CHAPTER II
TROPICAL CYCLONES

2.1 INTRODUCTION

This chapter is concerned with tropical depressions around which the wind circulates with speeds exceeding 17 metres per second (61 km/hr). If the speed exceeds 32 metres per second (115 km/hr) the depression is said to be of full hurricane force.

The severe storms of the tropics have a variety of names according to the region in which they occur. They are in essence the same type of storm and in this monograph it will be convenient to employ a single term, tropical cyclone, except when specific reference is made to a region where a different term is in common use. The descriptive terms used in the different regions are set out in Table I below.

TABLE I

Areas of occurrence of intense tropical cyclones and regional descriptions

Region	Range of maximum wind speeds (metres per second)	
	17.32	32.85
Western North Pacific Ocean	Tropical cyclone	Typhoon
Bay of Bengal and Arabian Sea	Cyclone	Severe cyclone
South Indian Ocean	Tropical depression	Tropical cyclone
South Pacific Ocean	Tropical depression	Cyclone
North Atlantic Ocean and eastern North Pacific Ocean	Tropical storm	Hurricane

In much of the literature on human disasters one finds the remark that tropical cyclones can cause more deaths and destruction than almost any other of nature's many forces. Numerous examples can be given, but it may be sufficient to refer to a storm which struck East Pakistan (now Bangladesh) in November 1970 and resulted in the loss of more than 300,000 lives. In this case the principal cause of disaster was the storm surge which was helped by the fact that the tropical cyclone made landfall at about the time of high tide. The converging coastline and the shallow waters at the head of the Bay of Bengal provided an ideal setting for stormy winds to sweep the sea over the offshore islands, and the low-lying coastal belt causing a high number of deaths by drowning and enormous damage.

However, the human and economic losses for which a tropical cyclone may be responsible can be greatly reduced provided that appropriate measures for disaster prevention are taken and provided that these measures are supplemented by a well-planned and effective organisation for disaster preparedness which would include a reliable early warning service and would have the support of an active, responsive people. In recent years a serious problem in most countries affected by tropical cyclones has been urbanisation and industrial development, accompanied by increases in population that have taken place in high risk localities such as coastal resorts and flood plains. In a country like the United States of America, while there has been a remarkable reduction in the death toll from hurricanes, there has been a significant increase in damage. These tendencies are shown clearly in Figure I which is taken from a US Government publication. In two 30-year periods,

1900-1929 and 1945-1974, the numbers of lives lost through the effects of hurricanes fell from 10,000 to fewer than 2,000. On the other hand, in two decades 50 years apart the amount of damage increased several fold even when adjustments are made for the effects of inflation. It will be appreciated that the increased number of building and installations has led to greater vulnerability, thus emphasizing the importance of such preventive measures as land-use planning and building codes.

2.2 THE NATURE OF TROPICAL CYCLONES

Compared with the depressions of temperate latitudes which cover extensive areas of the earth's surface, a tropical cyclone is small. The circular area within which the wind speeds are greater than 17 metres per second has an average diameter of about 500 or 600 km. The so-called 'eye' of the storm is a central core, the diameter of which may range from 20 km to about 150 km, and in this area the weather conditions are quiet with light winds and partly clouded skies. The pressure at the centre of a tropical cyclone is very low, well below 1000 mb and occasionally even lower than 900 mb. There is therefore a very large pressure difference between the edge of the eye and the outer boundary of the storm and, as wind speeds are proportional to gradients of pressure, this explains the strong winds of a tropical cyclone. These winds blow round the low pressure centre in an anti-clockwise direction in the northern hemisphere and in a clockwise direction in the southern hemisphere.

