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103. Such gymnosperms as *Agathis*, *Phyllocladus*, and *Dacrydium* presumably entered New Guinea in the upper Oligocene or Miocene and subsequently crossed Wallace's line.
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The Tornado Threat: Coping Styles of the North and South

Tornado death rates in Illinois and Alabama may be related to the psychology of their residents.

John H. Sims and Duane D. Baumann

Fortunately for the majority of Americans, their most vivid image of a tornado derives from their memory of the dark twister weaving across the plains of Kansas in the film *The Wizard of Oz*. But unfortunately for those living in certain areas of the North and South, the awesome force of the tornado is a very real presence (*1*). In these locations, the announcement of the tornado watch or the tornado warning are familiar spring messages (*2*). The kind of response made to these messages may determine the extent of physical injury an individual suffers or, indeed, whether he lives or dies. This article is concerned with the differences in human response to the threat of tornadoes and with the psychology affecting the nature of those differences, in order to attempt an explanation of a puzzling phenomenon—the disproportionately higher frequency of tornado-caused deaths in the South.

We begin with this fact: the number of tornado-caused deaths in the South is strikingly higher than it is in the remainder of the nation. This is best documented by Linehan (*3*, *4*): "Compared with all others, Region I [the South] is characterized in superlatives. In every tornado-death attribute selected, Region I outranks each of the other three, usually by a very wide margin. . . . Region I has nearly 12 deaths per 1000 square miles, more than three times the comparable figure for the next ranking region; its 23 deaths per 100,000 inhabitants is over five times greater." What makes this phenomenon perplexing is the difficulty encountered in explaining it. The most ready explanation for this concentration of deaths is that the South experiences more tornadoes or has a higher population density, or both. In effect, it is suggested that the highest potential for casualties is in the South.

Yet when Sadowski's geographic distribution of casualty potentials is compared to the geographic distribution of actual tornado deaths, the two patterns fail to coincide (*5*). On the contrary, whereas the highest incidence of tornado-death days (*6*) is in the South (Fig. 1), the casualty potential from tornadoes is found to be highest in a zone running from Dallas, through

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Topeka and Chicago, to Detroit (Fig. 2).

For a more precise expression of this contradiction, we derived, for each county, the tornado death index (TDI), a measure of the agreement between potential and actual tornado casualties:

$$\mathrm{TDI} = \frac{D/A}{(T/A)\ (P/A)} \times 100$$

where D is the number of tornado deaths in the county from 1953 to 1964 (*7*); A is the county area in square miles (1 square mile equals 2.6 square kilometers); T is the number of tornadoes in the county from 1953 to 1964; and P is the population of the county, according to the 1960 census.

These ratios are shown in Fig. 3—the larger the black circle, the closer the number of actual deaths approaches the number of potential tornado casualties for a given county. Again the disproportionately higher rate of tornado deaths that characterizes the South is illustrated, a phenomenon that differences in casualty potential (number of storms and density of population) cannot explain.

There are a number of other hypotheses available. One holds that the South may experience a greater percentage of its tornadoes during the night—the argument assumes that a tornado will have a more devastating effect on an unaware population. Five northern states were compared with five southern states in relation to the diurnal distribution of tornadoes during the years 1916 to 1961 (Table 1). Although these data do show a slightly higher proportion of nighttime tornadoes in the South, the average difference is only 3.1 percent and does not approach statistical significance. Furthermore, in Skaggs's data on the diurnal distribution of tornadoes throughout the United States (*8*), we find no pronounced incidence of nocturnal tornadoes in the South.

More specifically, although Indiana and Louisiana have virtually the same percentage of nocturnal tornadoes (Table 1), Louisiana has a much higher incidence of deaths (Fig. 1) and does so despite the fact that Indiana has a casualty potential several times greater (Fig. 2).

