# CHAPTER I

## INTRODUCTION

Estuaries are submerged features of the coastal zone developed by geological agents, influenced by physical and chemical processes, inhabited by organisms, and used by man. Understanding the dynamic attributes to estuaries lead to more effective management of them. Man's historical development has been closely linked with the estuaries. Human have always exhibited a nataural affinity for water and these bays and river mouths often present unique advantages. Since the dawn of the history, human civilizations have been originated and flourished within the vicinity of estuaries of large rivers all over the world. They are semi-enclosed and therefore provided natural harbours; they are effective nutrient traps and therefore are rich in food; they connect the oceans and inland rivers so that they are natural transportation centers; and their often high rates of flux and flush permit disposal of great quantities of waste.

Prior to about 1850 the research on these estuaries was probably unimportant, and was limited to the effects of silt erosion from agricultural areas and the disposal of wastes (Cronin, 1968). However, the enormous expansion during the last century in industrial activities, production and use of power, diversity of manufactured materials, transportation, fishing intensity, and human population have all placed diverse and increasing pressures on these waters. They all effect the

processes of the estuaries and their capacity for future use.

There are no physical, chemical, geological or biological processes unique in the estuary, but many are typical and distinctive mixture of sea and river. So many research works which have been carried out in the estuaries attempt to make discussions to these questions directly or indirectly :

a) What physical, chemical, geological, and biological processes are unusually significant in the estuary and may be modified by man?

b) How have human activities affected these processes beyond the normal range of variation present in the virgin estuary ?

c) What are the possibilities for future management of estuarine processes for optimal achievement of human values from estuaries ?

## 1.1 Purpose of Study

The main objective of this study is to investigate general characteristics and some physical processes of the Tha Chin estuarine system. The field investigation programme has been formulated to record changes that take place within this area covering the North-east and South-west Monsoon seasons during March 1979 and December 1979. The various aspects concerned are as follows :

a) Delineation of the estuarine and related environments within the area studied using aerial photographs.

b) Determine parameters and processes within the estuarine environment.

c) Synthesis the environmental conditions of the estuarine environment and neighbouring area.

The study can be said as the first attempt within this geographic area considering from the estuarine oceanographic view point. However, only a reconnaissance level has been covered which are primarily due to limited funds and time available and also the lack of background information of this area. For optimal achievement of human values from this estuary further detailed studies must be made against the base-line study carried out in the present investigation.

## 1.2 Location of the Area Study.

The Tha Chin river orginates in Uthai Thani Province, and flowing southerly through various provinces, namely, Chai Nat, Suphanburi, Nakorn Pathom and eventually enters the Gulf of Thailand at Samut Sakorn. The Tha Chin estuary is situated on the northern coast of the Upper Gulf of Thailand. Other main rivers which enter the Upper Gulf of Thailand are Mae Klong, Chao Phraya, Bang Pakong, and Petchburi. (See Fig. 1.2.1)

The area under the present investigation is limited within 100° 12' to 100° 21' east longitudes and 13° 28' to 13° 36' north lattitudes. (See Fig. 1.2.2). Consequently, the total area of study covers approximately 240 square kilometres, and the distance of survey along the river channel is approximately 10 kilometres. The site selection aims at covering the lowest part of Tha Chin flood plain, coastal plain and some off-shore area of the Upper Gulf of Thailand. This manner of site selection enables to put the Tha Chin estuary approximately right in the middle part

