MAJOR HAILSTORMS RETRACE TRI-STATE TORNADO TRACK IN ILLINOIS

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ABSTRACT. — Two adjacent very damaging hailstorms in March 1967 occurred exactly along a portion of the famous Tri-state tornado that crossed southern Illinois 42 years earlier. This enormous 3-hour tornado killed 606 persons in Illinois and has left a still-evident and inordinate fear of severe weather in many older citizens of that area. The 2 hailstorms occurred in a dense weather-observation network and added storm data came from a field survey. The storms occurred in a 31-minute period and 3-inch diameter hailstones resulted. The tendency of a populace to remember very severe weather events through 1 or more generations has been evident over the past 200 years, but it may be changing due to the continuous exposure by news media to information on worldwide severe weather disasters.

It has been observed that many older residents of southern Illinois cities and towns devastated by the famous Tri-state tornado of 18 March 1925 exhibit more than normal apprehension when severe thunderstorms approach. The Tri-state tornado began in southeastern Missouri and moved northeastward across southern Illinois and into Indiana along a nearly straight path of 219 miles (longest on record) at a near-record average speed of 62 mph (Changnon and Semonin, 1966). During most of its 3.5-hour lifetime it produced a damage path 1 mile wide, and caused the deaths of 695 persons (606 in Illinois), injuries to 2,027, and damages totaling $40 million (in 1964) dollars.

The terrible lesson learned by area residents in 1925—that a tornado funnel could be hidden from view because of its huge width, closeness to the ground, and preceding veil of dust and low clouds—causes the local residents, particularly those of age 55 years or older, to be inordinately fearful of similar dark, low-based thunderstorms.

The reaction of local residents and the news media to a severe hailstorm day in 1967 that occurred along a portion of the 1925 tornado track almost exactly 42 years later reveals this tornado memory and the fear that still lingers in this area of Illinois.

The oddity of a second series of severe storms along the same track of the 1925 tornado is of considerable interest to meteorologists and climatologists. These hailstorms were the subject of a detailed meteorological study, and some of the pertinent findings are presented in this paper. The other reason for this paper is to describe the effect of a severe weather event on the memory and attitudes of those experiencing the event, and to speculate as to types of severe weather events that may be retained in regional memories for more than just a few years.

Description of 12 March 1967 Hailstorms

A dense raingage network comprising 49 gages in a 550-square-mile area was established in 1957 in southern Illinois by the Illinois State Water Survey to make various climatological and meteorological studies of rainfall (Changnon, 1963; Huff and Changnon, 1966). This square-shaped network with its uniform array of standard raingages (Fig. 1) was centered on West Frankfort, one of the two cities that experienced major losses from the Tri-state tornado.

As a part of the multiple hail studies being sponsored by the Atmospheric Sciences Section of the National Science Foundation (NSF GA-482), several severe hailstorms during 1967 were field-studied in detail (Changnon, 1968a). Results of these studies of 1967 storms and others similarly investigated in 8 prior years were the subject of a recent paper dealing with modeling of severe hailstorms (Changnon,

