FORECASTER PROFILE

Joseph G. Galway

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1. Prologue

Joe Galway was a severe local storms forecaster for 27 years (1952–65, 1972–84), and Lee Ballanfant was a major league umpire for 22 years (1936–57). As I read and listened to oral history interviews from these men, I noted striking similarities in their personalities and approach to business. They were direct, almost measured in their communication, where statements were concise with no tendency toward exaggeration. Their professional attitudes are captured in the following quotations.

Galway:

> Success in severe storms forecasting demands dedication, and vacillation on the forecast is your worst enemy. You've got to stay on an even keel and try to forget the blown forecast (J. Galway 1994, personal communication).[1]

Ballanfant:

> The most frequent mistake an umpire makes is calling the play too quickly. . . . I tried to discipline myself against that in the minor leagues. . . . And I never went through a lot of gyrations, just took my time. . . . When I had a bad day. . . I went home with a clean conscience, went to sleep, and met the challenge of the next day. That's the way it has to be
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> (Ballanfant 1980, 35–37).

The consequences of a ''blown forecast'' are of course potentially much more serious than a ''bad call'' in baseball.

2. Profile

Joe Galway was typical of many Bostonians; he was Irish and Catholic. He also typified many meteorologists who grew up in New England; he was fascinated with snowstorms and the occasional hurricane. As recalled by Galway,

> In 1933, at the age of eleven, I started to keep a journal of weather statistics. My weather instruments were a yard stick for measuring snow depth, a thermometer, and a rain gauge. I recorded data and described the weather. I remember seeing one of our trees completely uprooted by the hurricane of '38 [Minsinger 1988]. It made me wonder ''what makes these things kick.'' I kept records until the early 1940s when I had to leave Boston. I still have this journal.

Joe's parents encouraged him and his older brother John to get a college education. They both attended Boston College in Chestnut Hill, Massachusetts, where Joe majored in mathematics and economics. He enrolled in fall 1940, and with war imminent, the degree programs were accelerated to prepare students for military service. Joe attended college for 28 months uninterrupted and finished his ''third year'' (junior year) in December 1942. As he recalled,

> School seemed like it was never-ending, but thank goodness for the Sugar Bowl of 1942. The B.C. [Boston College] Eagles had gone undefeated during the '41 season and the team accepted a bid to play against the Tennessee Volunteers [also undefeated] on New Year's Day, 1942. Six of us headed for New Orleans in a questionable vehicle, but arrived in time for the game. It was the greatest game I ever saw, and our scrawny little halfback [Charley O'Rourke] scampered for a TD in the last minutes to give us a 19–13 victory. The city of New Orleans was never the same after we celebrated that victory.

Joe decided to join the U.S. Army Air Force (AAF) after completing his junior year. He enlisted and was assigned to the ''B'' school at Brown University, a 26-week premeteorology program that was offered at six universities. Approximately 1600 students started ''B'' school on 15 March 1943, 200 of them at Brown (Wal-

[1] Quotations from Galway were obtained from several oral history interviews that took place at the National Severe Storms Laboratory during September 1994.

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ters 1952). Upon completion of B school, Joe entered the 9-month Cadet program (''A'' school) at the Massachusetts Institute of Technology (MIT) on 4 October 1943.[2]

There were 250 students in the October 1943 Cadet class at MIT. Since Cadet classes were started at 6-month intervals, the overlap in training produced class enrollments of approximately 500 students. The professors at MIT in fall 1943 were James Austin, Bernard Haurwitz, Henry Houghton, Tom Malone, Hurd Willett, and several instructors (typically air force lieutenants who had been held over from previous Cadet programs). Edward Lorenz and Robert M. White were among this group of instructors for the Cadet class of fall 1943 (E. Lorenz 1992, personal communication; R. White 1993, personal communication). The following comments from Haurwitz and White give the flavor of instruction.

Haurwitz:

> There was one class—I think the largest class at MIT—when we had 500 students at one time. . . . Unfortunately, MIT, which after all is a fairly large school, had made no provision for classes of 500 students. There was one very large room that was for convocations and things like that. But this room was occupied by another large class, so I had to give my lectures twice, for 250 students each time. I had to give dynamic meteorology three times a week, once in the morning and once in the afternoon, one hour each. . . . I think at that time if somebody had wakened me about 3:00 in the morning or so—just when I was most deeply asleep—and had told me to derive the equation for the Ekman spiral, I could have started right out without any blackboard or anything and just mumbled the whole thing right through
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> (Haurwitz 1985, 629).