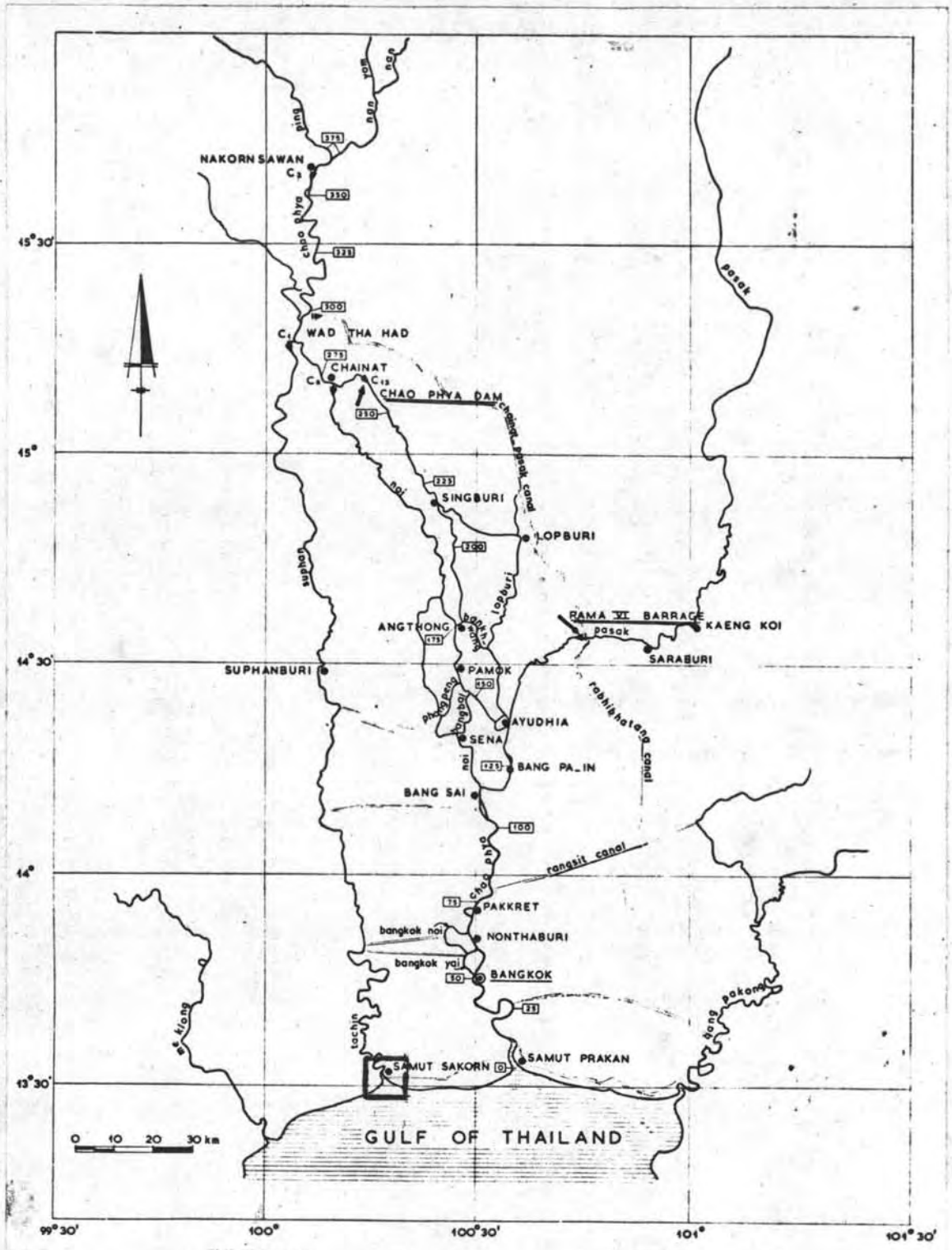


Figure 1.2.1 Index map illustrating the area of study (after NEDECO, 1965).