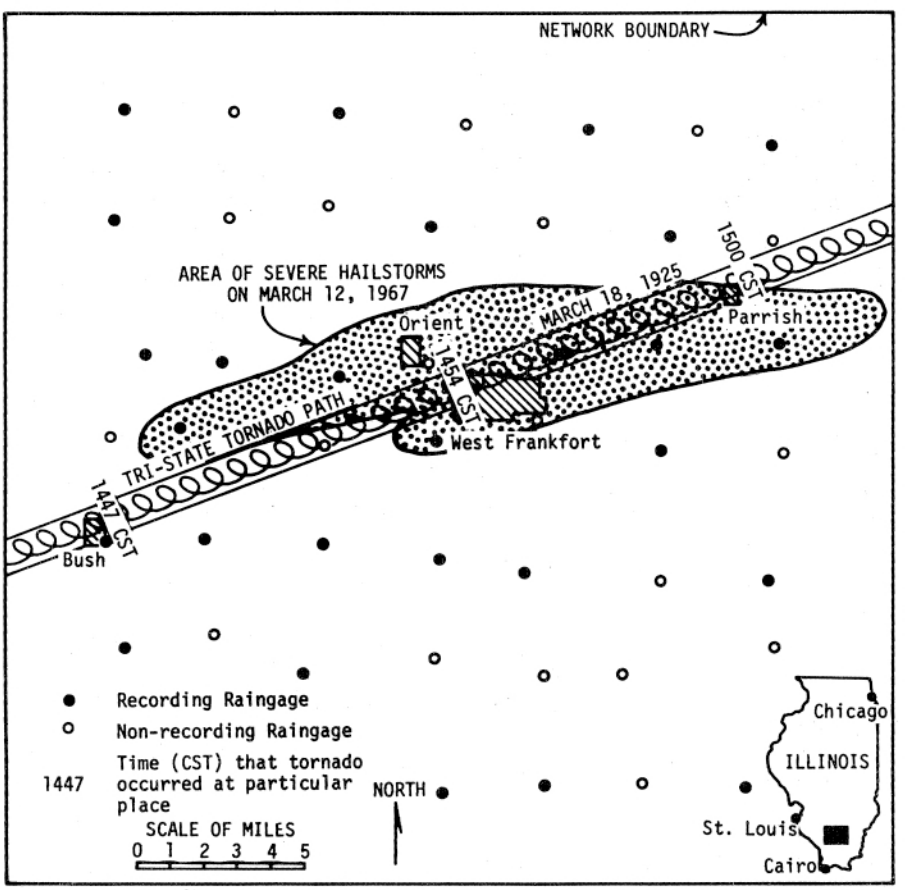


Figure 1. Storm Areas and Raingage Network in Southern Illinois.

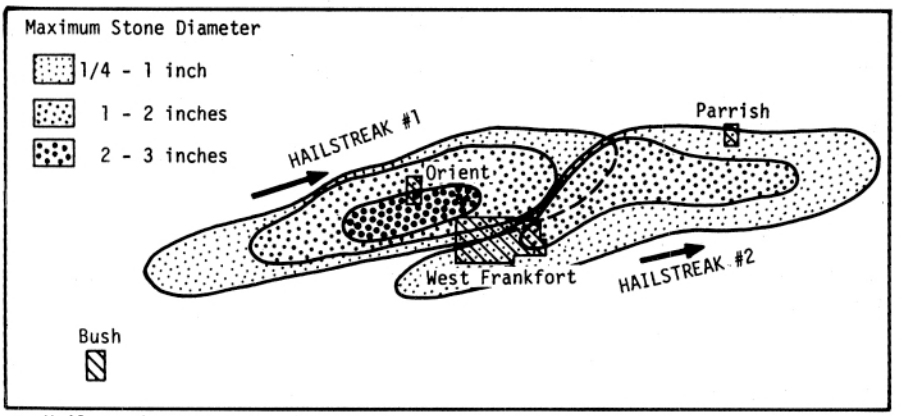
1968b). The occurrence of two of the 1967 severe storms in a dense raingage network was scientifically providential, since the cooperating observers at the non-recording raingages had been asked to report hailfalls in detail. Also, the recording raingages had been modified to record hailfalls (Changnon, 1966), and the recording raingage data allowed determination of the rainfall produced by the hailstorms. A field man, responsible for the weekly servicing of the network's recording raingages, made a detailed field survey in the area encompassed by the two 1967 storms (Fig. 1). He obtained point data on time and size of hailfalls for 33 locations after interviewing 85 persons. These data, plus those from the recording raingages and cooperative observers, were used to reconstruct the surface patterns of the two hailstorms that together produced hail over 73 square miles (Fig. 1).

On the afternoon of 12 March, an east-west stationary front lay across south-central Illinois with storm-producing low centers (waves) moving eastward along this frontal zone. Afternoon surface temperatures in the portion of Illinois south of the front (including the network area) were in the 78° to 83° range, whereas those north of the front were in the 55° to 65° range. Moist Gulf air was moving into the region, and a situation quite conducive to severe spring thunderstorms existed throughout southern Illinois.