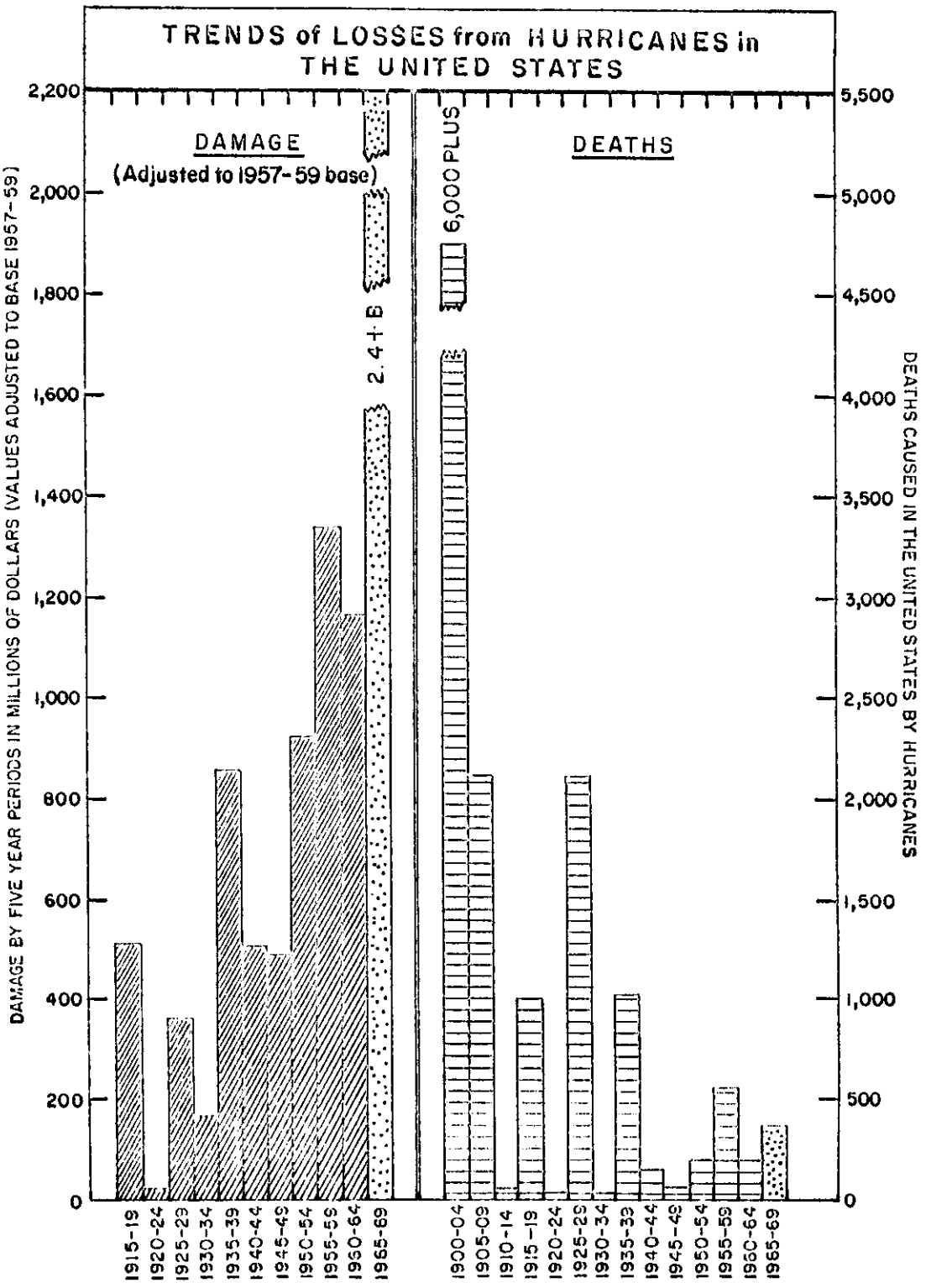

Figure 1 – Trends in losses from hurricanes in the United States summarized by five-year periods. Damage statistics have been adjusted to the 1957-59 Department of Commerce Composite Cost Index for Construction. The right side of diagram shows trend of decreasing deaths due to hurricanes. The decrease should be attributed to improvements in the hurricane warning service and community preparedness programme

The eye of the storm is surrounded by wall clouds of great vertical extent which are organised in bands spiralling inwards to the perimeter of the eye. These clouds mark a region of the most violent winds, torrential rain, strong vertical motion and considerable turbulence. These distinctive features are displayed in Figure 2, a radar picture of a mature tropical cyclone, i.e., hurricane BETSY - September 1965. Figure 3, also of hurricane BETSY, shows what a mature storm and its environment look like as seen by a satellite. A number of features are clearly shown although the dense cloud at high levels tends to obscure the cloud structure near the storm centre.

Figures 4a and 4b illustrate how wind speeds vary across a tropical cyclone and shows the band of very strong winds which encircles the calm, central core. As the eye of the storm passess over a place, the winds fall to light or even calm but this is only a temporary phase soon followed by a resumption of violent winds and blowing from the opposite direction. During this temporary period of calmer winds, people are apt to imagine that the storm is over and leave the safety of their shelters. Many deaths have resulted from such a misunderstanding.