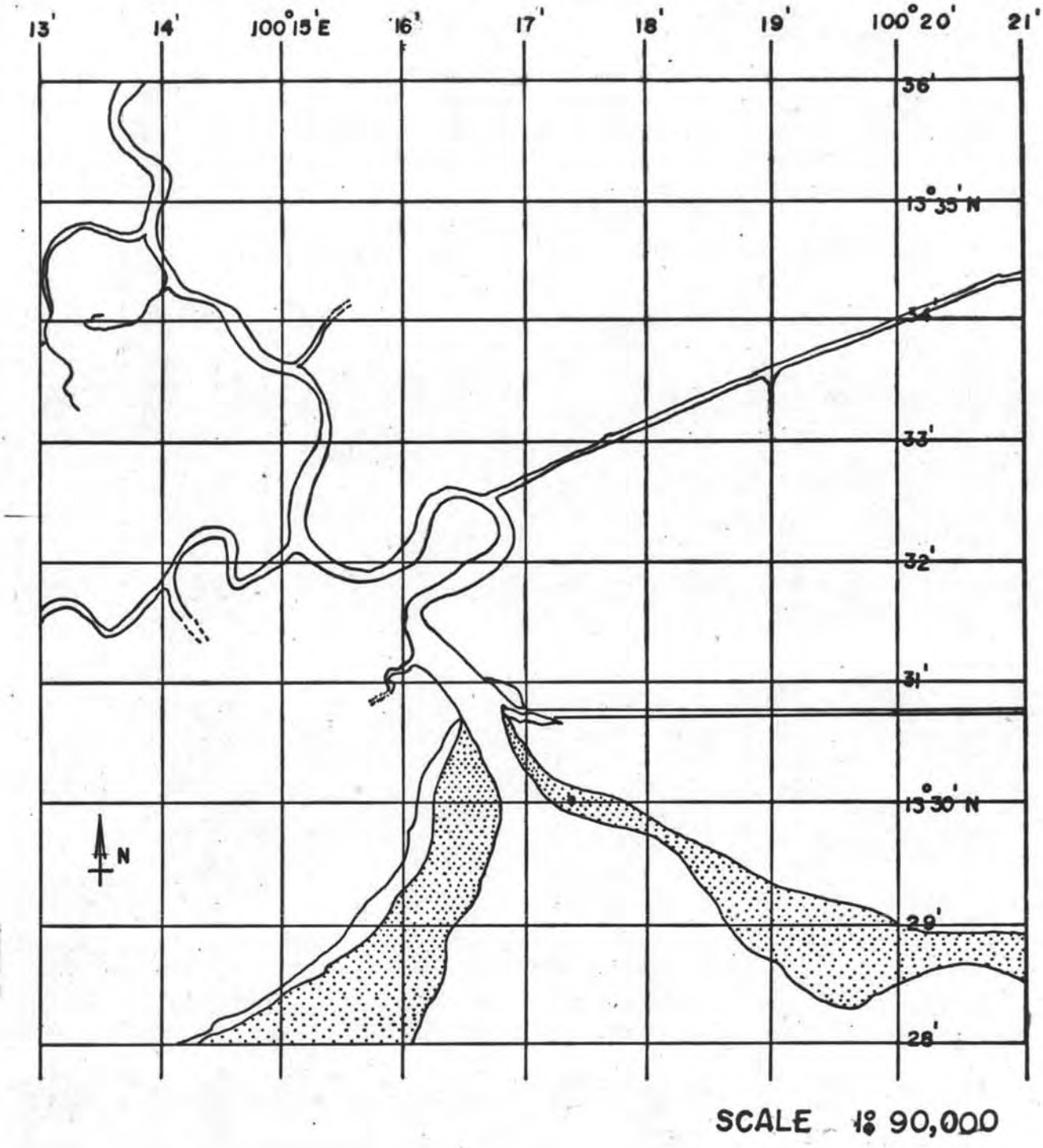


Figure 1.2.2 Map of the Tha Chin estuary.

of the area under investigation.

## 1.3 Climate

The climate of Thailand is dominated by the Monsoons. Monsoon winds are essentially seasonal winds, blowing in one direction part of the year and in the opposite direction the remainder of the year. They are caused chiefly by the differential heating of land and water masses.

In the winter monsoon, the vast Asian continent cools considerably faster than the waters of the Indian Ocean, and a comparatively higher pressure area forms over South-east Asia, resulting in a wind movement from the land mass towards the ocean. Geostrophic effects cause this wind movement to be deflected to the right on the northern hemisphere, so that the dominant direction of the winds blowing over Thailand during this part of the year is northeast.

In the summer months the opposite happens : the continent becomes warm faster than the Indian Ocean and the air pressure above the ocean becomes relatively higher, resulting in winds blowing from the ocean towards the continent. Again due to geostrophic effects, these winds are deflected to the right and wind directions during this season are predominantly south and southwest.

The phenomena described give only a rough picture of the atmospheric circulations. For one thing, the two seasons do not change abruptly from one into the other but are seperated by periods of transitional weather. Interruptions of the "normal" monsoonal air movements are frequent, partly

due to relief and other local influences and partly determined by cyclonic atmospheric disturbances.

In general the climate in the Central Plain of Thailand can be divided into four seasons :

(1) The North-east Monsoon season. This season starts from November to February. Land winds from the China mainland bring frequent cold spells during this season. The north-east winds which descend from the slopes of the mountains of Indo-China and move through continental Thailand are quite dry and very little rain is experienced over the Central Plain during this part of the year.

(2) The Retreating North-east Monsoon season. It extends from March to mid-May and bring highly variable winds. When the wind changes are very intense, cool northern air and warm southern air mix vigorously and may lead to the development of cyclonic rains.

(3) The South-west Monsoon season. This season begins in mid-May and ends in September; the moisture-laden winds blowing in from the ocean cause appreciable rainfall throughout the country. Although in general the South-west Monsoon is more persistent than the North-east Monsoon, variations may occur in the form of a late start, a prolonged break, an early termination or an excessive concentration of rainfall in localised areas. The first three variations generally result in a deficiency of rainfall, often in drought. Extremely heavy falls in short periods may bring flash floods. Record of past years indicate that both conditions, droughts and floods, appear with approximately the same

frequency. Long-term observations further indicate the occurance of a break during the early stages of the rainy season (June, July).

