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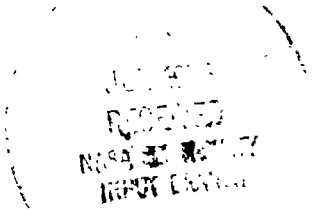
LUMINOUS ELECTRICAL PHENOMENA IN HUNTSVILLE, ALABAMA, TORNADOES ON APRIL 3, 1974

By Otha H. Vaughan, Jr. and Bernard Vonnegut

May 1976



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16. ABSTRACT

Unusual lightning and varicolored luminous phenomena were observed on the evening of April 3, 1974, when severe tornadoes passed through Madison County, Alabama. Photographs and eyewitness accounts of this electrical activity are related to the trajectories of the tornadoes and the damage areas they produced.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

TECHNICAL MEMORANDUM X-73301

LUMINOUS ELECTRICAL PHENOMENA IN HUNTSVILLE, ALABAMA, TORNADOES ON APRIL 3, 1974

INTRODUCTION

The relationship that exists between the tornado and the equally puzzling phenomenon of thunderstorm electricity remains a fascinating unsolved scientific riddle. It has long been recognized that tornadoes are sometimes associated with storms having extraordinary electrical activity [1,2], but, as has been noted by Davies-Jones and Golden [3], this is by no means always the case. As a recent example, on June 16, 1974, several intense wind storms did considerable damage in the Albany area, striking within 20 miles of the home of one of the authors. These wind storms were later classified by the Albany Weather Bureau as "mini-tornadoes." The weather system from which they came was apparently without any electrical activity whatsoever. No lightning was seen, no thunder was heard, and before, during, and after the period of the tornadoes not a single sferics crackle could be heard on the broadcast band of a radio. The height of the cloud tops of the Albany storm as measured by radar was only a modest 8 km. Since it is recognized that lightning frequency increases rapidly with height [4], it is perhaps not surprising that electrical activity was absent in this storm.

By contrast, during the night after what Fujita [5] has characterized as the jumbo tornadoes of April 3, 1974, the Defense Meteorological Satellite Program records show that there was unprecedented lightning activity taking place in the storm system [6]. In view of this intense electrical activity, it is surprising to find that few, if any, eyewitness accounts mention electrical activity of any kind. There appear to be several possible explanations for this. Perhaps electrical activity was indeed absent during the day, when most of the tornadoes occurred. It may be that, although electrical activity was observed, it was not considered worth mentioning by the observer. Most of the tornadic activity occurred during the daylight hours which would have made it difficult to see lightning or other luminous phenomena against the background illumination of clouds.

Whatever the reasons may have been for minimal eyewitness reports of electrical activity elsewhere on April 3, eyewitnesses reported unusual electrical activity associated with the tornadoes that passed over northern Alabama near the Huntsville area that evening. These accounts appear to be worth reporting, particularly because several of those who described the tornadoes were well-trained scientific observers.

TRAJECTORIES OF TORNADOES

On the evening of April 3, 1974, a large weather system was over northern Alabama, as shown in the NOAA-3 satellite photograph (Fig. 1). At least six tornadoes were tracked during evening and night by radar as they passed over Madison County Alabama, moving from the southwest to the northeast; three of these tornadoes, and the most destructive, are indicated by the dotted lines in Figure 2. The first severe thunderstorm celis, which later spawned the more destructive tornadoes (designated Tanner 1 and 2 by the National Weather Service), were tracked southwest of Russellville in Franklin County, Alabama, at approximately 5:22 pm (CDT). The first severe and destructive storm cell (designated Tanner 1) moved across Lawrence County, taking 14 lives, and into Morgan County where it damaged the Amoco Chemical Plant at approximately 6:50 pm (CDT). From this point it crossed the Tennessee River/Wheeler Lake into Limestone County where it produced considerable destruction and claimed five lives southwest of Tanner.

The Tanner 1 tornado then continued into Madison County where it also produced considerable destruction and claimed eight more lives near Harvest. It lifted off the ground southeast of Harvest, Alabama, at approximately 7:20 pm (CDT). The Tanner 1 tornado stayed on the ground approximately 51 miles.

At approximately 7:25 pm (CDT), or approximately 30 minutes after Tanner 1 tornado had entered Limestone County, Tanner 2 began its path of death and destruction. This tornado moved through Limestone and Madison Counties, Alabama, and then through Lincoln and Franklin Counties, Tennessee where it lifted off the ground at approximately 8:00 pm (CDT). The Tanner 2 tornado stayed on the ground approximately 50 miles and claimed 23 lives. These tornadoes appear to have been spawned by the same severe thunderstorm or cloud system.

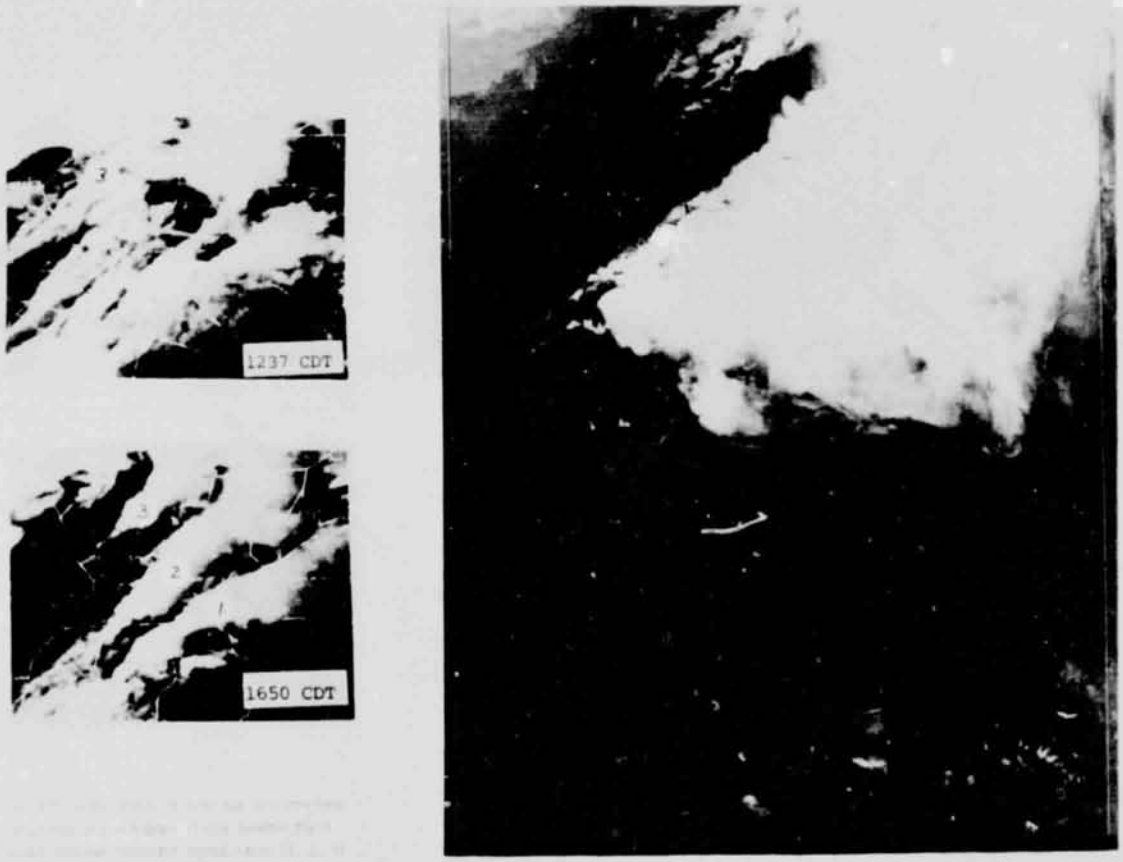

Figure 1. Satellite photographs of tornado-producing frontal systems over the southeastern United States.

