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A-bomb Tests Linked to Tornadoes? A Case for What Makes Weather

Feature

In truth so deeply was I excited by the perilous position of my companion, that I fell at full length upon the ground, clung to the shrubs around me, and dared not even glance upward at the sky—while I struggled in vain to divest myself of the idea that the very foundations of the mountain were in danger from the fury of the winds. It was long before I could reason myself into sufficient courage to sit up and look out into the distance. "You must get over these fancies," said the guide, "for I have brought you here that you might have the best possible view of the scene of that event I have mentioned—and to tell you the whole story with the spot just under your eye."
Edgar Allen Poe, Descent into the Maelstrom, 1841

Clouds render visible air currents, and are full of meaning.
J.P. Finley, The Special Characteristics of Tornadoes: With Practical Directions for the Protection of Life And Property, 1884

We talk about the weather, and we experience weather. By talking about the weather, we attempt to make sense of our experience of it, attaching the information we sense to broader temporal and geographic frameworks that describe a given climate. With recurring features such as seasons, zones, fronts, highs, lows, and averages, climate provides a narrative that links documented changes in the weather to anticipated ones, and joins our sensible environments to cognitive territories. It shapes perceptions of which climatic events are "normal" and which stand out as anomalies.

At the foundation of these climate narratives are data. Climate data and the complex sociotechnical systems that produce, assimilate, and interpret that data make up what historian of science Paul Edwards refers to as a "vast machine."[1] By "inverting the weather and climate knowledge infrastructures," or interrogating the means by which global climate knowledge has been produced, Edwards exposes the various material, cultural, technological, and institutional agents at work within them. This inversion reveals interdependencies and moments of friction among these. "Over time," Edwards continues, "as knowledge production becomes infrastructural, these relationships become increasingly invisible, even as they continue to evolve. The difference between controversial claims and settled knowledge often lies in the degree to which the

[1] Paul Edwards, A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming (Cambridge, MA: MIT Press, 2010).

production process is submerged. Thus an established fact is one supported by an infrastructure."[2]

Outside the scientific community, this knowledge infrastructure is even less visible, though it is embedded in everyday life. Historical accounts, daily reports, weather maps, local forecasts, and personal anecdotes not only provide indirect access to climate knowledge for the non-expert, but some of these may also constitute raw material for climatologists, who are essentially historians of weather.[3] Where a climatologist applies theoretical models to assimilate this raw data, the non-expert finds comfort in the visible consistencies across weather's diverse representations. But what happens when these narratives diverge? When the experience of the weather misaligns with the official story? The climatic anomaly, like the "controversial claim," can have the effect of rendering this invisible background infrastructure more explicit. It prompts us to ask: what makes the weather? And by asking what makes "the weather," known to us through diverse forms of information, we are essentially inquiring after the sociotechnical compositions that produce them.

"A-bomb Tests Linked to Tornadoes?"[4]

This 1953 headline expressed a sentiment that was not uncommon among Cold War-era news stories in the U.S. Unseasonal temperatures, heavy rains, droughts, and a minor earthquake—weather atypical enough to become an event—were all attributed to the atomic weapons program, which had been underway since 1948.[5] On remote sites in the southwest and the Pacific Ocean, this series of nuclear tests were producing atypical weather events of a different kind. The spectacular cloud formations after each airborne detonation appeared to prefigure yet unknown atmospheric mutations. The energy added to the weather system would have to be expended somewhere, so it seemed, and possibly at a distance from the isolated test site.

The tornado outbreak that prompted this headline started a few days after the eleventh test drop of Operation Upshot-Knothole, in Nevada's Yucca Flats. The device's nickname: "Climax."[6] From 7 to 9 June, tornadoes levelled farms in Nebraska and Iowa, killed 115 people in Flint, Michigan and

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[2] Ibid., 22. By "controversial claims," he is referencing debates around the science of climate change, which is the subject of his book.

[3] Ibid., 431. "If engineers are sociologists, as Michel Callon and Bruno Latour have taught us, then climate scientists are historians."

[4] United Press International, "Politician Sure, Then Denies It: A-Bomb Tests Linked to Tornadoes," The Globe and Mail, 11 June 1953, 1.

[5] Gene Sherman, "Do Atom Blasts Change Weather?" Los Angeles Times, 13 March 1955, B5.

[6] US Department of Energy, Nevada Operations Office, "United States Nuclear Tests: July 1945 through September 1992," Revision 15, December 2000, www.nv.doe.gov/library/publications/historical/DOENV_209_REV15.pdf.