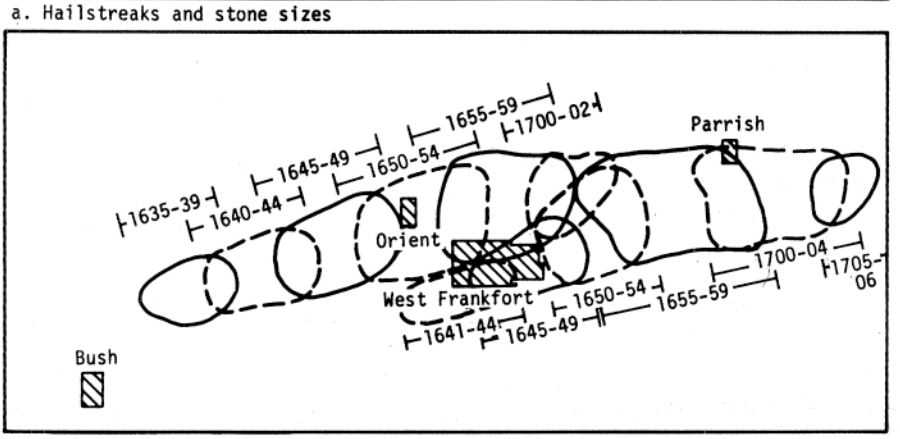
Six eastward-moving thunderstorms occurred in the network during the 1630-1830 CST period, and three of these produced hail. The second and third (as defined by time) thunderstorms developed over the network and each produced severe and widespread hail along paths that were adjacent and partially overlapping. The two paths of continuous hail, labeled as hailstreaks, are shown in Fig. 2a, which also depicts hail areas based on the diameters of the largest hailstone sizes.

Hailstreak number 1 began at 1635 CST and terminated at 1702 CST with a forward speed of 31 mph. Its length was nearly 14 miles and its maximum width was 3.1 miles. Most of the property experiencing 1-inch or larger stones was damaged to some extent, and within the 2- to 3-inch stone area (Fig. 2a) damages to automobiles and homes were excessive.

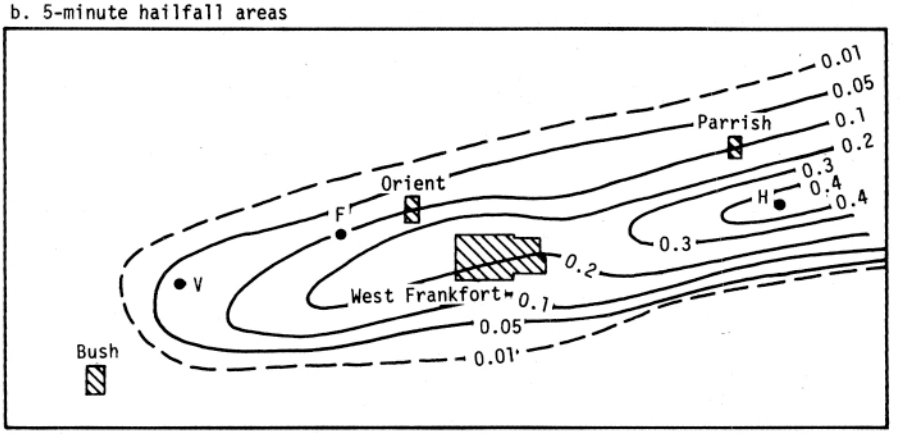
Hailstreak number 2 began at 1641 CST (after hailstreak number 1 had been in progress for 6 minutes, note Fig. 2b) and lasted until 1706 CST. It had an average forward speed of 37 mph, a length of 15 miles, and a maximum width of 3.1 miles, thus closely matching the surface characteristics of the other hailstreak. The largest stones from the second hailstreak were 1.5 inches in diameter, and some property damages resulted in the area defined by these stones. At most points, the hailfalls from each storm lasted 2 to 4 minutes. People in the area experiencing 2- to 3-inch stones reported a loud whistling or hissing roar sound that has been heard in other large hailstorms (Changnon, 1960). This was likely an aerodynamic sound created by the rapidly falling large hailstones, rather than that from a funnel aloft. No evidence of a tornado could be found.



a. Hailstreaks and stone sizes



b. 5-minute hailfall areas



c. Isohyetal pattern for hailstorms, rain in inches

FIGURE 2. Hail and Rainfall Patterns on 12 March 1967.

The eastward progression of the storms and the size of areas of hailfall for 5-minute periods are shown in Fig. 2b. Their equivalent orientations and expanding hailfall areas in their early stages are clearly shown. One area northeast of West Frankfort experienced hail from both storms (Fig. 2a), and comparison of the times of the hailfall areas (Fig. 2b) in this overlap region shows that these hailfalls were separated by 4 to 10 minutes. The hailfall areas had expanded continuously into their mid-late stages (1650-54 CST for streak 1, and 1655-59 for streak 2), but thereafter the hailfall areas began to decrease, with a rapid diminishment in the final 2 to 3 minutes of their existence.

