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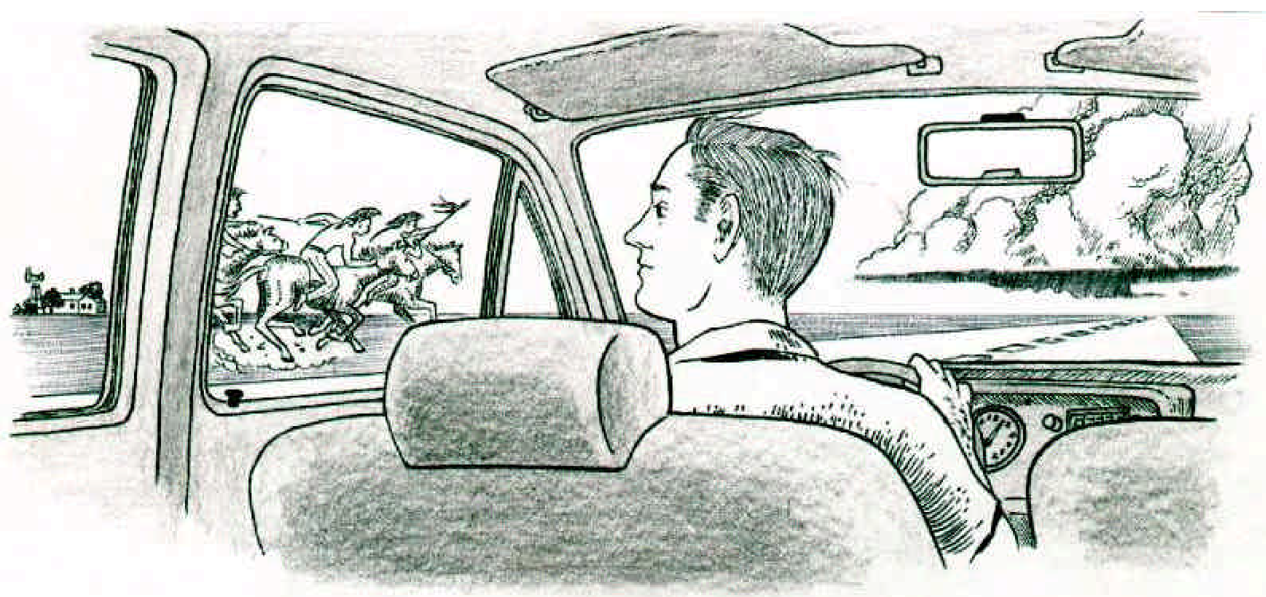
I. COMMENTARY

Why chase tornadoes? This is a question frequently asked of chasers. It is not something that can be answered while waiting for the elevator or in small conversation at a cocktail party. It touches many levels and requires a measured response to fully answer. If my experience is characteristic of most chasers, there are at least five levels at which we relate to the big storm. <u>First</u> is the sheer, raw experience of confronting an elemental force of nature, uncontrolled and unpredictable, which is at once awesome, magnificent, dangerous and picturesque. Few life experiences can compare with the anticipation of a chaser while standing in the path of a big storm, in the gusty inflow of warm-moist gulf winds, sweeping up into a lowering, darkening cloud base, grumbling with thunder as a great engine begins to turn. <u>Second</u> is the challenge to forecast accurately and consistently where these deadly storms will occur. In a field that is still very much "state of the art,," each chaser must draw upon science, experience and intuition. Every day is a new puzzle of atmospheric ingredients, different from the day before, or last week, or last year. There is no textbook for what we do, that works every time. Even the National Severe Storms Forecast Center misses some big ones (ergo Grand Island, June 3, 1980, etc.). <u>Third</u> is the sense of participation in a great event that comes with knowledge of the dynamics and structure of these storms. Knowing the turbulent mosaic of wind streams that weave over, around and through the towering thunderheads, and understanding their sources in the great rivers of air that sweep the continent, makes the observer almost become a part of that which he observes; as if by force of will he could detach himself from earth and ride the wind up into the storm's core. <u>Fourth</u> is an experience of something infinite, a sense of powers at work and scales of movement that, so transcend a single man and overwhelms the senses that one feels intuitively (without really seeking) something eternal, but ephemeral, almost a conscious thought, but just below the surface. As when a vertical 50,000 ft wall of clouds glides silently away to the east (intermittent, distant thunder) and goes golden in a setting sun against a deep, rich azure sky, one can only pause and look and wonder. <u>Fifth</u> is an associative value with each spring and each chase, bringing back memories of other storms and places, recalling the alchemy of exhilaration at your first twister, as if you had not changed or aged at all but were again young and free as the winds you followed. There is the imagination and, looking out the car window as you chase, the Arapaho, Comanche and Sioux ride again, wild and free across fenceless endless prairie. There are memories of family and friends and good times, all in a land whose only hallmark on an otherwise featureless plain are the cloud towers that march across its face. A pool of memories, reflecting the great storms and the shaping of young lives, inextricably intertwined, the one and the other.



