FORECASTER BIOGRAPHY

Grady Norton: Hurricane Forecaster and Communicator Extraordinaire

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(Manuscript received 10 June 1988, in final form 17 June 1988)

1. Introduction

Grady Norton, senior hurricane forecaster in the U.S. Weather Bureau from 1935–54, had remarkable success in predicting hurricanes. His ability to analyze and interpret all available observations enabled him to make accurate forecasts of landfall up to 24 h in advance, in an era before objective track guidance and weather satellites. His explanations of hurricane advisories in simple terms earned him the respect and admiration of the media and public.

Norton joked that he came from "Fleahop, Alabama," but actually was born in 1894 in Womack Hill in Choctaw County, Alabama—about 150 km west of Montgomery. He was the son of a farmer, and attended elementary and high schools in Alabama and Mississippi. He was fascinated by severe weather as a boy and received his first introduction to meteorology in high school as part of a general science course (Kobler 1948). Although he took correspondence courses, he was largely a self-educated man. He read extensively and was knowledgeable about history, Shakespeare, mythology, and the Bible.

Norton joined the Weather Bureau in 1915 and was drafted into the army near the end of World War I. He served 10 months with the Signal Corps in 1918–19 and attended the Corps' meteorology program at Texas A&M University. The program was directed by Oliver Fasig and Charles F. Brooks was one of the instructors. Grady was one of 300 enlisted men who participated in the program that was taught only once—in May and June of 1918. Ivan Ray Tannehill, who later became prominent in the Weather Bureau, was also one of the students (G. A. Franceschini, personal communication 1988).

During his military service, Norton was assigned to a weather unit in Washington, D.C., and rose to the rank of sergeant. Upon completing his military service, he rejoined the Weather Bureau and subsequently worked at local weather offices in Little Rock, Arkansas; Macon, Georgia; Meridian, Mississippi; Louisville, Kentucky; and New Orleans, Louisiana, before being named the senior hurricane forecaster at Jacksonville, Florida in 1935 (Kobler 1948; Weather Bureau Topics Staff 1954). The hurricane forecasting unit in Jacksonville moved to Miami, Florida in 1943, so that forecasters could work more closely with Air Force and Navy hurricane reconnaissance units.

In the early years of his career, Norton did not specialize in hurricane forecasting. In 1928, while he was assigned to the Louisville weather office, he took a late summer vacation to visit some relatives in southern Florida. He happened to drive into West Palm Beach during the mass funeral for the more than 1800 victims who were drowned on 16 September, when water driven by a major hurricane overflowed the shallow rim of Lake Okeechobee (Mitchell 1928; West 1975). Norton overheard a remark that the great loss of life would not have occurred if the weather forecasters had provided a timely warning for the victims to evacuate the area (Norton 1947). Although he did not disclose that he was a Weather Bureau forecaster, the comment about the inadequacy of the warning, which was not entirely true, made a lasting impression on Norton, and he resolved to dedicate his life to the prevention of such tragedies (Colbert 1954).

On Labor Day 1935, a few months after Norton became the chief hurricane forecaster at Jacksonville, the most intense hurricane to strike the United States since accurate weather records were kept, made landfall in the lower Florida Keys. At landfall, the hurricane had a minimum central pressure of 892 mb and maximum sustained winds $\sim$ 90 m s^{-1} (McDonald 1935a,b). More than 400 people died, many of them unemployed veterans from the Washington, D.C. area who, in the midst of the economic depression, had been encouraged by government officials to help build a road to Key West. Almost 1000 veterans had been sent to the Keys, but fortunately most of them were in Miami for the Labor Day weekend. A train was sent to evacuate the remaining veterans to high ground, but it left