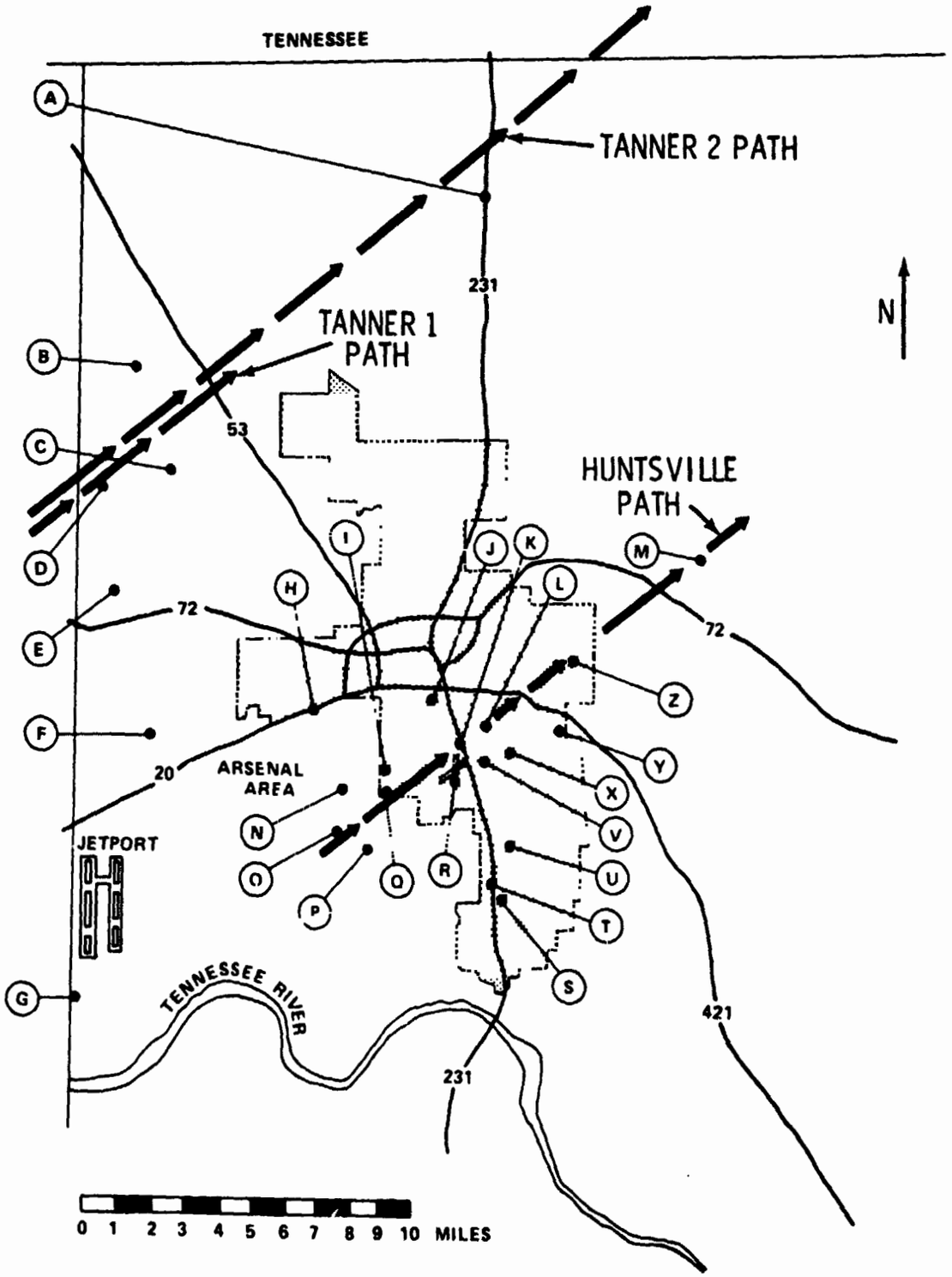

Figure 2. Madison County, Alabama, showing the paths of the Tanner tornadoes and Huntsville tornado on April 3, 1974 (Letters indicate locations referred to in text. Shaded area is city of Huntsville, Alabama.).

The third severe storm system had its genesis in Mississippi and crossed into Alabama in Lamar County approximately 3 miles southwest of Sulligent, where it touched down and later destroyed homes south of Beaverton before crossing into Marion County. At 9:02 pm (CDT), this tornado ripped into Guin, Alabama, in Marion County, leveling every house in its path, killing 23 people and injuring 300. It proceeded northeast through the William Bankhead National Forest, causing considerable destruction of trees as can be seen in ERTS 1 photography (Fig. 3). This tornado, designated Guin, then proceeded through Oakville (2 killed) and into Morgan County. At approximately 10:10 pm (CDT), after crossing the Tennessee River and proceeding into Limestone County, it lifted off the ground and was proceeding toward the northern half of Huntsville with its projected path over the Huntsville-Madison County Jetport. At approximately 10:48 pm (CDT), this tornado (path not shown on our map) damaged the Woolco Department Store roof, passed over the North Side Plaza Shopping Center, and was last seen at approximately 11:10 pm northeast of the Huntsville city limits.

While the Guin tornado was passing over the northern part of Huntsville, a second tornado, now designated the Huntsville tornado (Fig. 2), had begun touching down on the south bank of the Tennessee River, at approximately 10:10 pm (CDT), and was proceeding in a projected path which would place it south of the Huntsville-Madison County Jetport, through the NASA/Redstone Arsenal Complex, and through the southern part of Huntsville. This tornado touched down at approximately 10:40 pm (CDT) near Gate 7 and inside the Arsenal boundary where it subsequently damaged many buildings including Building 4200. It then proceeded over the gap in Madkin Mountain, dropped into the Redstone Troop area (3300 area) at approximately 10:53 pm (CDT), and skipped across the Arsenal area where it either damaged or destroyed 96 buildings. No one was killed, but 26 were injured.

The tornado then continued its southwest to northeast path, tearing off roofs, damaging and destroying homes, and finally destroying numerous mobile homes in the Glenn'll Trailer Park as well as a part of a nearby church. It then proceeded north of the old Huntsville Airport and through the Parkway Shopping Center and the adjacent area where numerous business buildings and other property were either damaged or completely destroyed. Then the tornado moved across the Thornton Acres subdivision, breaking trees, tearing roofs, and destroying homes before it lifted shortly after crossing Whitesburg Drive. It then touched ground near the upper western slope of Monte Sano Mountain and sheared out a wide swath of trees and destroyed or damaged five homes on

