Two Ice Glaze Storms Over U. S. Interior Plains, January, 1949

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After driving, January 1st, 1948, from Detroit to St. Louis on ice glazed highways from which more than 50 telephone and power line crews were clearing broken poles and tangled wires, it seemed worthwhile to ascertain the area, duration and damage cost of such a storm. A year later first-hand observation and experience during four days of January without water, light, telephone, or newspaper, caused by severe ice glaze damage in southeastern Oklahoma stimulated this study.

Ice glaze storms may result from (1) a moist air mass which is present over a region being uplifted by an inrushing polar continental air mass; or (2) from warm moist air over-running the cool dry mass; with temperature of surface air mass between 10°-33° F. while the upper moist air reaches a condensation point above 32°. During January 9-12, 1949, such conditions were charted by the Weather bureau (Map 1, Frontal Action, 1st Ice Glaze Storm) as *cPK* pushed from Canada towards Texas and Kentucky. The trend of the cold front action (designated on the map by heavy black lines) was influenced (1) by a slow movement of the low over the Great Lakes on the 9th and 10th and (2) by "high" on the 11th and 12th over Alabama-North Carolina. This ice glaze storm was characterized by the Des Moines meteorologist as "caused by a wide stream of warm moist air overrunning a shallow cold air-mass that covered the mid-west" (1). The Albuquerque director noted severe icing in southeastern counties; first, from displacement of warm moist air already present on the ninth; secondly, by cold air being overrun by warmer air moving towards Arizona low (2).

Surface temperatures favorable to glaze extended from Green Bay, Wisconsin, to Lubbock, west Texas. (Map 2, Days with Maximum 19°-33° F. First Storm) Compilation of this map utilized one station in each county reporting a maximum temperature between 19°-33° F. These tentative criteria were selected when examination of all daily weather charts for January, 1949, revealed numerous instances of freezing drizzle at tempera-that the one-two day area is narrow on both the warmer and colder portions of the glaze area and wide over the High Plains.

Chronologically, Southwestern Bell Telephone reports severance and restoration of service thus: "January 10—Ice, one-half to one inch in diameter, covered wires in a storm-damaged area which extended from a section around Lubbock and Sweetwater, Texas, up through Oklahoma touching southern Kansas and on into southwestern Missouri; January 11—The scope of the storm increased and by that afternoon there were 31 Bell and 113 connecting company exchanges isolated, and over 18 per cent of the company's toll circuits were out of service. Preliminary estimates indicated the total cost would be $500,000; January 12—Storm-isolated towns increased to include 43 Bell and 135 connecting company exchanges. Approximately 1,900 construction men besides the regular maintenance forces were engaged on restoration work. Revised estimates put the expected cost of the damage at one million dollars. January 13—High winds during the night caused severe damage in the northwest section of Texas and a total of 2,592 toll circuits were out of service. In other sections of the storm area, ice was thawing. A construction force of 2,300 men, assisted by all maintenance people available, made considerable progress during the day on restoring plant damage. A later afternoon report showed a reduction of 354 made in the toll circuits out of service and the total exchanges isolated reduced by 41. January 14—Monday morning showed 1,194 toll circuits out

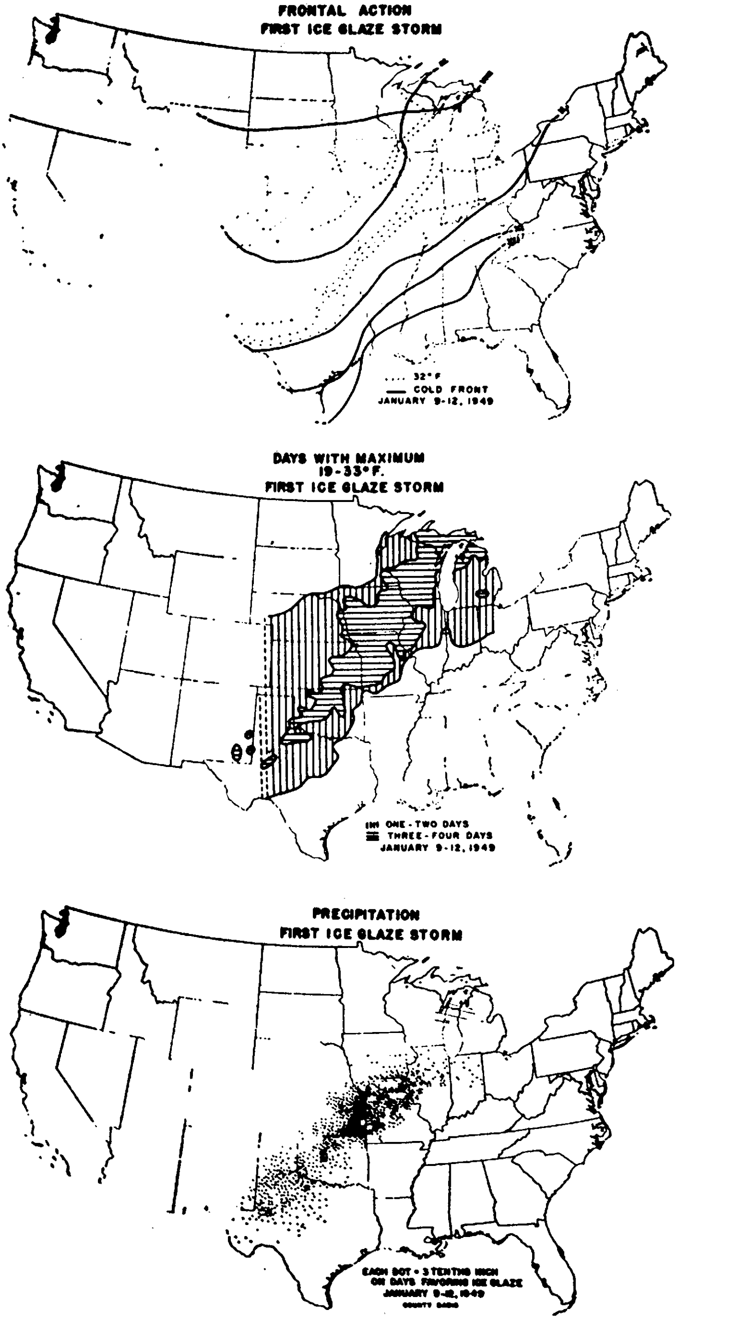
FRONTAL ACTION
FIRST ICE GLAZE STORM
32° F
COLD FRONT
JANUARY 9-12, 1949
DAYS WITH MAXIMUM
19-33° F.
FIRST ICE GLAZE STORM
ONE-TWO DAYS
THREE-FOUR DAYS
JANUARY 9-12, 1949
PRECIPITATION
FIRST ICE GLAZE STORM
EACH DOT = 3 TENTHS INCH
ON DAYS FAVORING ICE GLAZE
JANUARY 9-12, 1949
COUNTY BASIS