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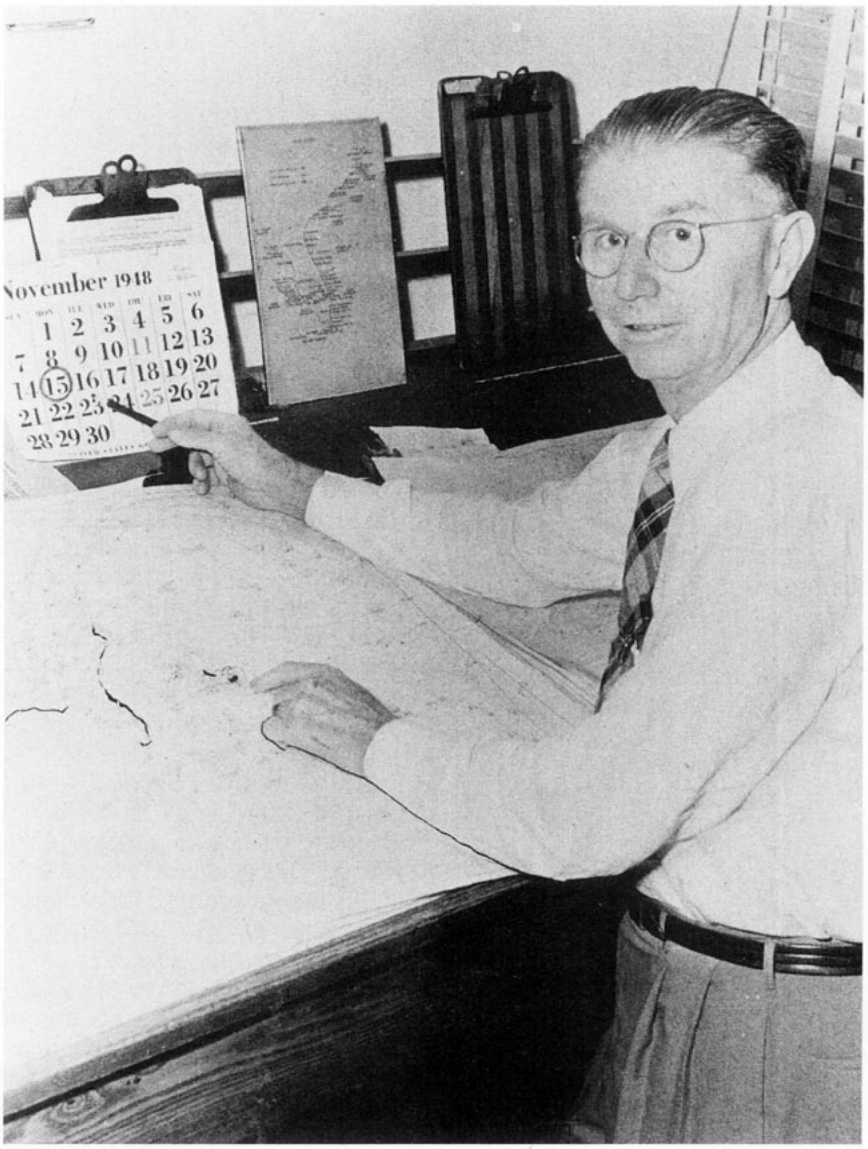

Grady Norton at the Miami Weather Bureau office in November 1948. The surface map shows the position of an Atlantic hurricane at 1230 UTC 9 November. The unusual November storm occurred only a few days before the end of the hurricane season which at that time was 15 November. The photograph was obtained from the files of *The Miami News*.

Miami too late. After picking up the veterans, it was turned on its side in Islamorada by a storm surge > 5.5 m high. The head of the Veterans Administration appointed an investigator to assess the timeliness of the forecasts and evacuation procedures. Although Norton had provided more than 12 h advance warning to the administrator of the veterans camps, the investigator split the responsibility for the tragedy between the Weather Bureau and the Florida East Coast Railway (Wood 1954).

