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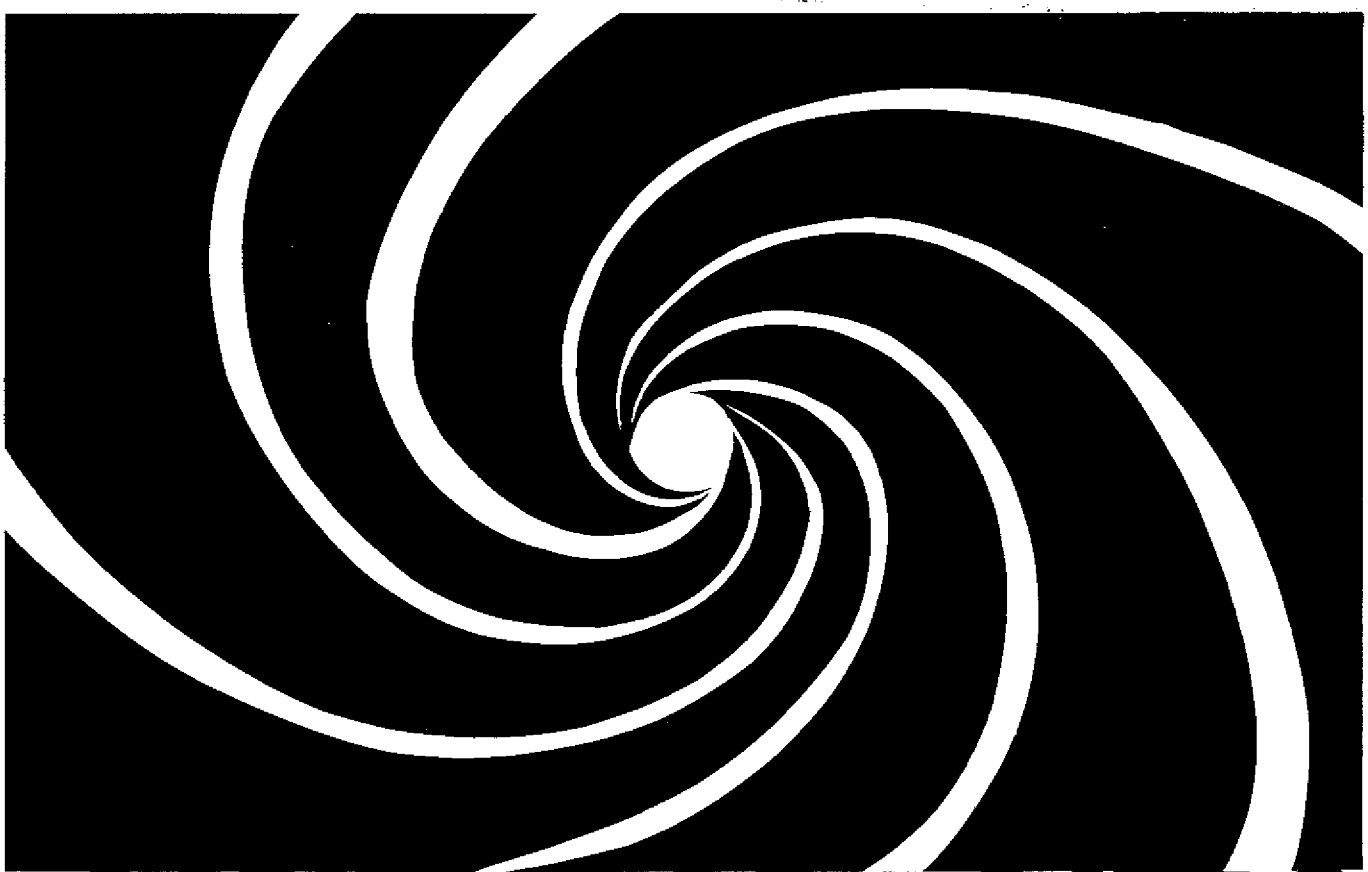

HURRICANES on the Texas Coast

Description and Climatology 1

TEXAS A&M UNIVERSITY • A SEA GRANT COLLEGE

TABLE OF CONTENTS

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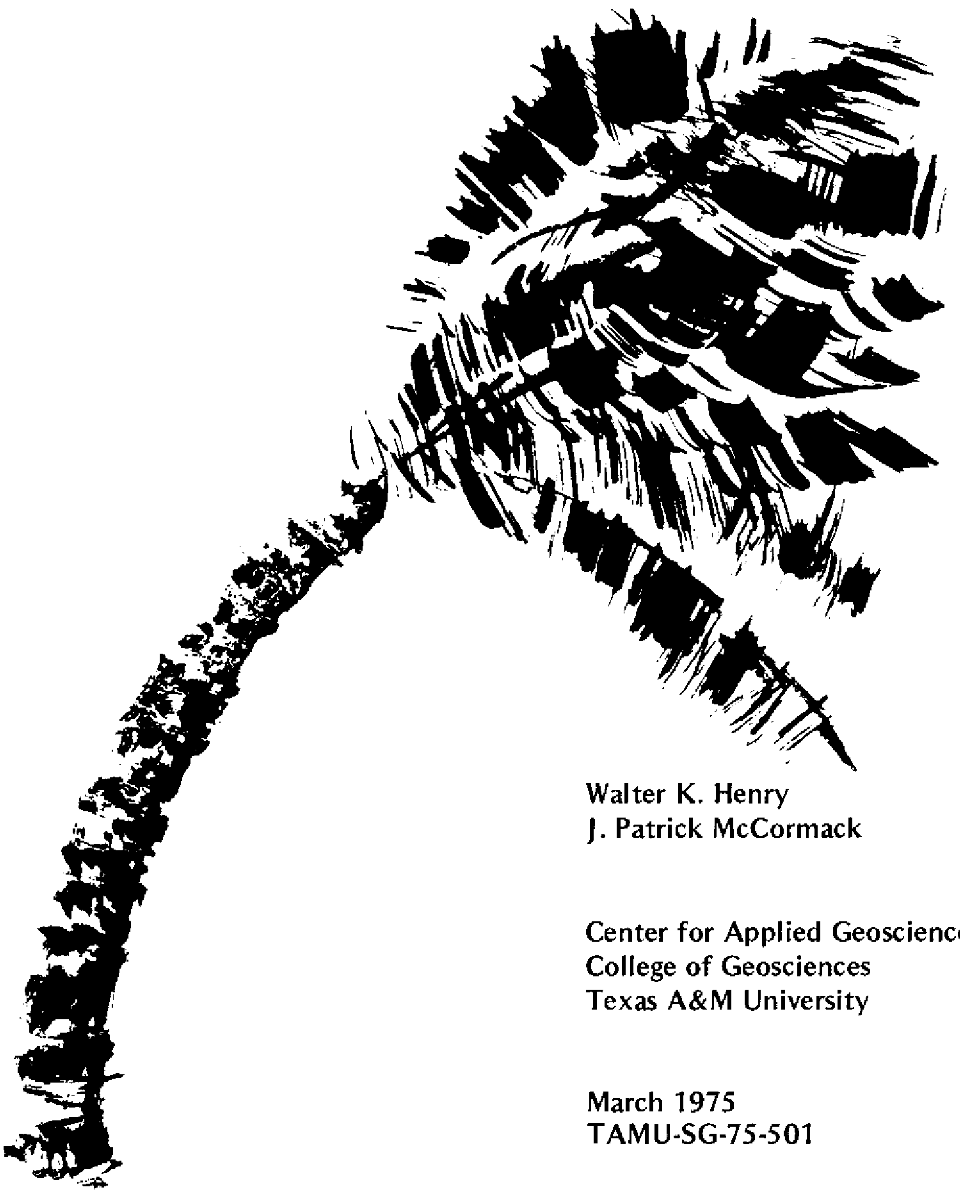
Description and Climatology



Walter K. Henry
J. Patrick McCormack

Center for Applied Geosciences
College of Geosciences
Texas A&M University

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I. FOREWORD

When a hurricane, regardless of its size or intensity, strikes the coast of Texas and travels inland, it affects the lives of thousands and possibly millions of Texans. Besides the obvious physical damages due to storm surge, high winds, and high tides, which are usually restricted to the area near the coast, there are also damages due to large amounts of rainfall that may extend inland for many hundreds of miles. This rainfall sometimes helps to relieve drought, but more often it causes widespread flooding, harmful erosion, and ruined crops.

This booklet is the first in a series of three prepared by Texas A&M's Center for Applied Geosciences for publication by the University's Sea Grant Program. The series is designed to help Texans understand, prepare for, and recover from the harmful effects of hurricanes. This publication describes various types of tropical cyclones and hurricanes. The characteristics of hurricanes and their frequency of occurrence over sections of the Texas coast also are analyzed. The second booklet in this series deals more specifically with hurricane damage due to flooding, either by storm surge or heavy rains, and wind and tornado hazards. The final booklet discusses precautions and actions that may be taken to minimize hazards and to save lives.

II. ACKNOWLEDGMENTS

We extend our most sincere appreciation to Dr. Robert H. Simpson, former Director of the National Hurricane Center, Miami, Florida, for his timely comments and assistance on the final draft of this booklet. We wish to thank Dr. James R. Scoggins, Director of the Center for Applied Geosciences, Texas A&M University, for his continued guidance and support throughout this project. Thanks also are given to Dr. Dennis M. Driscoll for his assistance on the many drafts of this volume. Also, we would like to acknowledge the help of Mr. Joseph Pelissier of the National Hurricane Center, who furnished background information, and Ms. Teena Conklin of the Texas Highway Department for assistance in obtaining many of the photographs used in this study. Special thanks are extended to Ms. Polly Luther for the professional typing of the many drafts.

III. THE MOST DESTRUCTIVE WEATHER PHENOMENON KNOWN

What *is* a hurricane? It is an immense, cyclonically (counterclockwise) swirling storm system covering thousands, sometimes hundreds of thousands of square miles. Peak wind gusts near the center of the hurricane may exceed 200 m.p.h. Due to its size, intensity, and duration, the hurricane is the most destructive weather phenomenon known to man.

The English word "hurricane" probably comes from the Spanish word "Huracan," which was derived from either Hunraken, the Mayan storm god, or Hurakan, the Quiche god of thunder and lightning. The word hurricane designates large cyclonic storms occurring in the western hemisphere. Similar storms are known as typhoons in the western Pacific, cyclones in the Indian Ocean, and Willy-Willys near Australia.

A HURRICANE GLOSSARY

Bulletin: A public release from a Weather Service Hurricane Warning Office issued at times other than those when advisories are required. A bulletin is similar in form to an advisory but includes additional general newsworthy information.

Cautionary Advice to Small Craft: When a hurricane is within a few hundred miles of a coastline, small craft operators are warned to take precautions and to avoid entering the open sea.

Cyclone: A closed system of cyclonic (counterclockwise direction) circulation characterized by low pressure and inclement weather.

Extreme Hurricane: A tropical cyclone with maximum winds of 136 m.p.h. (118 knots) or higher and minimum central pressure of 28.00 inches Hg (711.20 mm Hg or 948.19 mb) or less.

Eye: The roughly circular area of comparatively light winds and fair weather at the center of a hurricane.

Gale Warning: A notice added to small craft advisories when winds of 38-55 m.p.h. are expected.

Hurricane: A tropical cyclone with sustained winds of 74 m.p.h. (64 knots) or greater.

Hurricane Warning: A warning that within 24 hours or less a specified coastal area may be subject to (a) sustained winds of 74 m.p.h. (64 knots) or higher and/or (b) dangerously high water or a combination of dangerously high water and exceptionally high waves, even though winds expected may be less than hurricane force.

Hurricane Watch: The first alert when a hurricane poses a possible, but as yet uncertain, threat to a certain coastal area, or when a tropical storm threatens the watch area and has a 50-50 chance of intensifying into a hurricane. Small craft advisories are issued as part of a hurricane watch advisory.

Land Subsidence: The sinking of the land, caused mainly by the withdrawal of underground water from wells supplying cities and industries. This phenomenon may cause coastal areas to become more vulnerable to tropical storm flooding.

Local Action Statement: A public release prepared by a Weather Service Office in or near a threatened area giving specific details for its area of responsibility on weather conditions, evacuation notices, and other precautions necessary to protect life and property.

Major Hurricane: A tropical cyclone with maximum winds of 101 m.p.h. to 135 m.p.h. (88 to 117 knots) and a minimum central pressure of 28.01 to 29.00 inches Hg (711.45 to 736.60 mm Hg or 948.53 to 982.05 mb).

Seiche: A series of fast-moving waves that sometimes are superimposed upon the storm surge. This phenomenon may cause total destruction and great loss of life.

Storm Surge: An abnormal rise in the level of the sea produced by the hurricane. This inundation is usually responsible for the greatest loss of life and destruction of property.

Storm Warning: A notice added to small craft advisories when winds of 56-73 m.p.h. are expected. Both gale and storm warnings indicate the coastal area to be affected and the expected intensity of the disturbance.

