July 31, 1982 | STORM-TRACK | Vol. 5, No. 5
3415 Slade Court | $2.25/year | Bi-monthly
Fairfax, Virginia

I. COMMENTARY

Every few years, one storm season stands out and joins the ranks of those considered as legendary. This was just such a year for many chasers in Oklahoma and Texas. A record 365 tornadoes were reported in May, most during the middle two weeks. Unfortunately, the Editor of ST had to reschedule his leave at the last minute due to a work imperative and arrived at the tail end of this period. Nonetheless, he photographed 4 small tornadoes, 9 funnels and 2 "gustnadoes", for a good chase season (thru June 11). Moreover, he had the good fortune to encounter many other chasers, on the road, on repeated occasions (much more than in other years), as individuals from Texas, Oklahoma, New Mexico, Florida and Virginia crossed each other's paths repeatedly in the middle of nowhere with only a forecast and a roadmap to guide them. Chuck Doswell's memorable salutation, "We'll meet at the vortex!" was realized again and again, near wall clouds, funnels and tornadoes. Coming around a curve or just over a hill, near the rain-free base, would be one or two chasers, with cameras at the ready.

Most of the severe weather stayed in Texas this spring, where all my pictures were taken. That chase record will be reviewed in a future issue of ST, while this one focuses on the notable record of others. These accounts are based on abbreviated notes and recollections of the Editor, from conversations and movie/slide shows with other chasers. Many notes were taken this trip on personal encounters and humorous experiences, which will be included here and in future STs.

II. ROSTER

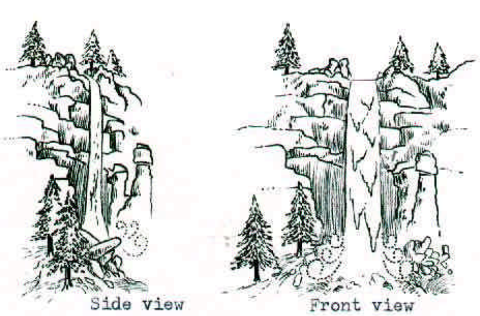
Roy Britt asked me to add his name and address to the ST roster. You are reminded that the purpose of the roster is to let other chasers know of those interested in making contact and corresponding. Unless subscribers volunteer information in this fashion, I will respect their privacy and not mention them here. A personal note: I have known Roy for several years now, and he is a good example of what the rest of us like to see in a new chaser. Roy has done his homework before even setting out to chase. He has studied the technical journals extensively, has an excellent personal library, and probably the best documentation on Virginia tornadoes of anyone in the state. The last two years he has taken some excellent tornado slides (among the best I have ever seen). Knowing what to look for and something about the dynamics of storm formation and structure, he brings knowledge and the ability to contribute to a chase team, not just be a passenger and depend on others for guidance.

Name	Address	Chase country - range
Roy L. Britt	6200 Strathmore Road Richmond, Va. 23234	Texas to Kansas

(Biography: age -30s, single; has late model compact car and new Canon camera this year; began chasing in Oklahoma and Texas in 1980. Has seen and photographed at least 9 tornadoes in the past two years, including one mile wide twister.)

III. LETTERS TO THE EDITOR

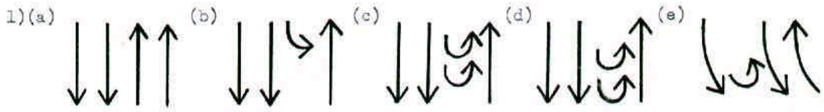
Charles Vlcek wrote earlier this spring with comments on the Garden City, Kansas storm that ST featured in its January issue with emphasis on the unusual microburst characteristics.



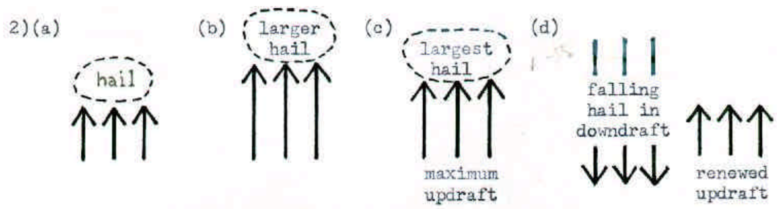
"Take a good long look at, a good-sized waterfall. The spray will readily show the pattern of 'outflow similar to that in rain and hail-laden downdrafts. The side view illustrates a 'macro (or 'meso', if you will) downburst from a relatively steady-state smooth flowing waterfall or precip core.