Why chase tornadoes? You can't explain it in small conversation at a cocktail party or while waiting on the elevator. It is more, much more.

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Some of you who chase up Dodge City way this spring might be interested in hearing that Lee Stinson, the veteran KIC there for many years now, may be retiring this year. Those who know him might like to drop by and bid farewell. I have known him as a good and steady friend these many years. He shall be missed.

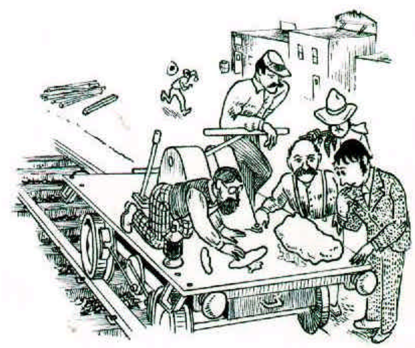
II. ROSTER

III. LETTERS TO THE EDITOR

Eighty Pound Hailstone!!!

Scientific American, 47:119, August 19, 1882

Considerable excitement was caused in our city last Tuesday evening by the announcement that a hailstone weighing eighty pounds had fallen six miles west of Salina, near the railroad track. An inquiry into the matter revealed the following facts: A party of railroad section men were at work Tuesday afternoon, several miles west of town, when the hailstorm came upon them. Mr. Martin Elwood, the foreman of the party, relates that near where they were at work hailstones of the weight of four or five pounds were falling, and that returning to Salina the stones increased in size, until his party discovered a huge mass of ice weighing, as near as he could judge, in the neighborhood of eighty pounds. At this place the party found the ground covered with hail as if a wintry storm had passed over the land. Besides securing the mammoth chunk of ice, Mr. Elwood secured, a hailstone something over a foot long, three or four inches in diameter, and shaped like a cigar. These 'specimens' were placed upon a hand-car and brought to Salina. Mr W.J. Hagler, the North Santa Fe merchant, became the possessor of the larger piece, and saved it from dissolving by placing it in sawdust at his store. Crowds of people went down to see it Tuesday afternoon, and many were the theories concerning the mysterious visitor. At evening its dimensions were 29 x 16 x 2 inches."



--- Salina (Kansas) Journal. --- Jan Curtis

(November 1959 in Coquille, Oregon)
"An unusually warm, dry, sunny month there, and very calm --until the 19th. The leaves all turned beautiful colors of brown and gold, but narry a one dropped, until the 19th. Then an approaching front brought storm force winds and a blizzard of leaves (but only 0.36" rain). The next morning was spent raking up two feet of leaves, with hardly a one left on the trees. How often does this happen?

(The exact date is not remembered but may have been February 1973 in Norman, Oklahoma)
"A morning of rain, sleet and snow gave way to intermittent light snow. At noon I noticed a line of level 3 echoes on the radar, approaching from the west. I considered going home during lunch to get my movie camera but didn't want to drive in that junk. About, 1330-1400 the line arrived; no thunder, but the flakes got bigger and bigger until they were 3" across and about an inch thick and fell like miniature parachutes only a few cm/sec. It was an unforgettable scene, but I can tell you I was utterly disgusted for not having my movie camera with me."