19 in Cleveland, Ohio, and caused unprecedented damage in central Massachusetts, leaving 90 dead in the city of Worcester. Lesser tornadoes, including one in Brooklyn and two in New England, were reported throughout the three-day outbreak.[7] While the tornadoes' quantity and intensity were significant, the fact that some occurred in the northeast, outside America's "tornado alley" added to public uncertainty. Could anyone deny with absolute conviction that A-bombs were not linked to tornadoes? The same news story's subheading, "Politician Sure, Then Denies it," is a reference to Congressman and Atomic Energy Commission member James Van Zandt, who told a reporter that he believed there were "definitely" links, citing the "weather phenomena" he observed during a recent nuclear test in Nevada. Within a few hours he retuned his message to fall in line with the official denial released by the Commission that same day. Van Zandt explains: "Nothing I said was intended to indicate a connection between the recent tornadoes and the testing of atomic weapons in Nevada."[8]

Nuclear anxiety had many expressions, and the possible climatic effects of the testing program were already one target of public scrutiny. Even before the June 1953 tornado outbreak, one editorial had pointed to the "freaky weather" happening globally and demanded a response from scientists and bureaucrats:

> *I believe that atomic explosions create frightful forces that disrupt and disperse those atmospheric layers composing the ionosphere about 60 miles above the earth. Some of those forces are reflected back to earth, which is thereafter and thereby peppered with disastrous storms in widely separated locations. The earth's daily and yearly motions have combined with the reflected atomic forces to produce the recent spells of wild weather.*[9]

On the other side of such claims, news reports shared findings from ongoing studies that addressed public sentiments by quantifying the tests' environmental by-products: the distance of fallout, the change in electrical conductivity in the air, the presence of radioactivity in dust.[10] The reports typically comment that while materials like dust are known catalysts for precipitation, these by-products are minimal relative to the sheer scale of the global weather system. And the energy yield of each atomic test amounts to a "small impulse" compared to the solar radiation absorbed by the planet's atmosphere.[11]

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[7] John Brooks, "Five-Ten on a Sticky Day in June," The New Yorker, 28 May 1955, 39–52.

[8] United Press International, "Politician Sure, Then Denies It," 1.

[9] James E. Waddell, "Freak Weather," Chicago Daily Tribune, 6 June 1953, 15. Considering the date, this editorial is remarkably prescient, expressing apprehension about "wild weather" from human causes just days before the Worcester outbreak.

[10] "Chance That A-Bombs Caused Tornadoes Less Than One in a Thousand," Daily Boston Globe, 21 June 1953, 46.

[11] Sherman, "Do Atom Blasts Change Weather?" B5.

Whether as coincidence or causal link, the violent storms and nuclear tests of 1953 were placed alongside one another in the public imaginary, bringing local weather and national security into sharper focus as two sides of governmental oversight. Not only did the anomalous nature of the tornado draw a veil of suspicion over the authoritative word of experts, but there was also a degree of symmetry to these two instances of freaky weather. As Congressman Zandt had remarked, the tornado and the nuclear explosion share certain formal characteristics. A Boston Globe story that reported scientific arguments against the atomic-tornado connection ran two photographs that carried the opposite message: one of the Worcester thunderhead, and directly beneath, an image of a cloud formation photographed at Yucca Flats.[12] Both funnel cloud and mushroom cloud are figures of a short-lived but destructive force, this pairing suggests. Both concentrate and give visibility to distributions of energy, matter, and technics whose combined behaviour is unpredictable, and transfixing.

Formal and symbolic connections aside, a primary cause for public alarm was the timing of these atmospheric events. That year's active tornado season came to an unexpected and violent conclusion just days after another contentious series of tests.[13] Each testing series was organized as an independent military operation with an individual identity, and starting in 1961, each military operation itself was fit within the government's fiscal cycle.[14] While there were pragmatic reasons for this—chiefly to improve reporting and to manage budgetary allocations—the yearly cycles apply a structure of periodic regularity, consolidating an assortment of experimental weapon types, locations, and energy yields. It is as if subdividing the testing activity into seasons would further naturalize its atomic weather into a climatic and civic routine.

"Some Locally Severe"

In the 1950s, nationwide tornado documentation increased from 200 per year, on average, to over 500 in 1953.[15] More than most other weather phenomena, the tornado is reputed to be elusive in terms of both record-keeping and prediction.[16] Tornadoes are brief, typically disappearing after 20 minutes, and they are local, leaving trails of wind damage 400 metres

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[12] "Chance That A-bombs Caused Tornadoes," 46.

[13] Ibid.

[14] U.S. Department of Energy, vii.

