1957 and actions in the warning process for the Fargo June 20, 1957 tornado. The source are noted.

2300 CST 0000 CDT 12:00 AM LST. Raymond Wilson reports for 0000-0800 midnight shift duties. On his shift only a few scattered clouds were noted. Winds were mostly light southeasterly. Dew points held fairly steady in the upper 50s. (4)

0700 CST 0800 CDT 8:00 AM LST. Vernon Hendrickson, Robert Ross report for 0800-1600 day shift duties, relieving Wilson. Scattered to broken mid-level and high clouds predominated with a few cumulus clouds forming in the afternoon. Mid-level upward motion was evident as altocumulus castellatus clouds were reported. Dew points edged upward into the lower 60s during the shift and a southerly wind was blowing around 20 knots. (4)

1458 CST 1558 CDT 3:58 PM LST. Hourly aviation surface observation: Few Cumulus east at 3000 feet, 5/10 Altocumulus at 8000 feet, 5/10 Cirrostratus unknown height. TEMP 85, DP 63, RH 48%, WIND SSE 17G25 knots, SLP 29.98 inches, ALTIMETER 29.51, VSBY 15+ MILES. Robert Ross, observer. (4)

1500 CST 1600 CDT 4:00 PM LST. Ray Jensen reports for 1600-2400 CDT shift at weather station, relieving Hendrickson and Ross. (4)

1558 CST 1658 CDT 4:58 PM LST. Hourly surface observation: 1/10 Cumulus at 3000 feet, 3/10 Altocumulus at 9000feet, 6/10 Altostratus estimated at 9000 feet. TEMP 83, DP 66, RH 57, WIND SSE 11 knots, SLP 29.96 inches, ALTIMETER 29.51 inches, VSBY 15+ miles. Light rain shower (sprinkles) began 1547 CST. Ray Jensen, observer. (4)

1640 CST 1740 CDT 5:40 PM LST. Wheatland tornado forms. (1)

1658 CST 1758 CDT 5:58 PM LST. Surface observation: 3/10 Cumulus at 3000 feet, 4/10 Altocumulus at 9000 feet, 3/10Cirrostratus height unknown. TEMP 83, DP68, RH 61, WIND SSE 15knots, SLP 29.82, Altimeter 29.47 inches, VSBY 15+ miles. Rain shower ended 1610 CST. Towering Cumulus west through north. Ray Jensen, observer. (4)

1708 CST, 1808 CDT 6:08 PM LST. Special weather observation. 3000 scattered clouds, estimated 9000 broken clouds, overcast clouds above height unknown. Wind SSE 20 knots. Thunder began 1706 CST. Occasional cloud to ground lightning, thunderstorm northwest moving east. Ray Jensen, observer. (4)

1720 CST 1820 CDT 6:20 PM LST. Wheatland tornado ends. (1)

1720 CST 1820 CDT 6:20 PM LST. Severe thunderstorm and tornado forecast from Severe Local Storm Center (SELS), Kansas City, MO received at station. (2)

1720 CST 1820 CDT 6:20 PM LST. Casselton tornado forms. (1)

1722 CST 1822 CDT 6:22 PM LST. Severe weather forecast relayed to media, emergency officials. (2)

1725 CST 1825 CDT 6:25 PM LST. Tornado sighted by Jensen (Weather Bureau) and Grindeland (FAA), judged to be in Mapleton vicinity. (Personal observation)

1727 CST 1827 CDT 6:27 PM LST Mapleton tornado information and Tornado Warning for Fargo-Moorhead and Vicinity relayed to media and emergency personnel. Personal Observation.