A second hypothesis features another characteristic of the tornado—its strength. Perhaps the South has more violent storms. The most accurate available measure of a tornado's ferocity is the length of its path. The National Weather Service keeps such records, reporting measurements that vary from

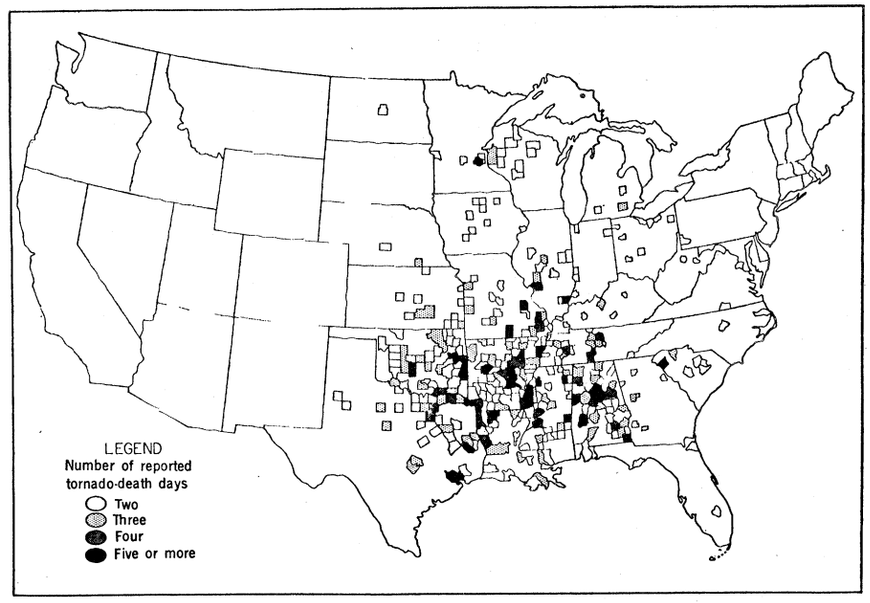

Fig. 1. Tornado-death days, by county, 1916 to 1953 [source: modified from Linehan (*3*, p. 45)].

the designation "short" (a touchdown of a few hundred yards or less), to explicit lengths ranging from less than a mile to hundreds of miles (1 mile equals 1.6 kilometers). To explore this hypothesis, we compared these data on ferocity for the tornadoes that occurred in Alabama and Illinois in the decade 1959 to 1968 (*9*).

During those years Alabama experienced 143 tornadoes. Of these, 32 percent were labeled "short," and explicit lengths were given for 68 percent. The average length for this latter group alone is 12 miles. If we add in the "short" tornadoes, estimating the length of each at a tenth of a mile, the average length of path decreases to 8.2 miles. The analogous figures for Illinois follow: the state experienced 219 tornadoes, of which 26 percent were labeled "short"; explicit lengths were given for 74 percent; the average length for this latter group is 12.6 miles; adding the "short" tornadoes decreases the average length of path to 9.3 miles.

Clearly, by this measure, tornadoes are not more violent in the South: Alabama had more short tornadoes, fewer long ones, and, no matter how it is figured, the average length of path of the Alabama tornado was shorter than

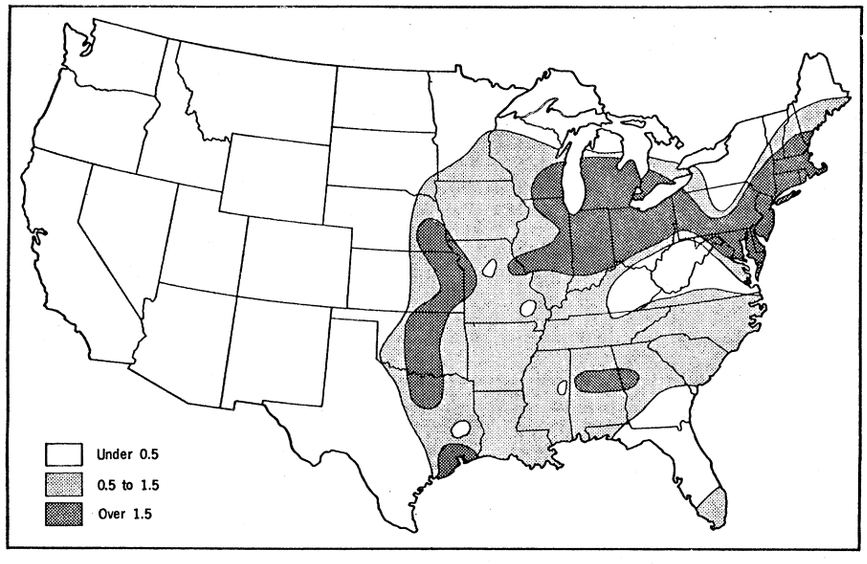

Fig. 2. Potential casualties from tornadoes (per square mile), 1916 to 1961 [source: modified from Sadowski (*5*)].