The loss of life from the 1935 hurricane renewed Norton's determination to make accurate forecasts and to communicate warnings to the public so that there would be *no* lives lost during the landfall of major hurricanes. Although Norton was never able to achieve this goal during his tenure as senior hurricane forecaster, he helped to reduce the average number of deaths from a major hurricane striking the United States from about 500 to 5. In 1949 Norton received the Department of Commerce (DOC) Silver Medal for Meritorious Service, the DOC's second highest award, in recognition of his lifesaving, accurate forecasts and his ability to communicate with the public (Dunn and Miller 1960). Norton was posthumously awarded the DOC Exceptional Service Gold Medal, in recognition of his outstanding contributions to the Weather Bu-

reau's hurricane warning service (Weather Bureau Topics Staff 1955).

Until the 1930s, hurricane forecasts were based upon interpretation of surface observations. Observations of upper air winds were possible only where observers could estimate cloud motion or determine winds from tracking balloons that were not obscured by clouds. In the early 1940s, the development of radar and radio direction-finding equipment made it possible to obtain winds throughout the troposphere, regardless of cloud conditions, and military requirements during World War II resulted in a significant increase in the number of upper air observing stations. With the availability of better upper air wind observations, Norton developed a theory that hurricanes moved with the wind flow in the upper troposphere and subsequently referred to himself as a "wind jammer." The theory is summarized in Cecil Gentry's recollections, which are included in this article. Norton's first opportunity to test his theory came in October 1944. Using the wind observations, he predicted that a fully developed hurricane would move through a surface high-pressure area. According to earlier theories, hurricanes tend to move around a surface high. To the astonishment of his associates, the hurricane followed the predicted course (Norton 1947).

Norton displayed outstanding skill in forecasting hurricanes, yet his most extraordinary talent was communicating warnings to the public. He had an Alabama drawl, spoke in a folksy way with a dry sense of humor (Jones 1957; Jones 1975) and translated meteorological jargon into a language that everyone could understand. For an anxious public, his strong, clear voice was calm and reassuring. He never minimized the dangers. When protective action was required, he communicated a sense of urgency over radio or television that motivated people to respond to the warnings (The Miami Herald Editorial Staff 1954).

Complacency bothered him. Many people moved to southern Florida during the mid 1940s. Most of them had never experienced the full force of a hurricane and did not heed the lessons from the 1935 hurricane in the Florida Keys. During the hurricanes that affected southern Florida in the 1940s, Norton noticed that few people used Red Cross shelters and that many remained at home in flimsy houses near the waterfront. He renewed his efforts to increase public awareness of the damage potential of hurricanes, and gave many after-dinner talks. He studied flaws in the Dade County codes that were revealed by the destruction associated with each storm affecting southern Florida and worked with government officials and engineers to improve the code (Wallace 1949). He felt that his efforts were worthwhile when only three deaths resulted from the 1950 hurricane that struck the Miami area with maximum winds of 55 m s^{-1} (Wood 1954).

Norton was a dedicated worker who hated to waste government money. He frequently did minor carpentry jobs around the forecast office rather than follow standard government procedures required to select a contractor. On one occasion, a contractor estimated that it would cost $800 to make some office repairs. Norton felt that the estimate was much too high, stating that if his father were still alive, they could complete the work in a day. It took the efforts of the entire office to persuade him not to undertake the repairs (Baggs 1954).

Norton viewed meteorological textbooks and research papers as sources of general knowledge that were useless in forecasting for a specific area for issuing or severe weather warnings. He believed that his experiences could be helpful to future hurricane forecasters, but did not want the rules he set down to be as ineffective as his perception of the formal publications of his predecessors. To avoid following in their footsteps, he wrote his ideas on hurricane forecasting in the form of a soliloquy (Norton 1947). This is his only extensive written work on hurricanes, and covers a range of topics that include the temperament and philosophy of the hurricane forecaster, analysis of observations, and hurricane forecasting as an art.