Often, the current pulsates, and blobs of water come down in 'Vs' (front view) with resultant, outward bursts of spray.... These 'V's provide your minibursts. If you have a strong updraft next to a strong downdraft, as is often the case (and both are pulsating), two things can happen.

In the first case" (diagram),"turbulent, eddies form in the shear zone (b), collect rain and hail (c), then surge downward under the increased load (d), and fall back into the main updraft (e) before striking ground, so that it picks up more downward momentum.



The second case is of 'pockets' of hail (a) which grow rapidly (b) in an updraft which weakens just as the hail zone was getting too heavy anyway (c) -and falls into a downdraft, while renewed updraft, activity separates fresh hail from" that just, fallen. "I'm not sure if the second example is significant on the mini-scale. anyway, think of mini-bursts as huge (several hundred meters) turbulent eddies full of large hailstones.

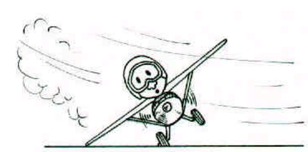


I have noticed that precip rates are highly variable along an interface, especially on the SW side, where new cell formation on the flank complicates the picture. If 'nodules' formed instead of whole new cells, that, would be another source of minibursts. Time-lapse movies of the precip shield would be revealing here.

[Editor's note: One characteristic of the Garden City storm which I failed to note was that most of the micro-bursts observed occurred well outside of precip areas. In fact, no heavy precipitation was evident anywhere to the northeast (or anywhere else) during the early half of micro-burst activity.]

With regard to the direction of outflow: basically the flow is in all directions from where the downburst lands, but the observer is also getting environmental and storm movement flow. Thus, the net wind is rarely from the E or SE, at least with sufficient force to grab attention. You mentioned that the cells were moving slowly, possibly the environmental field (at the surface) was weak also. Thus, westward moving burst outflow was not, being cancelled by other airflows.

The last observation brings to mind an ... incident. I was a student pilot at Max Westheimer Field in Norman, Oklahoma, preparing to make my first unsupervised solo in a Cessna 172. As I taxied out to Runway 17-35, I noted clear skies, except for a cluster of CBs 20 to 40 miles to the east (distance indicated by NSSL radar). As I did my final pre-flight warmup, I was suddenly buffeted by strong breezes from the east. I switched to runway 14-32 (not my favorite) and took off, hoping that the wind would subside before I had to land (it did). Upon returning to NSSL, I took a look at the wind trace and noted a sharp spike where the wind had shifted from 180 deg at 5 kts to 090 deg at 29 kts. All I could think of was, "Gee, if I had been landing on one-seven when that squall hit ..."



IV. <u>BULLETIN BOARD/COMMERCIAL MARKET -$- FOR PICTURES</u>

V. <u>CAMERA TIPS</u>

<u>FUNNEL FUNNIES:</u> Last Rites

VI. TRAVEL TIPS

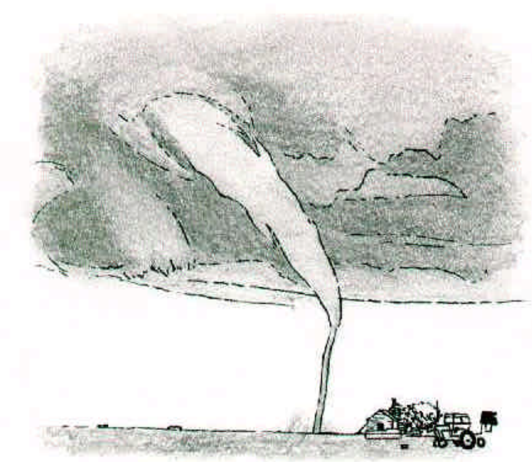
VII. FEATURE #1 Highlights of Storm Chase '82

May 9 - Magic month in the Land of Oz dawned on Sunday at (yes) Dawn, Texas as Tim Marshall extensively photographed a rope shaped tornado at 8:06 PM for two minutes at 0.3 miles. The second occurred well after dusk and hit Bushland (just, west of Amarillo); observed by lightning.