"November 11, 1911 (i.e. 11/11/11!) started as a beautiful Saturday afternoon to watch football at Oklahoma U. (at Norman). In fact, the temperature ture climbed all the way to 83 deg F at Oklahoma City, which was a record for that date. Suddenly the strong southerly breeze shifted to northerly, gusting to around 50 MPH, and the temperature dropped 40 deg in one hour. By midnight, it was down to 17 deg for a record low for that date. Both records still stand. Must have been a lot of unhappy football fans. . .

--- Charles Vlcek

IV. BULLETIN BOARD/COMMERCIAL MARKET -$- FOR PICTURES

V. CAMERA TIPS

VI. TRAVEL TIPS

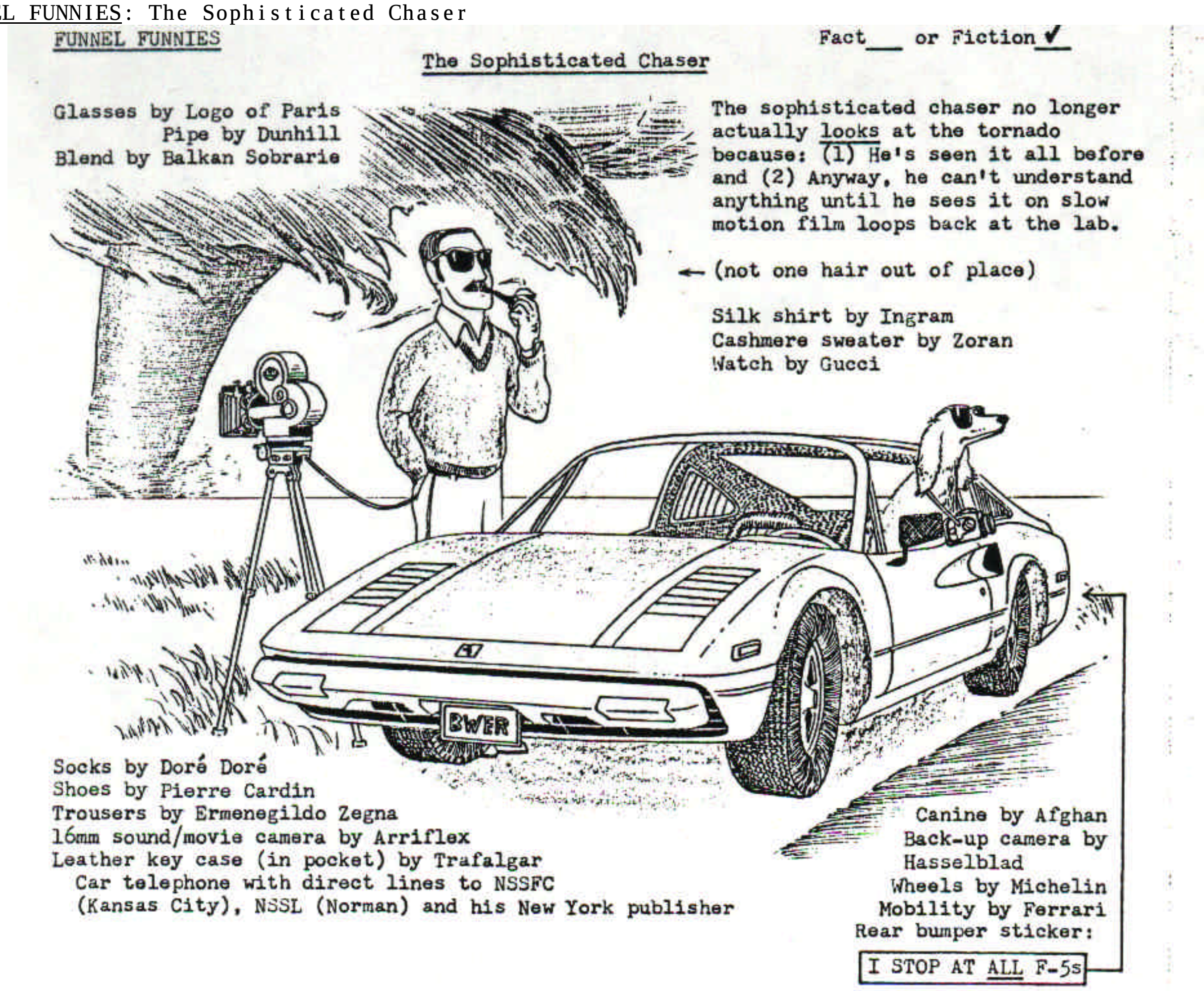
Move West or South of the Tornado

The conventional wisdom on what to do in open country when confronted with a twister is to "move away from the tornado's path at right angles" (Tornado, NOAA, Dept. of Commerce, 1970). Unlike that other spin-off of the "old time religion" that told you to go to the southwest corner of the basement, I am not aware of anyone who has challenged this advice on "moving ... at right angles." Here is my effort to amend this potentially dangerous advice. If most tornadoes occur in the Midwest and plains states, where road systems are generally laid out in north-south and east-west grids, and if most tornadoes move from the southwest, then a person north or east of a tornado who chooses to drive at a right angle to the storm will wind up driving into it half of the time! For example, if he is east of a tornado, on a north-south road, and he only remembers to drive at a right angle -and goes north, he will eventually intersect a northeast-moving vortex. He is either right or wrong 50% of the time. The same is true if he is north of the tornado on an east-west road. I appreciate that the beauty of this simple advice is that panicky people don't have to think – just react. However, I think it is fallacious and potentially dangerous.

Better advice would be "move west or south of the tornado." This makes the modest assumption that most people have a general sense of direction when out driving. It will preclude a wrong decision for this reason: If there are the only two choices, the logical person will not choose the one that takes him toward the tornado. Example: Our driver is again on a north-south road and sees a tornado to his west. He panics and thinks "Go west or south". Since he will not likely go west into the teeth of the storm, he goes south. The northeast moving