2. Reminiscences

Reminiscences were provided by the following forecasters who worked with Norton: Gordon E. Dunn, former Director of the National Hurricane Center from 1955–68, was the junior hurricane forecaster with Norton in Jacksonville from 1935–38; Cecil Gentry, former Director of the National Hurricane Research Laboratory, was a hurricane forecaster under Norton from 1947–54; Paul Moore, former head of the Scientific Services Division in the southern region of the Weather Service, worked as a hurricane forecaster with Norton from 1948–54; Robert H. Simpson, former Director of the National Hurricane Center from 1968–74, was a hurricane forecaster and Norton's principal assistant from 1944–46.

a. Gordon Dunn

The Weather Bureau's hurricane warning service was located in Washington, D.C., from its inception until 1935. Interest in hurricanes increased in 1933, when an Atlantic-basin record of 21 tropical storms and hurricanes occurred and 6 hurricanes affected the United States. Many southern government officials believed that the Washington office was not sufficiently concerned about the hurricanes that threatened their states. This concern heightened when a hurricane forecaster in 1933 or 1934 issued warnings to the entire Texas coast about a hurricane in the Gulf of Mexico. The hurricane was moving slowly and coastal residents observed no indications that a hurricane was approaching. Members of a local Chamber of Commerce were upset

that activities were being curtailed unnecessarily and sent a telegram to the Washington Weather Bureau office to find out where the hurricane was, and when it would arrive. A map plotter had just come on duty and sent back a telegram stating "forecaster out on golf course." This answer enraged Texans, who demanded a more responsive hurricane service. Of course, they did not know that it was common for the duty forecaster to be away from the office for most of the afternoon. Weather Bureau forecast shifts were scheduled differently in those days. There was only one forecaster on duty and that forecaster's duty day lasted 24 h. The forecaster could issue forecasts on time and still be away from the office for several hours during the afternoon.

At this time, Ivan Ray Tannehill, previously in charge of the Galveston, Texas weather office became chief of the forecast division of the Weather Bureau. He was sensitive to the damage potential of hurricanes, because in 1900, many years before he started working in Galveston, 6000 residents were killed by a hurricane. Tannehill was instrumental in reorganizing and upgrading the hurricane warning service, for which Congress appropriated about $115 000. This appropriation led to the beginning of modernized hurricane services in the United States.

In 1935, the hurricane forecasting service was decentralized and centers were established in Jacksonville and New Orleans, continued in Washington, and reestablished in San Juan, Puerto Rico. Jacksonville was the only complete center and was responsible for the area from Cape Hatteras, North Carolina to Apalachicola, Florida, and for most of the Atlantic. A 24 h hurricane teletype network was set up between Wilmington, North Carolina, and Brownsville, Texas. Grady was transferred to Jacksonville from New Orleans as the senior forecaster, and I was transferred from Washington as the junior forecaster. We were responsible for issuing warnings every 6 h, 7 days a week, from June to November.

On Labor Day of 1935, only a few months after the new service was established, we had to deal with the most intense hurricane to strike the coastal United States since accurate records were kept. It had a very small concentrated center, with winds $\sim$ 90 m s^{-1}. Several hundred veterans were in the Florida Keys building a highway as part of the Work Projects Administration (WPA). The night before Labor Day, Grady called the WPA office in Miami and issued a warning to evacuate the veterans. The only possible way to do this was by train on the Florida East Coast Railway, at a cost of $12 000. The Miami WPA officials wanted authorization from the head of the WPA before approving the evacuation, but they were unable to reach him. He was in the West making Labor Day speeches. At 1100 EST, the local WPA decided to send the train from Miami, but it was not until 1400 EST that arrangements could be completed. The train proceeded along the Keys, picking up veterans and civilians. At Lower Matecumbe Key, the locomotive was placed on a turntable and headed northeast for the trip back to Miami. The train went only a short distance before it was discovered that the track had been washed out by the storm surge. Shortly thereafter, the train was blown over—or perhaps washed off the tracks—and everyone on it was killed. Had the train continued on to Key West from Lower Matecumbe Key, the crew and passengers would have been saved.