May 10 - Four to five tornadoes reported near Bushland again, most occurring as large cones, multiple vortices and many long lived needles.

May 11 - Mention this date to almost any chaser from Texas or Oklahoma and eyes glaze over, followed by mostly incoherent babbling as slide cartons and film spools tumble out. This was one of two days (the other was May 19) when the doors to the Emerald City were opened. Over a dozen large and slow moving tornadoes developed in western Oklahoma, in excellent light, as chasers captured storm after storm on film.

Jim Leonard ("on a roll") caught a large "Union City" size vortex near Silverton, Texas at 4:30 "at very close range" on sound super-8 and then followed that storm to Plaska and Memphis, where several more tornadoes were photographed over a 3-4 hour period. Along with his girlfriend Barbara, Jim was almost caught by one mile-wide vortex after recording the inflow winds to another as a "screeching" sound on his audio-camera. For that storm, the tripod had to be held down by shaking hands, as 70-80 MPH gusts repeatedly tried to tip it. However, the singular, really noteworthy part, of this chase was the portable tape player inadvertently left recording in their back seat -catching every spontaneous exclamation, exultation and profanity, including one frightening moment (previously mentioned) when the intrepid duo wheeled around and literally fled for their lives as a 1/2 mile wide twister blew up in a field very close and took aim right at them.

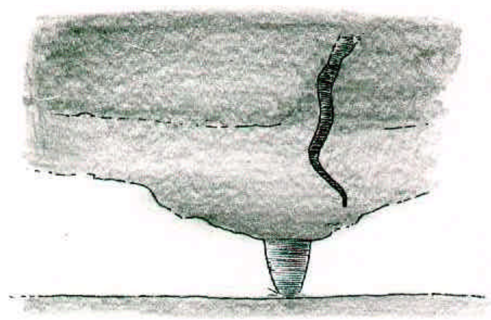


Tornado #1 NNW of Plaska; 7:20 CDT

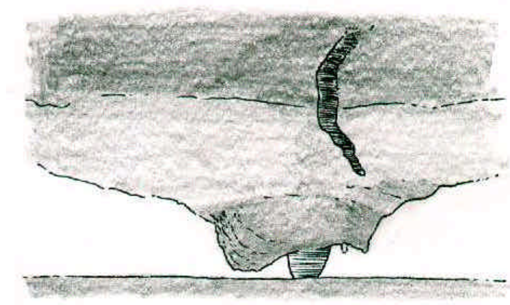
Tornado #2 NNE of Plaska; 7:35 CDT (Leonard pics)

That, afternoon came alive for friends of Jim at a late night slide/movie show some weeks later as the tape (synchronized with the films) played: "Hey, there's one now ... (clatter of camera gear and equipment falling over) ... Oh, wow! ... Jeez, look at that ... hey, there's another one ... I can't believe it! ... This is Tornado City! Oh, my God ... Hey, that's too close ... Jesus Christ, let's get out of here!" Jim's sharing of this marvelous tape with the rest of us brought both gales of laughter and total empathy from those who have had the same feelings at one time or another. It was a profoundly moving as well as funny evening, touching some respondent chord in all of us that was more than just amusement. Thanks Jim for an unforgettable evening, that seemed to sum up the whole experience of chasing!