[15] Brooks, "Five-Ten on a Sticky Day in June," 42

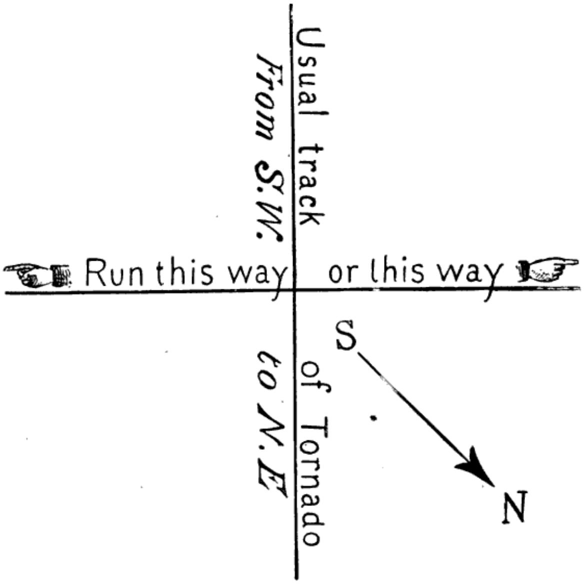
[16] "One of the main difficulties with tornado records is that a tornado, or evidence of a tornado, must have been observed. Unlike rainfall or temperature, which may be measured by a fixed instrument, tornadoes are short-lived and very unpredictable. If a tornado occurs in a place with few or no people, it is not likely to be documented. Many significant tornadoes may not make it into the historical record since Tornado Alley was very sparsely populated during the 20th century." "U.S. Tornado Climatology," National Climatic Data Center (NCDC), NOAA, October 2014, www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/trends.

wide and 25 kilometres long, on average. And that is only when they touch down. Tornadoes that go unobserved go undocumented. The Bureau applied this reasoning in response to the public's suspicion of atomic testing, assuring Americans that the statistical upturn of documented tornadoes in 1953 was a result of more accurate records, not an actual increase in tornado activity. In their official study ordered by the U.S. Government and released in 1955, the Bureau indicates that the national system for reporting tornadoes had not only improved "immeasurably since 1950," but that this improvement also confirmed the statistical accuracy of Nevada's local tornado records, which, they report, were stable throughout the years of testing. Here, where any effects of the atomic testing would presumably be noticed first, the absence of anomalous increases or decreases in annual tornadoes turned the logic behind the public's suspicion back on itself. In other words, according to the report's argumentation, national weather was no less stable or less natural; the national weather system was simply more pervasive and more watchful.

While this decade saw a more robust system for collecting weather data, methods of tornado prediction were still deemed experimental.[17] The timing of the 1953 storms was thus a significant factor in how the Weather Bureau managed their communications to the public. On the morning of 9 June, meteorologists at the Boston branch of the Weather Bureau agreed that the weather maps pointed to unstable conditions. The same squall line behind the previous days' tornadoes in Colorado, Michigan, and Ohio had continued eastward, carrying with it a high probability that similar, tornado-prone storms would develop by afternoon. However, probability is not the same as predictability, and this was a class of weather uncommon to the region. After some debate, the team in Boston issued the mid-morning forecast for the New England region: "Windy, partly cloudy, hot and humid, with thunderstorms, some locally severe, developing this afternoon."[18] The mild language now feels inadequate given the violent weather that followed. Weighing scientific judgment against bureaucratic duty, the meteorologists stuck to the Weather Bureau's policy. "Severe" was reserved for extraordinary conditions, and a 65-year ban on the use of the word "tornado" in public forecasts had recently, and only partially, been lifted. Methods for tornado

[17] Brooks, "Five-Ten on a Sticky Day in June," 46.

[18] Ibid., 48



From John P. Finley's The Special Characteristics of Tornadoes: With Practical Directions for the Protection of Life and Property (1884).

forecasting were considered too unreliable, for one, but the restriction on forecasting language was also a matter of civic order. The fear of provoking panic in the general population meant that certain information that was generated by a growing network of military intelligence and Bureau researchers stayed within the network.[19] There was thus a separation between knowledge of risk and its communication. Exceptions to these restrictions applied to regions of the country where tornadoes occur with more frequency; where localized weather watches were in place, residents recognized the signs of tornado weather, and practices for protecting property and taking cover were customary. Within the interior of the country, the Bureau would "leak" advanced warnings derived from their experimental forecasting techniques without worry of disrupting life.[20]

But Massachusetts was far from that interior. Only after the twin tornadoes had touched down in the central part of the state, and building debris blown eastward began raining down on Boston, did the Weather Bureau there upgrade its forecast, using the term "tornado" for the first time in New England's history.[21] Unfortunately, this warning came too late. The risk of inspiring general panic had outweighed the risk of a statistically unlikely disaster, and standard protocol disallowed the possibility of an anomaly. So the topologies of information management had

[19] Ibid.