ALABAMA TORNADO

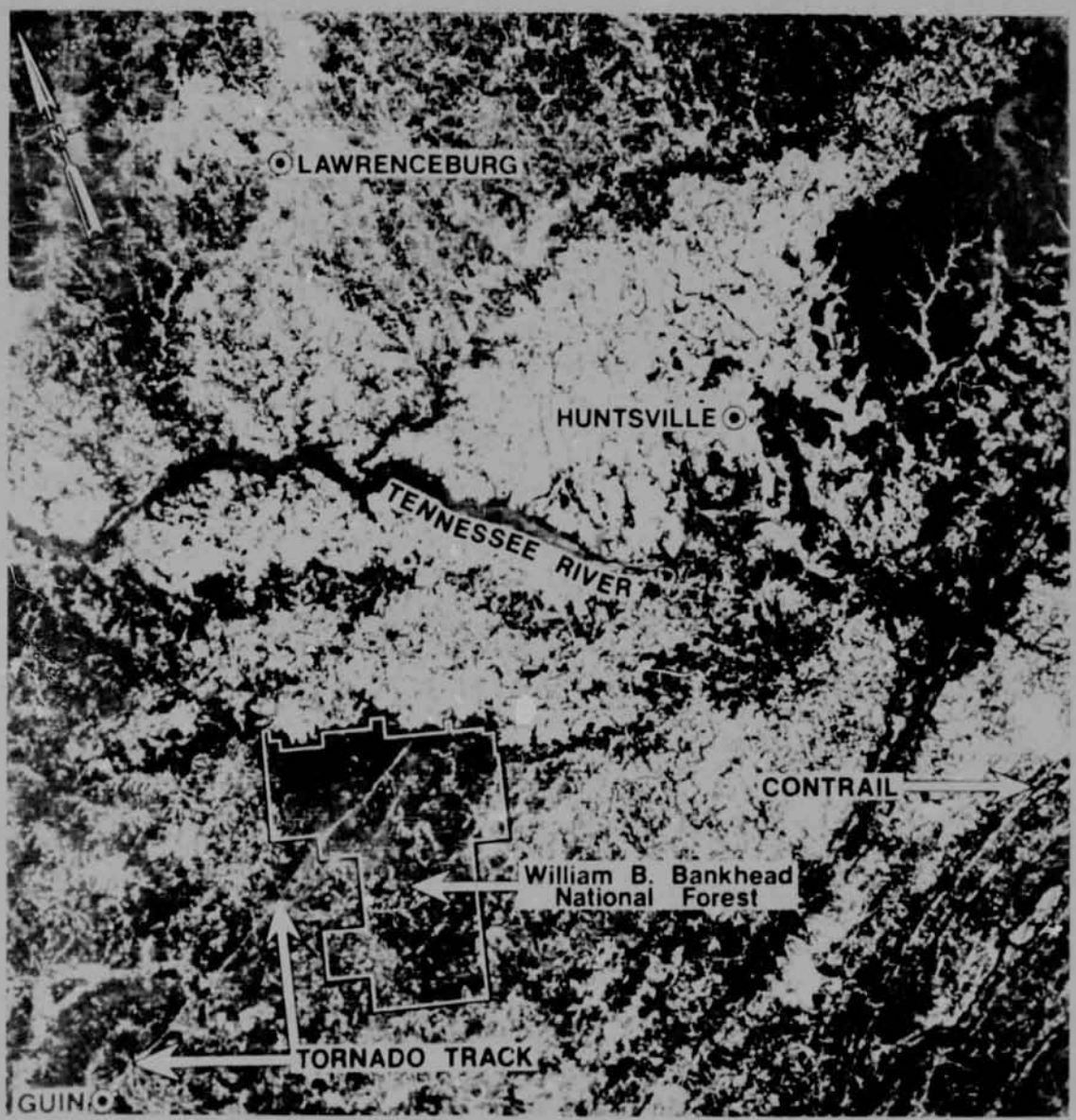

Figure 3. The Guin, Alabama, tornado ground track as recorded on ERTS image ID 81644154925 N000, 28 April 1974 (NASA photo).

Monte Sano Boulevard. The tornado lifted and then touched down again on the northeastern slope of the mountain where considerable damage was done to trees. It passed over Highway 72, destroyed homes near the Ryland area, and then proceeded toward Jackson County, dipping into the northern part of Paint Rock Valley where it terminated at approximately 11:30 pm (CDT). Although this tornado passed through a heavily populated area in Huntsville, there was no loss of life. Figure 4 presents aerial photos taken over Huntsville by NASA aircraft on April 5, 1974, showing the tornado's path and destruction.

EYEWITNESS OBSERVATIONS

Now that the stage has been set by the discussions of tornado paths and the destruction created by them, the eyewitness accounts obtained from scientific observers (designated SO with the name) and other individuals who either photographed or observed phenomena relevant to tornado research are presented. The following persons gave eyewitness accounts, and their locations are represented by capital letters as shown in Figure 2:

Kenneth Noel (E and F)

> We were working on a new house (E), and at about 7:00 pm we got a phone call that tornadoes were approaching from the west. The wind was calming down. A large black thunderhead was visible due west of us and appearing to come in our direction. Our electric power failed due to destruction of a 500 kV line west of us. We sat on the porch and watched the approaching storm. A small rain shower preceded the storm. There was not enough rain to wet the ground. The usual gusts of wind that precede a thunderstorm were absent. Instead it was very calm and warm; it was comfortable without a sweater.
>
> As the storm approached, the lower part of the cloud had the vertical shaft that often appears when a heavy rain occurs. The vertical shaft appeared to be at least a half mile wide. As the storm came still closer, it was evident that it would miss us.
>
> The head of the cloud showed continuously flashing lightning of a very intense nature. The majority was inside the cloud with very few ground strikes. The air surrounding the cloud glowed a light amber straw color. The vertical part of the cloud did

Figure 4. Aerial photograph of tornado track and damage for Huntsville, Alabama, and the Redstone Arsenal complex (In some regions the damage path was narrow and did not extend to the boundaries of the photographs. In other places it was wide and extended somewhat beyond them.).

not appear to rotate, and the traditional funnel was not visible. As the storm passed over the Clarkdale community (D), two vertical columns were visible. The second column was narrower than the first, and also did not appear to rotate. Both came from the same cloud. By 7:30, the storm had passed north of Capshaw Mountain (C) and became much less visible. However, it continued on past Hazel Green (A) and into Tennessee. The storm was extremely destructive. Previous tornadoes in this area have torn up trees and destroyed houses, but this one destroyed one store building so completely that no clean up was needed to rebuild. The only thing left was a concrete slab. Not one single concrete block remained of the building. Gasoline pumps were totally removed from a concrete island with not even a pipe sticking up.

I personally examined the ruins of the 500 kV line mentioned earlier. Fourteen steel towers were demolished in this area. The 1-1/4" aluminum triple cables in each of the three lines were bunched up by sliding the outer conductors along the inner steel core. These cables are anchored to the insulators by steel wrapping about 6 or 8 feet long. The steel outer wrap gripped the aluminum conductor so tightly that the aluminum was bunched up on the steel inner core until it was some 10 or 12 inches across. The tower remains were not over 6 or 8 feet high in some cases.

At about 7:45 pm, we went to our apartment (F). Later in the night the local TV station, Channel 31, was broadcasting weather radar, and at about 10:30 they showed a tornado approaching that crossed the border of the map (G). At this time, an intense storm was visible due west of my location. The same continuous lightning was seen as earlier. In this particular case, no tornado resulted. There was, however, later a tornado reported on the ground from (G) on the map to about (M) and beyond from the same general cloud. It was accompanied by heavy rain and intense lightning of the most unusual nature. It was brightly colored in pink, red, yellow, and some green. At times, a flash would emit red balls of fire that arched down like fireworks displays. Sometimes 10 or 15 balls would be visible. The lightning was bright enough to shut off light-operated street lights almost

continuously. I work with Tom Veatch who lives on Telstar Circle in Huntsville (Q). His back door was torn off when the storm passed about 150 yards south of his house. He tells me that even though he was outside looking for tornadoes, no lightning was visible and no rain fell. He only went inside the house when the nearby wind noise showed a tornado near. This storm hit about 11:00 pm.