Although the warnings for the Labor Day hurricane were far from timely, they were as accurate as the observations would allow. Grady and I did not realize the intensity of the approaching hurricane. About 3 days before striking the Keys, the center of the storm had crossed over Long Island in the Bahamas, about 300 km southeast of Nassau. Maximum winds were 17–18 m s^{-1}. There were no other observations from the core of the hurricane until it reached the Keys.

In September 1948, a hurricane moved across the lower Florida Keys toward Miami. On the evening of the twenty-first, Grady issued an advisory that gave the probable time of arrival of the center around Lake Okeechobee. Several hours elapsed and the stations around the lake did not show any signs of severe weather. In a discussion with other forecasters, Grady wondered what had happened to the storm. A reporter from the *Miami Daily News* overheard the remark and telephoned the newspaper. Immediately, a special edition was issued with a big headline that proclaimed "Weather Bureau Loses Hurricane."

Of course the hurricane had not been lost; it had just slowed down a little. The forecasters had to estimate the direction and speed of the storm based upon indecipherable wind observations from Everglades City, which is on the Gulf of Mexico coast west of Miami, and was the only location taking weather observations west of the storm center. The storm, which was moving very slowly, had a large eye that produced intermittent lulls in the wind, followed by hurricane-force winds at several places. About that time, a message was received from Everglades City that the storm center was still to the south and offshore (Associated Press 1948). Norton issued a special advisory to correct the storm position and indicated that forecasters had moved the storm center too fast due to the absence of observations (Beeber 1948). As a result of the "lost hurricane" newspaper articles, the public wanted to know what *had* happened to the storm. Norton felt that the forecasters had handled the weather information properly and that no apologies were needed. The Weather Bureau had posted hurricane warnings in all of the appropriate places at last 24 h before the strong winds occurred and forecasters had constantly estimated the storm center to be within 40 km of the actual track (that was determined a day later, with a complete set of observations). He placed blame for the

inaccuracies in the storm position on garbled wind directions from inexperienced observers in Everglades City, and also on the distorted eye of the hurricane (Baggs 1948b).

The publicity about the tracking of the storm made a lasting impression on the residents of southern Florida. Years later, when I gave hurricane-preparedness talks in the southern Florida area, people remarked about the time that the Weather Bureau lost a hurricane.

b. Cecil Gentry

Grady Norton was my supervisor from August 1947 until his death in October 1954. He was one of the best forecasters—especially of hurricanes—that I ever met. As a result of his forecasting skill and his ability to communicate his forecast in simple terms, the general public and the media held him in great esteem.

Long-time friends joked that the boll weevil caused Grady to become a forecaster. The story was that he was prepared to spend his life raising cotton in Alabama. Then the boll weevils eradicated his crop, and he was forced to find work elsewhere. If this is what actually happened, one has to give the boll weevil credit for at least one good deed.

Norton was the chief hurricane forecaster during a period of great transition. Live radio broadcasts of hurricane advisories were increased, radiosonde observations were developed and became prevalent during World War II, weather radar was developed, aircraft reconnaissance by penetration as well as by airborne radar became operational, and a network of land-based radars was installed along the coast to track hurricanes. He helped to improve the coordination of hurricane advisories between forecast offices within the Weather Bureau and between the civilian and military services.

Norton's career ended before many objective techniques for forecasting hurricane tracks were developed, so most of his forecasts were based upon qualitative evaluation of the observations and his experience and intuition. He did, however, develop the technique known as "high-level steering" to its greatest level of efficiency. He analyzed the upper level winds up- and downwind of a storm and determined the level at which the hurricane's vertical circulation disappeared (usually estimated to be between 8 and 12 km for mature hurricanes). The streamlines that he sketched at that level indicated the direction of motion of the storm for the next 12–24 h. In later years, when more winds became available near the storm center and objective studies showed that the "steering level" was in the middle troposphere, but varied from storm to storm, better techniques came into vogue. Nevertheless, Grady's use of the upper winds frequently helped him make excellent forecasts of hurricane tracks for at least 18 h, and I can remember a few times when he forecasted the direction of motion accurately for 30 h.

