



At left: Cloud to ground lightning in a thunderstorm, looking south from Norman, OK, 4 September 1980 (approx., 8:30-9:00 p.m. CDT). At right: Tornadic debris and wall cloud, north of Cordell, OK, 22 May 1981 (5:26 p.m. CDT), from one mile away. TOTO was deployed one-half mile from this storm.



The Confessions of a Tornado Chaser

Not all meteorologists chase storms. Those who do claim to do so unemotionally, like scientific machines — until they develop their photographs and see where they have been and what they have experienced.

By CAROL J. BURR

Storm Photographs by HOWARD B. BLUESTEIN

Some people move to Oklahoma and never become accustomed to the weather. Not so Howard Bluestein. Mention turbulent weather, and you have his complete attention. Forecast severe thunderstorms, and he betrays intense excitement. Suggest a possible tornado, and he is out the door on his way to the threatened area, his only fear that he will fail to cross paths with nature's most violent offspring.

A native Bostonian with degrees from M.I.T., Bluestein joined the University of Oklahoma meteorology faculty five years ago as an assistant professor "to be where the action is." As the leader of an intrepid team of OU tornado chasers, working in cooperation with the National Severe Storms Laboratory in Norman, he hasn't been disappointed in the showcase that Oklahoma weather has provided.

From April 1 to June 15 the storm chasers are on constant ready alert. Each morning they analyze reports coming over the department of meteorology's teletype, facsimile and satellite machines and make their forecasts from the surface and upper air data and satellite pictures. Comparing notes with NSSL, they determine the probability for severe weather within a 200- to 300-mile radius of Norman. If there is a possibility of severity, they stand by; a definite indication sends the team into action.

By 10:30 or 11 a.m., Bluestein will have committed his team to the chase. The area of concentration will have been narrowed to a 100-kilometer square considered most likely to produce a tornado. The team will be on the highway before the storm has begun to form. In constant radio contact with NSSL's "now-

caster" (as opposed to the familiar "forecaster"), the OU meteorologists keep up-to-date while enroute with readings from the Doppler radar, satellite pictures and surface reports. They may even change strategy in selecting the particular storm to pursue. They should be within an hour of the storm when it develops.

If all goes well for the scientists — if the storm develops where and when they anticipate — they will be successful in maneuvering themselves and their equipment into the right place at the right time and will have cameras and recording equipment set within a mile or two of the twister's path.

The sort of data which Bluestein and his crew collect — temperature, wind speeds, precipitation, pressure fields, motion pictures and still photographs — are designed to fill in the gaps in meteorologists' knowledge of tornadoes. The specific causes of tornadoes, their development within severe thunderstorms, the ability to accurately forecast their occurrence — all are subjects of speculation among scientists.



Rotating wall cloud, southwest of Norman, OK, 20 June 1979 (approx. 8:00 p.m. CDT). This storm was close to home, but Bluestein and the storm chasers will range from 200 to 300 miles from Norman, all over Oklahoma, into north central Texas, the Texas Panhandle and southern Kansas. Photo at top: TOTO, left, (without protective case) is calibrated by Bluestein and Jewett.

"You don't just walk into a tornado with your instruments and take readings," Bluestein explained. "And the chance of a tornado coming over permanently installed scientific instruments that can take such readings is remote. So we are not waiting for the tornado to come to us; we take the instruments to the tornado."

This spring the OU team ran field tests on a brand new portable instrument for recording severe storm data — wind speed, wind direction, temperature, pressure and electrical activity. Tagged TOTO (for Dorothy's dog in *The Wizard of Oz*, but officially named Torable Tornado Observatory), the 400-pound device was designed by Al Bedard of the Wave Propagation Laboratory in Boulder, Colorado. To be operable TOTO had to be set down in the path of a tornado. That's where Bluestein and Company came in.

Loaded on a pickup truck supplied by the Boulder lab, TOTO was driven to preselected sites and rolled down a ramp, flipping over on its side as it hit the ground and automatically beginning to record. Each deployment took 20 seconds. The truck crew then sped off to a nearby observation spot, the camera crew already having reached a separate spot in a second vehicle. When the storm had passed, TOTO was hoisted upright, automatically stopping the recordings, and hauled up the ramp by use of a winch. And the chase resumed.