1735 CST 1835 CDT 6:35 PM LST. Casselton tornado lifts into cloud, wall cloud and rotation still evident. (1)

1735 CST 1835 CDT 6:35 PM LST. Hendrickson returns to weather station to assist Jensen. (5)

1740 CST 1840 CDT 6:40 PM LST. Mr. Harness calls reporting tornado northeast of Casselton moving eastward. (2)

1741 CST 1841 CDT 6:41 PM LST. Media informed of tornado information from Harness. (2)

1744 CST 1844 CST 6:44 PM LST. T. P. Hannaher. Letter to Editor, Fargo Forum. "…From 6:44 until about 7:50 p. m. he (referring to "weather man on duty at Hector Airport") was on the hot line phone to radio and TV stations. His relayed messages must have been vital in sending citizens to safe locations…". (3)

1745 CST 1845 CDT 6:45 PM LST. Casselton tornado and associated rotation ends. (1)

1746 CST 1846 CDT 6:46 PM LST. Storm "Information" on teletype circuit: It is assumed Mr. Hendrickson was referring to the RAWARC circuit. (2)

1746 CST, 1846 CDT 6:46 PM LST. Special aviation weather observation. Scattered clouds at 3000 feet, overcast clouds at estimated 9000 feet.. VSBY 15+ miles.

Thunderstorm with very light rain shower. Wind SE 16 knots, Altimeter 29.43 inches. Thunderstorm west through northeast. Frequent cloud to ground lightning. Rain shower unknown intensity north. Tornado by public 1740 CST 20 west of Fargo. Ray Jensen, observer. (4)

1754 CST, 1854 CDT 6:54 PM LST. Hourly surface weather observation. 5/10 Cumulonimbus clouds at 3000 feet, 5/10 Altocumulus clouds estimated at 7500 feet. Thunderstorm with light rain shower. Temp 80, DP69, RH 68%, Wind SE 13, SLP 29.71, ALTIMETER 29.44 inches. Thunderstorm southwest through northeast moving east southeast. Frequent lightning in cloud and cloud to ground. Rain shower began 1735 CDT. (4)

1815 CST 1915 CDT 7:15 PM LST. Deputy sheriff call funnel cloud/tornado north of Mapleton. (2)

1816 CST 1916 CDT 7:16 PM LST. Sheriff information relayed to media, Fargo police department. (2)

1823 CST 1923 CDT 7:23 PM LST. Special aviation weather observation. Scattered clouds at 1000 feet, overcast clouds estimated at 3000 feet. Wind east northeast 28 knots. Visibility 3 miles in thunderstorm with light rain shower. SVERERG (6) thunderstorm approaching station. Vernon Hendrickson, observer. (4)

1828 CST 1928 CDT 7:28 PM LST. Fargo tornado forms. (1)

1833 CST 1933 CDT 7:33 PM LST. Special weather observation. Tornado approaching station from west southwest. Vernon Henderson, observer. (4)

1840 CST 1940 CDT 7:40 PM LST. Airport and weather station loses electrical and all telephone and teletype service. (2)

1850 CST 1950 CDT 7:50 PM LST. Fargo tornado ends. (1)

1900 CST 2000 CST 8:00 PM LST. Raymond Wilson telephones Weather Bureau Forecast Office in Minneapolis, MN from home in Moorhead, MN to report Fargo tornado. (4)

1910 CST 2010 CDT 8:10 PM LST. Glyndon tornado forms. (1)

1915 CST 2015CDT 8:15 PM LST. Jensen and Hendrickson leave powerless weather station for downtown Fargo telephone company office to report tornado, warning actions and damages to Central Region Headquarters, Kansas City, MO. Personal observation.

1930 CST 2030 CDT 8:30 PM LST. Glyndon tornado ends. (1)

1950 CST 2050 CDT 8:50 PM LST. Dale tornado forms. (1)

2010 CST 2110 CDT 9:10 PM LST. Dale tornado ends. (1)

6. References

(1) Fujita Weather Bureau Technical Paper 42.

(2) Hendrickson interview Fargo Forum Special Edition June 1957.

(3) T. P. Hannaher, program director, KVOX, Moorhead, Letter to Editor, Fargo Forum, date unknown.

(4) U. S. Department of Commerce, Weather Bureau, Surface Weather Observations, WBAN 10A,B.

(5) Personal letter dated Monday afternoon (June 24, 1957) from Ray Jensen to his parents concerning his on-duty activities during the tornadic episode.

(6) I have been unable to translate the abbreviation " SVERERG" as hastily written by Mr. Hendrickson as it is not a standard Weather Bureau abbreviation. The standard abbreviation for severe is SVR. If he meant "SEVERE" in long-hand, it would accurately describe the approaching thunderstorm.