Norton's skill in handling the public was even greater than his forecast skill. People had great confidence in his advisories. When a storm approached land, especially in areas that could be reached by radio from the Miami forecast office, Grady did many of the broadcasts. Acquaintances outside the office often would not ask me if the hurricane was coming, but rather, "Has Grady started broadcasting yet?" Many people informed us that there was something soothing about his presentations. They said that after listening to him they stopped worrying and prepared to react only when he advised them to do so.

Norton enjoyed writing to people who either complimented or condemned the hurricane service. I remember that he received numerous letters from one man who criticized our advisories in ways that were completely unjustified. He demanded accuracy in our statements that far exceeded the state of the art. Finally, Norton decided there was no point in reasoning further with the fellow and wrote a letter something like the following:

> Dear Sir:
>
> I am sorry that you cannot appreciate the general excellence of our work. As one Irishman to another, begorrah, I believe you are right! You have not been getting your money's worth for the taxes that you pay to support the Miami hurricane office. The Weather Bureau recently estimated that the average tax payer contributes one-seventh of one cent each year to support hurricane forecasting in this office. Enclosed is a penny which will refund your portion of our support for the next 7 years.
>
> Very sincerely yours,
> Grady Norton, Chief Forecaster

We did not hear anything further from the man.

Once a storm became a threat to land or an important marine activity, it had Norton's undivided attention. There were three experienced hurricane forecasters in the office, in addition to Grady. We usually arranged the schedule when the forecasts were critical so that one of the three of us was on duty every hour of the day. This let Grady come and go as he pleased, although he rarely left the office for more than an hour or two and was usually on call 24 h per day.

Norton was a deeply religious man; by that statement I refer to his belief in a supreme power. He belonged to a church, but was not one of the active members. His beliefs, however, were emphasized to me, after his death, when I found a page he wrote at the office. It expressed his philosophy about his work as a hurricane forecaster. The principal theme was that if he prepared himself, and worked hard to make outstanding forecasts, once he reached the limit of his ability, a "supreme power" would give him the ability or insight in order to better serve the public.

Mr. Norton was a fighter—but he picked his circumstances. If one of the map plotters needed disciplining, he could rarely bring himself to do the scolding. He would ask one of his assistants to take care of the matter. If, however, the chief of the Weather Bureau did something he did not like—that was another matter. Grady usually dictated letters to his secretary, so if someone saw Grady pecking out a letter with one finger, it was a safe guess that he disapproved of some action that the chief had taken. We often joked that Grady had sent out for asbestos paper and started typing the letter himself.

c. *Gordon Dunn and Cecil Gentry*

Norton worked well with the media and had strong support from the press in his activities. His excellent relationship with the media was never more evident than during the October 1947 hurricane that struck Savannah, Georgia. This was also the first hurricane that was seeded with dry ice (Langmuir 1948), but the seeding was not announced publicly at the time. The hurricane formed in the western Caribbean, then moved across Cuba, the Florida Keys and southern Florida, and stalled about 500 km east of Jacksonville during a period in which there were few reports to locate the storm center. Tracking the center of the storm was further complicated by at least one report that was received at the office with an incorrect wind direction. The hurricane then abruptly turned westward and ultimately caused about $3 000 000 in damage in Georgia (Sumner 1947). By the mid-1940s, Grady had established a goal for himself of giving 18 h advance warning of damaging winds. However, because there were few observations, forecasters were not immediately aware of the hurricane's turn toward Savannah, and Norton was able to provide only 6–7 h of advance warning. Grady believed that he had mishandled the storm, but considering the circumstances and the paucity of observations, he probably did quite well.