Tropical cyclones form over the open sea generally five or more latitude degrees from the equator and where the temperature of the sea-surface is at least 26°C. The warm sea provides the over-lying atmosphere with a continuous supply of energy and moisture, first to generate a tropical cyclone and then to maintain its destructive violence. This source of energy is, of course, cut off if, as frequently happens, the storm crosses a coastline and moves inland. The winds and turbulence then moderate steadily, but the rainfall may still persist for some considerable time.

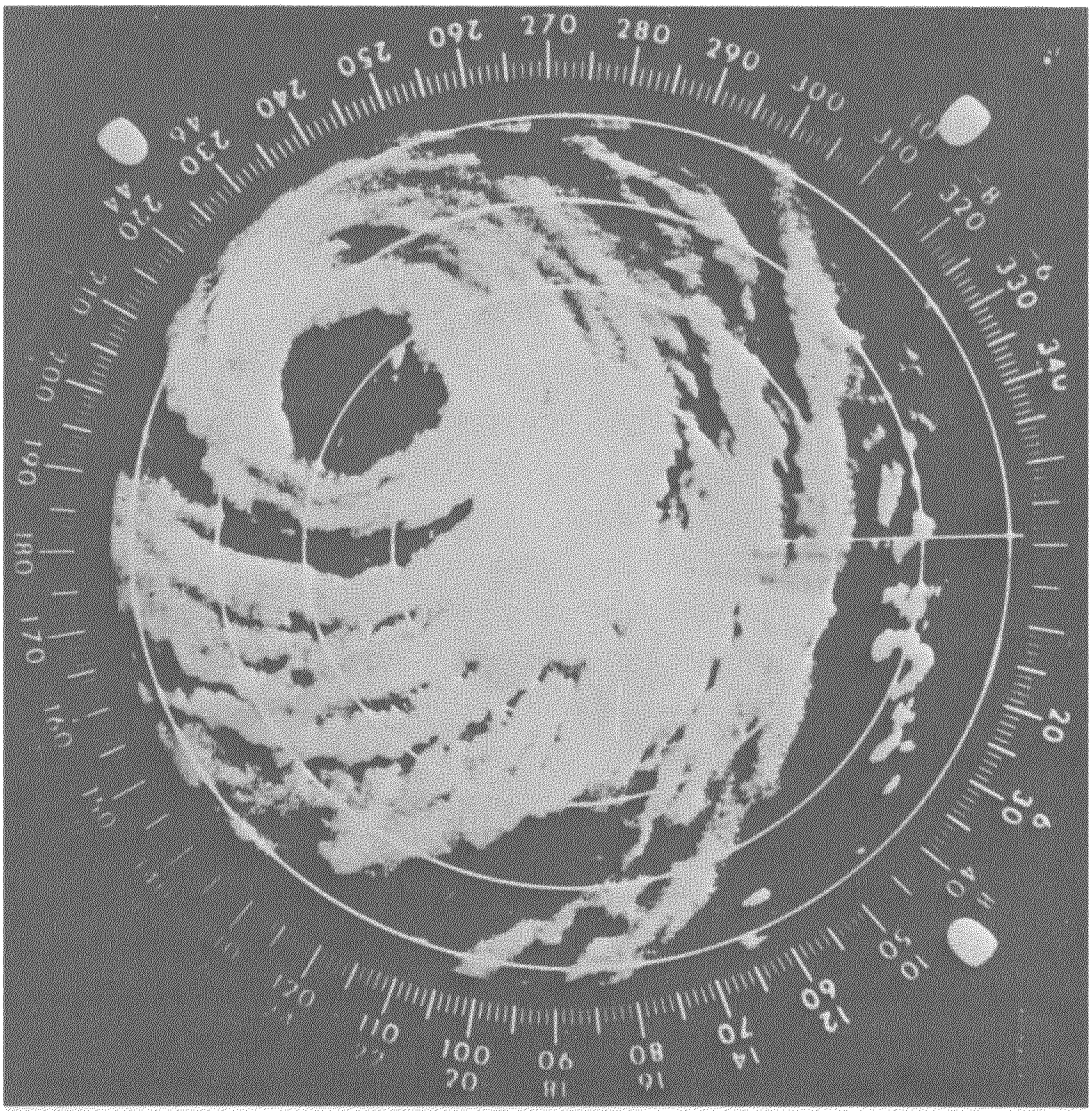

Figure 2.