vortex passes harmlessly north of him. The same case holds if he is on an east-west road, looking south at the tornado (He'll be afraid to go south, so he goes west). Although no short-hand advice like this, intended for mass consumption, can ever be exhaustive of all contingencies, it should at least provide a better chance of avoiding the most likely tornado occurrence in the most likely part of the country. Moving at right angles to the tornado can be downright dangerous!!

-- Dave Hoadley

FUNNEL FUNNIES: The Sophisticated Chaser



VII. FEATURE #1 How Close Am I?

Having seen many tornado slides shown by other chasers, I have quietly noted one characteristic common to many. Tornadoes are often reported as being closer to the observer than I would have estimated. I will concede that I was not always aware of whether a wide angle lens was used or whether a measured distance had been made. However, I suspect that there is also a little "macho" pride in stating the distance on the close side, when in doubt. I would be the last to challenge any of my friends on this (or on vortex width estimates), but suspect that this aspect of chasing needs a little closer scrutiny. Since we are often the source for spotter training slides and descriptive information on these slides, it is incumbent on us to be as accurate as possible. Perhaps NWS should develop a set of training/tornado slides of known distances to train spotters and/or develop a technique for use "in the field" to immediately approximate distance. For example, a spotter looking across a town at a tornado on the other side should be able to report whether it is 5 or 15 miles away (how much time does the town have to seek shelter?). I concede that different mesoscale parameters (humidity, pressure, etc.) may affect the cloud base in different parts of the country. Perhaps an average cloud base could be stated on a regional/climatic basis by month. Anything that would give spotters a standard to go by would aid in estimating tornadic distance.

Print #1

Print #2

Let's test <u>your</u> sense of distance. The following prints were copied almost border to border from the original slide. Each tornado was taken with a 50 mm lens and had a known or close-to-known distance from the photographer at the time of the picture. Examine and guess these distances, then look at the answers on the last page. You will also find there a proposed scale card for use with similar 50mm slides/prints of yours.