White:

> After the morning lectures in dynamics and thermodynamics, the students would meet at the ''Clinics'' in the afternoons. Here we would go over a variety of synoptic situations using ''canned data sets.'' The students would make practice forecasts from these sets, and we would then scrutinize the cases and identify the features that the students didn't sufficiently take into account. It was a very clever way to instill skills in these students
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> (R. White 1993, personal communication).

Galway graduated from the Cadet program on 5 June 1944, the day before D-Day. He was also given the rank of second lieutenant along with 231 other Cadets in MIT's graduating class (MIT 1944a). Based on information in the national newspapers, graduation announcements, and Army Air Force historical documents (*Los Angeles Times* 1944; *New York Tribune* 1944; University of Chicago 1944; MIT 1944; Walters 1952), it is estimated that 1000–1100 students were graduated from the Cadet program over the three-day period 3–5 September 1944. By this time, the air force was overstocked with meteorologists, and many graduates were assigned to nonmeteorological jobs in navigation, flight control, and communications. In Galway's case, it was an assignment as an air traffic controller. Galway served in the Pacific theater, first at Finschafen, New Guinea, and then at Johnson Island, an atoll approximately 1000 miles southwest of Hawaii.

With roots in the Irish tradition of writing, Galway kept notes from his experiences in the Pacific and organized them into a document titled ''Across the Pacific'' (J. Galway 1947, unpublished manuscript). In the foreward he says, ''Look for no plot in these jottings nor consider it a diary or a time table. . . . I cannot remember all the happenings I have seen or heard . . . but two things remained with me throughout, one to be a factor in defeating our enemy and second to return home.'' Galway's skill as a writer emerges from these ''jottings,'' and the vignettes could easily be expanded and developed into short stories. The document is essentially the experiences of two young AAF lieutenants, Galway and his buddy from Minnesota Walter Johnson. They traveled together from San Francisco to Hawaii to Australia and finally to ''Finsch'' (Finschafen). The flavor of wartime comes through the pages, and these young men's experiences capture the moment with stories of a young Royal Air Force pilot who went on his missions with a rosary in one hand and a machine gun in the other, the dread disease in New Guinea called ''scrub typhus'' that left its victims motionless for six weeks at a time, and life in a mosquito-infested tropical jungle under the despotic rule of an air force major who caused the boys to ''gnash their teeth.''

After discharge from the air force in 1946, Galway returned to Boston College and completed his degree in 1947 (B.A. in economics). He was uncertain about a career and decided to enroll at Babson Institute of Business Administration in Wellesley, Massachusetts.[3] As Galway recalls:

> I thought I'd use my economics background to enter the business world. So here I am at Babson along with these rich kids whose fathers had sent them to Harvard and Dartmouth, but now wanted them to take over the family business. Kids like the offspring of Gerber, the founder of the baby food company. I graduated after

[2] MIT was one of six institutions offering training in the cadet program. The other schools were California Institute of Technology, University of California, Los Angeles, University of Chicago, New York University, and the Air Force Technical Training Center at Grand Rapids, Michigan. Fourteen hundred students started the A program at these six institutions on 4 October 1943 (Walters 1952, 67).

[3] The school was founded in 1919 by Wall Street tycoon Roger Babson who won fame for predicting the 1929 economic crash.

> the intensive one-year course and went for a job interview at the Texaco Oil headquarters in Boston. I spoke with one of their V.P.'s and was then asked to wait in the lobby. I started to watch the employees, coming and going in a state of agitation; then when lunch time came, they raced out of their offices and pushed and shoved one another to get to a clock where their timecards got punched. After that scene, I got up and walked out of the building and never gave a second thought to a career in business.

Galway then took refresher courses in meteorology at MIT during the fall quarter of 1949 and simultaneously applied for work as a Weather Bureau forecaster. While waiting for a job offer from the bureau in 1950, he worked at Woods Hole Oceanographic Institution. In December 1950, the bureau offered him a forecasting job at Jacksonville, Florida, and he reported for duty 1 February 1951.

In the spring of 1952, U.S. Weather Bureau (USWB) Chief Francis Reichelderfer decided to form a special unit concentrating on severe storm forecasting. His decision was partially dictated by the successes of the Air Force Weather Unit at Tinker Air Force Base in Oklahoma City. On 25 March 1948, this military unit made a tornado forecast that received national attention; the bureau was forced to consider a counterpart in the civilian sector (Galway 1992; R. Miller 1994, personal communication). The USWB decided to offer a series of three-week courses at the Washington, D.C., forecast office in the hopes of attracting field forecasters into the fledgling unit. Joseph Galway was the first bureau forecaster to accept assignment to this unit. He was followed by James Carr, Robert Martin, David Stowell, and Alan Brunstein. They became known as severe local storms forecasters (initially known as SELS forecasters, and subsequently called SELS lead forecasters).[4] Albert Showalter and Joe Fulks supervised the group until December 1952, when Kenneth Barnett was put in charge. This group of five forecasters was trained by members of the Weather Bureau Army Navy Analysis Unit. The bureau had devised some severe storms forecasting rules (e.g., Shuman and Carstensen 1952, 1953, unpublished manuscript; Showalter 1953), but the techniques for severe storm forecasting were rudimentary at best (Galway 1992, section 6).