[20] T.P. Grazulis, The Tornado: Nature's Ultimate Windstorm (Norman: University of Oklahoma Press, 2001): 87-89.

[21] Brooks, "Five-Ten on a Sticky Day in June," 52

produced an inside and an outside, where tornadoes and their threat belonged, and where they took everyone by surprise.

“Watchful for the Country”

Advanced warning systems for severe weather in the U.S. were assembled upon the organizational frameworks and communication techniques of the military. Before radar technologies exposed a “signature” for the rotating winds of a tornado, the majority of what was known about tornadoes came from first-hand observations, and the most systematic collection of such accounts belonged to John P. Finley.[22] A lieutenant in the U.S. Signal Corps, Finley interpreted empirical information alongside decades of uneven weather records, with the ambition of dispelling persistent myths about the tornadoes that he believed endangered human life.[23] The Signal Corps was, in its beginnings, responsible for overseeing long-distance communications and maintaining related infrastructure; over time, its oversight extended to multiple categories of information management, including weather data. Upon enlisting, Finley received instruction in “military tactics, signaling, telegraphy, telegraphic-line construction, electricity, meteorology, and practical work in meteorological observation.”[24]

The eclectic scope of the Signal Corps is credited to the resourcefulness of its chief officer, Army Major Albert Myer, who sought to extend the Corps’ functions beyond wartime, effectively delaying the diffusion of its services into various civilian agencies. The building of a national weather bureau, for one, almost fell to the Smithsonian Institute after the end of the Civil War, but Myer had it transferred to his Army division.[25] Weather and military strategy were, after all, forms of information, and the value of this information depended on its effective communication across distant territories.[26] Just before the war began, the War Department had selected Myer to organize and command this special division of the Army on account of the success of the signalling system he had invented. Known as the “wig-wag,” this line-of-sight signalling technique used two hand-held flags, waved in precise sequences to convey messages in code. The wig-wag required dedicated men with special training to send and receive messages, as well as good visibility between communication points during a range

[22] T.P. Grazulis, The Tornado: Nature’s Ultimate Windstorm, 77-80

[23] Joseph Galway, “J.P. Finley: First Severe Storms Forecaster,” Bulletin American Meteorological Society 66, no. 11 (November 1985): 1389–1395.

[24] Ibid., 1389.

[25] Lee Sandlin, Storm Kings: The Untold History of America’s First Tornado Chasers (New York: Pantheon, 2013), 120.

[26] Myer employed his system of corps observers and weather stations to report on the railroad strikes of 1877, furnishing intelligence to President Hayes that would lead to the president sending troops to certain sites of demonstrations. Sandlin, Storm Kings, 122.

of weather and lighting conditions. The arrival of the electronic telegraph led to the Signal Corps phasing out the wig-wag as a communication technique.[27] During this transition, however, Finley offered an improvement to his commander's wig-wag system with his own invention, the heliograph. This instrument would reflect sunlight with mechanically controlled flashes, replacing the bulky equipment of multiple flags for multiple conditions with one portable, off-grid device. Where other communication infrastructures were composed of a chain of linearity—and thus limited by speed (a courier on horseback) or by location (a train's tracks)—the wig-wag and the heliograph implied a horizontal field, defined by mobile points of reference. These communication systems overcame distance via portability and visibility, describing a territory through the logic of the relay, as information was sent from one point to the next without much significance placed on the in-between. With the distributed probability of a tornado's occurrence across a vast field, the requisites of portability and visibility in military communication technologies would translate to techniques for tornado chasing, for both Finley and storm-chasers today.

The emphasis on visibility lends significance to the figural qualities of the sender and receiver of the signals, either presenting a frontal elevation to the other. The changing profile of that figure carries the message ("enemy advancing" or "retreat to the south"), messages that condense the complex narratives of strategy and field into an urgent minimum of moves. The wig-wag translates a constantly changing milieu into a direct, symbolic language that can be learned, and it was a similar act of translation that Finely performed on the tornado, to him an enigma only until its signs and signals could be properly read.[28] Directly after joining the Signal Corps in 1877, he began his "systematic study of the storms of the United States, especially those of a violent character, namely tornadoes."[29]

In Finley's 1888 pamphlet, Tornadoes: What They Are, and How to Escape Them, he draws from his own observations and a collection of first-hand accounts to define the typical characteristics of tornadoes. The pamphlet is instructional, guiding the reader in how to recognize weather patterns that portend tornadoes, track the formation of the tornado cloud itself, and predict their movements. It is as if he is explaining how to "read" a tornado as an organized body of legible signs. (At this

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[27] Joseph Willard Brown, The Signal Corps, U.S.A. in the War of the Rebellion (Boston: US Veteran Signal Corps Association, 1896), 94–96. The universal time enabled by the telegraph would enable simultaneous weather data across multiple locations, a crucial step in meteorology.

