CHASING TORNADOES by Tim Marshall

(published in Weatherwise Magazine, August 1983, photos added)

Tornado is an all-too-familiar word to the folks in West Texas. Each spring, atmospheric conditions favorable for the development of tornadoes seem to converge over the area. Spring 1982 was no exception. A total of 58 tornadoes were reported during May. More than half of those tornadoes occurred between the 9th and the l6th including an outbreak of 16 tornadoes on the 19th. As most residents headed for shelter, a group of tornado researchers at Texas Tech University was out in the field attempting to observe and photograph the tornadoes. By the end of May, fifteen tornadoes had been photographed from distances ranging from one half to four miles away.

Intercepting Tornadoes

The Texas Tech Tornado Intercept Program was first organized in 1978 by a group of professionals and laymen interested in studying tornadoes. Members include graduate students in meteorology and engineering &s well as volunteers from other disciplines. The group attempts to take high quality still photographs and movies of tornadoes and associated debris clouds at close range. The films are studied to determine the speed of tornadic winds and how the winds interact with structures.

A Typical Chase

A typical tornado chase day begins at the local Weather Office where members of the Tornado Intercept Team assemble to study the morning weather maps, A variety of forecast techniques are used to predict potential afternoon tornado activity. Hourly surface changes in temperature; dewpoint, air pressure, and wind are monitored. Soundings are plotted and stability indices are calculated.

By noon, if conditions are favorable, a target forecast area, about 60 miles in diameter, is identified as having the best potential for tornado formation. The team travels to the target area equipped with cameras, tape recorders and meteorological instruments. While enroute, team members watch the sky for signs of initial thunderstorm development. If a thunderstorm develops, the team approaches the rain-free portion of the cloud base and watches for the development of an organized lowering or wall cloud, which may precede a tornado (see Figure 1). When · wall cloud is observed, the team positions itself on the east or southeast side · few miles away. If a tornado develops, this location affords the best resolution of the tornado's structure on film and assures the best photographic contrast of a light-colored tornado against a dark rain-laden background.

A Case Study: Pampa, Texas

On May 19, 1982 the Tornado Intercept Team observed 6 tornadoes which formed from a slow moving supercell thunderstorm near Pampa, Texas. The storm initially developed ahead of a

dryline bulge around 4 p.m. near the city of Borger. As the storm developed the team passed near Plainview and traveled north toward the storm. Refer to Figure 2.

By 5:30 pm, the team was northeast of Amarillo and observed a violently rotating wall cloud to the north. Moving northeastward, the team observed striations under the rain-free base that were moving rapidly toward the wall cloud. As rotation at cloud base intensified, the team stopped on the east side of Pampa and quickly set up for filming. At 6:00 pm, a tornado developed about 10 miles west of the team near the town of Skellytown. The tornado was rope-shaped and traveled eastward across ranchland for about two minutes. Refer to Figure 3.

After the tornado dissipated, the storm appeared to go through a transition stage as another large updraft merged into the storm from the south. Soon, the circulation at cloud base widened and intensified and a large wall cloud emerged. At 6:23 pm, a laminar funnel protruded from the wall cloud and finally touched ground about 4 miles west of our location. As the tornado gradually moved northeastward, it widened into a V-shaped vortex and became obscured by dust. Refer to Figures 4 through 6.

Weather observations, taken every few minutes, revealed air pressure fluctuations up to 4 millibars. Winds were primarily from the east at speeds no greater than 25 mph. Cloud-to-ground lightning discharges became so frequent that the team members had to film the tornado from inside their car. A damage survey the next day revealed that the tornado traveled only 2 miles during the 22 minutes it was on the ground. The damage path extended northeastward and then curved back toward the northwest where a residence was demolished. The entire building was moved more than 100 yards towards the west with debris scattered northwestward. Closer inspection revealed that the building was not anchored to its foundation. Trees in the area were stripped of large branches and telephone poles were snapped off at the ground. Several large oil tanks were damaged by flying debris and covered with mud.

Meanwhile, another circulation at cloud base developed over Pampa and moved eastward. The team followed and set up a second filming location four miles east of Pampa at 6:50 pm. Within minutes, a third tornado developed and touched down 2 miles west of the team's location. The single-cell tornado was initially V-shaped and widened rapidly into a cylindrical-shaped vortex. After only a few minutes, the tornado dissipated and the circulation at cloud base widened. Then a large tornado with three sub-vortices developed a mile northwest of our location. The sub-vortices formed one at a time on the southern periphery of the circulation and moved around to the northeast side where they dissipated. The tornado traveled northward through a plowed field picking up loose soil which changed the tornado to a dark red color. At the same time, an anticyclonic funnel developed overhead and moved northward along the eastern periphery of the updraft.

By 7:05 pm, the large, cyclonic tornado reversed its direction and moved southeastward toward our location. As a result, the team had to make a fast exit toward the east to avoid the oncoming tornado. A short time later, the tornado struck the Pampa Industrial Park and leveled 7 prefabricated metal buildings causing more than 3 million dollars in damages. This tornado proved

to be the costliest one in West Texas that spring. After passing through the Industrial Park, the tornado crossed Rt. 60 and dissipated. Refer to Figures 7 and 8.