The Severe Weather Unit product was a simple-worded message that went out over the teletype. The guidance message was titled ''Severe Weather Discussion 1200–2400 CST'' and was transmitted to the major forecast centers. Designation of forecast areas was more free form than in later years. Quoting Galway, ''The areas were not necessarily boxes in the early days of the unit. Some were quite unusual; I remember a case where the watch area was a circle, 15 miles in diameter, situated 25 miles southwest of Longview [Texas]!''

Within a year of the Severe Weather Unit's formation, one of this century's most devastating weather systems moved through the central and eastern United States. The synoptic system moved from Nebraska up through the Great Lakes and into the northeast (Brooks 1953). As recalled by Galway:

> The three days of 7 June to 9 June of 1953 were traumatic as a surge of tornadoes from Nebraska to Massachusetts resulted in the loss of 243 lives and injuries to 2635 people. The Severe Weather Unit was organized into work shifts of 2300–0700, 0700–1500, and 1500–2300 EST with one forecaster for each shift. While the tornado activity on 7 June and 8 June was well covered, the late afternoon of 9 June began with pilot reports of tornadoes in the vicinity of western West Virginia and south of Pittsburgh, Pennsylvania. These reports occurred around 5:00 EST, but no further information followed. The first report of the Worcester

TABLE 1. SELS lead forecasters. Those who have served as SELS lead forecasters are listed below. The 29 forecasters are ranked by years of service. Service during a given calendar year is counted as an entire year. Asterisks are used to indicate current SELS lead forecasters.

Name	Start	Years	Rank (by Years)
Joseph G. Galway	1952	27	1
Bernard W. Magor	1954	24	2
John E. Hales*	1975	21	3
Larry F. Wilson	1975	20	4
Robert H. Johns	1979	16	5
Clarence L. David	1965	15	6
Hilmer A. Crumrine	1962	13	7
Donald S. Foster	1954	13	8
Steven J. Weiss*	1984	12	9
Richard W. Anthony	1985	10	10
Perry A. Wood	1959	8	11
James H. Henderson	1977	8	12
Robert A. Sanders	1966	7	13
Jean T. Lee	1954	6	14
Edward L. McGuire	1971	5	15
Robert P. Krebs	1966	4	16
Charles F. Chappell	1965	3	17
James A. Carr	1952	3	18
Joseph A. Rogash*	1994	3	19
Stephan F. Corfidi	1994	3	20
Dansy T. Williams	1963	3	21
Edwin G. Provost	1970	2	22
Donald V. Baker	1994	2	23
Robert C. Baskin	1960	2	24
David Stowell	1952	2	25
Robert Martin	1952	2	26
Alan Brunstein	1952	2	27
Michael Vescio	1995	2	28
Robert C. Miller	1965	1	29

[4] The SELS unit was renamed the National Severe Storms Forecast Center (NSSFC) on 13 February 1966. The number of SELS forecasters at any one time has always remained at five. A list of those individuals who have served as SELS lead forecasters is found in Table 1. On 1 October 1995, the NSSFC changed its name to the Storm Prediction Center as part of the National Weather Service reorganization.

> [Massachusetts] tornado came from Petersham [25 miles NW of Worcester] at 5:25 EST. (This was the first sign of activity.) At 7:00 EST, the report that Worcester was almost leveled reached the forecast office in Washington, D.C. One of our SELS forecasters asked to be transferred from the unit after this tragic event, and his request was honored.

During the summer of 1954, the bureau and air force began negotiations to establish a civilian–military severe storm center. The bureau argued for an office in Chicago, while the air force advocated a site in Kansas City. The SELS forecasters moved to Kansas City, Missouri, in August 1954 and they were joined by the air force unit [Severe Weather Warning Center (SWWC)] in January 1956. The SWWC was directed by Major Earnest Fawbush, and Captain Robert Miller was the principal meteorologist in the group. These military meteorologists had published several important papers on severe storm forecasting (e.g., Fawbush et al. 1951). Especially noteable was Miller's ''compositing technique,'' which facilitated the view of three-dimensional structures in the atmosphere by the judicious overlap of two-dimensional fields. These composite charts were highlighted by the intersection of the maximum wind axes, moisture ridges, and drylines, for example.[5] The two severe weather groups shared the same office space in the Kansas City Federal Building at 911 Walnut Street for 10 years.