[28] John P. Finley, The Special Characteristics of Tornadoes: With Practical Directions for the Protection of Life And Property, Signal Service Notes 12 (Washington, DC: 1884), 7.

[29] Sandlin, Storm Kings, 120.

time, he had not observed a tornado himself.[30]) This knowledge could mean the difference between bodily harm and safety: "How can people save their lives or avoid terrible injuries? In regard to this, much, if not everything, depends upon the manner and direction a person moves, together with the distance of the tornado cloud, its direction, and the kind of motion prevailing at the instant one determines upon changing his position."[31]

Survival here is a matter of one's strategic and instantaneous positioning on a Cartesian plane. Other than cardinal directions and the moving reference point of the tornado, what other information does an observer have time to process? Here Finley changes his address from "an observer" to "you" to describe possible configurations: "Assuming the average width of the destructive path of the tornado cloud to be forty rods and your position at the centre of that path, it will be seen that you have fifteen seconds in which to reach the outer edge of the path to the north (a distance of twenty rods) before the tornado cloud could arrive at your location." His hypothetical scenarios call to mind a map—a plan view in which the observer's position is plotted, and information is relayed as straight lines between that observer and his or her environment. The changing profile of the tornado cloud, directionality of wind-blown debris, and the calculated vector insisting that you run...

While there is a touch of the absurd in these didactic scenarios, tactical descriptions pervade his writing about tornadoes, including advice for community preparedness. <u>The Special Characteristics of Tornadoes: With Practical Directions for the Protection of Life And Property</u> (1884)[32] includes recommendations on reinforcing homes, building tornado shelters, and even selecting which corner of one's basement to take shelter.[33] Moreover, he advises that every citizen learn the "premonitory signs" of tornado activity, which he outlines in detail. Consolidating quotes from numerous eye-witness accounts, he summarizes these signs according to four categories: the colour and peculiar character of storm clouds ("They were the worst looking clouds I've seen, perfectly awful..."); their movement and behaviour ("The clouds appeared to be boiling up like muddy water..."); sensed weather conditions ("There was not a breath of air stirring..."); and time of day.[34] All should be vigilant, and anyone can raise an alert. Finley envisions a system for severe weather prediction and early

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[30] Ibid., 125.

[31] John P. Finley, <u>Tornadoes, What They Are, and How to Escape Them</u> (1888).

[32] Finley, <u>The Special Characteristics of Tornadoes</u>, 8–9.

[33] These section headings include: "Building Sites," "Dug-outs," "Protection of Life," "Protection of Property," and "Protection in an Emergency." Ibid., 13–18.

[34] Ibid., 7–9.

alerts that is disaggregated, coupling on-the-ground intelligence from citizen observers with meteorological expertise who had a "panoramic view" of conditions via the consistently updated weather map.[35] This vision extends the U.S. Signal Corps' motto, "Pro Patria Vigilans" or "Watchful for the Country," from a matter of national security to that of public preparedness.

Finley studied tornadoes until the first part of the twentieth century, developing experimental techniques for forecasting, including coordinated daily measurements taken in eighteen observation districts that he subdivided the country into. At this time, forecasts were known as "predictabilities," though his system for anticipating tornado weather favoured probability over prediction. Each district would be given a number that represented either the probability that a tornado would occur or the probability that a tornado would not occur.[36] Even in favourable weather, all known locations were described in terms of the relative likelihood of an infrequent meteorological phenomenon. However, Finley's forecasting work met resistance during a period when the U.S. government shifted weather monitoring from military to civilian control. It was Finley's commander William Hazen who, in 1885, initiated the ban on the use of "tornado" in public forecasts, stating that even when Finley had significant certainty, the word would inspire undue alarm. Instead, Hazen suggested the phrase: "violent local storms."[37] The Boston Weather Bureau meteorologists who sat debating the wording of the morning forecast on 9 June 1953 had to choose between similar categories of risk. With superior techniques for determining the likelihood of a tornado, their chosen language of prediction revealed the power of precedent, where causing general panic among listeners represented a greater danger than the weather events being forecast.

Geographies of Risk

Tornadoes can occur anywhere on the planet, but the majority of documented tornadoes are within the United States, at an average of 1,000 per year. Of those, most occur in the central part of the continent known as Tornado Alley.[38] One explanation for North America's disproportionate claim is that the continent spans a climatic zone most prone to the conditions that spawn tornadoes. Generally speaking, warm air carried up from

[35] Ibid., 7.