Returning to our accounting, Tim Marshall also caught the Memphis storm, which he described as "two tornadoes ... embedded in rain ... seen briefly. The first was ½ mile wide and occurred under the parent, updraft occlusion. The second was small, short lived and occurred northeast of the occlusion" at the boundary of the inflow updraft and the occlusion. National news was made by the storm that occurred near Altus, Oklahoma and was photographed by Lou Wicker and Neal Rasmussen. 400-500 ft of movie film was shot along with several hundred slides by chasers and reporters from Texas Tech, OU, NSSL and local TV and newspapers. Literally dozens of photographers lined up for a storm that was fairly obvious in its early development and easy for all to spot and follow. Neal Rasmussen from OU got "a spectacular 16-mm movie of a double tornado on the ground simultaneously, west of Altus…"

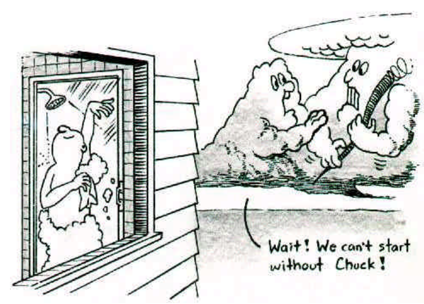


From Rasmussen movie, large tornado 2 miles distant with a funnel 1 mile away. Field in the foreground showed wheat stalks laying flat as the inflow wind literally shook them with its force.(Illustrations based On Zipser sketch from film)



Tornado toward end of Rasmussen film, as the wall cloud actually drops to the ground.

For those of us (such as ST's Editor) who were rooted to our jobs during this week and unable to chase, the supreme insult (to injury) came with the report that Chuck Robertson left work at his normal 5:00 PM, stopped for a shower, and -then- drove out to Clinton, OK where he and Mike Foster photographed eight more tornadoes' Chuck said, "Unbelievable!" The Editor of ST says that Chuck is "Unbelievable'" I've heard of taking a shower before dinner, but Really! To see a tornado?



May 15 - Gene Moore did his thing, photographing several tornadoes in Kiowa County, Oklahoma.

May 16 - Chuck Robertson and Randy Zipser crossed paths with Gene Moore and Bill Moyer near Turkey, Texas, where both were in pursuit of a "large tornado enshrouded in a dust column to cloud base just NW of Matador." Randy got 20 ft of 16 mm movies and Chuck got several slides. A long track tornado was reported from Canadian, Texas to Logan County, Oklahoma (north of Oklahoma City), which was believed to have been covered by OU chasers that day.

This is a good place to break of our accounting of 'Chase '82' and continue it in the next issue (otherwise I may bust the two ounce limit for postage on this missive). The next ST will start off with May 19 and the many short stories of this memorable day, along with more insights and personal experiences of chasers.

-- The preceding account was prepared with the assistance of Randy Zipser, Tim Marshall, and Jim Leonard.

VII. FEATURE #2

HISTORY OF THUNDERSTORM FORECASTING
Part V: The General Circulation in the Twentieth Century

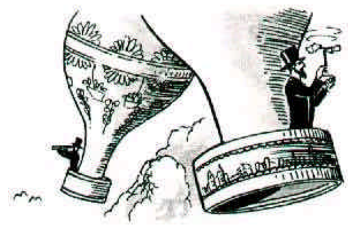
By John F. Weaver

Twentieth century meteorology is marked by many important advances and events. The nature of the upper flow and its relation to surface weather features has generally been established. Better prediction techniques have evolved as new knowledge has been added, along with the advances made in the field of electronic computers. Computers have also helped to model the atmosphere mathematically, in order that we might 'study' weather in the laboratory.

I think that it, can be safely stated that what we now know regarding the nature of the atmosphere outweighs what we don't. The acid test for this statement is the fact that we can now predict, weather events, over even a relatively small region, with more than seventy percent, reliability. Prior to the turn of the century, this was probably not true. But, it is important to remember that knowledge is cumulative. Without the dogged determination of those early meteorologists, we would have little to feed our computers today. Man has a tendency to forget faraway events. For example, when the Norwegians developed a full, three-dimensional model of the life cycle of cyclones, it was easy to speak of the 'Norwegian air mass analysis and forecast technique', without constantly mentioning the groundwork in air mass theory laid by the American meteorologists Espy and Loomis, and tested by the Scottish Admiral Fitzroy. It is the purpose of this, as with any historical record, to assure that the early contributions are not forgotten.
The first recorded measurements of the upper atmosphere were the mountain top experiments on

pressure, conducted by Pascal and Perier in 1648. By 1686, enough was known about the vertical distribution of pressure (at least in the first few thousand feet), to allow Sir Edmund Halley to fit the values to a hyperbolic curve. (It's actually an exponential decrease with height, but a hyperbola is very close.) The vertical temperature distribution was first measured by Wilson and Melville at Glasgow, Scotland in 1749, utilizing a 'minimum' thermometer and a kite. Shortly thereafter (1782), hot air balloons were invented and during the following century scientists carried out experimental kits and balloon flights to study the characteristics of the upper air.

