

SOME COMMENTS ON TORNADOS

(These comments were originally written as correspondence with a scientist-friend of a colleague in Finland.)

Because I grew up in the state of Kansas, USA, I grew up knowing something about tornados, and their behavior. Principally, this is due to the following:

1. The frequency of tornados in Kansas is relatively large. I have not been keeping up with the statistics in recent years, but I recall that some years ago the state of Iowa had the greatest number per unit area, with Kansas second. In these areas, about 15 occur over every 50 square miles, annually. States best known for tornados are probably Texas and Oklahoma, but in fact they have occurred in every state of the Union, with the possible exception of Hawaii.
2. The plains of Iowa and Kansas have a reasonably evenly distributed population, large numbers of people with an unrestricted view of a relatively large area, and observers sensitized to the problem, so it is fairly certain that any tornado that occurs will be recorded.
3. Certain geographical regions tend to have "repeats", i.e., the same kind of tornados happen in the same places. Thus one can be educated about his own area, and can see regularities, and act accordingly. Being "tuned in" to these amazing systems can save your life!

Where I lived as a boy, in central Kansas, in the southeast corner of Stafford County, the tornados we saw usually passed by us dangling in midair. They had a tendency to be descending slowly, and frequently touched the ground some 50 miles or so northeast of us.

The most tornados that I ever saw at one time were five. It was on that occasion that I learned an adage from my father that the Army tried to teach me some years later--namely, that *Constant Bearing Means Collision!* As the five approached us from the southwest, my father pointed out that the two on the west, and the two on the east, were all slowly changing azimuth, but that the center one was not. We were therefore to keep our eyes on that one, and would seek shelter in our storm cellar when it was near enough. There was good

visibility. My mother, terrified, was already in the cellar, and was scolding my father severely for allowing me to stay out to watch, for in those days she regarded a six year old as worth saving. But Dad said that there would be plenty of time to seek shelter. I would guess that the funnels were moving 20-30 miles per hour. Before long, we could see that the middle one was beginning to move to drift to the left, ever so slowly, and the crisis was declared to be over.

While the tornado at the base of the clouds is moving with a more or less constant vector, the lower part, whether on the ground or in the air, is bending and twisting, and is capable of sudden changes in direction. Therefore, the length of the funnel is important, for a long one will be capable of surprising you, and can suddenly move directly toward you after you believe that it is going to pass by. For a very big tornado--the largest ones I know about can be approximately a half mile in diameter on the ground--it tends to move as a unit, at constant direction and velocity. They normally move between 10 and 50 miles per hour. The tornados that touched down in our vicinity were usually only a few yards in diameter, on the ground, and probably did not stay on the ground for more than a mile or two. Whenever a tornado slams into a city, or other complexities, observers report that it "lifts", to settle down to the ground again after traveling a few miles. I do not believe that it actually lifts, but that it does so much work that the end of the funnel is eroded away. For those that are among the most powerful known, the thing can stay right on the ground, grinding its way through whatever is there. But these are relatively rare.

One time, I think in the mid 1950's, I was visiting at the home of my uncle, adjacent to the house of my grandmother, who was then more than 90 years old. It was maybe 8 pm, and a huge weather front was approaching from the west. The lightning displays were awesome, and I was keeping an eye on it. I had with me my wife and children, and my uncle had a fine basement for refuge. I was standing outside with my wife, watching, hearing the low rumbling noise of the massive storm growing ever louder. The sound grows gradually, so there is really not one moment when one's alarm bell sounds. But suddenly, superimposed on the low rumble, there was the sound of a screaming jet engine. The combination of these two sounds--a nearby freight train and a jet engine--means TORNADO! My wife ran immediately to get the children and the others inside to take shelter, and I ran to my grandmother's house to get her. She was on the second floor, sleeping in her bedroom. She was quite small, being about

5 feet tall, and weighing no more than perhaps 80 pounds. I swept her from her bed, and ran with her to the cellar, some yards away from the house. She was greatly startled, of course, when I first snatched her from her bed, but when I said it was a tornado, she was quite prepared to have me running while carrying her, for she had been taking shelter from tornados for many decades!

I was now outside the house, running as fast as I could, when the Tornado arrived. Now the first rule in dealing with tornados is NEVER to be caught in the open. Yet here I was, with my grandmother! But this tornado was not all the way to the ground, and it passed overhead. As it did so, I looked up and saw into the funnel. There was a steady, yet flickering, intensely blue light, apparently cylindrically shaped. It was moving rapidly (as was I), so the sight was a short one, but I had no doubt of what I had just seen. Immediately as the funnel cloud passed, wind and rain arrived in a terrible onslaught, and I made our way, wet but safely, to the shelter. Subsequently, the tornado touched down about 25 miles to the northeast of us, but it did little damage.

Once again, when I was a boy, a tornado cut through a neighbor's house. We went to see it the next morning, and I still remember the destruction vividly. The house was cut exactly in two, with one part being totally gone. In the remaining part, the clothes were in the closets, the curtains on the windows, and there were even some newspapers lying on the dining room table! The surviving half looked totally unaffected. It was on this occasion that I saw, on the side of the house that was destroyed, the proverbial straw driven into wooden posts, and also saw many live chickens that had no feathers at all.

As is well known, the deep decrease in pressure causes things to explode, and the air in old wooden posts expands, creating openings, and the straw enters while the post is open. Most houses lose their roofs, at a minimum, but at times the explosions are so great that there will be virtually nothing left. If a person is exposed to the air, he will almost certainly be picked up, to be deposited again as much as 500 meters away. Automobiles are treated the same way, and there has been a fairly large number of survivors of such encounters. Individuals caught outside, however, almost never survive unless they have managed to lie down in a ditch, or otherwise able to find a way to reduce the amount of air around themselves.

Throughout the entire central part of the US, called the Midwest, there are many

stories of the kind I've related. In recent years there have been a number of books published on the subject. Dramatic video tapes have been taken in the very recent past, thanks to the prevalence of video cameras in the hands of ordinary citizens. It seems clear to me that there will be many more pictures in the near future than there have been heretofore.