[36] Sandlin, Storm Kings, 139–140.

[37] Ibid., 157–158.

[38] Howard Bluestein, Tornado Alley: Monster Storms of the Great Plains (New York: Oxford University Press, 1999): 7–8. See also the NCDC's website on Tornado Alley: www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/tornado-alley.

the Gulf of Mexico and cooler air heading eastward from the Rockies and southward from Canada, all meet in the flat region just west of the Mississippi river. This atmospheric mingling gives birth to "supercell thunderstorms,"[39] especially in warm, humid months.

In statistical terms, the boundary of Tornado Alley is an isometric gradient. A map plotting the frequency of tornadoes per year per 10,000 square miles shows a vertical zone highlighted from Texas and into Nebraska, an "alley" stretching south to north. But there are smaller islands of equal intensity in southern Mississippi, central Florida, the flat, eastern half of Colorado, and areas of Illinois and Indiana.[40] These areas are not contiguous, but by some combination of topography, climate, and record-keeping, they make up a unified territory of equivalent risk. This is based on statistical measures that rely on specific frames of reference, so that measures of frequency or intensity by other measures may yield different geographies of risk. The United Kingdom, for example, records more tornadoes per total land area than the sprawling United States. However, these are typically weak and rarely newsworthy.[41] Tornadoes are less frequent in Bangladesh than America's Tornado Alley, but the risk there is greater if assessed in terms of human lives lost rather than monetary damage.[42]

In an allegorical sense, Tornado Alley is a nowhere. Encompassing much of "flyover country," it is a less densely populated region than the rest of the country, made up places whose names are often unknown to the world until a disastrous event occurs. If documented tornadoes are the ones that intersect with human life, then those that give this region its reputation are the more destructive storms. This allegorical Tornado Alley is predicated upon an extensive landscape that is flat and without qualities. Finley's Cartesian landscape, where tornado aggressor and human observer play out hypothetical scenarios, seems derived as an average of numerous landscapes found in the American central plains. His fields of probability seem to map onto the gridded territories partitioned by the public land survey.[43] Abstracted into exchangeable parcels, this nowhere land consolidates numerous weather experiences into a singular place, a durable figure in the narrative that accounts for America's less predictable weather. In this way, Tornado Alley partitions the country according to a geography of risk,

[39] For a simple definition of supercell thunderstorms, see the "Glossary of Meteorological Terms" compiled by the American Meteorological Society: http://glossary.ametsoc.org/wiki/Supercell.

[40] The map's caption reads: "Frequency of occurrence of tornadoes (1950–1976) in the United States as number per year within a circle of radius of one degree of latitude-longitude. A maximum of 10.5 is located in central Oklahoma." Bluestein, Tornado Alley, 7. This means that within an area of about 50 miles in diameter, over 10 tornadoes were documented per year, on average, from 1950 to 1976.

[41] National Climatic Data Center (NCDC), NOAA, October 2014, www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

[42] Grazulis, Tornado Alley, 264-282. Grazulis includes several ways of calculating risk from tornadoes, alternately focusing on measures such as risk of property, risk of life, deaths per million people, etc. An unusual metric is his own "State-by-State Average Occurrence Interval," by which he ranks all states east of the Rocky Mountains by the statistical frequency someone in that state would be likely to encounter a tornado in his or her life. Mississippi ranks number 1, at once in 2,140 years. Compare that to New York at number 31, with a chance of encounter at once in 19,300 years.

[43] Brown, The Signal Corps, U.S.A., 125–126. Finley traveled over 500 miles surveying sites of tornado damage in 1879. He complained that his site observations were slowed down by the weather.

June 10, 1953; Shrewsbury, Massachusetts.

enclosing an inside where probability is high and an outside where possibility is negligible. While statistically meaningful, this separation of risks helped to reinforce the narrative connecting the tornado outbreak and atomic testing in 1953. Two accounts of “freak weather” occurred in two presumed exteriors: the not-Alley of the Northeast and the non-site of the Nevada desert. These events came together via the shared inside of global weather.

The Architecture of Geophysical Experiment

A photograph taken the day after the 9 June outbreak shows a young Senator John F. Kennedy, flanked by two healthy teens, walking amidst the debris of Shrewsbury, Massachusetts. Behind them rises the crumpled half-ruins of homes and an uprooted tree, and in the foreground lies an undistinguishable pile of building fragments. The architecture here is scenographic. Evidence of the destructive capacity of tornadoes, it forms a backdrop in front of which the assuring figure of the president-to-be stands to convey the nation's empathy for the storms' victims.