The isohyetal pattern based on the rainfall produced by the two hail-producing storms is shown in Fig. 2c. Amounts in the area of hailstreak number 1 were not large, generally less than 0.2 inch. The recording raingages were adapted (with funnels removed) to record hailfall "spikes" and thus the amount of water from the hail. Chart records at gages F and V (Fig. 2c) both indicated that most of their total amounts, 0.10 and 0.06 inch, respectively, were from the hail. The storm producing hailstreak number 2 yielded considerably more precipitation than the first storm. Rainfall was increasing, totaling 0.48 inch at gage H (Fig. 2c), near where the hail produced by this storm was terminating.

The surface rainfall and hailfall data furnished several interesting facts concerning these storms. The storm that produced hailstreak number 2 developed along the right-front flank of the storm that produced hailstreak 1, and this conforms to the multi-celled storm model described by Fankhauser and Newton (1965). The detailed study of the rain cores and hail areas at various times during both storms revealed that the larger hail fell in the center of its associated rain core, and not along the right flank as has been postulated for many hailstorm models. Much of the precipitation produced by these spring hailstorms was from the hail. In storm number 1, the hail fell throughout most of the storm's life history, as defined by the period of rain production, whereas the hail from the second storm fell only during the formative stage. However, the hailstreaks were alike in their times of occurrence and durations, areal extents, speeds, production of large hailstones, and their positioning at any given time with respect to their rainfall cores.

Of considerable importance is the fact that many of these findings prove that detailed, careful ground studies of hailstorms are needed to provide information adequate to describe and understand the actual processes involved. For instance, the proximity of the two hailstreaks in these two storms (Fig. 2a) could easily have led to the conclusion that only one large hailstorm had occurred, as outlined in Fig. 1, if detailed time data from many points had not been collected.

Comparison of Storm Damages

The Tri-state tornado covered 28 miles in a 1-mile-wide path across the area of the now existing raingage network. The times at which it

struck certain communities are depicted in Fig. 1. The town of Parrish was 90 percent destroyed (Changnon and Semonin, 1966). In its path across this network area, the tornado killed 188 persons (31% of the Illinois total), injured 492 (32% of the total), and produced $3.1 million (1964 dollars) in damages (9% of the total). The two hailstorms on 12 March 1967 certainly did not approximate this degree of damage, but they did result in more than $100,000 in property losses. Crop losses were minor because the storms occurred before the major crops had been planted. All homes in Orient (Fig. 2a) experienced damage from the combination of high winds and 3-inch stones. The northwestern portion of West Frankfort, which had been devastated by the 1925 tornado, was also that city's prime hail damage area in 1967. Certainly the areas affected by the 1925 and 1967 storms did overlap to a considerable degree. The Tri-state tornado was certainly a "design" event for tornadoes, and the occurrence of 3-inch hailstones is also infrequent. Point frequencies for hailstone sizes in Illinois indicate that 3-inch stones can be expected only once every 20 years (Changnon, 1967). Thus, by chance, two rather rare meteorological events have occurred in the same area.

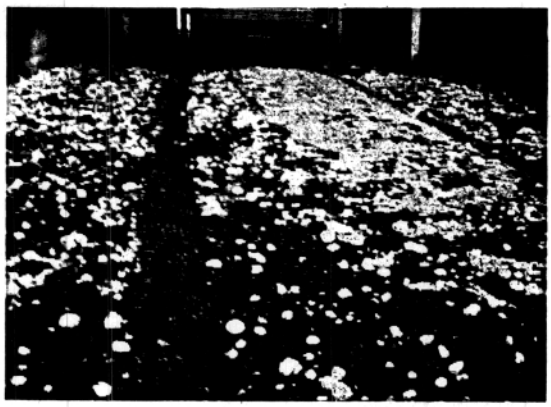
Recall of Severe Weather Events

After many years of visiting friends and relatives in West Frankfort (Fig. 1) and meeting many persons in that immediate area during the installation of a raingage network in 1957, I became aware of an inordinate fear of thunderstorms among many of the older residents. In particular, older women would call with alarm for the gathering of the family in the storm shelter or basement at the first sight of any dark cloud, regardless of whether any severe storm warnings had been issued. Initially, I attributed this to native fear of the unknown. However, after a careful study of the Tri-state tornado and in subsequent discussions of this event with those who had experienced the storm, it was obvious that their unusual fears were rooted in their experiences during the 18 March 1925 tornado.