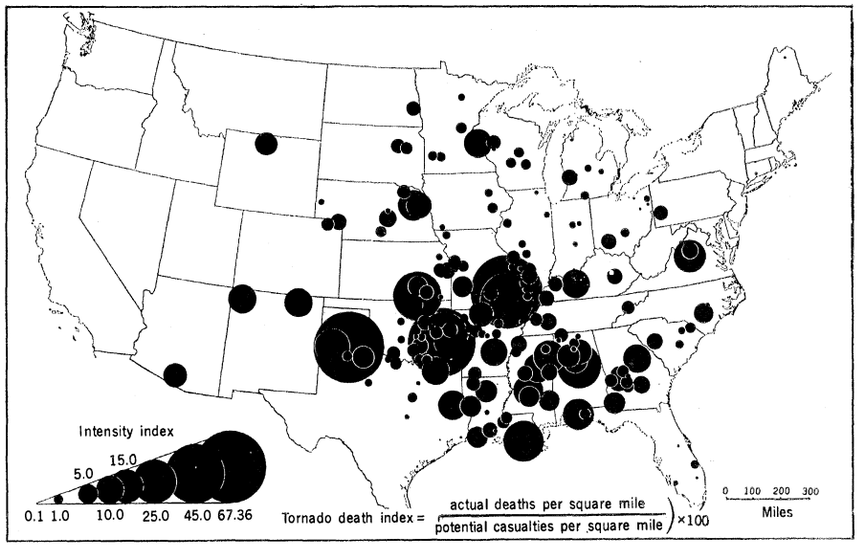

Fig. 3. Tornado death index, 1953 to 1964.

that of the Illinois tornado. Not only does Alabama experience fewer tornadoes, the evidence suggests they are of lesser violence.

Another set of hypotheses shifts the focus from variations in the characteristics of tornadoes to variations in the human environment. A frequently mentioned example stresses the kind and quality of housing in the South. It is well established that housing in the South is less substantially constructed (*10*). The question is, Is it therefore more vulnerable to tornado damage and thus more dangerous? Flora is convinced that it is (*11*): "the high death rate from tornadoes in the Deep South is undoubtedly due to a large extent to the fact that it is not necessary to construct buildings as sturdily there as in cold northern states." On the other hand, Bigler's analysis of tornado damage argues that the issue is not so clear-cut (*12*).

> In studying damage to structures, two general modes of collapse, one typical for frame houses, and the other for masonry structures, could be distinguished. Masonry buildings responded to the internal force caused by the pressure reduction outside of the building, which pushed the walls outward and allowed the roof to fall in, while frame houses with more ventilation and therefore more possibility for equalization of pressures, showed rather the struggle to resist the sheer driving force of the wind. In the latter, the roofs were ripped off by wind motions, and the walls blown over and strewn along the tornado path. Masonry walls, exhibiting more rigidity, acted as a unit and were pushed over at once, *while frame construction could give and was therefore not so frequently seriously damaged* [italics added].

This argument quite reasonably allows for the possibility that the greater frequency of substandard houses in the South results in their sustaining less damage from tornadoes than do the more solidly constructed houses in the North.

A similar point is demonstrated most forcefully by Fujita in a paper on tornado "suction spots," those areas in which the wind forces and pressure drop are most concentrated. He presents a photograph of three adjacent structures, all of which were in the direct path of a tornado (*13*):

> . . . three buildings with increasing structural strength; a wooden shack, a frame house, and a block church. After the passage of the tornado, the damage to these three structures was exactly opposite to what would be expected from constructural strength. The block church was 90% destroyed, the frame house had damage to the roof and broken windows, while the wooden shack that could have been easily destroyed by 100 mph winds was nearly free of visible damage.

At the very least, these arguments make it clear that no easy generalization relating housing type to tornado casualties is possible. The problem must await further evidence.

Finally, there is the question of possible differences in the quality of warning systems; the nature and coverage of tornado alert systems may be inferior in the South, compared to other areas in the United States with equal or higher potential tornado casualties. However, prior to 1952, no community had the benefit of the nationwide warning system; yet then, as now, the South recorded the greatest frequency of tornado-caused deaths (*3*). And, since 1953, the forecast information from the Severe Local Storm Center in Kansas City has been available to all communities (*14*).