Tornado: A violently rotating column of air, nearly always observable as a funnel cloud.

Tornado Forecast Information: An advisory stating that conditions are such that tornadoes may occur.

Tornado Warning: An advisory stating that a tornado actually has been sighted by human eye or indicated by radar.

Tropical Cyclone: A general term for the nearly circular cyclones that originate over tropical oceans. It includes tropical storms, tropical depressions, and all types of hurricanes.

Tropical Cyclone/Hurricane Advisories: Messages issued simultaneously by the Hurricane Warning Offices and the National Hurricane Center in Miami every six hours describing the storm, its position, anticipated movement, and prospective threat.

Tropical Depression: A tropical cyclone with sustained winds of less than 39 m.p.h. (34 knots).

Tropical Storm: A tropical cyclone with sustained winds of 39 to 73 m.p.h. (34 to 63 knots).

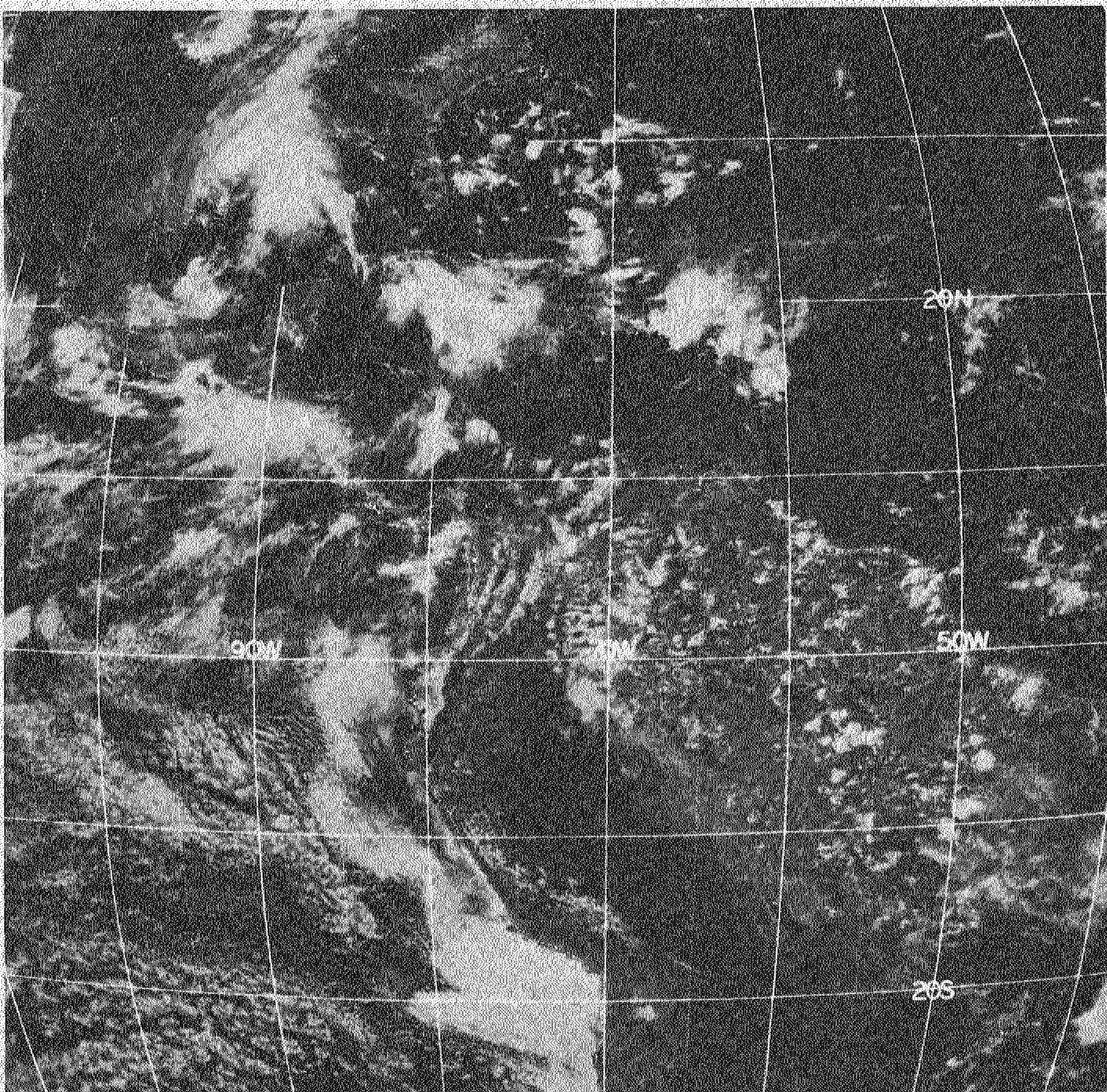


Fig. 1. A satellite view of North America, taken on September 4, 1973, at 1649 Greenwich Mean Time by ATS3. Tropical Storm Delia is located on the eastern coast of Texas and Tropical Storm Christine is near Puerto Rico. Photo courtesy of NOAA-NESS.

Fig. 2. The remains of a building after the walls were collapsed by winds of Hurricane Celia. Photo by Texas Highway Department.

IV. DESCRIPTION OF THE HURRICANE

Tropical cyclones form and grow over warm water. Those which approach the Texas coast form over the Gulf of Mexico, the Caribbean Sea, or the tropical areas of the North Atlantic Ocean. These areas are under the influence of the trade winds, which are on the south side of the Azores-Bermuda High (see Fig. 3). On occasion a low pressure area forms in the broad flow of the trade winds, and a few of these lows develop into tropical cyclones.

When a low intensifies, winds blow counterclockwise around it, an extensive cloud layer forms, and rain showers develop. If meteorological conditions are favorable, a tropical cyclone may develop through the stages of tropical depression, tropical storm, hurricane, and even to an extreme hurricane.

It is important to realize that each hurricane is different. The description that follows is general and might not apply in all aspects to a specific hurricane.

The eye of a hurricane is the feature which makes it unique from cyclonic storms of the more northern latitudes. The eye is a somewhat circular area of comparatively light winds. It is usually rain-free and may vary from four to more than 40 miles in diameter. Diameters of 12 to 20 miles are common. The eye is the focal point of the hurricane.

As can be seen in Fig. 4, hurricane winds are not symmetrical about the eye. When facing the direction in which the hurricane is moving, the strongest winds will usually be to the right of the eye and may approach a speed of 200 m.p.h. The radius of hurricane force winds may be 50 miles, but it varies from ten miles in small hurricanes to a hundred miles in larger storms. The strength of the wind decreases in relation to the distance from the eye as shown in Fig. 4. At 200 miles from the eye the winds may be gale force and gusty.

Rainfall forms in cumulonimbus clouds. The clouds' location with respect to the eye is shown schematically in Fig. 5. Rainfall is showery and quite variable. As the rain clouds move past, rain starts and stops. Rain clouds spin around the storm like a large pinwheel while the center of the pinwheel also is moving. Thus, the movement of any one shower is difficult to illustrate. Rain is not uniformly distributed about the eye, with most falling in the area of maximum winds. Rain squalls may extend out from the eye for 20 to 200 miles.

Low scud clouds accompany areas of rain. Cirrus clouds cover the cyclone and extend outward from it. Prior to the use of radar and aircraft reconnaissance, cirrus clouds were the first sign that a storm was approaching. The satellite photo, Fig. 6, shows cloud cover, but rain bands are partially hidden by cirrus clouds. An example of a shower area is shown in the radar picture, Fig. 7.

Hurricanes cause destruction in several ways:

Strong winds may destroy some structures, as shown in Fig. 2.

Storm surge can level structures and float houses and boats from their foundations and moorings. Figs. 8 and 9 show the aftermath of the storm surge.

Heavy rains may cause flooding in the flood plains.

Tornadoes are often associated with hurricanes.

Residual problems, such as displacement of snakes from their usual habitats, disruption of communications, and destruction of utilities, may arise after the passage of a hurricane. Public health measures must be taken to prevent illness and epidemics.

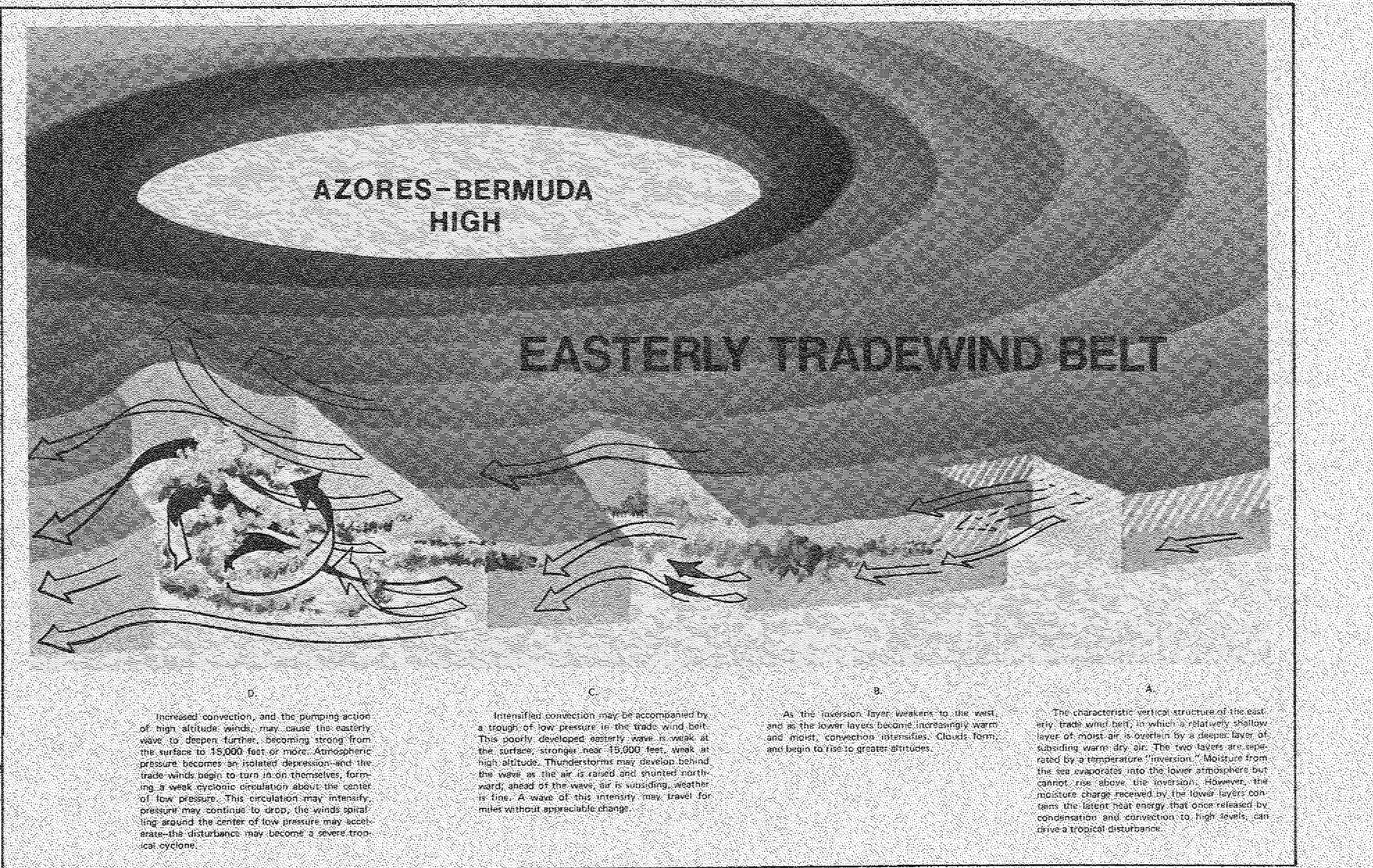


Fig. 3. Schematic development of a tropical cyclone in an easterly wave located to the south of the trade wind belt. Adapted and modified from Hurricane, the Greatest Storm on Earth, *by NOAA, see references.*