Paul Noel (Kenneth Noel's Son) (E and F)

The two tornadoes were seen starting at 7:10 pm and faded from sight about 7:35. They were closely following the same path and were in sight both at the same time in closely the same area of the cloud. I was amazed at the size of the tornadoes because they were about 1/2 mile in diameter each. They were tilted in the line of travel only slightly with the base trailing the top. The rotation of the funnel in both cases was almost not perceptible, although some was occurring in clockwise direction. This rotation may have been because of forward progress rather than actual rotation. An amber glow was associated with the funnels in the air surrounding them. Lightning in the storm centered in the top of the funnels and in the remaining parts of the storm clouds, which came after. Rain in the storm was almost absent completely until the funnels had passed. The lightning was quite out of character that entire night, for it flashed in colors--red, blue, green, and the usual white. While I watched at a distance, I got an overall view of the storm as I saw the funnels at the range of just less than 3 miles at the closest. When I was watching the two tornadoes, I noticed the peculiar condition the funnels were in, for they seemed to be a vapor contained in the amber glowing air and quite a dense vapor at that. The division between the vapor was quite well defined with the glow around and was this way continuously, even in the northeast. The glow, when added to the lightning which continuously flashed at the top of the funnels, made it easy to see. In association with all the other strange things, the lightning went from the top of the tornadoes to the ground in extremely large bolts which had an extremely loud noise at this distance. Later in the evening, I was at my apartment in Madison (F), and witnessed lightning in color such as I have not seen lightning have before. It was not "bolts" either. It was splintered and even flamed as a fourth of July

mortar bursts with flame. It also flashed continuously as before. What I saw at the apartment was the same clouds which brought tornadoes which damaged the Redstone Arsenal and a portion of Huntsville. From the damage areas, I can say with certainty that the two that passed to the north were the most powerful.

Al Visone (N)

I was watching out the window (B), primarily for my own family's safety, so we would know if a tornado was going to hit our home. About 7:14 (the reason I can remember the time is because that's when all our power went off), I noticed, between Athens and Decatur (outside of map), the dark cloud formation. It was different from the rest of the clouds that evening--it was hanging lower. As it got closer, I noticed that all the surrounding clouds were being pulled into it from the side. To me, that looked like a tornado, so I put my family to safety. It was about 7:20 that it actually got near my home, and I was able to see it even though the sun was down and it seemed like the lightning was constant. It seemed always to be lit up in that area. After it had past, I went back outside to see, and it wasn't too far passed. It was just a minute or two, and this lightning that kept it lit up, which from my viewpoint always seemed to be on the opposite side of the storm, enabled me to see the debris that was flying around. The next morning, I found out that the debris was parts of mobile homes and houses which were about 200 yards from my home. I heard other people that had seen it. Most of the people had their homes destroyed. They said that it was bright green. I never noticed any color. I wasn't planning on making too much of an observation, and this all happened within a span of about 5 minutes from the time I first saw it until the time it was gone. I did notice, later on in the evening, that there seemed to be colored streaks of lightning, but not any one particular color that I noticed. The only different types of lightning that I saw that night, one that struck me as being peculiar, did not look like most lightning. It started in the cloud and then had one bolt toward surface to ground. It seemed to start about half way up between what would look like the cloud layer and the ground and it went out in several directions from there. That lightning was light--it was bluish green. When the tornado was coming, I paid particular attention to the sound because I had always heard that

it makes a sound like a freight train or a flight of jets. I was listening while in a half bathroom of my home, and the tornado started out having a roaring sound, but I would associate the sound as it got closer more with maybe the sound of a child's top, the kind when you press down on it, the higher the pitch becomes. It sounded like the humming noise of maybe a large generator as you're starting it.

Robert Allen Moss

My name is Robert Allen Moss (Z), and I would like to discuss my observations of the Huntsville tornado on April 3, 1974. I was on top of Huntsville Mountain, on the Space Walk Trail up where the TVA high tension towers cross the mountain (Y), about 10:30 pm, and off toward the west I observed a very large green flash near the side of Madkin Mountain out on the Arsenal. The flash was more bluish green type color, and it reached high into the clouds, I would guess about 4,000 feet. It traveled directly toward me and I would guess it was about 10 miles away. It took about 15 minutes for it to look as if it was moving toward me. About the time it approached the Memorial Parkway and Drake Avenue area (K), I left this Mountain quickly and moved north toward Monte Sano. We drove up Monte Sano Boulevard and passed through the intersection of Monte Sano Boulevard and Panorama Drive. We then drove on toward the Old Chimney Road on the northwest side of the Mountain (Z). When we got to the Old Chimney Road, and looking to the west, we noticed that the tornado had changed direction and that it looked like it would pass south of our location now. There was a lot of thunder, lightning, and extremely high winds with a loud roaring sound, and it lasted about 5 minutes. There were a lot of explosions within the tornado--I am not sure what these were, maybe power lines exploding--but these bright green explosions seemed to vary in intensity of brightness, very light to real bright, but at no time was it as bright as what I saw in the green cloud initially. These explosions were occurring when the tornado was moving through the city.

H. Prescott Sleeper (V) (SO)

I was observing, on Airport Road (V), the Hazel Green tornado which came through some time prior to 8:00 o' clock in the evening. It was essentially pitch black, except for lightning. The storms I was watching were those storms which passed, I would say, roughly 10 miles west of Huntsville. So, we could see the sky was essentially lit up--flash, flash, flash--with just a tremendous amount of lightning, almost continuous. We watched the clouds for something of the order of 3/4 of an hour or so, and were listening to alerts to find out whether it was clear as far as Huntsville was concerned. We stayed watching them until the alert was lifted, which was sometime, I think, between 8:00 and 9:00, probably closer to 9:00. A particular item that I thought may be of some interest is that the lightning had been more or less continuous, mostly cloud-to-cloud and more or less of sheet lightning variety or just continuous lightning of the cloud itself. I did see two or three cloud-to-ground lightning bolts, which were quite unique as far as my casual observation of lightning is concerned. This lightning occurred from the bottom of a cloud which was fairly well defined and was way off on the horizon. I would guess it was 10 to 12 miles away. The apparent visual angle was quite small, just a degree or so. The thing that was unique about it was the fact that the lightning struck and it seemed to be much more brilliant and at a much bigger size and last longer than would be a conventional lightning bolt that you see from a typical thunderstorm. It was just extremely bright. It struck once and then perhaps a minute or so later, it struck again, and it seemed to last longer than I would normally expect. I watched it and I saw it occur again in one or two minutes and again in two or three minutes.

Elias C. D. Mitchell (L)

My wife told me to wake up and look out our bedroom window that faces southwest (L). She saw a patch, almost a diffused ball of light farther to the south, almost directly perpendicular to the window. She now became convinced by the sound that a tornado was coming. On looking out, I immediately realized that I was seeing the same atmospheric condition I had only seen before on the night of the tornado in Tulsa. There was an immediate flash

of lightning. My wife says that she was looking directly out the window and saw this flash as peculiarly yellow colored. I was looking higher and somewhat southward, and I saw a horizontal "S" in the sky, a tornado funnel or core coming down from the sky to a low point, levelling off or going back up and then down again toward the ground. This was sidelighted by the lightning. It was close. I estimate not over 200 yards southwest of us. The touchdown point was south of us and looked like it would pass to the south if it did not switch around. The point where it came out of the clouds looked like it would pass over us or even north of us. All this was instantaneous guessing based on the momentary lightning-lighted vision and the expectation that tornado funnels travel northeast.

Almost immediately, there was another flash and I had shifted my view somewhat down to the right. A whole patch of sky that I was viewing flashed a bright, rich red color. My wife saw the same thing. After the tornado had passed, we looked out the window that faces northeast, and I became aware that we were looking out on a lighted scene. The level of illumination was that of late twilight, colors were not visible but details could be seen. Most remarkable, however, was that the light was not a discernible series of lightning flashes. In fact, there was an inverse lightning type of effect. You would get the same effect if you were in a somewhat dimly lighted room, and if someone switched off the lights and then switched them back on again--and then switched them off again and switched them back on. The off periods may have been less than a second. The on-periods were longer. I do not know whether the periods were regular. I asked in amazement, "Are you seeing what I am?" My wife said, "This is the strangest thing I ever saw!" We have since agreed in detail on this phenomenon we witnessed. I really don't know where the light came from. We were not aware of anything like a source of light in the direction the tornado had gone. If there had been a continuous light source between us and the retreating funnel, however, and if at random times the funnel had switched back and forth, each time blocking the light for an instant, and with all this covered by a haze so we only saw the general lighting effect, this might explain it.