FIGURE 1.

of service compared with the previous week's high of 2,592. Flood conditions existed around Coffeyville and Parsons, Kansas, where our leads were under water. By late afternoon 127 toll circuits and 340 exchange stations had been restored. January 18—Oklahoma had cleared all toll circuits. In other storm-damaged areas, 90 toll circuits were restored during the day. The number still out of service was 1,066 because of 150 new troubles in Missouri, principally in the Springfield, Webster, and Illinois districts. One Bell exchange and 41 connecting company exchanges were still isolated from the toll network. January 19—A total of 221 circuits in Missouri failed as a result of the new ice-storm in Missouri the day before. Two hundred twenty toll circuits and 2,682 exchange stations were restored. However, end-of-the-day figures showed 570 toll circuits were still out of service as well as 10,091 exchange stations. January 20—Late afternoon reports indicated 158 toll circuits and 2,189 exchange stations were restored. A total of 412 toll circuits and 7,902 exchange stations remained out of service. January 21—Plant reported 31 toll circuits and 1,266 exchange stations restored by the end of the day(3)."

Judson S. Bradley notes the effect of temperature almost wistfully, "And it is a bit of a paradox that in the north, where day after day of dry snow driven by bitter winds brought damage, suffering, and death in a vast area, telephone plant stood up well and telephone service was a carrier of important tidings and a bringer of needed help; while further to the south the ice and sleet caused nothing much more serious than inconvenience to the people in the affected territory and yet laid low telephone plant which it is costing about $10,000,000 to restore(4)."

Precipitation during 9-12 of January did not take place over all the favorable area, particularly on the north and west sides from northern Michigan to New Mexico. (Map 3, Precipitation, 1st Glaze Storm) Many white spaces within the dot pattern result from lack of station reports for those counties.

Reports of line crews point out that weight of glaze may bring down poles but that many line breaks are result of (1) wind action or (2) snapping and whipping as thawing glaze drops off. J. A. Carr of Bell Telephone Laboratory writes, "As the area of a circle is in proportion to the square of the radius, the weight of ice accumulation on wires increases rapidly with the thickness of the coating. A sheath of ice one quarter of an inch thick adds a load of only two ounces per foot of wire, whereas a one-half-inch coating adds six ounces per foot. A one-inch radial accumulation amounts to about 22 ounces for each foot, and in a 150-foot span this becomes about 200 pounds, or about 15 to 40 times the weight of the wire itself.

It is not only the weight of the ice on the wire, however, which makes damage possible. The 'sail area' that the wire presents to the wind is increased. The diameters of line wires commonly used in telephone work vary from about .080 inch to about .165 inch, and it is readily evident that a one-half-inch radial ice coating increases the area exposed to the wind by seven to 13 times. With a strong wind transverse to the line, the wind pressure per foot of ice-covered wire and ice combines. For this reason ice load acting together with wind forms a particularly destructive combination.

Winds need not have a very high speed to cause damage to the telephone plant. Some which are steady and moderate under certain conditions will set up damaging vibrations in wires and cables. When wind blows across a suspended cylindrical material such as line wire, eddies are formed alternately near the top and bottom on the ice side of the wire. These eddies impart little kicks to the wire and force it to vibrate. The frequency of such vibrations is directly proportional to the diameter of the conductor and inversely proportional to the speed of the wind. The vibrations cause the humming sound often heard in the vicinity of open wire lines. If the wires are not properly held at the supports, the vibrations may cause the wire to fatigue and eventually to break.