Extra tropical disturbances-typhoons-occasionally come from the South China Sea during this season. They may dissipate themselves in north and central Thailand, causing torrential precipitation, particularly in the months July to September, with an extension into the next season.

(4) The Retreating South-west Monsoon season. This is another transitional period, lasting from the end of September to October, bringing about a marked decrease in precipitation in Thailand.

Due to local conditions, mainly of a topographical character, Thailand may be divided into five climatic regions which correspond with the physiographical provinces. The climate in the Central Plain is affected by the lack of relief and the nearness to the sea. The temperature pattern here is very uniform throughout the region. During the trasitional hot weather of March, April, May the temperature in the afternoon may rise above 38°c, while the hot nights give scant relief. During the rainy season (South-west Monsoon) maximum temperatures generally range from 32° to 38°c, and the minimum temperatures are about 24°c. During the North-east Monsoon or cool season the temperatures are milder and the daily variations are greater; maximum temperatures are about 31°c and minimum temperatures are abaut 15°c in this period. Cutbreaks of cold air from Siberia and the mainland of China occasionally bring down temperatures even further.

The annual mean relative humidity of the whole country lies

between 70 to 80 percent. During the rainy season the monthly mean relative humidity is the highest, about 80 to 85 percent. During the North-east Monsoon season, i.e. in the winter, the mean relative humidity falls to its lowest values, about 65 to 70 percent.

The rainfall in Thailand is closely related with the monsoon seasons. The actual distribution and quantities vary according to local conditions. Although no one month is completely without precipitation, the quantities falling in the dry season (December to March) are negligible (in Bangkok an average of 1 to 2 inches). April and November are transitional months from dry to wet season and vice-versa.

Approximately 85 percent of the yearly precipitation falls during the months of May to October. The greater part of this rain is caused by the regular South-west Monsoon winds, but a smaller portion falls in the form of very intensive showers, resulting from tropical stroms.

The pattern of precipitation in the central part of Thailand reaches the maximum value in September and decreases gradually to the value in October.

Cloudiness is least from November through March. During this period, perfectly clear skies are frequent particularly during the forenoon and at night. Most of the clouds that occur during this period are of the high type, although fine weather Cumulus may be seen every now and then. During the southwest monsoon, the clouds are almost entirely Cumulus, Cumulonimbus and Stratocumulus. Perfectly clear skies are rarity during this period except in June, when fine weather may occur in frequent

intervals of 2-3 days, particularly before noon. Average cloudiness is about 6 oktas during this season.

The climate in the area of the Central Plain is of the monsoon type with north-easterly winds in winter and south-westerly winds during the summer of the northern hemisphere.

Winter or North-east Monsoon season, November to February, is governed by the regime of the North-east Monsoon with its characteristic cold and dry continental wind system. The prevailing wind blows mainly from the north, northeast and east, the direction and strength changing in relation to variations in place and intensity of the Asiatic anti-cyclones; but in February it tends to shift to the southern quarter.

During March, April and May there is a transitional period with variable winds mainly from south, southeast and east. This season is commonly termed the hot season of Thailand, due to the development of a thermal low in the central part of the country and combined with active sea-breezes in the afternoon.

From May to September, Thailand is under the influence of the southwest monsoon. The prevailing winds are mainly from the south, southwest and west. It is weaker than the northeast monsoon and there are many variations caused by typhoons and depressions over the South China Sea. October is transitional period from the southwest to northeast monsoons during which high pressure over China intensifies occasionally. As a consequence, the southwest monsoon retreats southward giving way to north, northeast and east winds particularly after the middle of October.

At other times the wind are generally variable.

Due to the fact that no meteorological station is available in Samut Sakorn province, meteorologicel data obtained from Bangkok are therefore used to represent the local climatic conditions of the area under present investigation.

The annual mean temperature within the area of study is 27.5°c (25-year period from 1951 to 1975). Minimum temperatures appear in the month of December and January, whereas maximum temperatures appear in the month of April. However, monthly variation in the temperature recorded during the previous mentioned period varies between 7.4°c to 11.6°c. Data regarding this matter is summarized and presented in Figure 1.3.1

Rainfall reaches maximum value of about 400 mm. in September. In rainy season, rainfall lies in range of 150-200 mm. (May-October), but in the other part of year, rainfall is less than 70 mm. ( 25 years period from 1951 to 1975). However, the annual mean rainfall obtained from 25 year record is 127.1 mm. (Figure 1.3.2)

The hythergraph for 25 years period (1951-1975) prepared from monthy mean rainfall values and monthly mean temperatures shows that high amount of rainfall occurs during mean temperature range from 27.6 to 29.2°c and low amount of rainfall covers a relatively greater temperature range from 25.4 to 29.5°c (Figure 1.3.3).