Of course, the efficacy of a warning system is not only a function of the quality of its emission. To be effective, a warning must be heeded. It is this consideration that draws the search for explanatory variables away from factors external to man, toward man himself—that is, to man's perception of, and response to, the tornado threat. For example, in a study of the warning system in Indiana, Brouilette accounts for the increasingly poorer and slower response to forecasts as follows (*15*).

> Tornado forecasts are rather frequent in Indiana and each concerns a very large area, in the order of 20,000 to 30,000 square miles. The chance that funnels will develop over any given area is extremely small and the probability that a damaging tornado will strike is even more remote. It would be extremely difficult to get the general public to stop whatever they are doing when a tornado forecast is announced and to take precautionary measures . . . the Weather Bureau and other tornado-warning disseminators too often assume a simple stimulus-response type of communication to be adequate. This fails to take into account the effect of a person's past experience on his interpretation of the alert.

Of course, it is not only past experience that affects an individual's interpretation of a forecast. Adams has shown that, because most people want to think of themselves as being safe, any ambiguity in their environment will be interpreted as evidence for the best (*16*). On the other hand, according to Hudson, anxiety-high persons will perceive events in the environment as confirming their anxiety (*17*).

These examples illustrate the general and well-established fact that man's confrontation with his physical environment is influenced not only by the facts of that environment, but by his ideas and feelings about it, and that these, in turn, are influenced by his personality and culture. Could it be, then, that such factors might be involved in accounting, at least in part, for the disproportionately higher incidence of tornado deaths in the South?

For purposes of our study, this large, general question was reduced to a small, specific scale. A brief sentence completion test of 15 stems was designed for two purposes: first, to identify the various ways people cope with the threat of a tornado; and second, to

get a measure of a single psychological dimension—the extent to which an individual feels he controls his own life, generally referred to in psychology as "internal versus external locus of control."

It was our judgment that the sense of being autonomous versus the sense of being directed by outside forces was an aspect of personality that promised to be particularly relevant to the question of how responses to tornado threat vary by geographic area. On the one hand, internal versus external control has been found to be related to general coping style. Studies report that "internals" exhibit more initiative in their attempts both to achieve goals and to control their environments, whereas "externals" appear to be more anxious, less able to respond constructively to frustration, and less concerned with achievement than with the fear of failure (*18*). On the other hand, internal versus external control has also been found to be related to variation in sociocultural groups. Graves (*19*), for example, found differences among Ute Indians, children of Spanish-American heritage, and whites in the same community, and a number of studies have found consistent differences among groups drawn from various socioeconomic levels (*20*). Thus, the psychological dimension of internal versus external control seemed germane to both aspects of our question—variation in response to tornado threat and variation in cultural group, represented here by Northerners and Southerners.

The sentence completion test was administered to a total of 57 respondents, 33 from four counties in Illinois, 24 from four counties in Alabama. All are white females, between the ages of 31 and 60, with at least an elementary school education, and from households with incomes ranging between $5,000 and $10,000 (*21*). Within each state, the four counties were selected for comparability in respect to past occurrences of tornadoes, potential casualties, and occurrence of tornado-caused deaths.

We used Sadowski's method to calculate the potential casualties per square mile, using county data from 1916 to 1961. The tornado casualty potential for the counties in Alabama is 0.30 per square mile, for those in Illinois, 0.59. The tornado death index for the counties in Alabama is 0.06 per square mile, for those in Illinois, 0.03. Thus, although the area in Illinois has a higher potential, the area in Alabama shows a higher tornado-death rate (compare Alabama and Illinois in Figs. 2 and 3).

Table 1. Percent of nocturnal tornadoes (8 p.m. to 7 a.m.), 1916 to 1961 (source: U.S. Weather Bureau, Silver Spring, Maryland).

State	Nocturnal tornadoes (%)
North	
Illinois	27.2
Indiana	34.4
Iowa	26.8
Missouri	35.3
Ohio	29.3
Average	30.6
South	
Alabama	36.7
Arkansas	37.0
Georgia	30.3
Louisiana	34.2
Mississippi	30.6
Average	33.7

Of the 15 sentence stems used, statistically significant differences between Illinoisan and Alabamian respondents were found in the completions to eight (*22*). Three of these deal directly with the issue of internal-external locus of control; they will be considered first. The other five completions deal with behaviors specifically related to the tornado experience, although they too are implicitly germane to the question of autonomy.