'Galloping' or 'dancing' are terms given to another form of wind-induced vibration. In this type the wire or cable vibrates only a few times each second, but with high amplitude as compared to the rapid, low-amplitude vibrations just described. These low-frequency vibrations appear to occur where the lines are open to prevailing winds of moderate speed, and particularly when some ice is present on the wire or cable. The dancing is sometimes of sufficient violence to short-circuit the wires; to cause mechanical damage at the insulators due to chafing; or to produce breaking or weakening of the wire from the fatigue of the metal which results when the wires are bent back and forth while dancing. Some types of long-distance carrier telephone circuits must be built with relatively close spacing between the two wires constituting each pair, and on such circuits the swinging of ice-glazed wires in the wind may result in actual freezing together of the wires"(5).

Unexpectedly, "The greatest villian—after the sleet—was mud; sticky, heavy gumbo, the kind that won't come off. Even four-wheel-drive trucks with chains on all four wheels bogged down, and when a driver gave full power to wheels that the mud gripped fast, an axle was likely to snap. More than one crew, loaded with crossarms or wire or hardware, had to walk miles through mud which grew heavier with every step because no truck could negotiate the mire which halted direct access to the line"(6).

The cyclonic movement during January 23-28 with interaction of cold and warm fronts had a trend of cold fronts and freezing isotherms similar to the storm of January 9-12. A feature not present in the previous storm is the active front surging northwestward on the 23rd and 24th, extending from Ft. Worth to Cincinnati. Freezing isotherms did not penetrate southward and eastward beyond a similar zone. Let it be noted that an active *mT* air mass was a more potent factor regarding temperature in the Ouachita-Ozark area than a combination of altitude and cold front.

Favorable days for ice glaze on the second storm were spread over sixteen states. While the one-two day favorable area is narrow as before both on the cold and warm sides of the favorable-to-glaze zone, the three-four day area is much more extensive, and wider to the southwest. A new item is the five-six day area over upper Great Lakes.

Precipitation in this second storm was reported for the entire favorable-days area. Greatest intensity is discovered north of Dallas, south of Joplin, and in the southeastern third of Iowa. C. L. Meisinger in Monthly Weather Review, 1920, states that width of glaze belt equals distance between 32 degree isotherm and wind-shift line (7). It is my tentative conclusion, based upon company reports of loss, that the warm side of the glaze storm receives most damage.

Geographers have cause to be interested in ice glaze storms since (1) such storms extend over a number of states, (2) such storms adversely affect business activities, especially telephone, telegraph, and electric power companies, (3) such storms are numerous, (4) widely-tested temperature limits favorable to ice glaze are needed for better delimitation of affected area.

Forty-seven of 148 companies in answering my letter took occasion to note frequency of damaging ice glaze over the last five years:

none—13	3 times— 9	6 times—5	10 times—5
once—18	4 times—12	7 times—3	12 times—2
twice—17	5 times—11	8 times—1	20 times—1
			36 times—1

American Telephone & Telegraph Company's magazine editor reports, "a crew which rebuilt and restrung an open-wire pole line and left it firm and secure might be called back a few days later to pick it up out of the road where it had been flung by a second crushing load of ice. In some places such heartbreaking occurrences actually happened three times in a row. . . ." (8).

At the end of January, 1949, the type and amount of materials lost and the amount of emergency materials needed by all companies may be indicated by the staggering score for Southwestern Bell:

Losses (9).	Replacements (10).
24,000 telephone poles	2,100,000 lbs. copper line wire
36,000 cross-arms	9,800,000 ft. drop wire
200,000 breaks in toll wire	241,000 lbs. copper tie wire
53,000 telephones dead	108,000 lbs. steel line wire
200 communities isolated	720,000 ft. of strand
4,800 long distance circuits out	1,771,000 copper tie splints
	1,469,000 sleeves
	81,700 crossarms
	15,000 poles

Dollar losses to utilities from these two January glaze storms are not obtainable from insurance companies, public service and utilities commissions or newspapers. Personal correspondence with 148 companies serving three or more communities within the following sixteen states reveals these unsuspected tremendous dollar losses:

	Telephone & Telegraph	Electric Power
Arkansas	$ 10,120.	$212,000.
Colorado	———	500.
Illinois	251,000.	40,850.
Indiana	18,000.	246,000.
Iowa	273,000.00	21,800.
Kansas	879,500.	3,300.
Michigan	90,900.	35,000.
Minnesota	74,000.	3,500.
Missouri	2,165,172.	503,274.
Nebraska	164,596.	257,000.
New Mexico	95,000.	———
Ohio	53,000.	———
Oklahoma	2,324,050.	474,325.
South Dakota	50,000.	———
Texas	5,496,800.	153,998.
Wisconsin	76,741.	37,100.
Bell Long Lines	1,000,000.	———

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