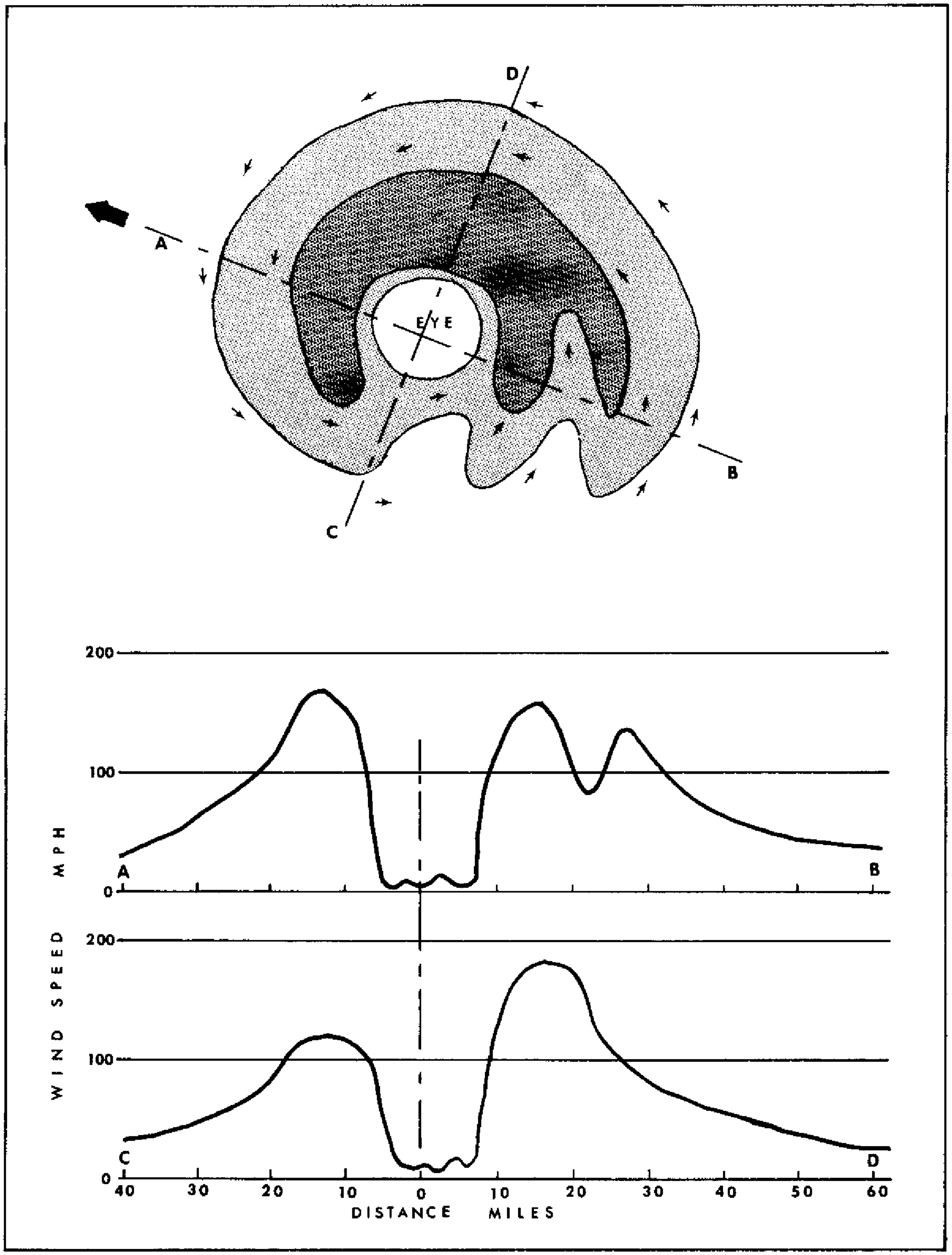


Fig. 4. A schematic representation of the wind distribution around the eye of an extreme hurricane. The large arrow pointing to the upper left indicates the direction of the hurricane movement. The smaller arrows indicate the wind direction within the hurricane. The light hatching indicates the area of hurricane strength winds. The darker hatching indicates the area of winds greater than 136 miles per hour. The graphs below indicate the variation of wind strength along the lines A-B and C-D.

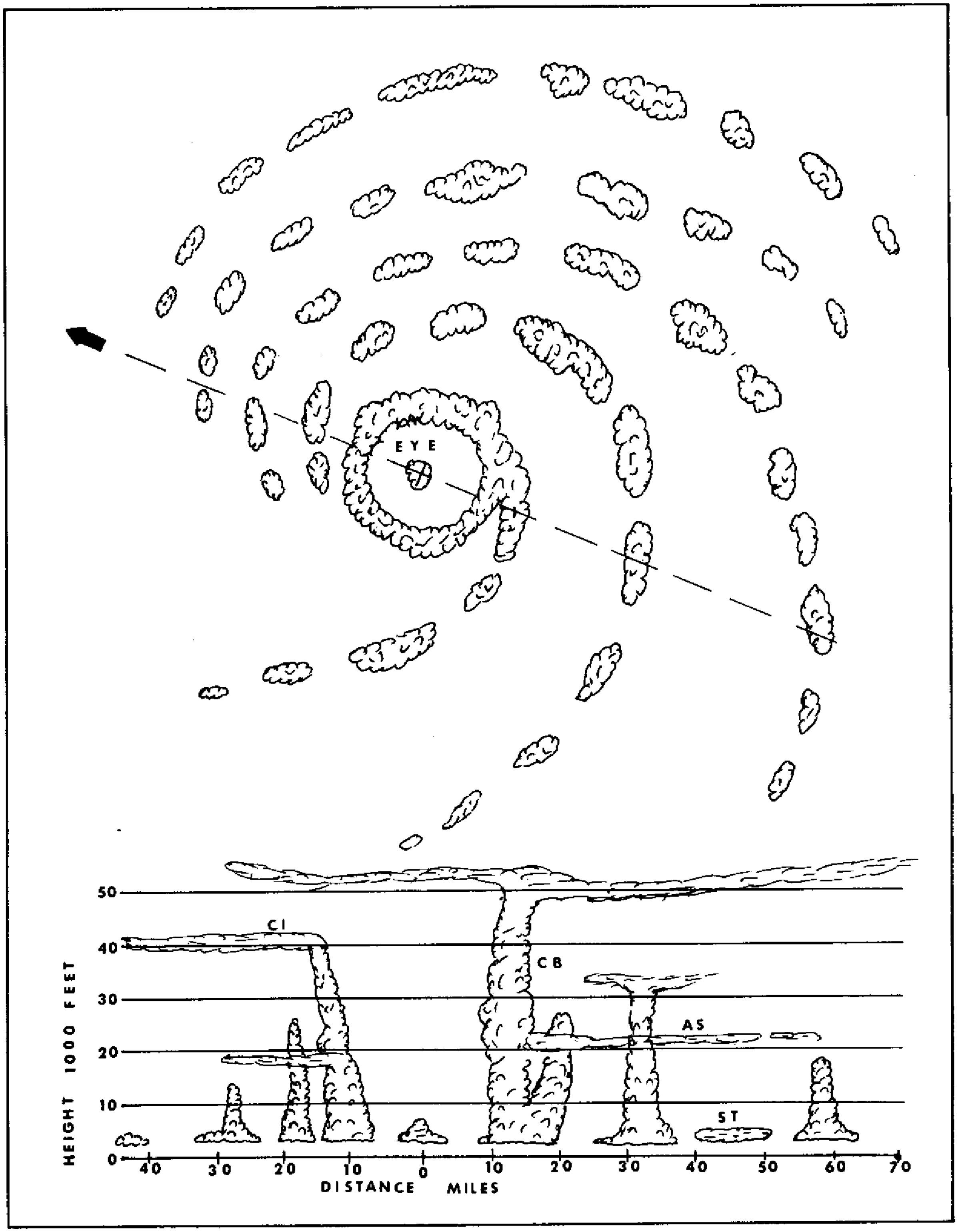


Fig. 5. A schematic plane view and side view of the rain clouds of the same generalized hurricane in Fig. 4. The heavy arrow indicates the direction of the hurricane movement. The rain clouds are arranged in spiral bands. Clouds along cross sections about the direction of movement are indicated in the side view. Cloud types shown are cumulonimbus (CB), altostratus (AS), stratus (ST), and cirrus (CC). Cirrus clouds cover the entire storm, and low stratus (scud) clouds hide the upper cloud structure from the ground.

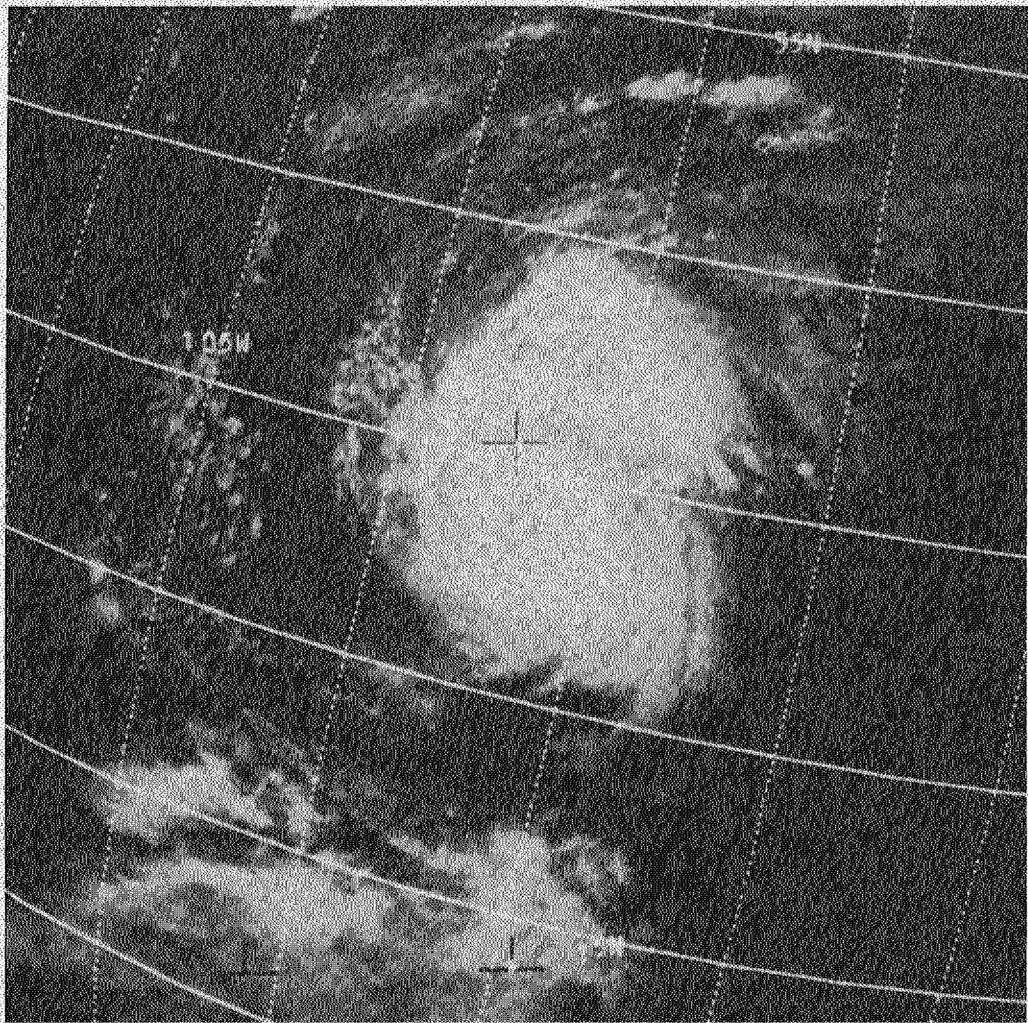


Fig. 6. A satellite picture of Hurricane Beulah. The eye is easy to identify, just below the +. Note that the eye is not in the center of the cloud mass. The spiral bands of clouds can be seen around the eye. Photo courtesy of the National Hurricane Center.

V. A BRIEF RESUMÉ OF A FEW TEXAS HURRICANES

In one respect, hurricanes are like snowflakes--no two are exactly alike. Hurricanes can form anywhere from the Cape Verde Islands off the west coast of Africa to about 150 miles off the coast of Texas. Those affecting Texas can form anytime from June through October. Other characteristics, such as rainfall distribution, tornado occurrence, storm surge, and wind intensities, also are extremely variable.

The costliest hurricane (in terms of lives lost) ever to hit the Texas coast was the Great Galveston Hurricane of September 8-10, 1900. More than 3,600 homes were *completely* razed as storm surge tides of 15 to 20 feet swept the first two to five blocks of the east, south, and west sections of the city. People were advised to leave the island prior to hurricane landfall, and an estimated 12,000 people did so. Nevertheless, an estimated 6,000-8,000 people died, making this the worst weather disaster in U.S. history. Only 10 to 15 percent of the people who remained on the island during the storm survived.

On September 16, 1875 a hurricane hit Indianola, Texas. The storm surge carried away three-fourths of the town and killed 176 people. Eleven years later, on August 20, 1886, Indianola was struck again. This time the storm surge carried away or left uninhabitable *every* house in the town. Indianola was never rebuilt and today the area is a state park. The Indianola experience clearly illustrates the destruction due to storm surges.

Hurricane Celia, August 2-5, 1970, destroyed an estimated $500 million worth of property and became the costliest hurricane to strike the Texas coast in terms of property damage. *Weather Wise*, a publication of the American Meteorological Society, describes some of Celia's unique characteristics. First, nearly all damage resulted from wind (Fig. 10) and not flooding or storm surge. Second, the highest winds occurred in the rear lefthand quadrant rather than in the right front quadrant as would be expected and came in streaks spaced about 1.5 miles apart. Between these streaks almost no damage resulted, even to the frailest of structures. Third, Celia intensified explosively just prior to landfall.