The newspaper headline and story reproduced in Fig. 3 came from the 13 March 1967 issue of the *West Frankfort Daily American*. It reveals the local recognition of the coincidence between the two severe storm events, even indicating that the 1967 hailstorms came within 6 days of the forty-second anniversary of the tornado. Interestingly, March 12 and 18 both are in periods with quite frequent occurrences (singularities) of severe weather in Illinois (Changnon, 1962).

The persisting recollection of a single severe weather event in a region by many of those who experienced it is an interesting phenomenon. Ludlum (1968) has reported on such regional persistence in relation to persons experiencing certain very severe midwestern winters in the 1821-1870 period. However, this was in a period when severe weather events 1) exerted more direct hardships on life and property than they generally do today, and 2) were less understood than they

It's Not a Cotton Patch



Large-sized hailstones, ranging from marbles to A-size hen eggs and even some "baseball-sized" pelted the West Frankfort community Sunday evening causing heavy damage to roofs, car tops and aluminum awnings.

Shades of March 18, 1925 — Huge Hail Stones Pelt Area

MONDAY PAPER

Shades of March 18, 1925.

A big wind, roaring like freight trains, blew over the West Frankfort community area shortly after 5 p.m., Sunday, preceding a pelting by gigantic hail stones that did uncounted damage.

Would You Believe?

That's a Grade A Large chicken egg in the middle. The other two objects are samples of the egg-sized hail that pelted the west side of West Frankfort Sunday evening. "Baseball-sized" hail was reported further west — in the Orient, Plumfield, Zeigler area.

Hail stones were reported ranging in size all the way from mothballs to hen eggs (Grade A Large) to "baseball" size.

The Sunday storm was within a week of matching the date of the 1925 tornado that ripped Southern Illinois and West Frankfort and killed 689 persons in Missouri, Illinois and Indiana.

Late Sunday afternoon, following a balmy unseasonable summerlike day that had the temperature climbing up and nudging the 80 degree mark, billowing decked storm clouds built up the the southwest and west, rolling towards West Frankfort.

Several persons, including this reporter, reported hearing a terrific roaring sound — like several freight trains passing through at high speed — at high altitude preceding the storm of pelting gigantic hail stones.

The hail started slowly at first and then built up in intensity and size until it appeared like it was raining hailstones. They bombarded roofs of houses and garages with such force and intensity that it sounded like a gigantic rock-throwing fight.

When the hail-storm ended it was followed by rain. The ground cover of hail stones slowly disappeared under the melting effect of the rain.

Many Damage Reports

Insurance agencies in West Frankfort today reported receiving numerous damage reports, mostly to roofs, and more were being received through the morning hours.

This reporter saw a convertible auto roof Sunday night that looked like it had been riddled with a shotgun.

Aluminum awnings were bent and dented, as were the roofs of cars and trunk and motor deck lids. Glass panes in green houses were also riddled.

The northwest side of West Frankfort, the same area wiped out by the 1925 tornado, apparently received heavy damage, according to insurance agency reports.

"Baseball sized" hail was reported west of West Frankfort. Hail damage spread both east and west of the community. Both Orient and Zeigler were reported to have been pounded hard by the hail storm. Damage was said particularly heavy in Orient.

Southern Illinois was included in a wide-spread Arkansas, Missouri Kentucky, Illinois and Indiana tornado alert Sunday afternoon by the weather bureau as a "low" moved down a stationary cold front and centered in the Southern Illinois area.

FIGURE 3. Article on 12 March 1967 Hailstorms from the *West Frankfort Daily American* of 13 March.

are today. It is possible that our present capability to meet the challenge of severe winters may never provide us or our descendants with lifelong memories as they did Americans of the Nineteenth Century, although any severe winter storm that disrupts electrical power may be remembered for a period because of our concurrent dependence on electricity.

Another form of prolonged weather disasters that has some lasting effect on the populace are severe droughts, such as those of the 1930's. Comparable future droughts in agricultural areas will likely leave large imprints on the memory and behavior of those experiencing them. Severe floods from heavy rains and/or rapidly melting snow also may continue to produce certain lasting memories in rural and urban areas. However, our current society with its fluid population, extensive means of mass communication, and constant awareness of many worldwide disasters may not remember local severe weather events over long periods of time.

The situation in the Tri-state tornado area 42 years after its occurrence certainly suggests that occasional, exceptionally severe tornadoes or hurricanes of the future may still cause sufficient sudden destruction and deaths to be imprinted also on the memories of those in the storm area through one or more generations. The effect of such severe weather events to condition human activities might well be the subject of future sociological research.

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