Although many of the general features of the vertical structure of the atmosphere (at least to 15,000') were measured, it wasn't until 1898 that serious efforts were made (via instrumented kite flights)to study the space and time distribution of upper air pressure, temperature and dewpoint.



Meteorologists' desire for upper air observations was becoming increasingly strong as the twentieth century approached. For the previous century and a half, much had been suggested concerning the upper atmosphere -- there was a lot of theory, based on few measurements. The theories might have represented important, insights, but a bit more substantiation was needed. In 1755, Leonard Euler had utilized Newton's three laws of motion to formulate equations for fluid motion. Observational and experimental meteorologists during the 1800 s had accumulated sufficient knowledge to show that the atmosphere behaved as a fluid. Euler's equations could, therefore, be applied, if more about the upper air characteristics were known. In 1904, Vilhelm Bjerknes suggested a method for objective forecasting which could apply the equations of motion to yield a numerical solution for forecast values of atmospheric variables. Unfortunately, the calculations required massive amounts of data and data manipulation and, so, could not be tested at the time.

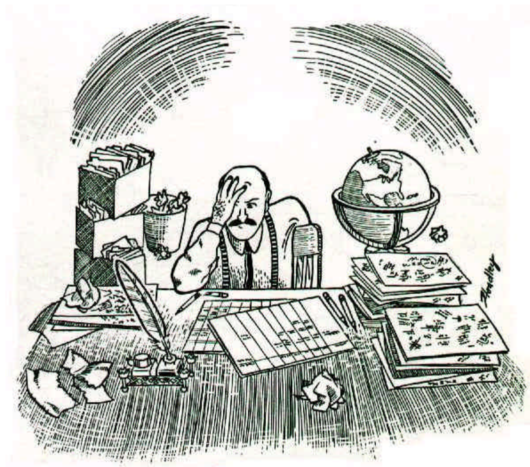
There were several major problems that remained unsolved at the time, not, the least of which was that -somehow- the upper and lower portions of the troposphere were being treated as almost separate entities. Meteorologists knew that, there were important interactions (e.g. vertical motion near the center of extratropical cyclones), but too little information was available to tie them together. It wasn't until 1901, for example, that a group headed by Leon de Bort discovered the tropopause and stratosphere. However, this lack of understanding and knowledge was soon to be substantially reduced. In 1909, balloons equipped with parachutes and continuously recording instrument packages (Marvin meteorographs) began to replace kites in the United States. The balloons occasionally reached altitudes of 50,000 ft (but more commonly 15-20,000 ft), becoming a data source for forecasters by the mid-1920's.

In Europe, more abundant surface and upper air data were also becoming available. Discoveries in many facets of meteorology, including forecasting, were increasing. In 1918, V. Bjerknes took a closer look at, the structure of extratropical cyclones. Utilizing surface data and cloud observations (along with subsequent implications from the continuity equation), he constructed an improved three-dimensional cyclone model. His results gave forecasters a clear, understandable picture of a cyclone as a 'mover of air masses', of a system wherein cold air undercuts and lifts warm at the cold front boundary -and wherein warm air rises gently as it moves into cooler air at the warm front boundary. He called the two boundaries the 'squall' and 'steering' boundaries, respectively. In 1922, J. Bjerknes and H. Solberg of Norway then described the full lifecycle of extra-tropical cyclones. These authors envisioned cyclogenesis as a small, shear-induced, horizontal wave on the interface between two different air masses. They suggested that once warm air advances -even slightly- into the colder air, the pressure near the wave falls, and the winds take on components from cold toward warm air behind the disturbance, and vice-versa in the region ahead. A cyclone is thereby generated, along with the associated cold front/warm front boundaries. It was also noted that cold fronts advance faster than warm fronts and eventually overtake them. when this occurs, the region where cold air undercuts the warm front is referred to as an 'occlusion.' As this occlusion grows, the air mixes, becomes stable and barotropic, and finally dissipates the wave through friction.