The heaviest rains from Celia amounted to only 6.50 inches at Aransas Pass and 6.38 inches at Corpus Christi. The towns of Pearsall and Jourdanton, located just 30 to 40 miles north of the eye of the hurricane, experienced no rainfall at all. The highest storm surges occurred at Port Aransas Beach and Port Aransas Jetty and measured only 9.2 and 9.0 feet above mean sea level, respectively.

Celia demonstrated two categories of wind damage that may accompany an extreme hurricane. First, many buildings collapsed due to pressure from rampaging, rain-laden winds. The pressure exerted on a surface increases as a function of the *square* of the wind speed. This means that buildings which can withstand winds of 60 m.p.h. may buckle under winds of 180 m.p.h. because the pressure on their surfaces has increased by a factor of *9*. Second, on the lee side of large buildings the dynamic effect of the wind tends to create a partial vacuum. The force due to this vacuum may be strong enough to cause windows to be blown outward. Wind entering the building from the windward side augments this pressure difference and increases the possibility of windows being blown outward. A person taking shelter behind a large building could be showered with falling glass. Some high-rise buildings in Corpus Christi lost their windows and doors during Celia (1970) because of this phenomenon.

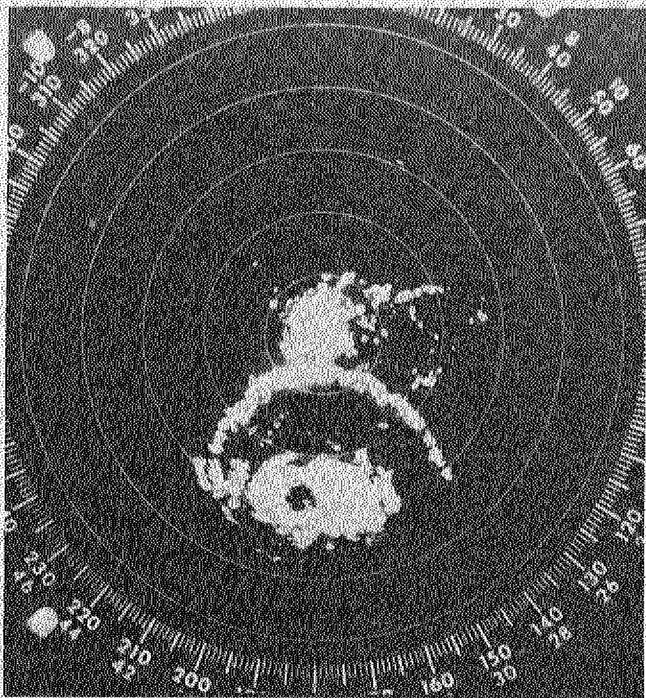


Fig. 7. A radar picture of Celia taken from the Galveston radar, 1245 Greenwich Mean Time, August 3, 1970. Celia was not a rainy hurricane, but the spiral bands of rain clouds do show. The eye is the black hole below the center of the radar picture, between the second and third rings. Photo courtesy of the National Hurricane Center.

Fig. 8. Boat carried inland by the storm surge of Hurricane Carla. Photo by the Texas State Highway Department.

Beulah was another unique Texas hurricane. Not only did she drench the state with the greatest amounts of rainfall, but she also spawned more tornadoes (more than 100) than any hurricane on record. Almost the entire area from Matagorda Bay northwestward to San Antonio and southward to Laredo received at least 10 inches of rain between the 19th and the 23rd of September 1967. This partially was due to her unique track, first moving northward, then recurving southwestward and entering Mexico south of Laredo. Many areas received deluges in excess of 20 inches, and a few areas were inundated with up to 30 inches of rain. Many stations received more rain in four days than they normally would receive in a year.

These torrential rains set off major flooding of every river and stream south of San Antonio. The San Antonio river set new flood records when it crested at 18.4 feet above its flood stage of 35.0 feet. The Nueces River crested at 46 feet, 2 feet above its previous all-time high. The Lavaca River crested at 5.2 feet above its flood stage of 21.0 feet. The Navidad River, which also has a flood stage of 21.0 feet near the town of Ganado, crested at 31.9 feet. Much to the chagrin of local residents, oily residues carried from oil fields by flood waters were deposited on buildings, thus leaving distinctive high water marks.

Beulah's more than 100 tornadoes broke Hurricane Carla's record of 26 in September 1961. Usually, tornadoes produced by hurricanes have a diameter and ground path length of about half the magnitude of tornadoes formed on the Great Plains. The reduced magnitude of these hurricane-associated twisters could be one of the reasons why only five people died due to Beulah's tornadoes. Beulah's winds achieved hurricane force but weakened after landfall so that during the heavy rainfall period she degenerated into a tropical depression.

Not all hurricanes are as unique as Celia and Beulah. Carla, like most hurricanes which slam the Texas coast, was predictable. But this did not diminish her potential for damage. Carla, an extreme hurricane, ravaged Central Texas from Victoria to Dallas and caused $300 million damage. She continued northward into the Dakotas causing heavy rains. In terms of monetary damage she is second only to Celia. Port Lavaca took the brunt of the storm surge and measured tides 18.5 feet above normal. Rainfall ranged from 2.82 inches at Paris, in East Texas, to a torrential 16.23 inches at the Galveston airport. Carla's maximum winds peaked at an estimated 175 m.p.h.

Carla was the largest hurricane in recorded history to strike Texas, even larger than the Great Galveston Hurricane of 1900. Yet with $300 million damage, only 34 people died during the storm. Mass evacuation of over 250,000 people from the central and upper coastal cities resulted in the low death toll.

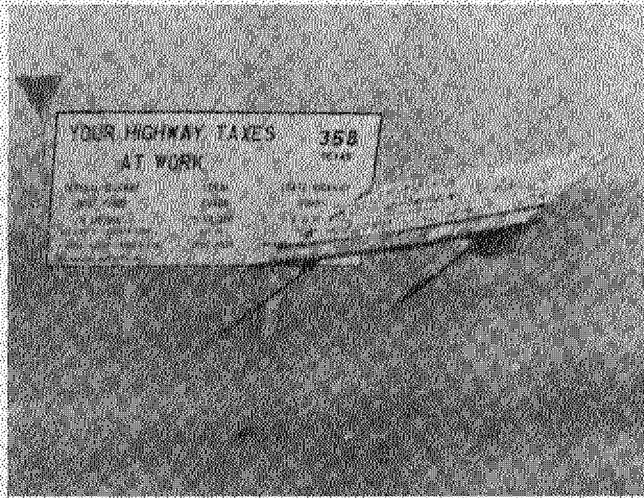


Fig. 10. The wind and rain of Hurricane Celia. Photo by the Texas State Highway Department.

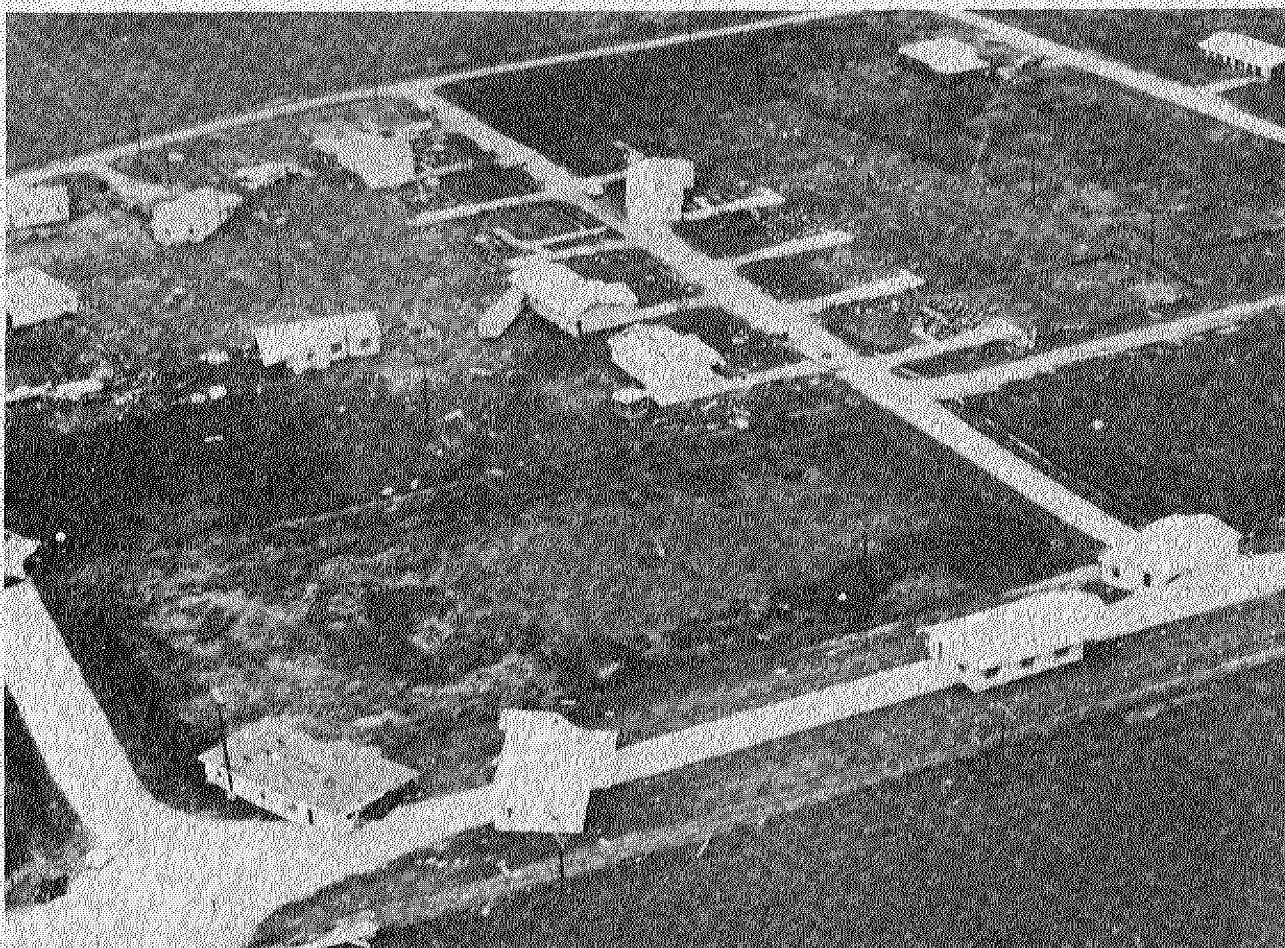


Fig. 9. Houses floated from their foundations by the storm surge and then blown by the wind to new locations at Palacios, Texas, by Hurricane Carla. Photo by the Texas Parks and Wildlife Department.

VI. CLIMATOLOGICAL DATA

Christopher Columbus encountered the first hurricane reported in the New World during his second voyage. On June 16, 1494, he experienced a violent storm in the vicinity of Santo Domingo, which caused him to declare, "Nothing but the service of God and the extension of the monarchy should induce him to expose himself to such dangers." That same summer he encountered two more violent storms.

During the 103-year period, 1871-1973, 43 hurricanes made landfall in Texas. Ten more came close enough to the coast to cause damage. During the same period 25 tropical storms entered the Texas coast and 12 side-swiped the area. For a complete listing of these storms see Appendix I of this booklet.

On the average the Texas coast experiences a hurricane every other year and a tropical storm every third year. However, no real uniformity exists because some years have two or more tropical cyclones while others experience none.

Tropical cyclones form only during certain seasons of the year and only in certain regions of the oceans. Since 1871, which is as far back as our records extend, no tropical cyclone has hit the coast of Texas before June or after October. This does not mean that they cannot form or strike Texas during other months, because new weather records are established almost every day. Tropical cyclones have formed as early as February and as late as December, but for Texas the season of vulnerability has been from June through October. Fig. 11 shows the earliest and latest occurrences of tropical cyclones for 50-mile segments of the Texas coast.

The path of the eye differs in each tropical cyclone. Appendix II presents the partial tracks of cyclones entering Texas or coming close to Texas for the years 1871 to1973.

VII. WHAT'S THE PROBABILITY?

On the average, one tropical storm or one hurricane occurs every year. However, none occurred during half the years between 1871 and 1973. No tropical storm activity at all was reported from 1903 to 1908. Therefore, the average occurrence of hurricanes and tropical storms has little meaning when applied to any one year.

The Texas coast is long, and considering the size of any hurricane, it can be seen that one storm may not affect the entire coast. The storm tracks show that, in general, storms approach the coast at right angles (Appendix II). However, in some unusual cases storms may travel parallel to the coast causing damage along almost the entire coast of Texas.

Climatological frequencies are usually accepted as probabilities for the future. In this case, with approximately a hundred years of records (1871-1973) available, some reliance can be placed upon the determined climatological frequencies and they may be interpreted as probabilities.