When placed within the path of a tornado, architecture is a materialization of readiness and aftermath. The moment of collision between vortex and physical structure is too brief and too unlikely to be directly observed, but the measure of its force is told by the extent of damage done to the physical structure. Ted Fujita, developer of the Fujita scale of tornado intensity, catalogued images showing buildings at various states of demolition according to the scale of a tornado's intensity.[44] Like an apocalyptic play on Ed Ruscha's parking lots, the serialized aerial views show a range of scenarios, from roofs with missing shingles to the ghosted remains of a building plan. A similarly systematic approach to imaging and measuring the impact of nuclear blasts on architecture required the production of full-scale models. "Survival Town, USA" is the (rather sardonic) name given to the mock American townscape constructed one mile from the Yucca Flats test site.[45] Film documentation shows buildings and electrical poles being swept over by an invisible gust of horizontal force followed by dust and smoke. One small mannequin shakes beside a window, and another disappears from beneath a piece of concrete propped diagonally against the side of a larger structure.[46] In addition to promoting building practices better suited to numeric thresholds of wind, these photographs link sensible evidence to systematic measures of intensity. In Fujita's photographs, the buildings become unintentional evidence of natural force, imaging a weather event that itself resists systematic imaging. The "Survival Town" film documents architecture built as an experimental double of life. A news report on the tests states: "Inspections made so far appear to show that there is a certain amount of hope for survival—even within a mile of the explosion—inside a really thickly-built, indoor concrete shelter." This argument for hope amidst a fearsome technology rests on its resemblance to a naturally occurring force. The report continues: "The main street of 'Survival Town' looked as though it had been struck by a natural tornado instead of a man-made atomic device, three of the five houses in the central area of the mock American community being smashed to rubble by the last wave of a detonation equal in potency to 35,000 tons of T.N.T."[47]

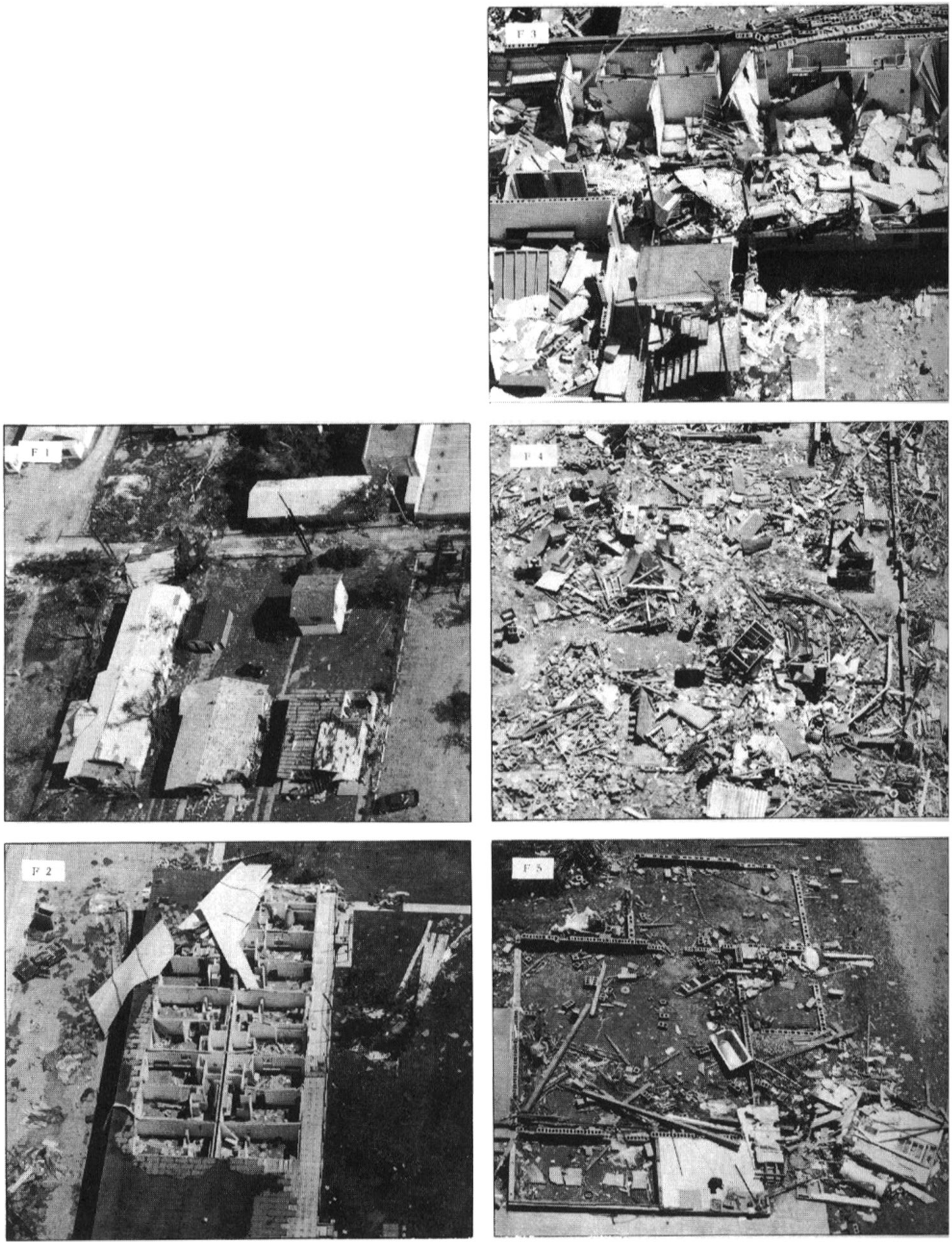
The June tornadoes were a premonitory display of the outcome that Americans feared most, and the architectural