The annual mean of relative humidity is 79% (25 years period, 1951-1975). The monthly mean of relative humidity reaches maximum during the same month of maximum rainfall and monthly mean of rainy season period

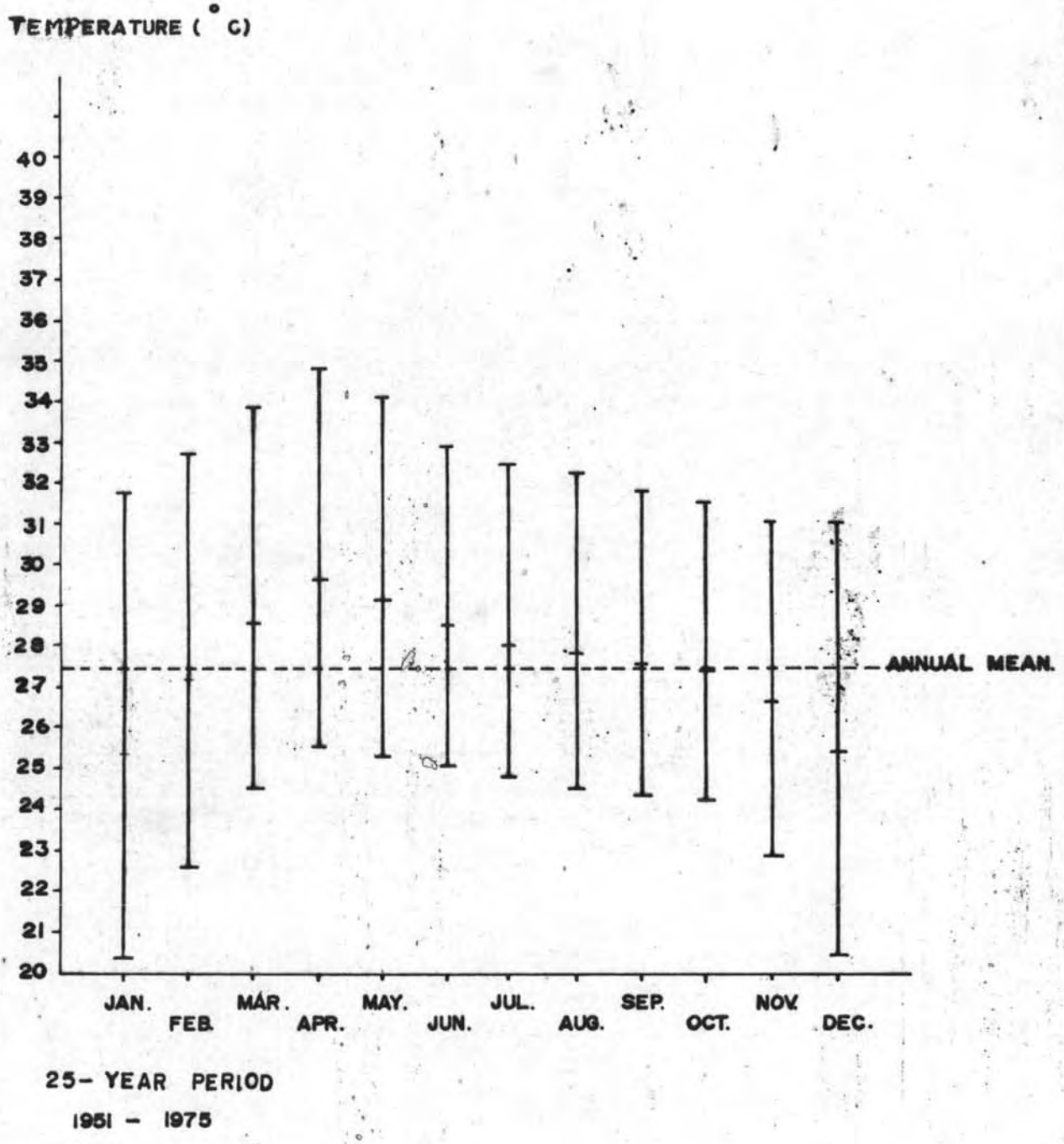


Figure 1.3.1 Illustrating the annual temperature pattern of the Tha Chin estuary with monthly temperature range, monthly mean and annual mean in 25 - year period.