In Fig. 12, the coastline is divided into 50-mile segments and the probability of tropical storm and hurricane occurrence during any one year period is computed for each segment to show variability along the coast and to estimate frequency of damage. The computed segment percentages are smaller than those given for the entire Texas coast because of the much shorter coastline involved. Probability data for each coastal section is presented in terms of three classes of storms: (1) tropical cyclones, excluding tropical depressions; (2) all hurricanes; and (3) only extreme hurricanes. A 20 percent chance indicates one occurrence in five years. (Note: This type of data may vary because of the differing criteria established by various authors.)

If a tropical storm makes landfall in any one of the 50-mile segments, it is considered to affect the segment to the right. A hurricane is considered to affect all segments within 50 miles of the eye. An extreme hurricane influences the area 100 miles to the right and 50 miles to the left of the eye. Tropical storms which come within 50 miles of the coast without making landfall also are considered to affect coastal segments.

Fig. 13 shows the average number of years between tropical cyclones of different intensities for each coastal segment. At first look, there appears to be a discrepancy between Figs. 12 and 13. This occurs because more than one cyclone may hit during a season, and when this occurs it usually is counted in two or more segments. One cyclone during one summer and one the next summer would be counted as one year. An occurrence every other year would be two years.

More than one tropical cyclone can occur during any season within any 50-mile segments. Fig. 14, based on data from 1871 to 1973, shows the probability that two or more tropical storms or hurricanes will affect the same segment during the same year. A particular segment of coast will be hit twice during a season on the average of one year out of 20.

All the information shown here is presented as averages. The reader must be aware that hurricanes do not understand averages and each behaves as it wishes without regard to the actions of previous cyclones. Each has its own individual pattern. Nevertheless, the concept of using climatological averages as probabilities for the future is a standard procedure and, with a hundred years of data, these values may be considered a reliable guide.

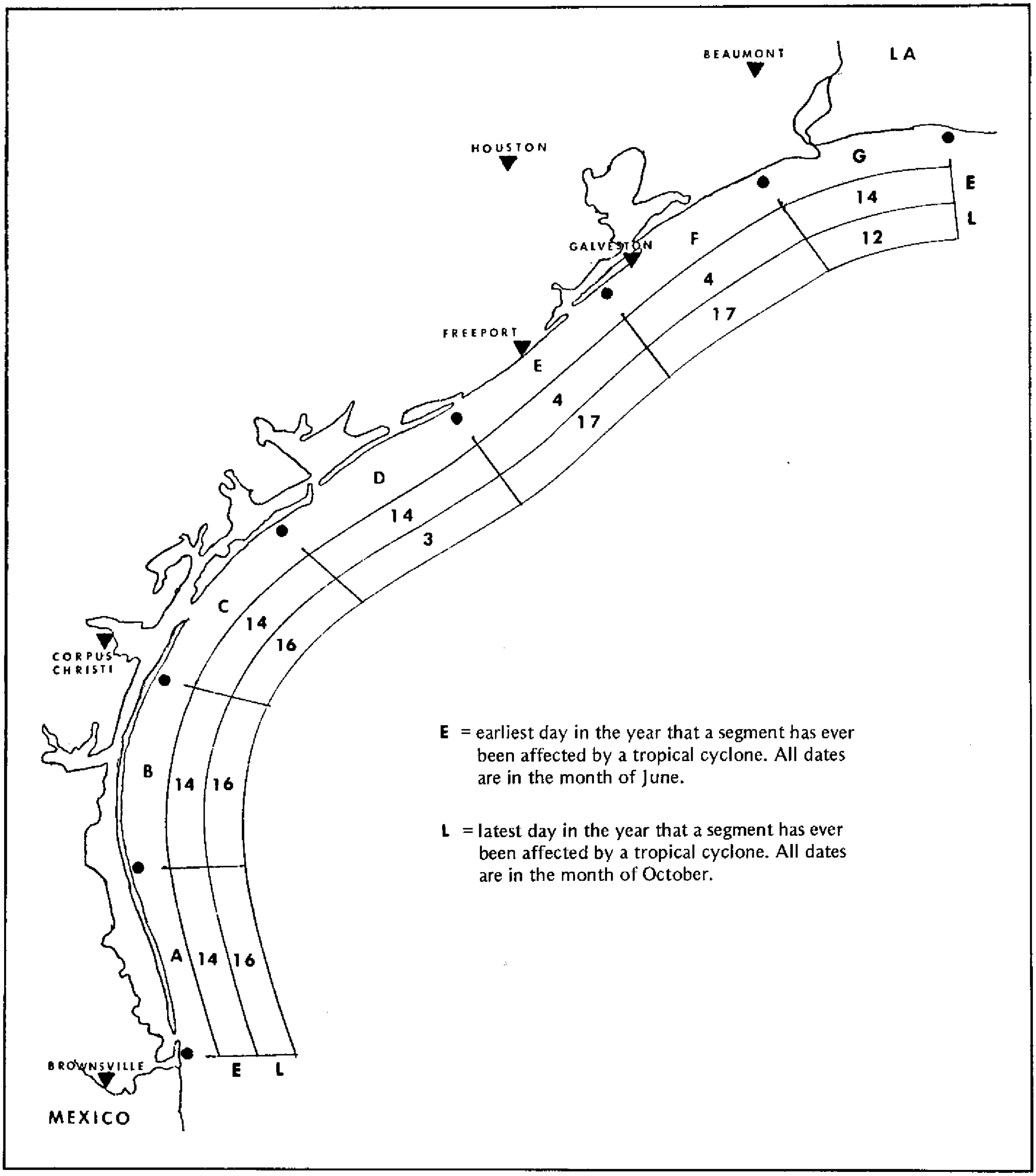


Fig. 11. The earliest and latest dates that a tropical cyclone has ever affected specified 50-mile segments of the Texas coast during the years 1871-1973.

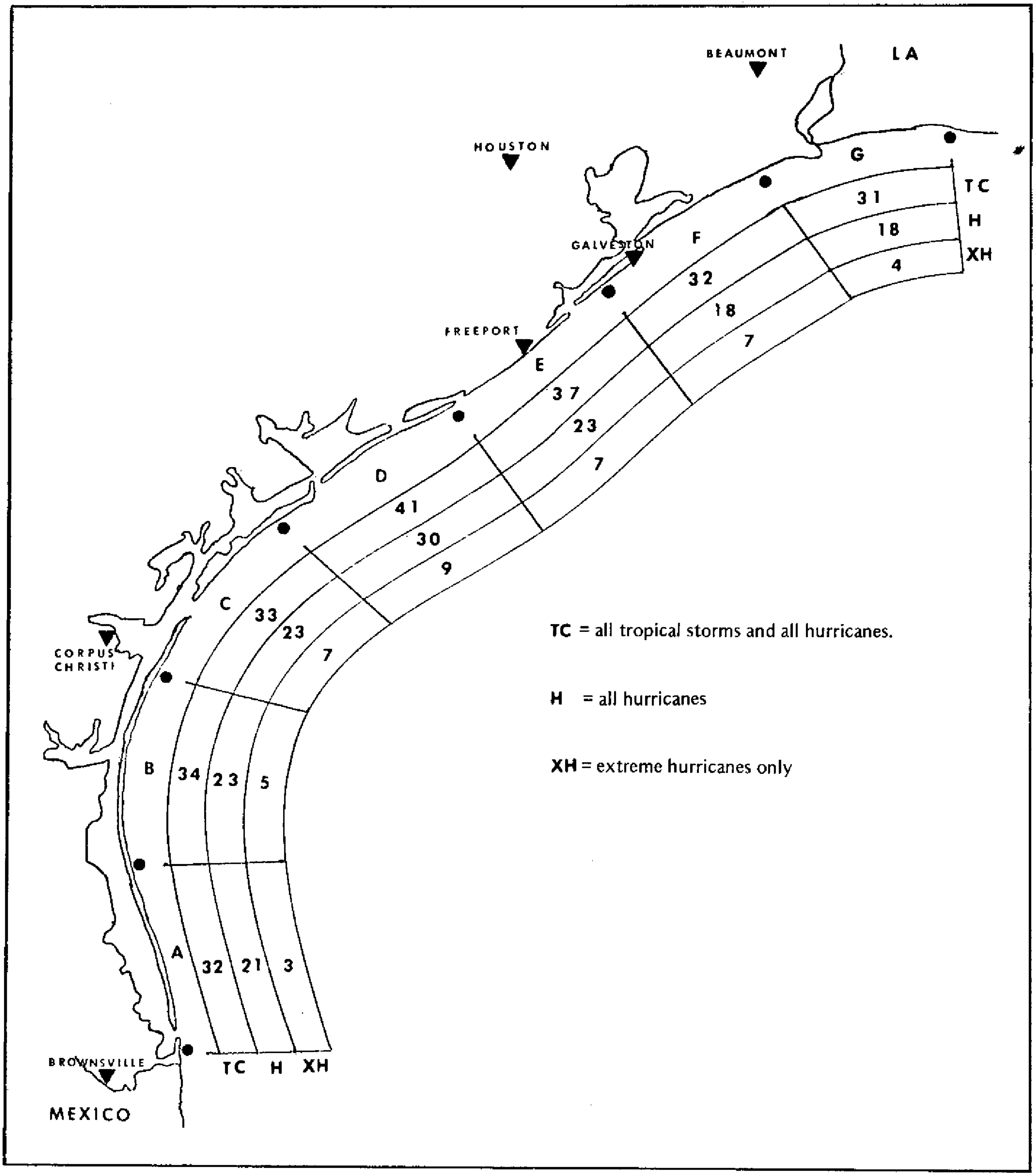


Fig. 12. Probability in percent of tropical storms and hurricanes affecting specified 50-mile segments of the Texas coast during any one year.

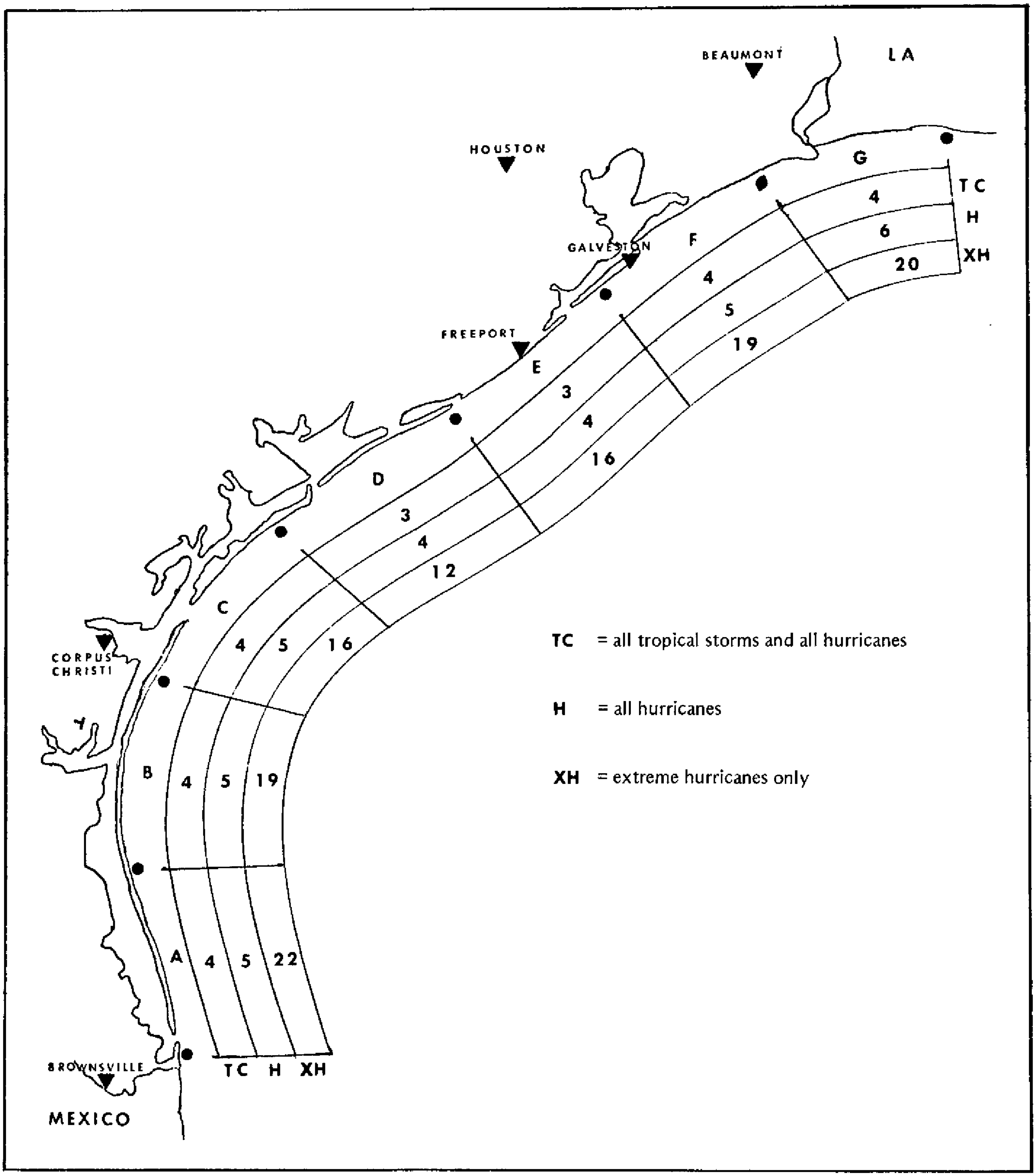


Fig. 13. Average number of years between the occurrence of tropical cyclones in specified 50-mile segments of the Texas coast based on data from 1871-1973.