Dr. J. Brisco Stephens (X) (SO)

My point of observation (X) was located about 70 meters above the valley floor. My deck overlooks Whitesburg Drive, the Army Arsenal, and the area of the tornado's path. We can observe approximately from the edge of the Army Arsenal down to Whitesburg Drive. That would be our scope of visibility. My observations were based on the plasma phenomena that took place. My basis for this observation is that I did my master's work in plasma physics. It appeared, looking at this map, that in the lower impact areas there was a light blue discharge present--roughly that associated with the ionization of molecular oxygen. In the high impact area, when it started to get near the parkway, we saw a slightly green glow, which would be very typical of the ozone discharges I have seen in plasma physics. These were very faint glows from my point of observations. They were not a strong or intense glow. After the tornado had passed through, and let me repeat that we did see it oscillate from a blue to a green as it was going along (this might have been something else, but it did look like there was a discharge) there remained, for a few minutes, a purple glow which would be very typical of ionized air that you would see as it passed through. The glow was more intense up near the clouds and tended to fade out as it worked toward the surface. Basically, that's what we saw.

The significant thing that seemed to me of importance going back over the area and looking at it that in the areas that a couple of people [Kelly Hill (J)] afterward talked about seeing the blue and the green above, and we didn't put it all together--my wife was watching it and this was 10:55. We saw it just before the lights went off and that was at 10:55, and she first saw blue and then she saw green. This was also reported to be observed by other people. It seemed that the green was observed in the areas of heaviest destruction. I went back out, and using the map here, we can triangulate approximately where the colors were. The purple glow must have stayed for about 5--not longer than 5 to 10 minutes afterward. In other words, it did not dissipate immediately. The purple glow was a lasting glow. It was almost, well I don't have any atmospheric phenomena to compare it to.

I've seen a lot of glow discharges in air, and this was just characteristic of that color, and the blue would be very characteristic of molecular oxygen. Those two I am sure of. The ozone I have observed in the laboratory. I have observed this phenomena in a Wood's tube (glow discharge tube) containing ozone--it had a greenish glow to it.

Otha H. Vaughan (S) (SO)

I was on the flight schedule out of Memphis, at 8:00 CDT, Southern 416, and the pilot on the airliner told us they had been warned of severe thunderstorms in the area of north Alabama and southern Tennessee, and that there were tornado watches out, so that we would be about 30 minutes late in leaving the Memphis airport. We would fly to the south and be about 75 miles off course from the normal flight path into Huntsville, and so it would take us longer to get to Huntsville than it would normally take. To make a story short, we left about 8:30, and a few minutes after we were airborne, we turned toward the southeast and the pilot told us he wanted us to look off to the northeast; he said because you'll see a tremendous line of clouds and there's a tremendous amount of lightning in those clouds. We looked immediately off to the left wing. We were about 22,000 feet altitude, and from my vantage point, at this altitude, it appeared that the lower storm clouds were only about 2,000 feet above the ground, while the upper clouds were in the neighborhood of 25,000-30,000 feet. The large clouds off to the northeast were possibly in height in the neighborhood of 55,000 feet. It was characterized by a very large anvil shape, and in front of each anvil were quite a few cumuli towers that had built up in front of these large anvil type clouds. As we were flying, we noticed that the lightning strikes inside the cloud were more like sheets of lightning. The lightning was horizontal, running for considerable distances, and it would actually light the cloud up inside with a brilliant white color. The strokes were quite frequent; they were like bang, bang, bang, bang, bang; very fast. The clouds would light up inside tremendously. I noticed during the whole flight, which lasted about an hour, that there were only about six lightning strikes to the ground, and these were very close to the side of the cloud we were flying around. The cloud was very turbulent inside because you

could see the frothing motion of the cloud, the rolling and churning of the clouds themselves. As we neared Huntsville, the pilot announced that we would start our descent to the Huntsville Airport and he could get in front of this thing and we'd land at Huntsville. As we came around the front of the anvil shaped cloud, there was a considerable amount of lightning inside and below the anvil, and there was lightning from these turrets back into the main cloud. These were not distinct streamers of lightning; they were like, as I had said before, sheets of lightning. We landed in Huntsville about 9:40. On most of the flight, we were way away from the clouds; and we didn't have any real turbulence. Also, we didn't penetrate the lower base of the major particular cloud. There was very, very little turbulence during descent. Dr. Ru Hung, on the flight, also made observations of the cloud with me, and he commented on how bright and how many flashes of lightning he noted in the cloud. He described the cloud the same way I did--sheets of lightning. After, I left the airport and arrived at my home, which is about 25 miles from the airport (around 10:15-10:20 approximately).

The radio in my car said that tornadoes had been sighted on the radar southwest of Huntsville and that a tornado was expected to be coming this way. It had already torn up some area southwest of us here, and it was on its way. I immediately rushed onto my back porch, which faces the west, and looked off toward the west. I also had our TV set on, and I was monitoring it as well as my small radio to try to hear reports while I could observe. The TV reported that the people at the airport, the National Weather Service, were abandoning the airport tower and their station because the tornado was passing near that point. So I immediately looked off to the west of my house. In that direction, I can see the NASA building 4200 complex (O) on the Arsenal and also the Madkin Mountain (P), which is ahead and to the right of the building from my observation point. Somewhere between the building 4200 and Madkin Mountain, I saw this tremendous flash of green light. Now, this was like a green finger of light, a green column. It was surrounded by a real pale apple green coloration, and then that had around it somewhat of a lightish blue tinge and then from that a very, very light blue, almost like a halo. It was almost instantaneous. It was just a flash and then it was gone. I turned my Super 8 movie

camera, loaded with Ektachrome 160 Type A film, on and began operating it, looking toward the point of the flash for a few seconds. Then, a few minutes later, I noticed to my right a second flash and again I immediately turned my camera on after this initial flash. There is a hill to the northwest of my home that blocks my view of the airport (R), and the tornado passed north of this airport, so I could not see anything after the first two flashes. Figure 5 shows a sequence of photos of the blue glow which I photographed.

That's about as good a description I guess as I can give of these phenomena. It appears now, from what I am able to determine, that these flashes occurred in areas in which the tornadoes were later reported to have struck. In the two areas which I am talking about, the first area being the area very close to building 4200, and later the tornado appears to have passed over Madkin Mountain (P), through the gap, and then to have hit the Army Missile Command area. It was about the same position that I observed the second flash.

Ernest Rickburg (I)

At the time, the main thing I was able to see was the intense electrical activity that occurred at the same time the storm came through the town. It was mostly cloud-to-cloud lightning. The feeling I got was that it was very silent for lightning. It was very intense; the whole area was illuminated almost all of the time. Very little thunder. Surprisingly little for the activity. The best way I can explain it is like fingers reaching out from cloud to cloud and climbing along the bottom of the clouds. I don't know any other way to express it. Like a hand crawling upside down on the bottom of the clouds. Very similar to that. The entire cloud and the ground and everything were illuminated. Visibility was excellent - until the rains hit and then it got kind of limited. The only other time I have observed a similar storm was a storm about six months before. One came through the area about a mile away. All I saw was the red glow. They were both tornado storms. In the recent storm, the lightning was just the white lightning. I didn't see any hue to it.