This was developed based on close analysis of 9 of 12 tornado slides. Four of the twelve vortices were from what appeared to be high based storms (three in the western third of Kansas), and 3 of these gave widely different data from other comparable slides. All four were excluded from development of the card scale. Also shown is the simple chart which I used to develop the card, including comparative accuracy of my distance estimates. Such a rudimentary guide could be used by a spotter with a camera or could be modified to a single marked-ruler-scale held at arm's length toward --a tornado (e.g. 6" = 1 1/2 miles, 4" = 3 miles, etc.) or to a simple hand spread at arm's length (e.g. tip of thumb to forefinger = 1 to 2 miles, etc.). A clear plastic sheet could also be used with a pre- printed scale across the the sides and top to measure vortex width as well as distance. For example, a spotter looking north with a town to the northeast could quickly assess the immediate peril to that, town. Although such reports could not be taken as conclusive on their own, they might still provide useful information.

--- Dave Hoadley

<u>FEATURE #2</u>

HISTORY OF THUNDERSTORM FORECASTING:
Part III: The Air

By John F. Weaver

With the coming of instrumentation during the 15th through 17th centuries, science began to move forward as it hadn't since the time of Aristotle. And while meteorologists went about the business of defining the atmosphere, chemists were involved in their own projects, one of which was discovering the nature of air. Now a legitimate question might be 'what does the chemistry of air have to do with thunderstorm forecasting?' The answer is probably 'very little.' But the story is an interesting one, and those fascinated with forecasting might also have an interest in air. On this tenuous thread, the following is presented.

The process of unraveling the constituents of the atmosphere began, as do many other scientific investigations, with the ancient Greeks. Between the 6th and 4th centuries B.C., Greek philosophers were embroiled in a great controversy concerning the nature of the Universe. All seemed to agree that some basic substance existed, a primitive sort of material from which all matter was composed, but agreement could not be reached as to what the material was. Convincing arguments were presented for water, for air, and for fire. Ideally, in about the middle of the 4th century B.C., Empedocles

suggested a compromise; namely, that some forms of 'water', 'air', and 'fire' as well as some solid, such as 'earth' (an addition of his own) might all logically be considered as the basic components of matter. This suggestion provided the basis for the doctrine of the 'four elements.' Various combinations of these four basic elements were thereafter utilized to describe all substances found in nature. The subsequent acceptance of this concept by Aristotle caused the elemental 'oneness' of air to become a casually accepted fact, by even the most careful scientists, for the next 2,000 years!

The modern reader is often tempted to entertain smug thoughts when reading early scientific notions, but cautious thought might be more appropriate. The theories presented were postulated by the most learned men of the time and were limited by the state of their art. Modern readers, though possessing more refined notions on the nature of the Universe, would be hard put to perform the demonstrations requisite to illustrating those principles we now accept as 'true'. Furthermore, some of these ancient ideas were not, as far wrong as at first glance they might seem. Suppose, for example, one considers the basic properties of each of the Greeks 'four elements'. With a little thought, it can be seen that these men actually chose a rather logical scheme for categorizing matter; namely: solids, liquids, gases, and energy. In lieu of later sophisticated data, could more be expected?

Eventually, however, repeated purposeful experimentation toppled erroneous theory. Alchemists had worked throughout the Dark Ages, attempting to create gold and had thereby performed uncountable chemical experiments on various solids ('earth'). Certain substances (e.g. copper, iron, etc.) had resisted centuries of attempts to break them into simpler substances. Others (e.g. bronze, etc.), however, could be resolved into more basic forms. As the Renaissance approached, an updating of chemical theory became inevitable. The first major break with Aristotelian dogma came when the chemist Robert Boyle (1627-91) published a new definition of the term 'element.' He decided to call a substance an element if, in actual experimentation, it could not be broken into two or more simpler substances. Thus, the term element went from an untested abstract to a more comfortable reality.

Various interesting aspects of 'air' were also being noted at about this time. The Flemish chemist van Helmont (1579-1644) noted that the 'air' given off by heated water must be different than ordinary 'air,' since it could be turned back into water. Thus, he gave the water byproduct a different name: vapor. This represented a major deviation from the Greek ideas and, for its time, was a courageous step. But the real breakthrough came via the substance called Phlogiston.