The new balloon data showed that, the upper westerlies were not truly zonal but flowed in rather smooth, wave-like paths, swinging first north then south in their journey about the globe. Typically, four or five such large waves (shaped like sine waves) were found around the hemisphere. These so-called 'long waves' were first investigated and described by Carl-Gustav Rossby and collaborators in the late 1930's. Rossby also found that, superimposed on these long waves, were smaller disturbances, called 'short waves', which traveled rapidly through the slowly moving long wave pattern.

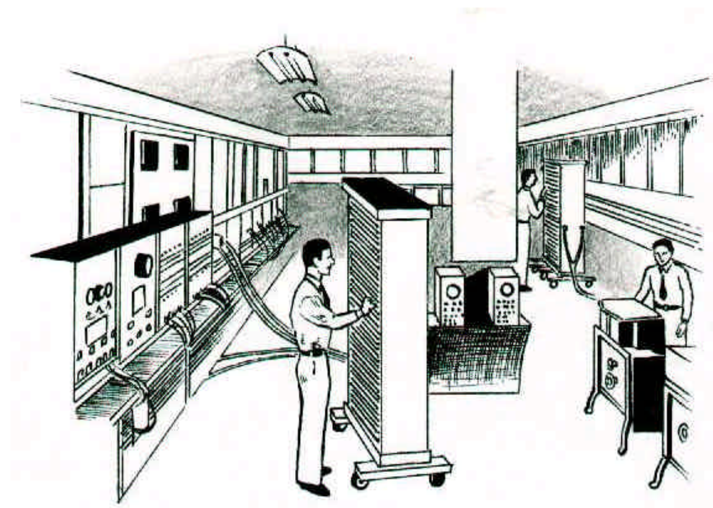
The relation between the upper tropospheric flow and the lower tropospheric cyclones was formulated in a paper by Bjerknes and Holmbe in 1944. Upper level shortwaves were postulated to form as a result of vertical motions induced by frontal waves (Earlier formed shortwaves might even help induce new frontal waves). Utilizing the gradient wind equation, the authors demonstrated the existence of divergence ahead of and convergence behind the traveling upper waves. They also found convergence ahead of and divergence behind the associated surface cyclone. Thus, the upper flow could provide for depletion of air in front of the surface system and accumulation behind. This, in turn, helps move the surface cyclone along. Also, should an upper shortwave be moving more rapidly than the surface system (which occurs quite frequently), there will be a time when the two will be 'in phase,' and the upper wave will serve to suddenly intensify, or deepen, the surface system.

But what about that fellow, Vilhelm Bjerknes, who had the idea for objective weather forecasts back in 1904? As we noted, he was unable to try out his idea because of the massive number of calculations involved. In 1922, Lewis Richardson carried out an objective forecast by hand for an area roughly equal to a third of the United States. Richardson was very innovative -- he wrote the first textbook on dynamic meteorology and designed a scheme of 'finite differencing' to help with his forecast calculations. Nevertheless, the computations for a several hour forecast took him weeks to complete. His results showed that it would require one hundred or more efficient people, calculating full-time, just to pace the weather in an objective forecast for an area the size of the United States.



Even as Richardson fought his way through the unwieldy pile of calculations, help was on the horizon in the form of rapid automatic calculators. Actually the first mechanical adding machine had been devised in 1642 by our old friend Blaise Pascal, and in the 1670's, Leibniz had provided a device that could multiply as well as add and subtract. During the period 1700-1900, mechanical calculating machines became larger and more complex.