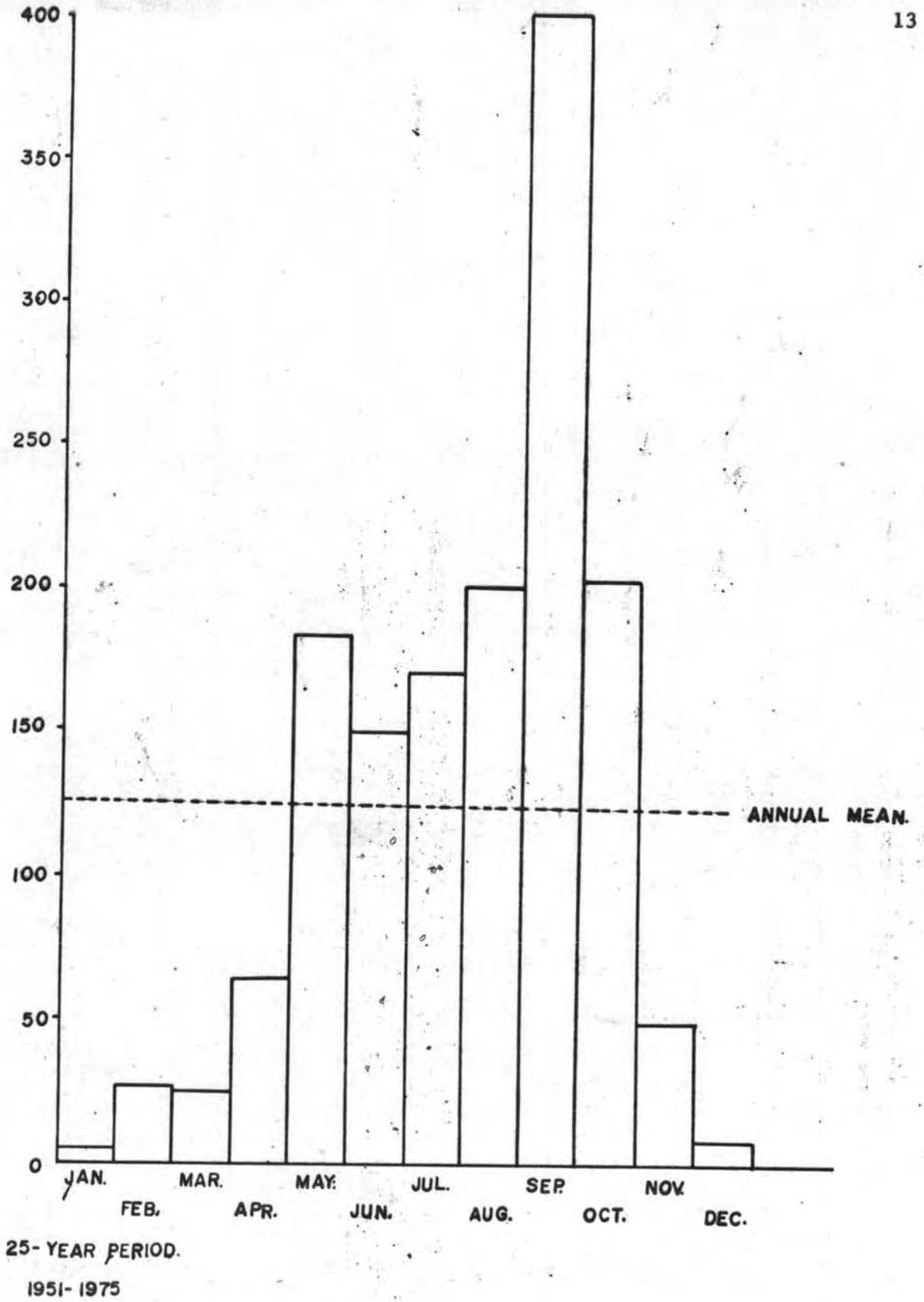


Figure 1.3.2 Illustrating the annual rainfall pattern of Tha Chin estuary with monthly mean and annual mean in 25 - year period.