About 1700, a theory of combustion was published by the German chemist G.E. Stahl (1660-1734) which, though itself one of the more famous 'near-misses' of science, led eventually to the unraveling of the composition of air. His theory, briefly stated, suggested that combustibles were capable of burning because they contain a substance called 'Phlogiston' (Greek 'to set fire'). As a material burns, it gives off phlogiston as visible fire. Air became an important part of his process by acting as a Phlogiston receiver. Stahl also showed that the rusting process is merely a slow 'burning' of metal. In rusting, he felt, Phlogiston is passed to the air very slowly; and while normal metal can be combusted, rust cannot.

In attempting to isolate Phlogiston, Joseph Black (1728-99) heated limestone and found that an 'air' was given off which, when exposed to pure lime, recombined to form limestone again. Now 'ordinary' air did not have this property, so -behold- another new gas. Because this new gas could be 're-fixed' to lime, Black called it 'fixed air' as opposed to 'ordinary air.' It was further noted that fixed air would not accept phlogiston (i.e. would not support combustion). Black proposed that fixed air might actually be 'Phlogisticated air', or air filled to capacity with phlogiston. But the chemist Daniel Rutherford (1749-1819) was suspicious. He decided to make some 'phlogisticated air' by burning a candle in a closed container until the flame expired, then compare the result to Black's fixed air. The two gases were found to exhibit very different proper- ties. Furthermore, when he next removed fixed air from his phlogisticated air sample (by bubbling it through a lime solution), his theory was confirmed. Fixed air and phlogisticated air were two different gases. Black stumbled across the fact that when water condenses, it gives off a small amount of heat in the process.

In the early 1770s, an amateur scientist named Joseph Priestly (1733-1804) stumbled upon the fact that when mercury is heated in air it rusts, and that when this rust is heated in a test tube, it breaks down to mercury again, giving off a rather unusual new gas in the process. He found that this particular new gas supported combustion better than air and must, therefore, be a much more efficient phlogiston receiver. He suggested that ordinary air must contain a certain amount of phlogiston by nature, while the new gas must be completely 'dephlogisticated' air. Another new gas had been found.

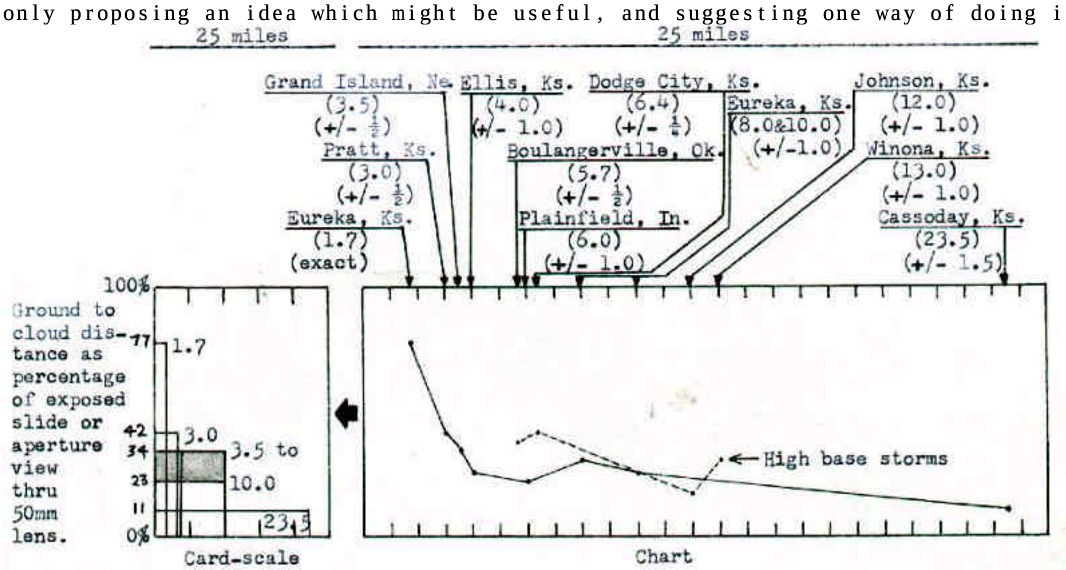
However, the phlogiston theory was about to fall into disrepute. The French chemist Antoine Lavoisier (1734-94), emphasized careful and accurate observation in his work. Consequently when he began to study the rusting process, he soon learned that rusted metal GAINS WEIGHT. This was completely unexpected. It implied that if a substance (phlogiston) was given off during rusting, that it, must have negative weight. So Lavoisier tested for negative weight. He repeated the rusting experiment but utilized a sealed container. Again, he found that, the rusted metal weighed more, but he also found that the weight of the metal plus that of the air remained constant.' Two possibilities suggested themselves; (1) Negatively weighted phlogiston might be mixing with the air to reduce its weight by the amount gained by the metal; or (2) Some of the air (i.e. some component of the air) might be combining with the metal during the rusting process. Which was true? Well, when Lavoisier had completed the experiment and opened the sealed container, air had rushed IN. It was evident that the volume of gas in the container had, therefore, decreased and that some component of air had combined with the metal during combustion. The concept of phlogiston became unnecessary.