The first stem to be discussed is "As far as my own life is concerned, God . . ." (Table 2). Although about a quarter of the responses of both groups are idiosyncratic, the majority can be grouped into two major categories: there are those who see God as playing an active, participatory role in their lives; and, there are those who see God as a benevolent, protective presence who wards off harm or evil and makes one feel secure, but who does not "interfere" with one's life. This latter conception of God is congruous with a sense of autonomy, of self-direction, of controlling one's own life. The former conception of God, on the other hand, explicitly acknowledges a force other than self that is actively involved in determining the direction of one's life.

The Illinoisans divide themselves about equally (36 percent and 30 percent, respectively) between these "controlling" and "noninterfering" images, whereas 59 percent of the respondents from Alabama identify God as an active agent and only 8 percent identify Him as a benevolent but definitely background figure. These data suggest that Southerners place more weight than Northerners on a force external to themselves—God—as a causal agent in their lives. They consequently feel themselves to have relatively less power in the determination of their own futures.

In their completions to the next stem shown in Table 2, "I believe that luck . . . ," five times as many Alabamians (29 percent) as Illinoisans (6

Table 2. Sentence completions measuring internal-external locus of control.

Sentence stem and response	Respondents (%)	
	Illinois ($N = 33$)	Alabama ($N = 24$)
As far as my own life is concerned, God . . .		
Is active in it: for example, "controls it"	36.0	59.0
Is a protective presence: for example, "watches over me"	30.0	8.0
Other	25.0	25.0
No answer	9.0	8.0
Total	100.0	100.0
I believe that luck . . .		
Is of major importance: for example, "is very important to me"	6.0	29.0
Is of minor importance: for example, "plays only a small part in my life"	27.3	17.0
Doesn't exist: for example, "there's no such thing"	21.2	8.0
Other	36.4	42.0
No answer	9.1	4.0
Total	100.0	100.0
Getting ahead in the world results from . . .		
Religious-moral power: for example "doing good works," "God willing it"	9.0	46.0
Work: for example, "hard work"	67.0	29.0
Other	12.0	12.0
No answer	12.0	13.0
Total	100.0	100.0

percent) identify luck as a major force in their lives. On the other hand, more Illinoisans see luck as playing either a minor role or none at all. These differences in attitude toward luck are in agreement with the previous distinction. Formerly, it was the Southerners who saw God as an external force participating actively in their lives. Here, another external force—luck—is similarly acknowleged. Again then, there is the consequent lessening of self-sovereignty, of control of one's own future.

The next data in Table 2 complete this argument. There, in their completions to the stem "Getting ahead in the world results from . . . ," the Alabamians again emphasize their belief in a future controlled by an external force; 46 percent see success as coming either directly from God, or indirectly from God via moral behavior. Less than a third of the Alabamians see success as resulting from their own efforts. In direct contrast are the respondents from Illinois, two-thirds of whom are believers in the Protestant Ethic—success results from hard work, one form of the more abstract conviction that one's future results from what one does himself.

This stem, touching as it does upon the issue of achievement, calls attention to what might be called the other side of the coin of autonomy—namely, a belief in one's efficacy. Belief in one's ability to control the future requires confidence that what one does will have an effect, will make a difference, will bring about a chosen end. The Illinoisans' emphasis on work reveals not only a belief system in which self can make choices, but in which self can successfully manipulate reality to effect those choices.

Three of the five stems dealing with aspects of the tornado experience focus on conditions before a tornado strikes. They are (i) "During the time when a tornado watch is out, I . . ."; (ii) "The best way of identifying 'tornado weather' is . . ."; and (iii) "The job done by the weather bureau in forecasting tornadoes . . . ."

In their completions to the first of these stems, "During the time when a tornado watch is out, I . . . ," Illinoisan and Alabamian respondents differ in several important respects (Table 3). First, they differ regarding the preferred mode of informing themselves on how a possible crisis is progressing. Alabamians favor the method of using one's own senses—they "watch the sky" or "look at the clouds." In direct contrast, Illinoisans keep themselves informed of the impending crisis by way of the media—they "listen to the radio" or "watch on TV."