During this time, there had been extensive discussion in the military services about the possibility of destroying hurricanes by seeding. There was some basis for believing that the October 1947 hurricane was seeded as it approached the Keys, and again as it stalled east of Jacksonville. Initially, there was criticism of the forecasts. In an interview with a reporter for the Associated Press, Norton speculated whether seeding of the storm by the military had caused it to change direction. The resulting Associated Press article was written in such a manner that the general public and the press assumed that it was Grady's belief that the storm was seeded and that the seeding caused the storm to change its direction of motion. Although the relatively little property damage or loss of life from this storm certainly helped to minimize the criticism, the excellent relations and prestige that he had with the media are the main reasons for the small amount of criticism expressed by anybody except himself.

A few years later, Mook et al. (1957) obtained ship logs and found data not available to the forecasters. They showed that the storm had started turning westward about 6 h before the seeding commenced.

d. *Paul Moore*

Grady Norton assumed responsibility for the hurricane warning service at a time when it was held in low esteem as a result of a number of disastrous storms. The public believed that the forecasts for these storms had been inadequate. Grady reversed this attitude and began the development of confidence and respect in the service that it holds today.

He was totally dedicated to hurricane forecasting and expected the same from the other forecasters. When a storm was threatening the coastal area, it was not unusual for him to remain at the office around the clock for a number of days, with only brief respites on a cot. He recognized the vital role of communications and made his forecasts more effective by using apt literary allusions and allegories that enlivened advisories and contacts with the news media. Employing personification by attributing human characteristics to storms, he was able to focus attention on important elements of advisories and, at the same time, gain better acceptance of uncertainties or errors in forecasts. Norton referred to the September 1948 hurricane which moved slowly and erratically up the southern part of the Florida peninsula as the "oxcart special" (Baggs 1948a). As noted in Gordon Dunn's remarks, this storm had a distorted eye that made the center difficult to track.

Sumner (1948) quotes Norton's descriptive account of this phase of the September 1948 hurricane:

> When the hurricane was in Cuba, a news writer called it "a blind behemoth," but we believe a more descriptive character comes from mythology in Cyclops, the one-eyed giant. To carry this simile further, Cyclops must have encountered Ulysses in Cuba, because something happened to his eye! When he came out into the Florida Straits, the "eye" was distorted and elongated, and to some extent broken up, and it reminded us of Argus, otherwise known as Panoptes, for when it came over Florida on the 21st and 22nd there was an eye for everybody! There were so many eyes reported at so many widely separated places, and the movement was so slow (about 8 to 10 mph), we were reminded of an oxcart. So "Oxcart Panoptes" made his leisurely way up through the Florida Everglades ogling every community in the southeastern part of the State!

The writing style, and numerous references to literature are representative of many parts of his soliloquy (Norton 1947).

During the latter part of his career, hurricane research was becoming very active and numerous forecast

techniques were being tested. He encouraged development and examination of new methods but, at the end of his career, none of the statistical or numerical prediction procedures had become more than marginally helpful. He, therefore, relied primarily on rules and methods that he had adopted or developed over many years.

e. Bob Simpson

My three year association with Grady Norton at the hurricane forecast office in Miami, from 1944–46, followed forecast experience at New Orleans and meteorology classes at the University of Chicago. The contrast was enormous. At New Orleans, emphasis was on meeting deadlines for delivering forecast decisions—often stated woodenly—to a faceless mass of people known as "the public." During the 12 months that followed at the University of Chicago, I found that the thrust of the famous wartime "A" course in meteorology was on atmospheric dynamics and its application in making weather forecasts. Thus, my exposure to Grady Norton's world was indeed a unique, if not dichotomous, experience. For here was a warm, caring personality, a rugged individualist, largely and broadly self-educated, not only in meteorology, but in history, world literature, and philosophy, a man who looked upon the public he served as an assemblage of individuals whose lives and welfare depended individually upon his weather advices and warnings. As an avid student of the English language, he became a master communicator whose advice, both in radio broadcasts and formal advisories, spoke to the individual, not the masses—and the individuals believed him and responded accordingly.