SELS forecasters worked their shifts alone except for assistance from a ''chartist'' (map plotter). In the late 1950s, the SELS staff was expanded to include two assistant forecasters and a research forecaster, six chartists, and a radar specialist. The unit essentially operated in a ''master–apprentice'' mode, where assistant forecasters eventually replaced the SELS lead forecasters when they retired.[6] Although operational computer analyses and numerical weather forecasts became available in the late 1950s, these computer-generated products necessarily concentrated on the larger or synoptic scale, and the SELS forecasters relied on hand-drawn surface charts with embedded small-scale detail as a complement to the numerically generated products. Galway is shown giving a weather briefing in the early 1960s using some of the numerical products (Fig. 1).

In an effort to bridge the gap between operational severe storm prediction and research, a research unit was added to the Kansas City operation in the late 1950s. Those initially included in this group were Ferdinand Bates, Robert Beebe, Jean Lee, and Georgina Newbrandt. The SELS forecasters were also encouraged to spend time on research projects (during the cool season when severe storm frequency abated). Galway's research began in the mid-1950s and continued until his retirement in 1984. Among his early contributions were 1) the ''lifted index,'' a measure of atmospheric instability (Galway 1956), and 2) the relationship between the upper-level jet and tornadoes (Galway and Lee 1956).[7]

Some idea of Galway's tenacity can be gleaned by following his experience with the lifted index research. Papers authored by SELS forecasters and intended for publication in any of the professional journals were required to receive approval from USWB headquarters in Washington. Galway's paper on the index was submitted for bureau review in 1955 and was deemed unacceptable for publication. He revised the manuscript and resubmitted it. The paper was again rejected. Fortunately, letters to the editor and ''short contributions'' were not subject to the headquarters scrutiny. Galway wrote a letter to the editor (Galway 1956), in effect an abbreviated version of the original paper, where it received a favorable response and was accepted for publication.

Galway is remembered by his workmates as a determined, fiercely independent forecaster. Steve Weiss can remember his early days in the unit and working as Galway's assistant:

> ''I, of course, had great respect for Joe and knew of him through his forecasts that I read while stationed at various offices around the country [Chicago and Detroit]. I wanted to learn from him and I did, but I can remember that I had to give him some space and not disturb him in the heat of battle during some of those intense severe storm episodes. I later realized that each SELS lead forecaster has his own way of dealing with the pressure. I tend to be chatty and will often find that I'm freely talking to others on the shift. Friendly Bernie Magor had his inimitable way of intensely working and considering the various severe episodes that might occur'' (S. J. Weiss 1995, personal communication).

When Galway thinks about severe storms forecasting, the tornadic event in Topeka, Kansas, on 8 June

[5] The first publication describing the compositing technique is the ''Air Weather Service Digest of Procedures'' (Air Weather Service 1952). Miller conceived the idea in 1946 while serving as weather officer at Fort Benning, Georgia (R. Miller 1994, personal communication).

[6] From the mid-1970s until the creation of the mesometeorologist positions in the late 1980s, there was a position-grade gap between the assistants and the lead forecasters. Consequently, several assistant forecasters climbed the career ladder by leaving the SELS unit (and working in the Aviation Forecasting Section in Kansas City, e.g.) only to return at a later date as a SELS lead forecaster.

[7] The work by Miller and Fawbush (Air Weather Service 1952) listed synoptic criteria for tornado forecasting. Included in these criteria was the axis of wind maximum between 10 000–20 000 ft. Shuman and Carstensen (1953) included ''An approaching 300 mb [−27 000 ft] jet maxima'' as an important criteria for tornado forecasting, Galway's and Lee's work emphasized the jet at 200 mb (~35 000 ft).