At least two factors may be involved in these different preferences. First, it is not just metaphorical to speak of the mass media as extensions of one's eyes and ears. It is a characteristic of modern man's psychology that technology is incorporated as a part of self; like information obtained from reading, information acquired from the communications media is standard equipment for coping with reality. To watch the sky rather than listen to the radio, rather than tune in to the social system of information, can be considered psychologically anachronistic.

A second factor that may be at work here is the differing attitudes toward technology and authority, as manifested in the mass media's communicating the dicta of the weather bureau (National Weather Service). That is, implicit in their reliance on radio and television is the Illinoisans' trust in technological expertise, in the authority of science, and, indeed, in man's organized, social power to confront and cope with (if not conquer) nature. But each Alabamian is on his own and faces the whirlwind alone with his God.

This same stem, "During the time when a tornado watch is out, I . . . ," yields minor, but consistent, difference between the two groups: respondents from Illinois, with about five times the frequency of those from Alabama, take specific actions during a tornado watch —for example, seeking shelter, taking precautions, or alerting others. Such

Table 3. Sentence completions measuring responses to the tornado experience.

Sentence stem and response	Respondents (%)	
	Illinois ($N = 33$)	Alabama ($N = 24$)
During the time when a tornado watch is out, I . . .		
Am attentive to weather conditions: for example, "watch the sky"	9.1	29.0
Am attentive to news media: for example, "watch the news on TV"	24.2	0.0
Take action: for example, "alert others"	18.2	4.0
Other	21.2	17.0
No answer	27.3	50.0
Total	100.0	100.0
The best way of identifying "tornado weather" is . . .		
Using technology: for example, "listening to the radio," "the barometer"	42.4	4.0
Using one's own senses: for example, "the shape of the clouds"	9.1	33.0
Other	30.3	25.0
No answer	18.2	38.0
Total	100.0	100.0
The job done by the weather bureau in forecasting tornadoes . . .		
Is first-rate: for example, "excellent"	46.0	12.5
Is good: for example, "OK"	24.0	41.7
Is fair: for example, "not too bad"	21.0	16.7
Other	6.0	12.5
No answer	3.0	16.6
Total	100.0	100.0
The survivors of a tornado . . .		
Require assistance: for example, "need to be helped"	24.3	8.0
Experience negative emotions: for example, "feel terrible"	3.0	21.0
Are fortunate: for example, "are lucky, it could have so easily been them"	36.4	25.0
Other	12.1	12.5
No answer	12.1	12.5
Total	100.0	100.0
A community's response to the disaster of a tornado . . .		
Is to give assistance: for example, "is to help the needy"	55.0	79.0
Is seen as psychological: for example, "brings people closer together," "it brings out the curious"	21.0	0.0
Other	9.0	13.0
No answer	15.0	8.0
Total	100.0	100.0

efforts are congruent with that sense of efficacy we have already pointed out.

The second stem (Table 3) that deals with pre-tornado conditions is "The best way of identifying 'tornado weather' is . . . ." Again, we see the acceptance of technology almost exclusively in the Illinoisans: 42 percent of them, as against 4 percent of the respondents from Alabama, either identify the effectiveness of the media (for example, listening to the radio), or touch upon variables that figure in scientific explanations of tornadoes (for example, changes in barometric pressure). On the other hand, the Alabamians again speak primarily in terms of what their own eyes can see (for example, darkness of the clouds).

The next stem of this set is "The job done by the weather bureau in forecasting tornadoes . . ." (Table 3). Two-thirds of the Illinoisans rate the weather bureau as "good" or better; in contrast, only half of the respondents from Alabama do so. Further, almost four times as many Illinoisans as Alabamians evaluate the weather bureau as first-rate. The trust in expertise (technology fused with authority) felt by those from Illinois is again clearly far greater than that felt by those from Alabama.

The final two stems deal with a different situation—the aftermath of a tornado (Table 3). The first of these is "The survivors of a tornado . . . ." The completions to this stem by the respondents from Alabama are preponderantly affective. They stress either negative emotions (portraying the survivors as distraught or grief-stricken) or positive emotions (portraying the survivors as grateful and happy to be alive). In contrast, most Illinoisans are either coping-oriented and emphasize the survivors' need for aid, or, interestingly, portray the survivors as "lucky"; that is, they see survival as a matter of chance and not as a matter of fate or of God's will, a very different definition of luck from that of the Alabamians (*23*).