But strictly mechanical calculators were not the answer; being both bulky and slow. Less than twenty years after Richardson's first calculations, Howard Liken of Harvard created an electromagnetic computer by connecting a series of several dozen adding machines which were controlled by coded instructions on a single punched paper tape. The first fully electronic computer followed six years later (ENIAC, 1946), and in 1948, Jule Charney began working on the problem of numerical weather prediction utilizing ENIAC. Although the first machine prediction ran in 1949, it took three more years of computer development, work before the machines could even pace the weather, with just a simple barotropic model.



It wasn't until 1955 that the first routinely available computer forecasts were distributed to field forecasters. Progress since then has come quickly, with the rapid advances in electronics and computer science that have occurred over the past twenty years. By 1962, enough 'computer power' had developed to allow the running of George Cressman's three-level baroclinic model, which was upgraded to a six-layer model in 1966. Most recently, the Limited Fine Mesh (LFM) model made its appearance in 1971.

The modern forecaster can now study an approximation of the general circulation pattern as it, will appear at future times out to several days. The LFM model output furnishes twelve hour interval forecasts of long and short wave patterns aloft, moisture aloft, surface weather patterns and estimates of broad rain areas, to name a few. Because the equations used to generate these results are approximations (often necessary due to lack of knowledge or lack of computer time), and because the computational techniques represent further approximations (necessary due to time restrictions and -occasionally- solvability), the forecaster must use the output as general guidance. However, for a successful prediction, he must supplement this information with other skills, including analysis of actual data, and knowledge and conceptual grasp of the behavior traits of weather systems, analysis of satellite imagery, etc. The thunderstorm forecaster must go a step further, because thunderstorms are quite literally below the resolution of the large scale data. A special knowledge of the thunderstorm's favored environment must be combined with whatever inferences can be made from all data sources to generate these 'sub-scale' predictions. It is the specific question of 'what is known about the thunderstorm's environment, and how do we know it', that is next on the agenda for discussion.

- - -

That wraps this issue. The next ST will conclude an account of Chase '82, a review of the Editor's record and some interesting "gustnado" encounters, Part VI in John Weaver's excellent. series -- this one on "The Thunderstorm (to 1900)", and more Funnel Funnies.

At this time, I am reluctantly obliged to announce a substantial price increase for Storm Track, beginning with the 1983 Volume and renewal subscriptions due from you after the November 30 issue. Ironically, the reason is the increasing circulation and growing popularity of this newsletter! The number of subscribers has doubled from earlier years, and it is no longer practicable to continue using the copy services which have previously been available to me. This means I must turn to a strictly "cash and carry" operation. I expect the annual price to increase to $3.20. This is based on the assumption of shorter articles after Mr. Weaver's series is concluded and assumes economies of volume in a projection of added subscribers over the coming months. Assuming three 6 page and three 3 page editions, the total additional cost would be $1.00. Admittedly, this may be a quite conservative estimate, and I certainly am not inclined to cut quality or interesting submissions just to follow some arbitrary rule about issue length. However, this seems a reasonable goal and expectation for the coming year. Any costs that I assume over this would be on my own. STs of 4 to 8 pages run 37c for mailing. 3 1/2 pages just breaks under 20c, but 3 1/2 pages doesn't leave very much space to really take off on some material and illustrations which I have in mind for the future. I appreciate that this will strain some budgets and that some may drop out. However, economies are catching up and must be addressed. Oh yes, those who have already paid for future year subscriptions (a small handful) will not be affected by this increase until their long term subscriptions run out.

If anyone has any good ideas on how to cut costs, etc., please let me know. I may write some exploratory letters to camera companies, etc. to see if anyone wants to advertise in something like this (probably unlikely, but who knows).

- - -

One final note. I am planning to do a portrait page in a future issue, sketching some of the more active and better known storm chasers over the past ten years, and currently. To this end, I have been collecting candid pictures, when opportunity presents itself. To date, I have fairly good likenesses of Bluestein, Colgate, Davies-Jones, Doswell, Golden, Jensen (Bruce), Leonard, Marshall, Moller, Moore, Rasmussen and Zipser. If any of you want to be included or have any good group pictures to share, please send them to me. I think such a group portrait would be interesting not only to ourselves but to other subscribers who are curious as to what we look like ("Does a tornado chaser really look WEIRD or does he look like anybody?").