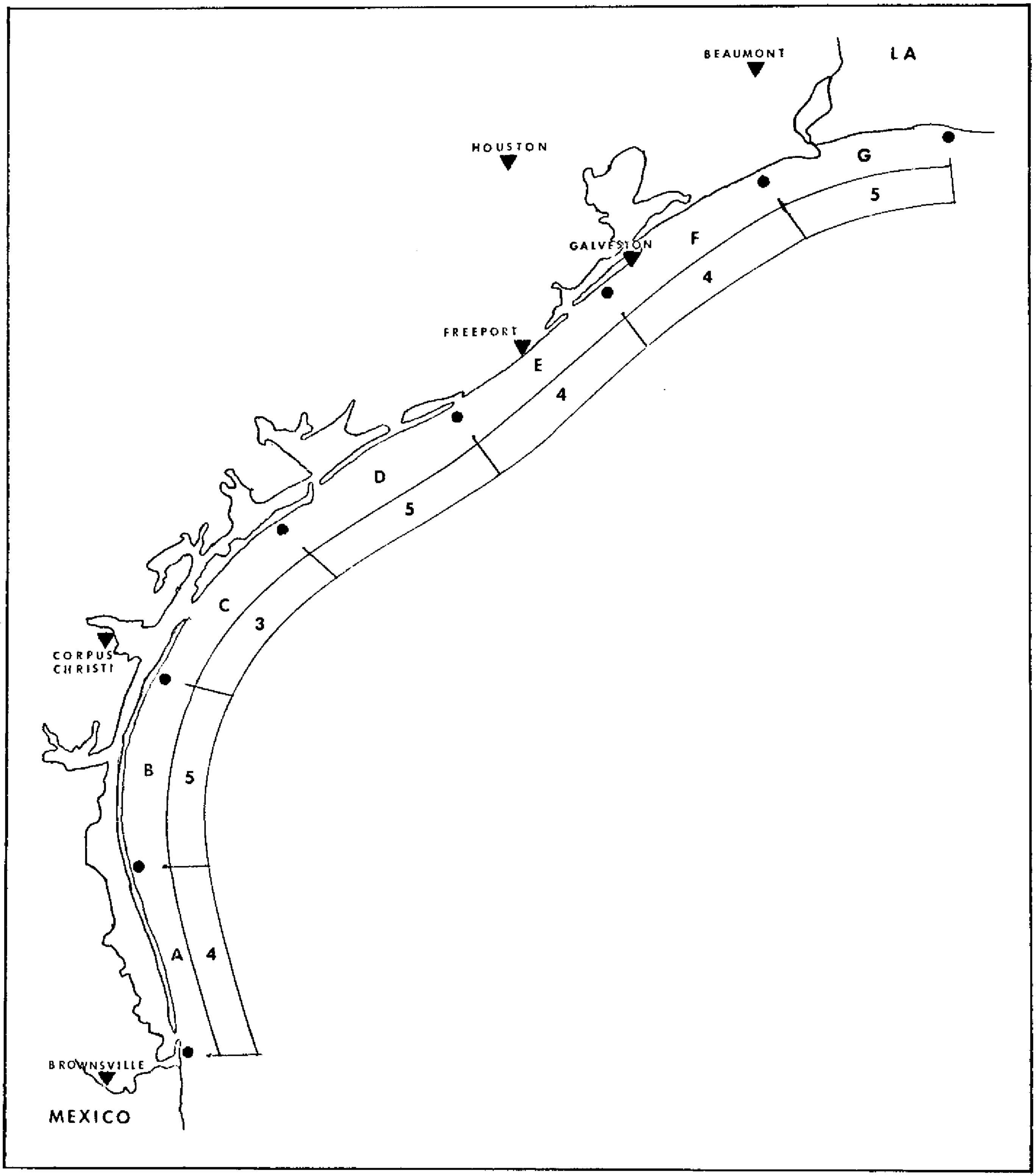


Fig. 14. The percent of years that two or more tropical cyclones have affected the same 50-mile segment during one season based on data from 1871-1973.

APPENDIX I

A chronological listing of the Tropical Cyclones which affected Texas from 1871-1973 is given in Table 1. Table 2 gives a summary by month of the data presented in Table 1.

TABLE 1

A list by date of hurricanes and tropical storms which made landfall on the Texas Coast, came close enough to affect it, or entered Texas through Mexico or Louisiana:

1871	June 4	Tropical Storm made landfall near Galveston
	June 9	Tropical Storm made landfall near Galveston
	October 2	Hurricane passed near central Texas coast
1874	July 4	Hurricane made landfall near Indianola
	August 4	Tropical Storm passed near lower Texas coast
1875	September 16	Hurricane decimated Indianola
1877	September 16	Tropical Storm passed near entire Texas coast
1879	August 22	Tropical Storm moved inland near High Island
1880	June 24	Hurricane moved inland near Victoria
	August 12	Hurricane passed near lower Texas coast
1881	August 13	Hurricane made landfall near Corpus Christi
1885	September 18	Hurricane passed near lower Texas coast
1886	June 14	Tropical Storm passed near central and upper Texas coast
	August 20	Hurricane decimated Indianola, town never rebuilt
	September 22	Hurricane moved inland near Brownsville
	October 12	Hurricane moved inland near Beaumont
1887	September 21	Hurricane made landfall near Brownsville
1888	June 16	Hurricane made landfall near Matagorda
	July 5	Tropical Storm made landfall near Matagorda
1891	July 5	Hurricane moved inland near Matagorda
1895	August 29	Hurricane moved inland near Brownsville
	October 6	Tropical Storm moved inland near Galveston
1897	September 12	Hurricane moved into Texas from Louisiana
1898	September 27	Tropical Storm moved inland from Galveston
1900	September 8,	Hurricane decimated Galveston, worst weather disaster in U.S. history
1901	July 10	Tropical Storm moved inland near Victoria

1902	June 26	Hurricane made landfall near Victoria
1909	June 30	Tropical Storm moved inland between Corpus Christi and Brownsville
	July 21	Hurricane made landfall south of Galveston
	August 27	Hurricane made landfall south of Brownsville
1910	August 31	Tropical Storm made landfall south of Brownsville
	September 14	Hurricane made landfall between Corpus Christi and Brownsville
1912	October 16	Hurricane made landfall between Corpus Christi and Brownsville
1913	June 27	Hurricane made landfall between Corpus Christi and Brownsville
1914	September 19	Tropical Storm moved into Texas from Louisiana
1915	August 17	Hurricane made landfall near Matagorda
1916	August 18	Hurricane made landfall near Corpus Christi
1918	August 6	Hurricane made landfall east of Beaumont in Louisiana
1919	September 15	Hurricane moved inland just south of Corpus Christi
1921	June 22	Hurricane made landfall near Victoria
1925	September 6	Tropical Storm moved inland near Brownsville
1926	August 27	Tropical Storm moved into Texas from Louisiana
	September 22	Tropical Storm moved into Texas from Louisiana
1929	June 28	Hurricane moved inland between Victoria and Corpus Christi
1931	June 27	Tropical Storm moved inland near Corpus Christi
1932	August 13	Hurricane moved inland near Galveston
1933	July 22	Tropical Storm made landfall near Matagorda
	August 4	Hurricane moved inland near Brownsville
	September 4	Hurricane moved inland near Brownsville
1934	July 25	Hurricane moved inland near Corpus Christi
	August 27	Hurricane passed near entire Texas coast
1936	August 27	Hurricane made landfall near Corpus Christi
	September 13	Tropical Storm moved inland near Brownsville
1938	August 14	Hurricane moved into Texas from Louisiana
	October 17	Tropical Storm made landfall near Matagorda
1940	August 7	Hurricane made landfall at Texas-Louisiana border
	September 23	Tropical Storm passed near upper Texas coast
1941	September 14	Tropical Storm made landfall near High Island
	September 23	Hurricane moved inland near Matagorda
1942	August 21	Hurricane moved inland at Galveston
	August 29	Hurricane moved inland at Corpus Christi

1943	July 27	Hurricane made landfall at Galveston
	September 27	Hurricane passed near lower Texas coast
1945	July 21	Tropical Storm moved inland south of Corpus Christi
	August 27	Hurricane moved inland near Victoria
1946	July 16	Tropical Storm moved inland near Beaumont
1947	August 1	Tropical Storm moved inland near Brownsville
	August 24	Hurricane made landfall at Galveston
	September 19	Tropical Storm moved into Texas from Louisiana
1949	October 3	Hurricane made landfall near Matagorda
1954	June 25	Hurricane Alice made landfall south of Brownsville and moved up the Rio Grande
	July 29	Tropical Storm Barbara moved into Texas from Louisiana
1955	August 2	Tropical Storm Brenda moved into Texas from Louisiana
	August 27	Tropical Storm moved into Texas from Louisiana
1957	June 27	Hurricane Audrey made landfall just east of the Texas-Louisiana border
	August 9	Tropical Storm Bertha made landfall at the Texas-Louisiana border
1958	June 15	Tropical Storm Alma made landfall south of Brownsville and moved up the Rio Grande
	August 6	Tropical Storm Ella made landfall near Corpus Christi
1959	July 25	Hurricane Debra moved inland at Galveston
1960	June 24	Tropical Storm moved inland near Corpus Christi
1961	September 11	Hurricane Carla moved inland near Victoria
1963	August 17	Hurricane Cindy made landfall near High Island
1964	August 7	Tropical Storm Abby moved inland near Matagorda
1967	September 20	Hurricane Beulah moved inland between Brownsville and the mouth of the Rio Grande
1968	June 23	Tropical Storm Candy made landfall near Corpus Christi
1970	August 3	Hurricane Celia moved inland at Corpus Christi
	September 16	Tropical Storm Felice moved inland near Galveston
1971	September 10	Hurricane Fern moved near Matagorda
	September 14	Hurricane Edith passed near entire Texas coast
1973	September 5	Tropical Storm Delia moved inland between Galveston and Matagorda

TABLE 2

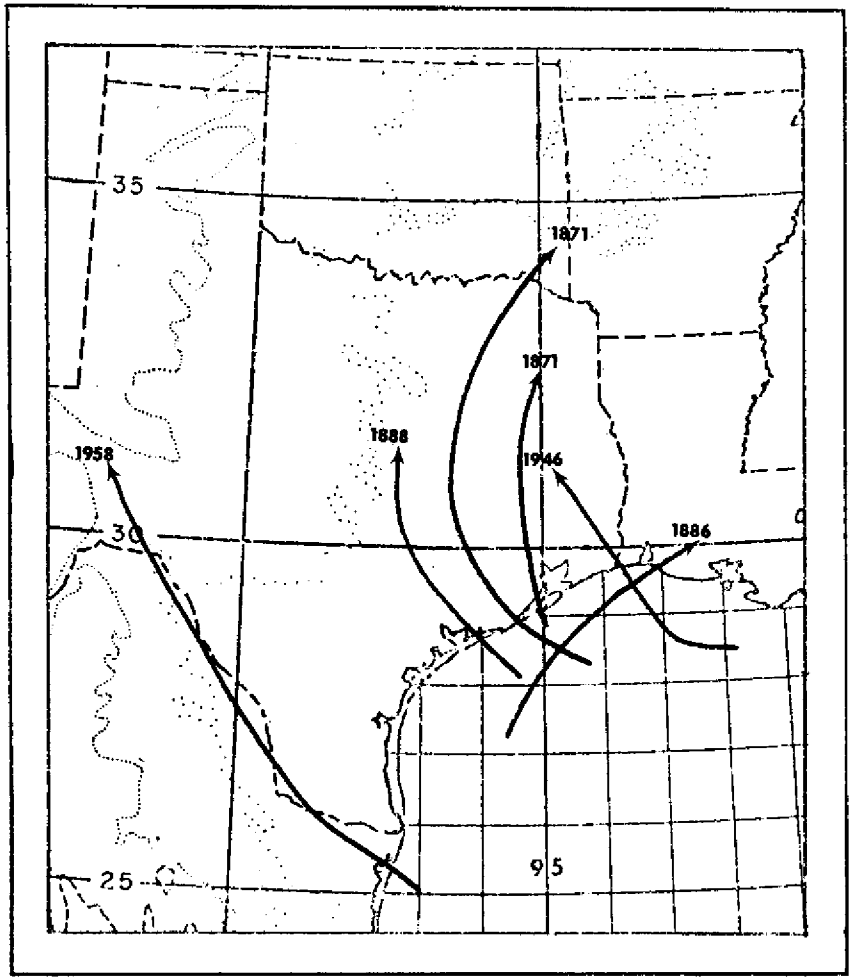
Table 2 contains the total number by month of hurricanes or tropical storms that hit the Texas coast, moved into Texas from Mexico or Louisiana, or affected the Texas coast as they passed through the Gulf of Mexico during the period from 1871 to 1973:

	June	July	August	September	October
Hurricane	8	6	13	13	3
Tropical Storm	7	4	4	8	2
Hurricane came close	1	0	5	3	1
Tropical Storm came close	2	1	4	5	0

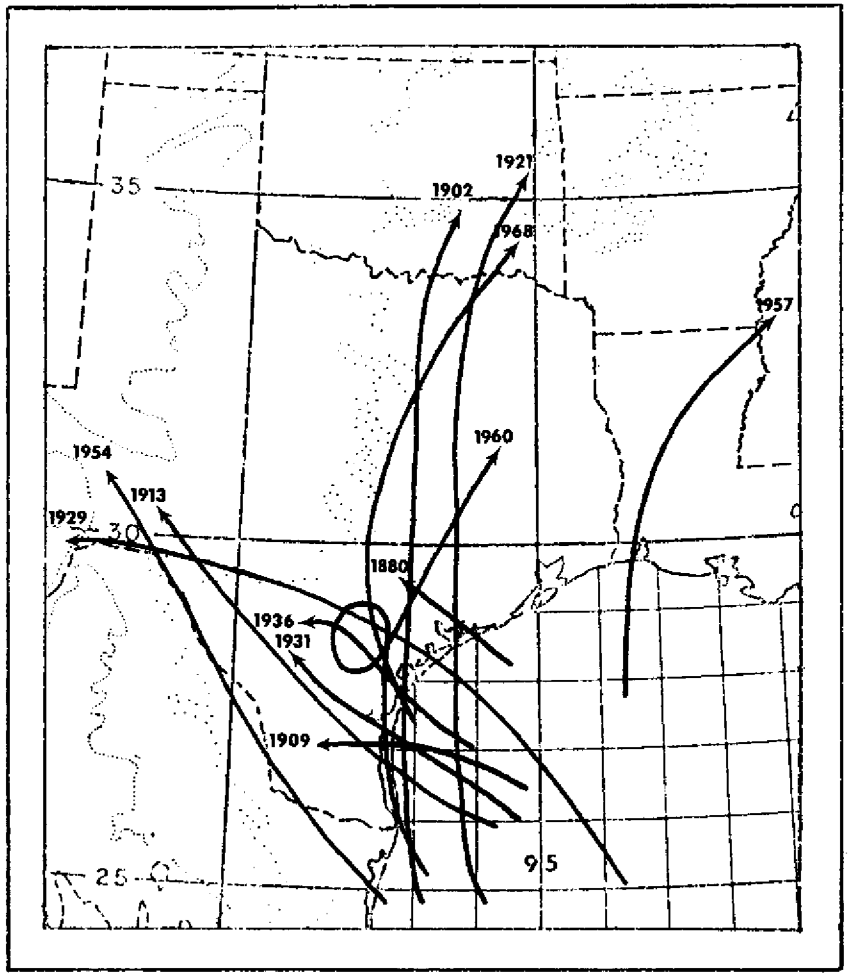
Number of years without a tropical cyclone: 44

APPENDIX II

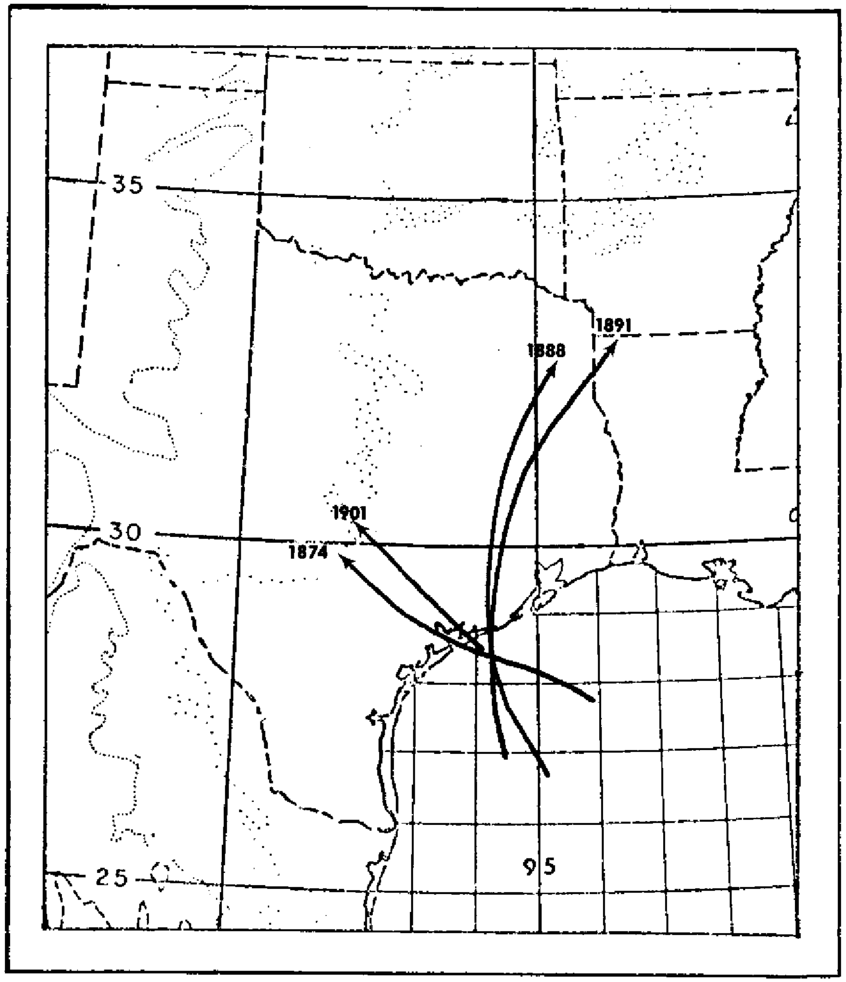
The tracks of individual tropical storms and hurricanes are shown. Tracks are separated by months and part of months. The year is indicated at the end of the track.