What kept TOTO from being damaged by the winds? Nothing. Since TOTO had not even been wind tunnel tested before being shipped to Norman, the amount of punishment it can withstand has yet to be determined. This spring the device was placed in the paths of a number of rotating wall clouds and on the edges of two tornadoes and withstood gusts of 97 mph without damage.

TOTO was a shoestring project, built by Bedard from spare parts without any special funding. For the field test, NSSL furnished a driver for the truck, OU student Gary Lucas of Wichita, Kansas, and a 16mm camera and film, while the University of Oklahoma supplied Bluestein with \$1,000 in seed money in hope

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that the project's results would attract future research grants.

The other regular student members of Bluestein's team were Lou Wicker, Springfield, Missouri; Brian Jewett, Toms River, New Jersey, and Kevin Thomas, Kent, Ohio, all volunteer labor. The project attracted other students not directly involved in the research but who go along for experience — and just for fun. Storm chasing is not a prerequisite for meteorologists, but enthusiasm runs high for the adventure among OU's 150 weathermen and women, many of them going along on a chase at least once.

The ideal distance from the tornado for observation and photography is one to two miles, although



22 May 1981, near Cordell, two minutes after photo on page 15, a classic midwestern tornado, dubbed the "Wizard of Oz."

the team succeeded in placing TOTO within one-half mile this spring, and Bluestein has been even closer.

"I'm not suicidal," Bluestein insisted. "I never feel that I am in any personal danger. We can predict the movement well enough. We study the development of the storm thoroughly and take the necessary precautions. We avoid being out at night. If I can't see, I'm scared just like everybody else."

The professor admits that the first time out anyone is apt to be a little frightened, but that the feeling goes away with knowing what to expect. "We are like machines out there. There isn't time to get excited or nervous. We are completely caught up in getting good quality movies and slides, with recording accurately the description and timing of the storm. But sometimes, when we come back in, develop our pictures and actually see where we have been and what we have experienced, then we get excited."

Of course weather forecasting still is not an exact science and skill in predicting tornadoes goes just so far. Many times the chasers go a long distance and

nothing develops. But one good day can make a whole season — a day like May 22, 1981, when they sighted eight tornadoes and got on the edges of two of them. TOTO's readings that day alone justified all the work that had gone into the project.

The motion pictures of the tornadoes also are vitally important to the meteorologists' study. By filming the debris in the tornado and tracking the debris from frame to frame, the meteorologists can measure how fast the debris is moving and estimate the wind speed.

Some of Bluestein's still photography in the form of color slides and prints have produced spectacular results. (A few examples in black and white appear with this article.) The University of Oklahoma Museum of Art has scheduled a September exhibit of the best of Bluestein's photos.

As important as any result of the storm chase is the verification it provides for the NSSL forecasting apparatus. "We can provide the ground truth for the Doppler radar," Bluestein said. If the meteorologists

are to provide better public warning, they must know how accurate the radar readings are, whether the severe storms and tornadoes the Doppler forecasts are actually developing, since most occur in open country. "We need to be on the site for visual confirmation and to scientifically describe the storms."

From an academic viewpoint, Bluestein rates storm chasing as invaluable. In a single season students and faculty can obtain several lifetimes worth of severe weather development and forecasting knowledge. "We are discovering new phenomena all the time from direct observation."

Couldn't tornadoes be studied in scientific simulators with less risk and inconvenience? "Studying the tornado without the thunderstorm is like studying the hand without the arm," Bluestein said flatly. "The tornado can be simulated, but not the thunderstorm that produces the tornado. We want to know how and why the tornado comes from the thunderstorm.

"Besides," he added, "it's just plain fascinating."



The beginning of a maxi-tornado, rotating debris cloud under a wall cloud, north of Binger, OK, 22 May 1981 (7:55 p.m. CDT). The damage path of this tornado, with wind speeds over 200 mph, averaged one mile across, up to a maximum of 1½ miles across. Since it occurred over open country, the Binger tornado didn't receive much publicity.