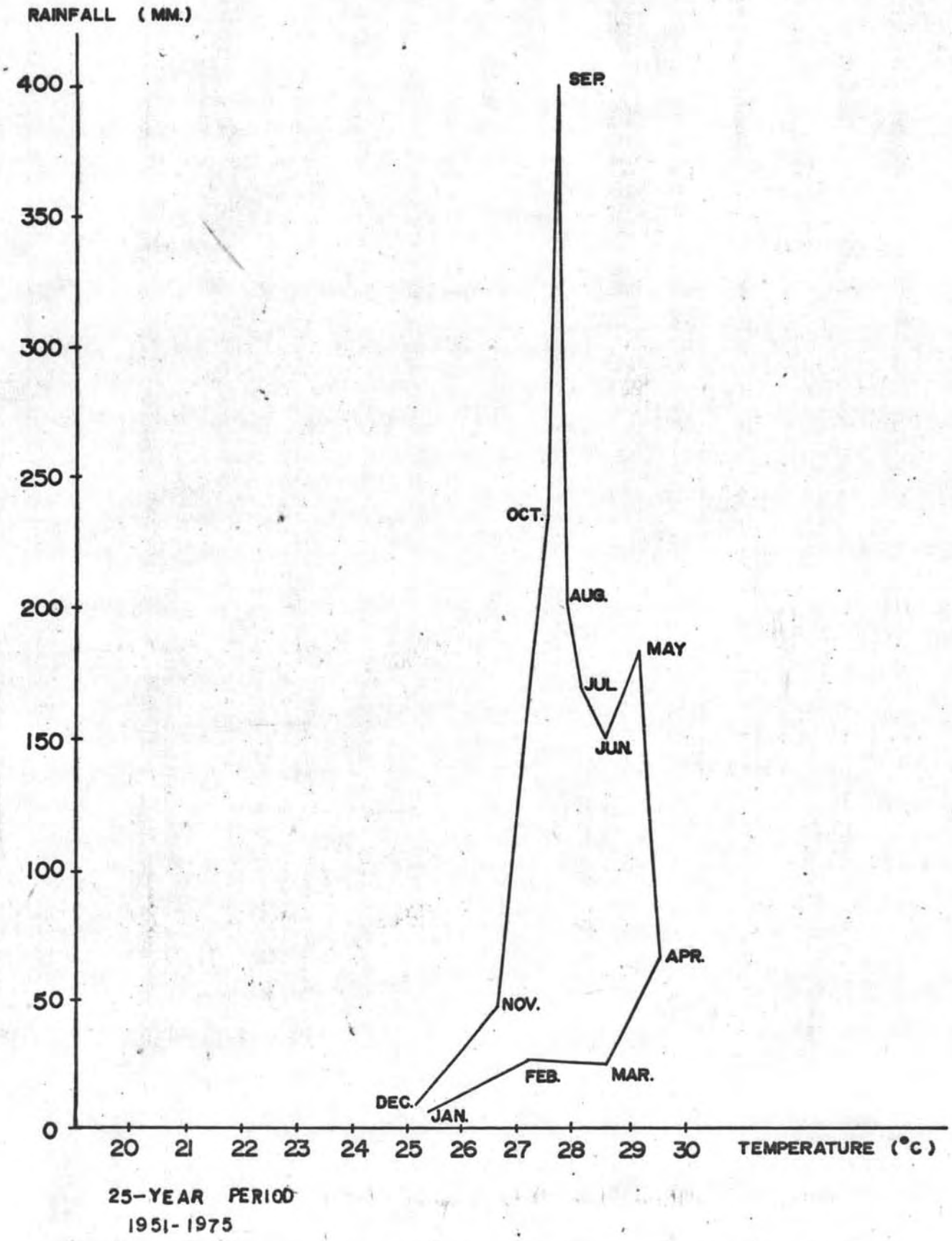


Figure 1.3.3 The hythergraph of the 25 - year period of Tha Chin estuary.

all appears higher than the annual mean. The other part of the year monthly mean of relative humidity values are lower than the annual mean value except in November. Monthly variation in the relative humidity during this period (1951-1975) varies between 27% to 42% (Figure 1.3.4).

From June to November, the evaporation (mean Pitche) is relatively low and the values lie within the range of 66-82 mm., where it reaches minimum in September. Evaporation increases from December and decreases again after May. The maximum evaporation appears in March when the hot season begins (Figure 1.3.5).



During November to February, the prevailing wind blows mainly from the north and northeast whereas in February it tends to shift to the southern quarter. In March, April and May, the prevailing wind still mainly blows from the south and southwest. From June to September, under the influence of the southwest monsoon, the prevailing winds are mainly from south, soutwest and west. After southwest monsoon season, the prevailing wind shifts to north, northeast and east again. Figure 1.3.6 shows the direction and speed of the prevailing wind all year round. Figure 1.3.7 shows the direction and maximum speed of the wind all year round. In addition, Figure 1.3.8 shows the windrose with the wind intensity frequency.