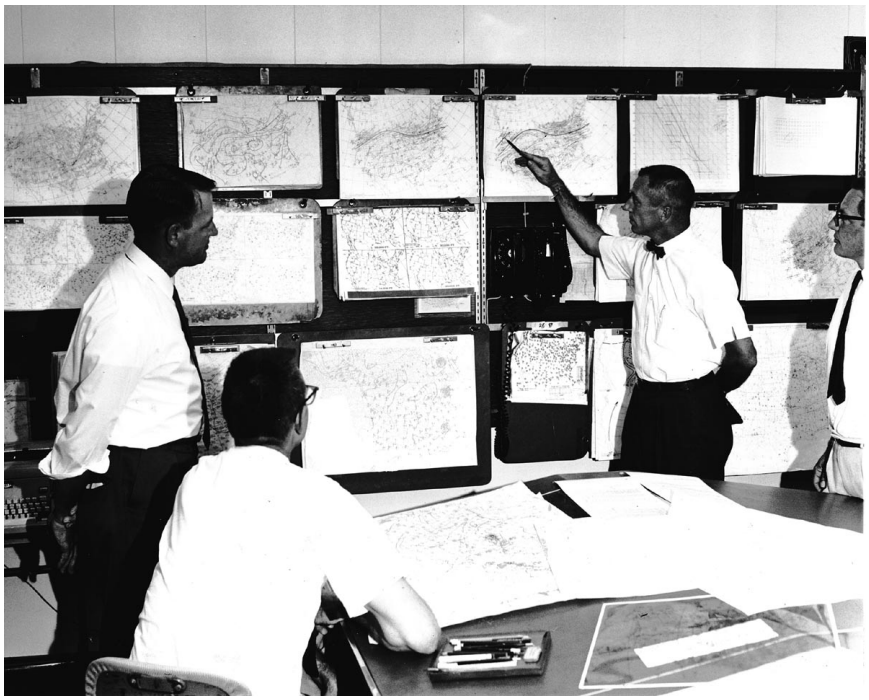

FIG. 1. Joe Galway delivers a weather briefing at SELS Forecast Center in Kansas City, Missouri. Staff members are (from left to right): Charles Hauck (SELS assistant forecaster), Don Foster (SELS lead forecaster), Galway, and Norman Prosser (SELS assistant forecaster). The large maps on the table to the right of Foster are hand-drawn surface charts (ca. 1963).

1966, is always at the forefront.[8] Seventeen people lost their lives, and over 500 were injured as a result of this tornadic event (Wagner 1966). Galway reconstructs the event:

> Earlier that day, about 4–5 A.M., a squall line went through Kansas City with strong winds, lightning, and thunder, but no hail. The line pushed its way to around Fort Smith. I forecasted the front to push back toward the north and put out a thunderstorm watch with the potential for tornadic storms in an area along the line connecting Hutchinson and Kansas City. The forecast was put out at 11 A.M. and was valid for the period from 3 P.M. until 9 P.M. [The official forecast was, ''60 miles either side of a line from 20 miles southwest of Hutchinson, Kansas, to 60 miles east of Kansas City, Missouri, valid for 3 P.M. to 9 P.M.; Topeka is situated in the eastern third of this box.] At 1 P.M. Kansas City was still in the cold air and I was beginning to think that I'd blown the forecast. But just about 2:30 P.M., the WSR-57 radar at Kansas City picked up echoes near Hutchinson. This was on the western edge of the watch box. The tornado struck Topeka at about 7 P.M. [7:15 P.M.].

Although Galway took pride in the value of this forecast, he was quick to remind me that he had missed the Worcester forecast in 1953: ''I forecasted the storms to occur in West Virginia and Pennsylvania. The climatological infrequency of tornadoes in Massachusetts at that time of year was an overpowering factor.''

Besides Galway's contributions to meteorology as an SELS lead forecaster and researcher, he is known as the ''historian of severe weather forecasting in the United States.'' Three valuable papers have been published on this history (Galway 1985, 1989, 1992). Again quoting Weiss:

> As far as I know, Joe is the only person who knew details about the history of severe weather forecasting and took the time to write about it. You could always go to him and ask a question about the origin of such-and-such a forecasting rule or about some severe weather criteria. For example, I remember asking him why ''3/4-inch hail'' was the threshold criteria for classifying an event as ''severe.'' He informed me that this was the smallest size of hailstones that could cause significant damage to an airplane flying at speeds between 200 and 300 mph. What a debt I personally owe him for his labor on this history; I believe he has connected the current generation of SELS forecasters with their rich heritage (S. J. Weiss 1995, personal communication).

Joseph Galway had a youthful ambition to find out what made storms ''kick.'' The pathway to achieving

[8] Between January 1965 and October 1972, Galway served as principal assistant (deputy director) at NSSFC. During this period, he would occasionally serve as lead forecaster, as was the case on 8 June 1966, the day of the Topeka tornado.

this goal was opened by the intervention of World War II and the opportunity to formally study meteorology in the Cadet program. Furthermore, he volunteered for work in the fledgling Severe Storms Unit in 1952 and became the Weather Bureau's first severe storm forecaster. Little did he know that his youthful ambition would be realized while serving at the Severe Weather Unit's forecasting desk during four decades.

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