In sending me to Miami, Dr. Reichelderfer, the head of the Weather Bureau, requested that I acquaint myself with Norton's concepts and techniques of hurricane forecasting, try to quantify them in a dynamical context, and collaborate in publishing the details of his methodology. I failed. But in trying, I gained an undying appreciation of the man and the thought patterns that contributed to his success. His basic "model" applied to hurricane forecasting was that the storm system moved in the direction of the geostrophic winds at the "top of the hurricane" and at 70%–80% of the speed of these winds. His decisions regarding the level of the top and his construction of streamlines and isotachs from the scanty wind observations at that level (usually conceived to be 8–12 km) were based on personal intuitive skill, which few of his associates could replicate objectively. But it worked for him!

The amazing forecast he made of the Caribbean hurricane of October 1944 has already been mentioned. In this case he predicted, without equivocation, that the hurricane then moving westward in the Caribbean would make landfall at Tampa Bay at midnight, some 42 hours later. It did so at 2300 EST. The forecast was documented, but not released to the public. In trying to uncover the thinking processes that went into this forecast, I had many discussions with Norton, who simply pointed to the streamline analyses made at the time of the forecast which were without any projection in time of the circulation. Ultimately, however, he confided,

> whenever I have a difficult challenge in deciding and planning where and when to issue hurricane warnings, I usually stroll out of the office onto the roof,[1] put my foot on the parapet ledge, look out over the Everglades and say a little prayer. By the time I return to the office, the uncertainties are swept away and I know exactly what my decision will be.

Aside from his prediction techniques, Grady Norton's greatest strength, in my opinion, was his ability to select precisely the right semantics and tone for his communications. Not only were his advisories folksy and low key, but he was able to describe the hurricane, its location, and quality of threat to the complete reassurance of his constituents, and he did so as often as possible without indulging in explicit predictions of where and when—an omission rarely noticed. When the time for protective action came, however, he rang the bell loud and clear, and the public responded promptly.

Unfortunately, for all his skills in using the English language, and his popularity as a speaker before lay audiences, Grady could rarely be persuaded to write even popular articles for release in meteorological publications. His one significant article, entitled "A Soliloquy," lay fallow on the shelves for years before being recognized as the masterpiece that it is.

3. Postscript

Norton had high blood pressure and suffered from severe migraine headaches for most of his life. On many occasions, his colleagues arrived at work and found Grady in considerable pain from the headaches. In late September 1954, Norton's physician warned him that he was risking his life by continuing his work. Norton responded that he was not going to retire (Colbert 1954). In early October, Hurricane Hazel formed in the eastern Caribbean, slowly moved toward the west-northwest, and developed maximum winds of 60–65 m s^{-1}. He plotted Hazel's course, during 12 h workdays, until Hazel reached an area about 500 km south-southwest of Haiti. On the morning of 9 October, Norton suffered a stroke at home and passed away later that day. He had remained a dedicated forecaster, ignoring his medical condition out of concern for Hazel's potential for loss of life and widespread destruction.

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[1] The hurricane forecast office at that time occupied the 19th floor penthouse of the Congress Building in downtown Miami.

Acknowledgments. I would like to thank Gordon E. Dunn, R. Cecil Gentry, Paul L. Moore and Robert H. Simpson for providing their recollections. Warren O. Johnson, a Weather Bureau employee who worked with Norton as an associate forecaster for 12 summers in Jacksonville and Miami; E. V. W. (Eddie) Jones, formerly a reporter for the Associated Press; and Leonard G. (Jerry) Pardue, a U.S. Weather Bureau employee at Jacksonville from 1935–1936 and Miami from 1948–1973, reviewed drafts of the manuscript. Alvin Samet, who worked in public service at the Miami forecast office from 1945–1985, remembered the articles in *Weather Bureau Topics.* Fred L. Zuckerberg found these articles in the library at the Eastern Region Headquarters of the Weather Service. Dennis M. Driscoll obtained information on Norton's studies at Texas A&M University. Constance Arnhols of the Hurricane Research Division provided editorial assistance. The photograph of Norton was purchased from the library of *The Miami News.* All newspaper articles in the reference list are available on microfilm at the Miami-Dade Public Library.[2]

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