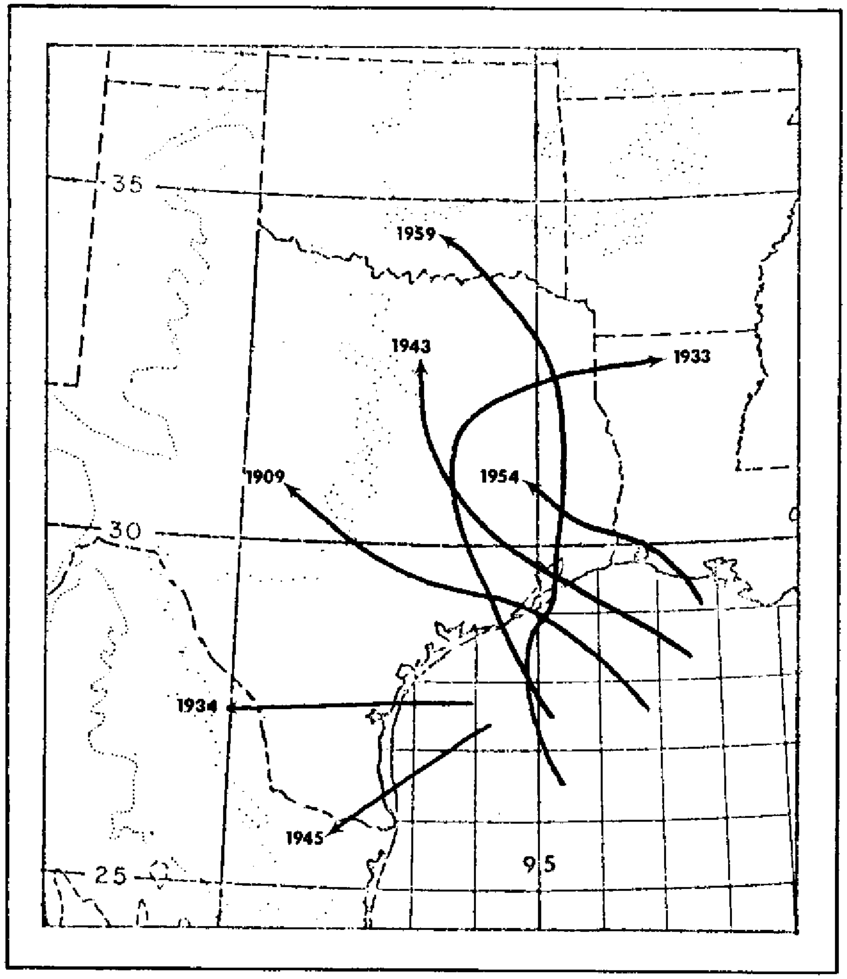
June 1-20



June 21-30

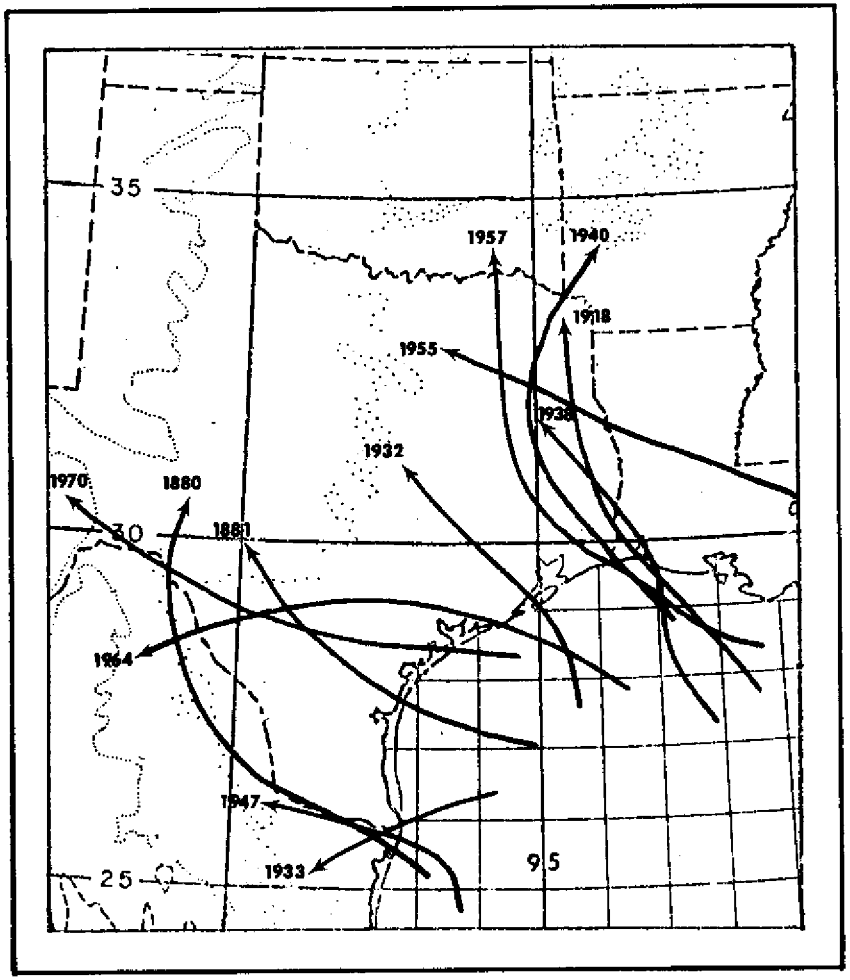


July 1-15

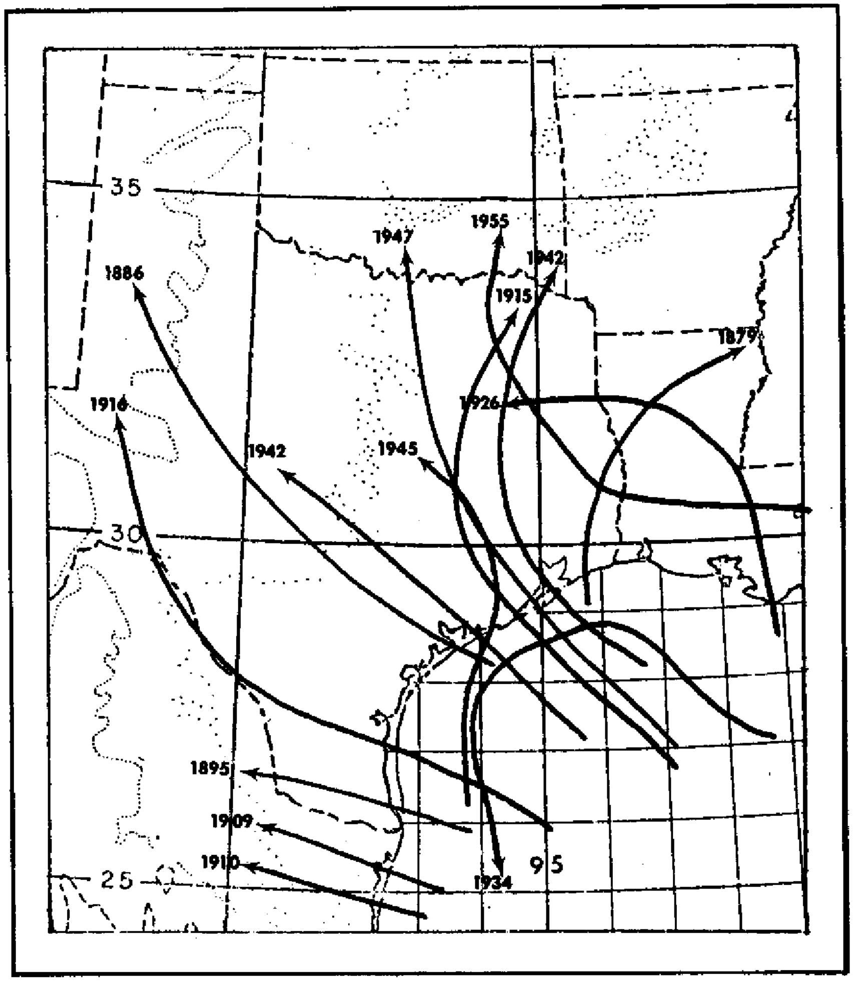


July 16-31

TROPICAL STORM AND HURRICANE TRACKS

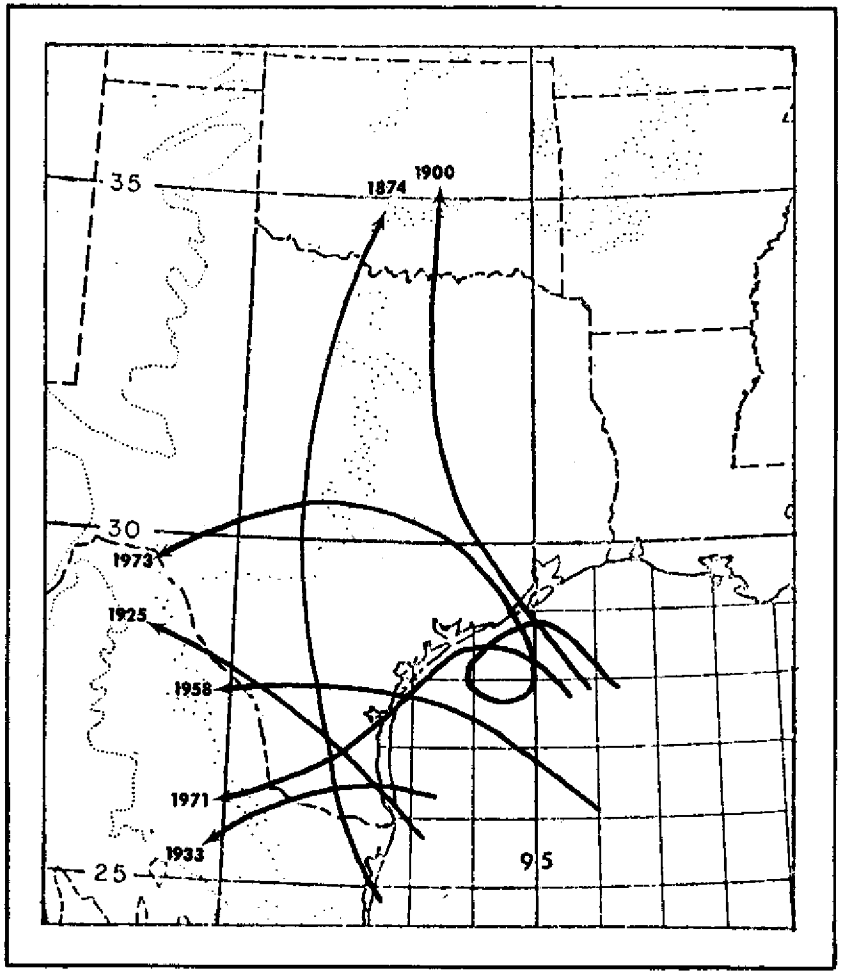


August 1-15

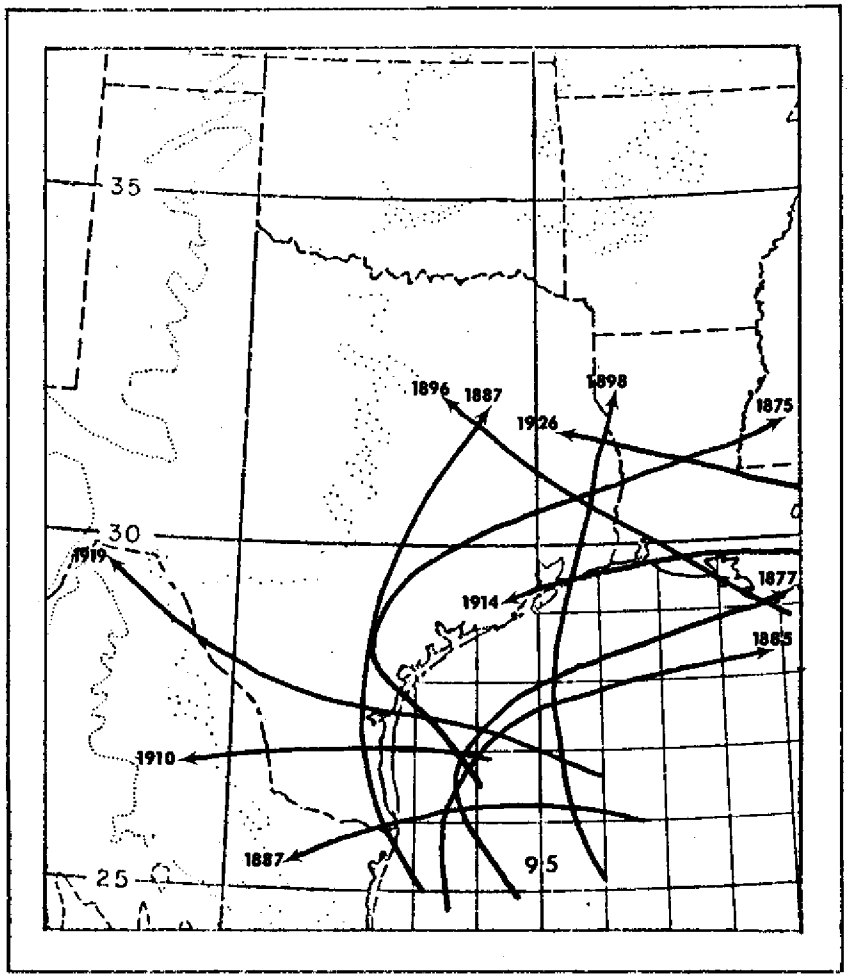


August 16-31

TROPICAL STORM AND HURRICANE TRACKS



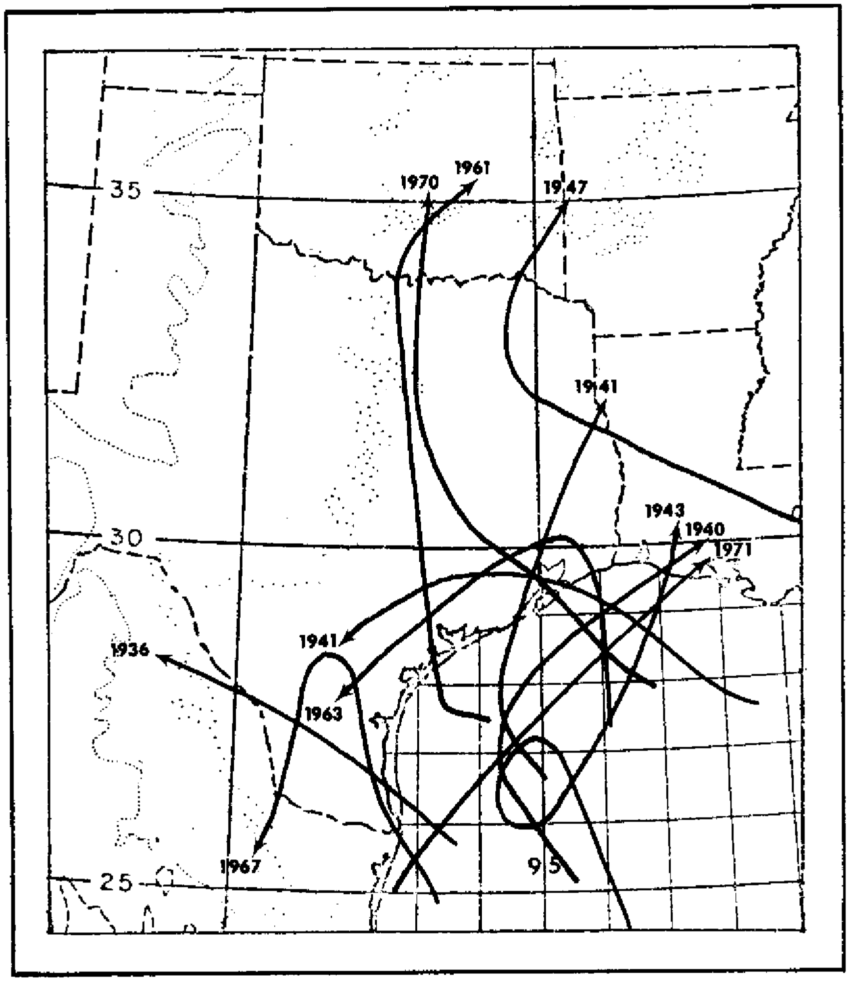
September 1-10



September 11-30

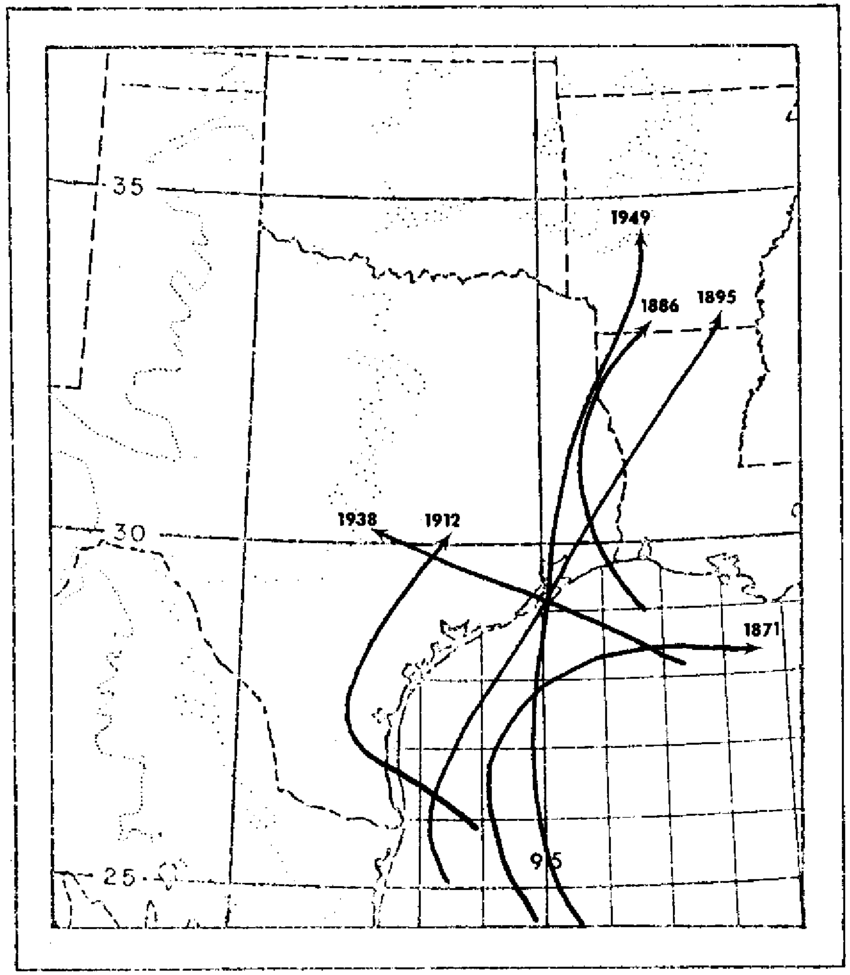
1871-1926

TROPICAL STORM AND HURRICANE TRACKS



September 11-30

1927-1973



October 1-31

TROPICAL STORM AND HURRICANE TRACKS

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FUTURE BOOKLETS

This series will include two more booklets. Volume II will deal with the principle types of damage that may accompany a tropical storm or a hurricane such as: storm surge, high winds and tornadoes, and heavy rains. Some recent Texas hurricanes will serve as examples to show how types of damage can vary from hurricane to hurricane. Volume III will describe the precautions that individuals may undertake to minimize hurricane hazards. It will outline actions governmental agencies may take to help before, during, and after a hurricane strikes.