The second stem focusing on what happens following a tornado is "A community's response to the disaster of a tornado . . . " (Table 3). This presents a situation that is less temporally immediate and that shifts from an individual to a social perspective. Here the majority of both groups define the community's response as one of helping those in need. What differentiates the two groups is a response category unique to the Illinoisans—20 percent of them are sufficiently removed from the shock experience to give responses that comment objectively on psychological phenomena (such as noting that disaster unites people or that it brings out the curious).

We have argued that the completions to the three sentence stems presented in Table 2 reveal Illinoisans to be more autonomous, more prone to see themselves as responsible for directing their own lives, and more confident in their own efficaciousness. On the other hand, Alabamians are seen to be more heteronomous, feeling themselves to be moved by external forces—fate, luck, and, particularly, God. They are consequently less confident in themselves as causal agents, less convinced of their ability to engage in effective action.

Another series of sentence completions, presented in Table 3, dealt with aspects of the tornado experience. These also revealed consistent differences between the two groups. First, Illinoisans were, at the most general level, more action-oriented, while Alabamians were more passive. Second, Illinoisans displayed more objectivity, more rationality in reacting to a tornado disaster. Finally, and most important, the respondents from Illinois were characterized by an acceptance of technology and authority—they use the expertise of professionals in forecasting and communications when confronting the possibility of a tornado. Alabamians do not. They ignore these functions of the social system; for them, the encounter is between individual man and Nature.

Juxtaposing these two sets of findings, we find them reasonably congruous. Persons like the respondents from Illinois, who believe they direct their own lives, who believe that what they do affects their futures, go about confronting the possibility of a tornado in characteristic style. They use their heads and the technology of their society, and they take action. In the aftermath of a tornado, they would indeed see those who had escaped as "lucky" (in the sense of random, not destined), go about helping the needy, and occasionally pause to observe themselves and their fellowmen as fascinating creatures.

Persons like the respondents from Alabama, who believe that God (or fate or luck) controls their lives, who have less confidence in their own ability to have an impact on reality, to effect change, also confront a tornado in a manner that is consistent with their attitudes. They place less trust in man's communal knowledge and control systems; they await the fated onslaught, watchful but passive. In the tornado's aftermath, they feel with the victims (there but for the grace of God . . .) and then recover to perform good works.

Although admittedly based upon only a small sampling of behavior of a small number of respondents, these findings and interpretations may be relevant to the disproportionately higher death rate from tornadoes in the South. Fatalism, passivity, and perhaps most important, lack of trust in and inattention to society's organized systems of warning constitute a weak defense against the terrible strike of the tornado.

In so concluding, we are not, of course, arguing that the psychological dimension of internal-external locus of control is the sole, or even the primary, determinant of the tornado death rate. Almost certainly that phenomenon is a result of multivarious forces in combination, of which the sense of locus of control is but one. Other psychological dimensions should be explored, and certain of the traditionally considered factors, such as quality of housing and storm violence, need to be reexamined with more and better data (*24*).

Our point is, rather, to emphasize the obvious, but so often neglected (or avoided), relation of man himself to the problems of natural hazards. The data and argument presented here constitute a suggestive illustration of how man's personality is active in determining the quality of his interaction with nature.

References and Notes

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2. Two types of tornado alert have been formulated by the National Weather Service. A tornado *watch* is a probability statement concerning the occurrence of a tornado (or tornadoes) within a given area (usually between 10,000 and 30,000 square miles) and is issued at least 6 hours before the possible event. A tornado *warning* is a message denoting that a tornado is imminent and that persons should be prepared to take cover immediately.
3. U. Linehan, *Tornado Deaths in the United States* (Government Printing Office, Washington, D.C., 1957), p. 16. See also Reed (*4*), who notes: "In Arkansas one person in 44 residing in the destroyed area was killed, versus one in 407 for Iowa." Region I includes Alabama, Mississippi, Tennessee, Kentucky, Arkansas, most of Georgia, Oklahoma, and eastern Texas, and the southern part of Missouri.
4. J. Reed, *Proceedings of the Seventh Conference on Severe Local Storms* (American Meteorological Society, Boston, 1971), p. 192.
5. A. Sadowski, *Potential Casualties from Tornadoes* (National Weather Service, Washing-