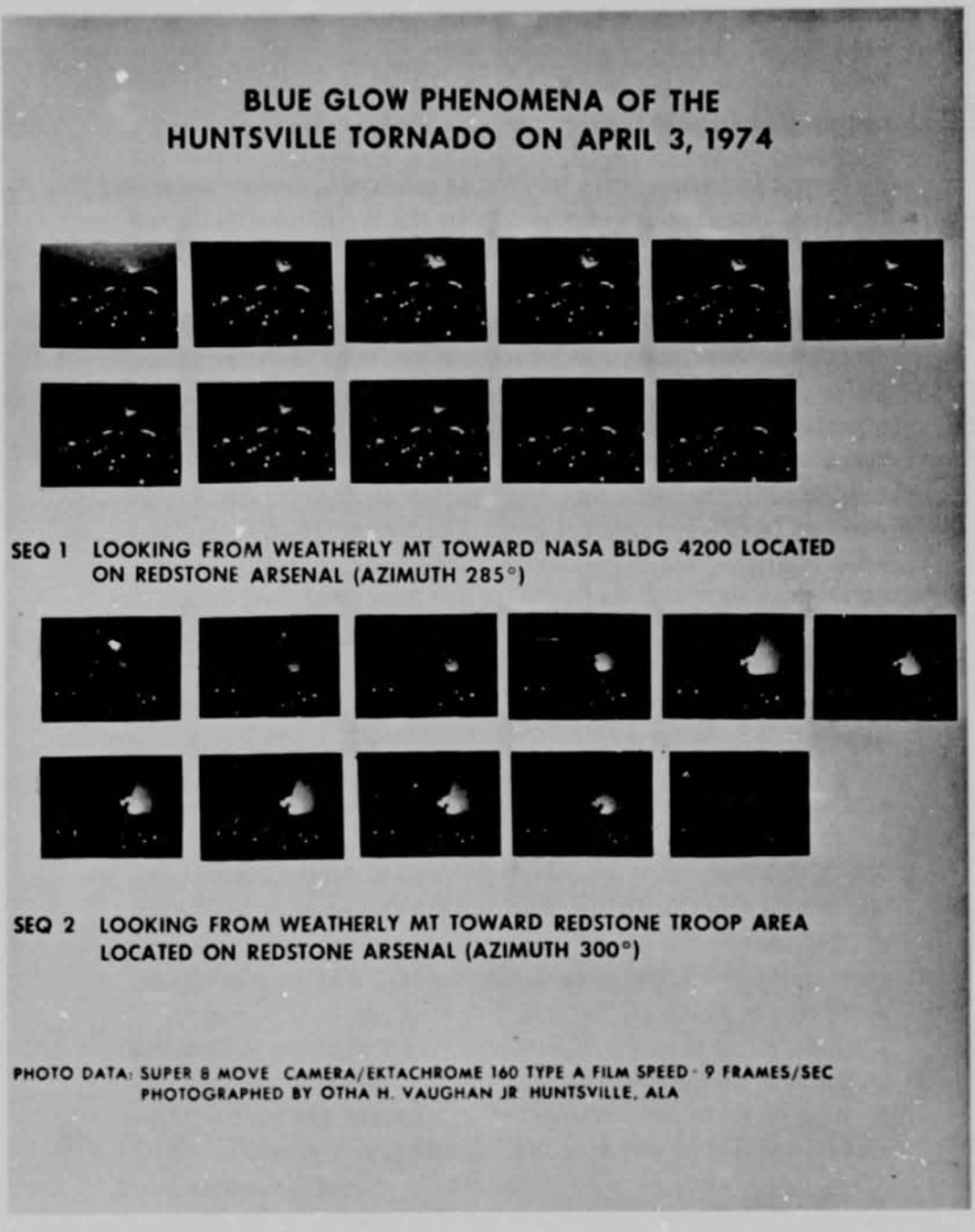

Figure 5. Film sequence of blue glow (Photograph from top of Weatherly Mountain by Otha H. Vaughan, Jr.; super-8 camera, Ektachrome 160, type A, 9 frames per second.).

Carl G. Craig (Y)

I was coming home from Huntsville mountain, where the power transmission line crosses it. I saw the big black clouds and storms to the west. I saw no funnel or anything resembling a funnel. The first unusual thing I noticed was a brilliant blue flash, like an electric arc, off on the horizon and west in direction. It appeared to be somewhere over there and many miles away. It was very short duration. It appeared to be a gigantic electric arc, and I thought at the time it was a power transmission line shorting out, but I've never found where the line was, if that's the case. That was followed about 5 to 10 seconds later by another gigantic flash of bright blue light in essentially the same location. There were just two flashes, nothing in between. At that time and after that, the entire sky in this area was just constant blue lightning flashes. This was all I saw until what I assume was the time the tornado came over Madkin Mountain (P). I never saw anything I could identify as a tornado, but somewhere in this vicinity I saw a very large yellow light, about the color of a carbon flame. It was poorly defined. It appeared to be sort of egg shaped--an egg standing on its end. The height of it was something on the order of 800-1,000 feet, that is assuming it was at Madkin Mountain and comparing it with the height of the mountain. The width of it, possibly 400 or 500 feet. This is the thing I remember most about the whole observation because I have never seen anything resembling it or heard of anything resembling it. It appeared as if in the cloud there was a gigantic yellow light bulb and it was turned on for perhaps 2 seconds and then off. It came on quite suddenly and went off quite suddenly. There was no buildup or tapering off. It was just a gigantic, super-sized yellow-orange glow in the cloud. About 5 seconds later, or something on that order, it did it a second time. Again, it appeared to be very near the same size. Afterward, after finding out what the tornado did, I believe this phenomenon may have occurred when the tornado was in that vicinity. I was, for certain, looking at a spot on the tornado's track, and I may have been looking at the spot where the tornado actually was.

Jane Ryals (J)

I have a daylight basement on Monte Sano Mountain (Z), overlooking the city, and my main exposure is to the west, the direction from which the tornado came. The electricity went off about 11:04 or 11:05, and the tornado occurred about 5 minutes afterward. We began to watch this, and I wish I had known at the time what I was watching. There was lightning flashing constantly. One after the other. It was like being in a room with one of those strobe lights that go on and off, because you really can't identify what you're seeing. Your attention is just all over the place. Everything got dark. What I thought was power lines going down was explained to me the next day as the dynamics going on inside the tornado itself. I thought that all these beautiful sparks were power lines going down someplace. Instead of being a funnel cloud that you typically think of, it looked, when the lightning was flashing, like a puff movement. When this thing would spark or when what I thought was power lines going down, it would start at the ground and then it would work its way up into kind of a mushroom. It would start out very intense and then it would kind of just glow. But there was one right after the other. I was really quite amazed. I couldn't figure out in my mind what kind of power lines going down would give off different colored lights. They were rainbow colors. Some were green and some were pink and red and blue and yellow. It was really something. We watched it right to the last minute. It lasted anywhere from 5 to 10 minutes, I would guess. The noise was terrific and the pressure dropped something out of sight. The noise was sort of a high whistle but behind all that was the low roar. This roar is like the finishing rumble of thunder.

Dr. Rudolf Hermann (Z) (SO)

I was close to the tornado at Huntsville--I live on Monte Sano Mountain (Z)/Inspiration Lane and the righthand edge of the main path was about 40 meters away from my house. I want to mention the observations made about 11:00 pm (CDT) on April 3, 1974.

First, nearly all the tornado pictures you see show the so-called funnels are long and of small diameter. But the one I saw, 30 to 60 seconds before it hit us, which at this time was over the city, had a very thick trunk. If you take the distance from the ground to the ceiling, where the clouds start, as unity (100%), then the base diameter of the trunk at the ground was about 35% of this height. Up on the cloud ceiling, the trunk diameter was about 150%. The whole structure looked like the upper portion of a large funnel (streamlined as vortices known in fluid mechanics). The ground diameter we could measure the next day, April 4, 1975, after all the trees were gone, turned out to be about 300 to 400 meters.

Second, I also found out the next day, looking in the marching direction of the tornado, on the righthand side, the marching velocity, and based on the TV progress reports, was about 20 meters per second. On the lefthand side of the tornado alley, all the trees were thrown into the opposite direction. Some people thought the tornado turned around and went back to town. That's incorrect. Obviously the rotational velocity was so much larger than the translational velocity (20 meters per second) that the rotational velocity determined the forces on the trees and the structures. That also shows that this tornado was rotating counterclockwise looking from above towards the ground, the same way, of course, as all the large meteorological low pressure areas rotate.