A damage survey revealed that the tornado path was a clearly defined loop that was nearly three-quarters of a mile wide. The tornado traveled 4 miles in the 22 minutes it was on the ground. Damage at the Industrial Park was carefully documented by photographs and tape-recorded comments. This information along with construction plans will be used to estimate the wind loads that caused the observed failures. The wind loads can then he used to estimate tornado wind speeds. Light standards at the Industrial Park indicated the direction of the winds at failure. Standards in the northern part of the Industrial Park were bent to the west whereas standards in the southern park were bent toward the east. Refer to Figure 9.

By 7:12 pm, the winds switched to the west as the gust front passed. Soon, visibility became reduced as rain and hail began to fall. Then a dark, ominous wedge-shaped tornado emerged from the heavy precipitation about a mile away. This monstrous-sized tornado was nearly a mile wide as it moved northeastward along Rt. 60 across sparsely populated ranchland. Baseball-size hail was encountered as the team drove eastward ahead of the advancing tornado. The tornado stayed on the ground for a half-hour before dissipating near Miami, Texas.

Results of Studying Tornadoes

Valuable information can he obtained by photographing tornadoes at close range and studying the damage caused to structures. Films of tornadoes can be used for photogrammetry to determine a range of wind speeds around the vortex. Likewise, documentation of structural damage immediately after tornadoes can lead to estimates of wind loads and finally wind speeds. Then the results of both methods can be compared and used in developing future design criteria for tornado-resistant structures providing more safety to the general public.

Acknowledgements

The author would like to thank Dr. James McDonald for his help during the preparation of this article as well as the members of the Texas Tech Tornado Intercept Team especially Erik Rasmussen whose forecast abilities were a valuable asset to the team success and Roy Britt and Bob Yudkin, who aided in photographing the Pampa Tornado Outbreak.

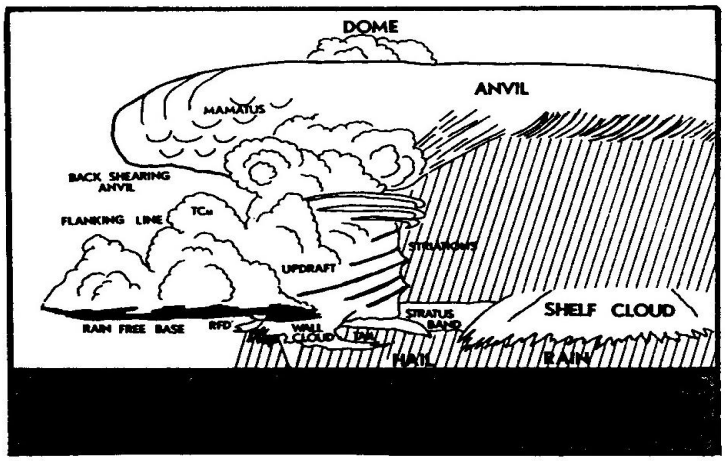

Figure 1. Schematic of a tornadic thunderstorm looking northwest with important features defined.

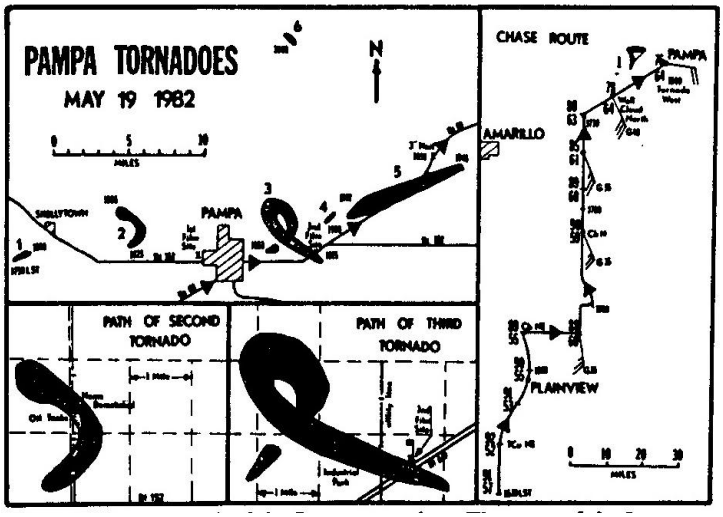

Figure 2. Damage path of the Pampa tornadoes. The route of the intercept team is shown by arrows.

Figure 3. First tornado was anticyclonic and developed at the back edge of the storm, thus,

it was in excellent contrast.

Figure 4. Large wall cloud develops in foreground and begins rotating very fast as another updraft merges into the storm from the south.

Figure 5. Funnel extends towards the ground as dirt and debris develop. Note how large the dirt whirl is compared to the width of the funnel. View looks west. Tornado is just west of Pampa, TX.

Figure 6. Large funnel forms east of Pampa, TX

near the Halliburton Industrial Complex.

Figure 7. Large tornado heads for the metal buildings at the Halliburton Industrial Complex.

Figure 8. Complete destruction of the Halliburton Industrial Complex caused an estimated three million dollars in damage.