ton, D.C., 1965). Potential casualties were calculated by multiplying the area of the average tornado by the number of tornadoes in a 2° square, and then dividing this sum by the area of the 2° square. This quotient was multiplied by the quotient of the population of a 2° square divided by the area of a 2° square.
6. "A tornado-death may be regarded as a 24-hour period, between an instant after midnight on one day and midnight the same day, during which one or more deaths occurred and/or during which one or more persons received tornado-induced injuries that subsequently proved fatal" (*3*, p. 3).
7. This decade was selected because, beginning in 1953, tornado data became more reliable as a result of the implementation in 1952 of a more elaborate detection network by the National Weather Service.
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21. The data analyzed here are drawn from our larger study, which involves a total sample of 420 interviews from four different areas of the country—Kansas-Oklahoma, Alabama, Illinois, and Massachusetts-Connecticut. For the particular problem addressed in this article, a sample of 57 respondents was chosen from Illinois and Alabama, controlling for education, income, sex, age, and occupation.
22. Using the chi-square one-tailed test, the differences shown in Tables 2 and 3 are significant at the $P < .05$ level.
23. Only examples of the data themselves can adequately convey the two very different meanings of "luck" used here by the two groups of respondents. Illinoisans define luck as a *random* phenomenon: for example, "The survivors of a tornado are lucky to be alive . . . it is a hit-or-miss thing"; or, "The survivors of a tornado are lucky, it could so easily have been them." Alabamians, on the other hand, define luck as *nonrandom* good fortune: for example, "The survivors of a tornado are lucky, it wasn't their time"; or, "The survivors of a tornado are very lucky, but tragedies cannot be questioned; it's all God's Will."
24. T. Fujita of the University of Chicago has developed a scale of tornado intensity that correlates wind speed with extent of property damage shown in aerial photographs. Since January 1971, state weather officials have been evaluating tornadoes according to Fujita's criterion photographs. At this time, only the data for January through April were available. As the geography of tornado occurrence is seasonal, moving northward during the late spring and early summer, it is too early to compare the North and South on this measure of storm violence.
25. This study was supported by Natural Hazards Research, a program funded by the National Science Foundation in a grant to Toronto, Clark, and Colorado universities; the program is directed by I. Burton, R. Kates, and G. White. Earlier drafts of this article were delivered at the annual convention of the Association of American Geographers, Boston, April 1971, and at the International Geographical Union Seminar on Natural Hazards, Budapest, 1971.

Information Technology: Its Social Potential

By means of cable television, an information utility could be made available to most U.S. homes by 1985.

Edwin B. Parker and Donald A. Dunn

Broadcast television is like the passenger railroad, taking people to scheduled places at scheduled times. Cable television has the potential of becoming like a highway network, permitting people to use their television sets in the way they use their personal automobiles; they may be able to select information, education, and entertainment at times and places of their own choosing.

The technologies of cable television (especially two-way cable television), video cassettes, computer information systems, and communication satellites are now at a stage that could permit the creation of an "information utility" for the purpose of fostering equal social opportunity in the United States. The unit costs of public access to information could be reduced so much that the total expenditure on information services would probably increase substantially. In the same way that the automobile led to greatly increased expenditure on transportation, and the printing press led to greater expenditure on production and distribution of information, so the newly developing technology of information accessibility will have broad social effects. The main difference between the present period of technological change and the earlier periods is that our society now has a greater opportunity to direct the development of the technology to meet positive social goals, instead of becoming the beneficiary (or victim) of uncontrolled technological change.

The greatest single potential of an information utility might be the opportunity to reduce the unit cost of education to the point where our society could afford to provide open and equal access to learning opportunities for all members throughout their lives. Total expenditures for education are unlikely to be reduced, but an information utility could make possible the provision of quality education at an economical rate to those not adequately served by the present educational system. Significant gains in economic productivity as a result of education may be the most promising way to stimulate general economic development. Denison's analysis of past sources of per capita economic growth in the United States supports such a conclusion (*1*).

The benefits of an information utility will not be attained quickly, or be guaranteed, unless there are major federal expenditures on the research and development needed for their accomplishment and some measure of coordinated planning and management of the overall system. The federal government has the continuing challenge of providing equal social opportunity for all citizens; this includes the provision of equal access to education and information, as well as the maintenance of an economy that provides equal opportunity of employment.

An information utility could be made available to every urban home and

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