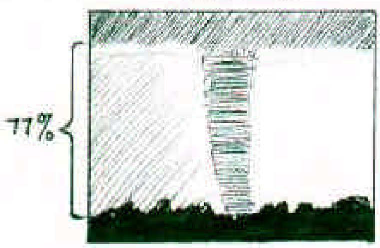
An extremely bothersome fact regarding combustion still troubled Lavoisier, however. It seemed that no matter what techniques he employed, only about one fifth part of a given volume of air could be made to combine in burning. It was not until 1774 that he finally realized the combination of gasses that made up ordinary air. He went on to show that air was composed of (by volume) about 78% Rutherford's 'phlogisticated' air (now called Nitrogen) and 21% Priestly's 'dephlogisticated' air (oxygen). It had already been shown by Black that air contained a small percentage of 'fixed air' (now called carbon dioxide) and, in subsequent years, trace quantities of other gasses were discovered to be part of this 'ordinary air.'

(FEATURE #1 Answers to test page, and card scale/chart to estimate tornado distance)

Figure #1 tornado was 23.5 miles away, with a possible error of +/- 1.5 miles.
Figure #2 tornado was 8.0 miles away, with a possible error of +/- 3/4 miles.

Following is the card scale and the rough chart that was used to develop it. The horizontal scale on both represents miles from the photographer, and the vertical scale represents the percentage of the exposed slide between cloud base and ground. Data entries are (1) adjacent-community/tornado locations across the 'horizontal axis, with distance in miles from the photographer and an estimated error range; and (2) cloud base to ground measurements as a percentage of the exposed slide. Of course, this data is by no means intended to be definitive from such a small sample. Storm Track is only proposing an idea which might be useful, and suggesting one way of doing it.





Example: Tornado is 1.7 miles away

One interesting aspect of the Boulangerville tornado, which was the only one o the "high base" storms that did not occur in western Kansas, was the absence of a low base during its dissipating stage. While it, seemed to start out with a normal lowered base, that base seemed to erode toward the end of the tornado until no base was evident even at almost 6 miles away. If "Storm Data" was correct in its location of this storm (I knew about where I was), it means that cloud base height can vary dramatically immediately adjacent to the tornado. Perhaps the best estimates of cloud base should be made early rather than late in a tornado's life cycle.

-- Dave Hoadley

I. COMMENTARY (Addendum)

One final comment as we begin Chase 1982. It is worthwhile to remember that not everyone shares our enthusiasm for tornadoes, and we should be considerate of others when we're being interviewed by the media or are out on the road and "talking up" the big vortex -in restaurants, markets, etc. Many people have encountered personal tragedy with these storms, including death, crippling injury and loss of property. We must always be conscious of these people, who may over- hear or read what, we say about such storms. Their views are totally different from ours, and some of them bear scars which we can hardly imagine.

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Next issue will feature Part, IV of John Weaver's continuing series on the History of Thunderstorm Forecasting: The General Circulation (to 1900). Also planned are camera Tips on taking panorama pictures and some selected advice from Henry Lansford's recent article in Kodak's "The 11th Here's How" on photographing storms. Excerpts from several interesting Letters to the Editor will be included, along with Funnel Funnies: Nightmares of the Storm Chaser (from personal experience!).