The third observation that I made was with respect to the electrical discharges. When I first saw it, it was a completely uniform discharge for about 3 to 5 seconds, constant with a uniform orange-red illumination inside the trunk, when suddenly it went completely dark, and I could see the trunk only from the outside by the lightning that was constantly going on. Then after perhaps another 5-10 seconds, it became illuminated from the inside, but this time bluish-white, not red. I wondered how it could change its colors so fast. How can the color be so different? I am quite sensitive to color at night during Astronomy class because I make spectral observations of the stars.

(Note: The next morning, 10 hours later, Dr. Hermann's wife, who is an artist and observed the tornado with him, made two watercolor paintings (Figs. 6 and 7) which show the appearance of the storm cloud and how it changed in an interval of approximately 30 seconds.)

Kelly Hill (J) (SO)

On the night of April 3, I had observations of lightning and associated phenomena with the tornado which hit Huntsville. At that time, I was at a position (J) on Bob Wallace Avenue about 1/2 mile west of Memorial Parkway. The path of the tornado actually passed about 1/4 mile to the south of my position. Earlier warnings were given on local TV stations, and I was on the lookout toward the southwest, the direction from which the tornado was coming. Several minutes prior to the tornado hitting nearest to me, a green glow was seen in the southwest sky, which at night was estimated to be the first time perhaps 10 miles away. That would approximate its location close to the time that the tornado hit the area around Marshall Space Flight Center. The green glow was seen at such a distance, that the first time there wasn't a great deal to see, only the green coming on and gradually fading away. But after that, as I stood and watched, the green glow appeared periodically, perhaps every half minute or minute or so; there were varying periods. As it came closer, it appeared as a glowing shaft of green from the cloud base to the ground, which would come suddenly on and then gradually fade away over a period of seconds, perhaps 5 or 10 seconds or so. The last time I saw the glow was just prior to evacuating and climbing in a ditch. At this point, the tornado was estimated to be southwest of my location or south-southwest of my location about a half a mile. At this time, I could hear the destruction taking place and above the noises of the destruction I could hear the noise of the tornado, which to me resembled the sound from a large number of bees or perhaps more like an engine of some sort, many engines going at the same time. Just at this last instant before getting in the ditch, the green glow appeared again as a long shaft of light, more intense near the center, which appeared to me to be exactly where the funnel was located,

Figure 6. Watercolor painting by Maja Hermann showing appearance of the storm cloud.

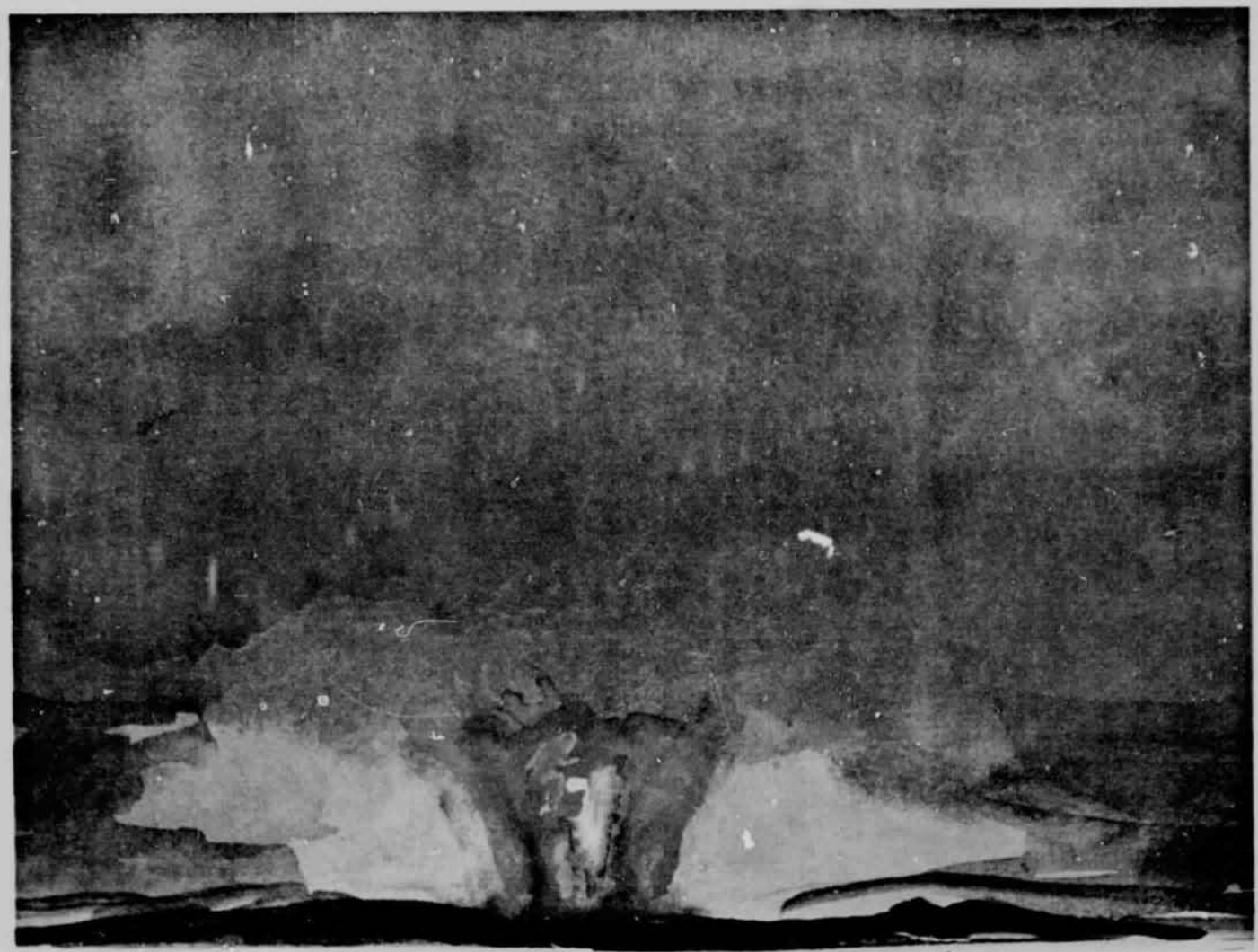

Figure 7. Watercolor painting showing the appearance of the storm cloud and the luminous phenomena approximately 30 seconds after Figure 6.

extending from the cloud base, which was perhaps 2,000 feet, to the ground or as near to the ground as I could see from my location. At this point, I evacuated and within seconds the tornado had passed, and I didn't observe the green glow any more from my location.

William M. Dobbs (T) (SO)

First comments I have refer to the two tornadoes which passed near Hazel Green, Alabama (A).

After seeing the tornadoes on the TV radar presentation by Channel 31, I went outside to see what I could see. Looking into the northwest sky, I saw one extremely large thunderhead. It had a top dome-like shape and it had an orange glow on top. After watching for a short time, I noticed that right behind it there were two thunderheads with domes and an orange glow to them, also. A lot of vertical lightning was in both storms. These storms were, I guess, about 20 miles from my point of view, visibility was striking good, and we had very little rain in my area.

The second comments refer to the Huntsville tornado. The storm that hit Redstone Arsenal was seen on the Channel 31 approaching and we walked out to see the storm approaching. Time was approximately 10:35 pm (CDT).

What we saw first was a green spike of light at about 7 miles west toward the Arsenal. The spike would move along and there would be a burst of light and it looked like some bombing was taking place. I decided to take the pictures using my camera, a Konica, with a 55 mm lens, and high speed Ektachrome film. I hand-held the camera and I exposed each shot for 2 seconds. There was about 1 second between exposures to rewind the film for the next exposure. The camera was focused at infinity and the f stop was 1.4. These photographs are seen in Figure 8.

After a while, we tried to follow the tornado, but we lost sight due to the trees.