[44] Grazulis, Tornado Alley, 130–142.

[45] "Concrete Is Only Atomic Safeguard," The Irish Times, 7 May 1955.

[46] "Survival Town" Atom Test, Newsreel Footage (1955), YouTube, youtu.be/W9wohRyu46k.

[47] Ibid.



Taken in Lubbock, Texas by Tetsuya Fujita for the National Weather service, these photographs demonstrate the original Fujita damage scale, from F1 (top left) to F5 (bottom right).

scenography of their aftermath as distributed by news reports conjured scenes of another menacing danger. The images showing Northeastern towns wrecked by "freak weather"—and the national government's quick and public attention to these sites underscored that these tornadoes were freakish—supplied a template onto which the nuclear imaginary could be projected. (The reporter's description of post-blast Survival Town as the site of a "natural" weather event shows this type of associative imagining.) However, when the Worcester tornado struck, there was more regulated education and campaigns for public preparedness for an atomic bomb attack than for tornadoes. The first nationally distributed educational film about tornado preparedness appeared in 1956, well after a number of public education films for atomic attacks had been produced. One example from 1951, Atomic Alert, features a sequence of exterior shots showing children running for cover between air strikes.[48] The townscape of rubble piles, collapsed building façades, and cars crushed by trees provides a convincing backdrop for the children's controlled panic. Recalling Finley's rarefied space of tornado dynamics and escape routes, the background that flashes by in the film is rendered with much detail and materiality; its realism makes sensible the unseen threat. What models furnished the filmmakers with this particular image of aftermath, and what was the real-world location that matched this architectural imaginary?[49] In different ways, these imagined spaces of encounter, the featureless field and the American Main Street, are exchangeable; they could be anywhere, suggesting that no one is immune from the possibility of an encounter.

The fear that the release of nuclear energy might be causing a chain of atmospheric events was tied to the sensible symptoms of localized weather. The tornado, already a more obscure type of climatic event, carried with it the possibility of unknown modifications to the atmosphere. Tornado debris and dummy town, funnel cloud and mushroom cloud, the nowhere of Tornado Alley and the anywhere of a nuclear America: the tornado and a-bomb were twinned in mid-century America's sociotechnical production of climate knowledge. Guarding both climate information and desert test sites, the realm of experts was not a trusted source of the whole story. Yet the possibility that there could be a true and total narrative persisted, inspiring links between atmospheric events separated by hundreds of

[48] Atomic Alert (Encyclopaedia Britannica Films, 1951), Prelinger Archives. archive.org/details/AtomicAl1951.

[49] Atomic Alert. This author was unable to find location information for the production of this educational film. One comment from an online discussion suggests the location was a scene of a "riot." However, the level of structural damage that buildings in the scene exhibit make that unlikely. A tornado hit downtown Richmond, Virginia in 1951, the year this film was released. This is also an unlikely location given that the film's research team was based in Chicago. It is tempting to wonder...

miles. Within this context of disaster narratives and geographies of risk, architecture appears as a before or after condition, a means for defense or hope for survival. Rather than re-inscribing these binaries, inverting the narrative could reveal “the weather” as neither normal nor anomalous. To experience weather is to be immersed in climate’s history and implicated in its ongoing production. In 1953, one journalist, weighing in on the possibility of a-bombs causing tornadoes, put it this way: “The rearrangement of the world’s climate was already in progress.”[50]

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[50] Sherman, “Do Atom Blasts Change Weather?” B5.