INITIAL PHOTO OF THE HUNTSVILLE TORNADO 3 APRIL 1974

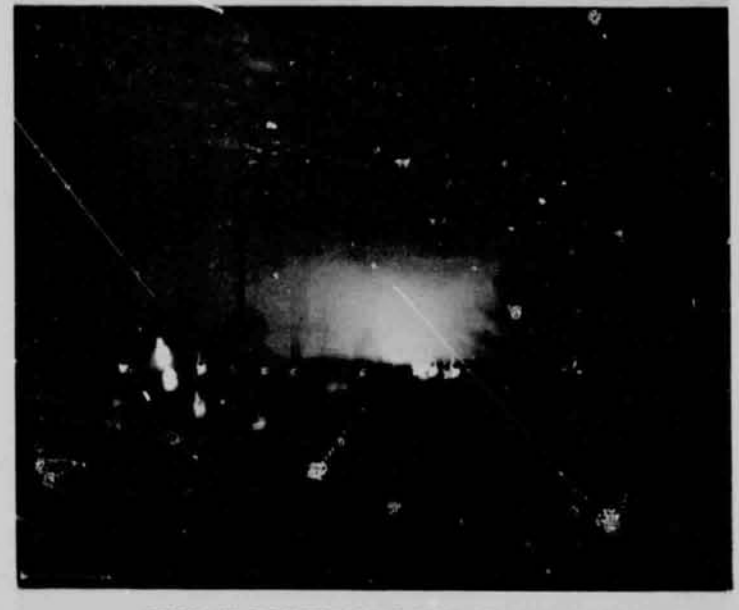

PHOTO OF THE TORNADO 3 SECONDS LATER

PHOTO BY W. M. DOBBS, HUNTSVILLE ALA. TAKEN FROM BASE OF WEATHERLY MOUNTAIN.

Figure 8. Still-camera film sequence of tornado (Photographed by W. M. Dobbs; Konica 55mm lens, high-speed Ektachrome).

Another thing we noticed about the storm was that it had quite a bit of vertical lightning. We never saw a funnel or funnel shape. The green light looked very much like the kind of light you would get from a laser made to lase in the green, very fluorescent in nature. There was no sound that we could hear from the tornado.

Clifton M. McClure, III (H) (SO)

On the night of April 1, 1975, the night that a tornado hit the Sherwood Park area here in Huntsville, I was able to observe the following from my place of business across from the Arsenal on Highway 20 and about 1 mile from the Sherwood Park Subdivision (H). First I saw a large bolt of lightning and a tall thin shaped funnel cloud, a really straight type column, not a converged divergent funnel but a straight small column. After the bolt of lightning hit, there was a tremendous amount of rain and during the rain there was a series of almost continuous lightning flashes not bolts but like sheets of lightning. I looked for the blue glows I had heard about but I didn't see any--I looked really hard--but all I saw was a lot of rain but there was also a lot of lightning, a lot of green and blue series of discharges, but not bolts. I couldn't see a tornado but the area near here was illuminated so brightly by the lightning that you could read a newspaper. On the evening of April 3, there was a lot of thunderstorms in the northern Alabama area and we were out at my business location again and we were following the progress of the storms on the radio and the TV. It was still daylight and we heard on the radio about the tornado crossing the Tennessee River and going northeast toward Harvest. This tornado was the one that later went through the Harvest-Hazel Green area around 7:00 o' clock and here is what it looked like to me. It was a very dense large cloud right on the ground and it looked like a tremendous column of rain and I cannot really say for sure that it was a tornado but there appeared to be a tremendous amount of weather in that column. Later, in the evening we began to hear more reports of tornadoes so we decided to go up to the north end of Monte Sano Mountain (Z) to see what we could see. We have two lots on the mountain, one which had a house on it that we rented and the other lot was where

the tornado later struck. Now when we were on the north end of the mountain, I was looking off in the north direction and when the lightning flashes came I could at least see two imperfect funnels. During this time also, I didn't observe anything happening down in the city since as I was not looking in that direction. Later we watched the tornado as it came over the mountain on the Arsenal and as it was coming toward the south end of Monte Sano Mountain. Now we decided prior to that time that the tornado began to hit the south end of the mountain that we would try to get on the other side of the tornado so we could see it better. We drove down the road toward the south end but we were blocked and exactly the same thing happened we saw in Sherwood Park on April 1. There was a big bolt of lightning and then there was no more lightning but there was a big series of blue-green flashes like a sheet lightning. Now I was looking for a glow but I didn't see it but there was so much rain it was hard to see. My wife, Bobbie, said she could see a funnel between the bolts and flashes of lightning when it struck the south end of Monte Sano near our lot. After the lightning and rain ceased, we tried to get down the mountain by going to the south end but there was so much debris that we turned around and went down the north end and off the mountain. Looking back at the mountain (Monte Sano) from downtown, there was so much lightning that we could see the base of the cloud with the top of the mountain. The cloud was about 200 to 500 feet above the mountain and there was a sharp base and there was a "beard of rain" as you see sometimes in the desert. Mostly a sharp line at the base of the cloud but there appeared to be funnels dropping out all the time and you could see them between flashes of lightning and what you see is changing very rapidly. Mrs. Bobbie McClure stated that she saw funnels earlier when she looked out at the Arsenal.

Don Bowden (U) (SO)

On the night of April 3, 1974, about 10:50 CDT, I was listening to my police band radio and was alerted that a tornado had crossed the jetport and was coming onto Redstone Arsenal. I went out onto my sundeck, which faces west toward Redstone Arsenal. I observed that the weather at that time was very good (no rain) at my house and that the visibility was in excess of 20 miles and

the ceiling was about 1000 feet. I could see lights flashing, lightning, and observed very strange colors as the tornado came across Madkin Mountain (P) and Ward Mountain (N). It appeared to be coming toward the east, over my house, but as I continued to watch, it appeared to be going toward the northeast-toward Parkway City (K). I observed several strange phenomena that I had never seen before. There appeared to be flares going off on the ground which were chartreuse in color. At first I thought this effect might be electrical transformers blowing up but it continued (with these electrical effects) while in its path. I was not very conscious of the lightning, maybe because lightning is a common thing that we often see and it didn't register. The green flashes seemed to be up the tornado, but they also seemed to be originating on the ground. As the tornado went off to my right, I could see things being picked up and I remarked to my wife that it was really tearing Huntsville all to pieces. I could see the electrical lights going off as power was lost as it passed through the Parkway City area. The tornado appeared to be about one-half mile wide and had no funnel shape to it. It came out of this 1000 foot overcast and came straight down to the ground. There was no rain between me and the tornado and it appeared to be a straight vertical column perpendicular to the ground. The column looked extremely wide and it didn't appear to be a rotating column. There was so much of the green glow that you could see objects moving inside. The noise was similar to a loud roar, like a jet plane or a rocket engine. It was not exactly a continuous roar but like a ripple and a crackling sound, similar to a large rocket engine of the Saturn class here which have been fired on the Arsenal.

CONCLUSIONS

The photographs, paintings, and accounts by scientifically sophisticated observers corroborate and add new detail to previous reports of extraordinarily frequent lightning and varicolored luminous activity that sometimes accompany tornadoes [7]. The interesting feature of these recent reports is that

the sophisticated scientific observer finds the phenomena quite as baffling as does the layman. To determine the nature and energy of these electrical phenomena and their relationship to tornado-producing storms it will be necessary to obtain quantitative observations similar to those that are now available for ordinary lightning. These should include measurements of currents, magnetic, and electric fields as well as time-resolved spectroscopic data.

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APPROVAL

LUMINOUS ELECTRICAL PHENOMENA IN HUNTSVILLE, ALABAMA, TORNADOES ON APRIL 3, 1974

By Otha H. Vaughan, Jr. and Bernard Vonnegut

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

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