## 1.4 Previous Investigations

There is very little on detailed study of the coastal area of Thailand has been done especially in estuarine environment. Most of works done were concentrated on pollution studies. Among the few investigations

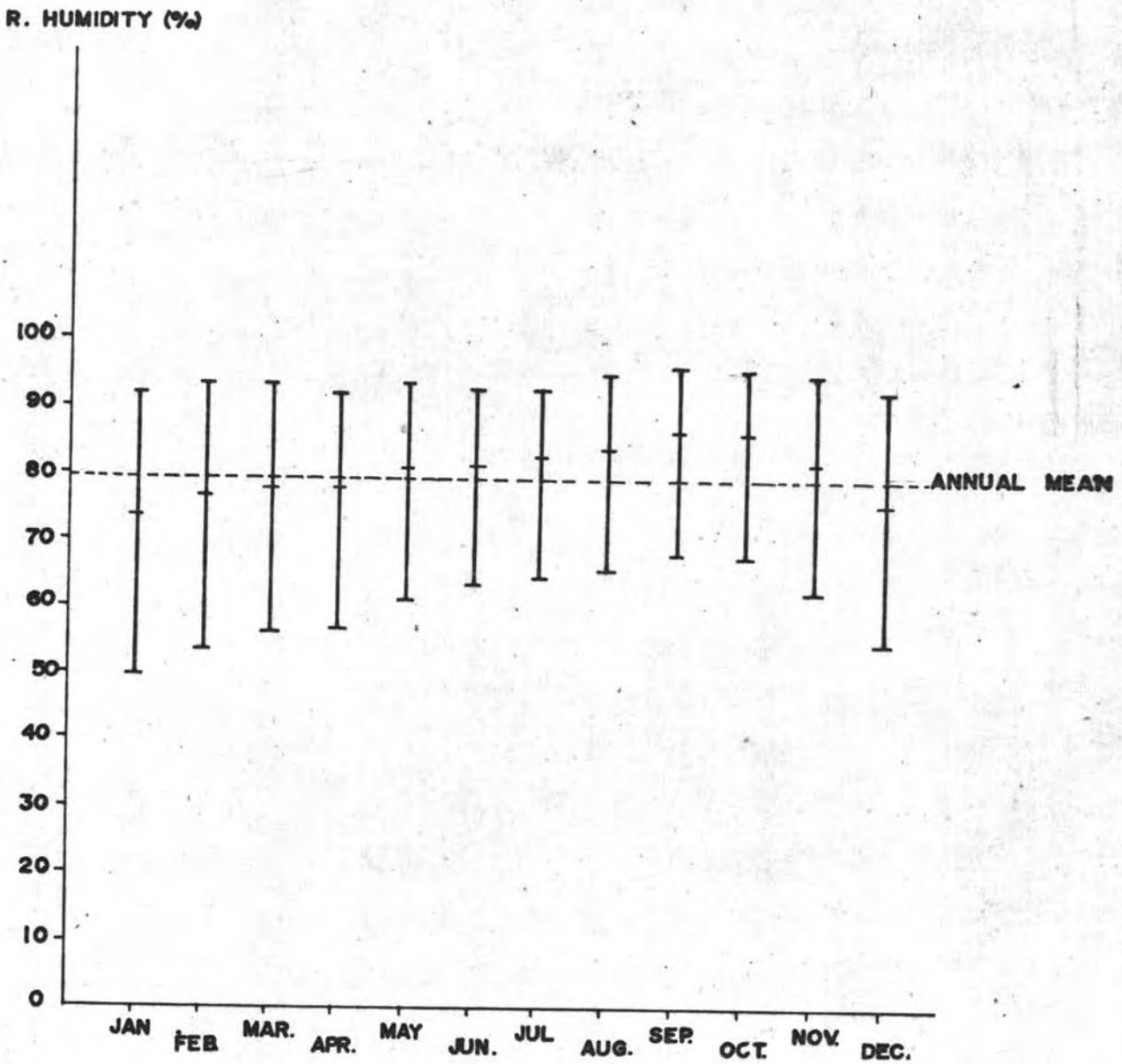


Figure 1.3.4 Illustrating the relative humidity pattern of Tha Chin estuary with monthly range of relative humidity, monthly mean and annual mean relative humidity.

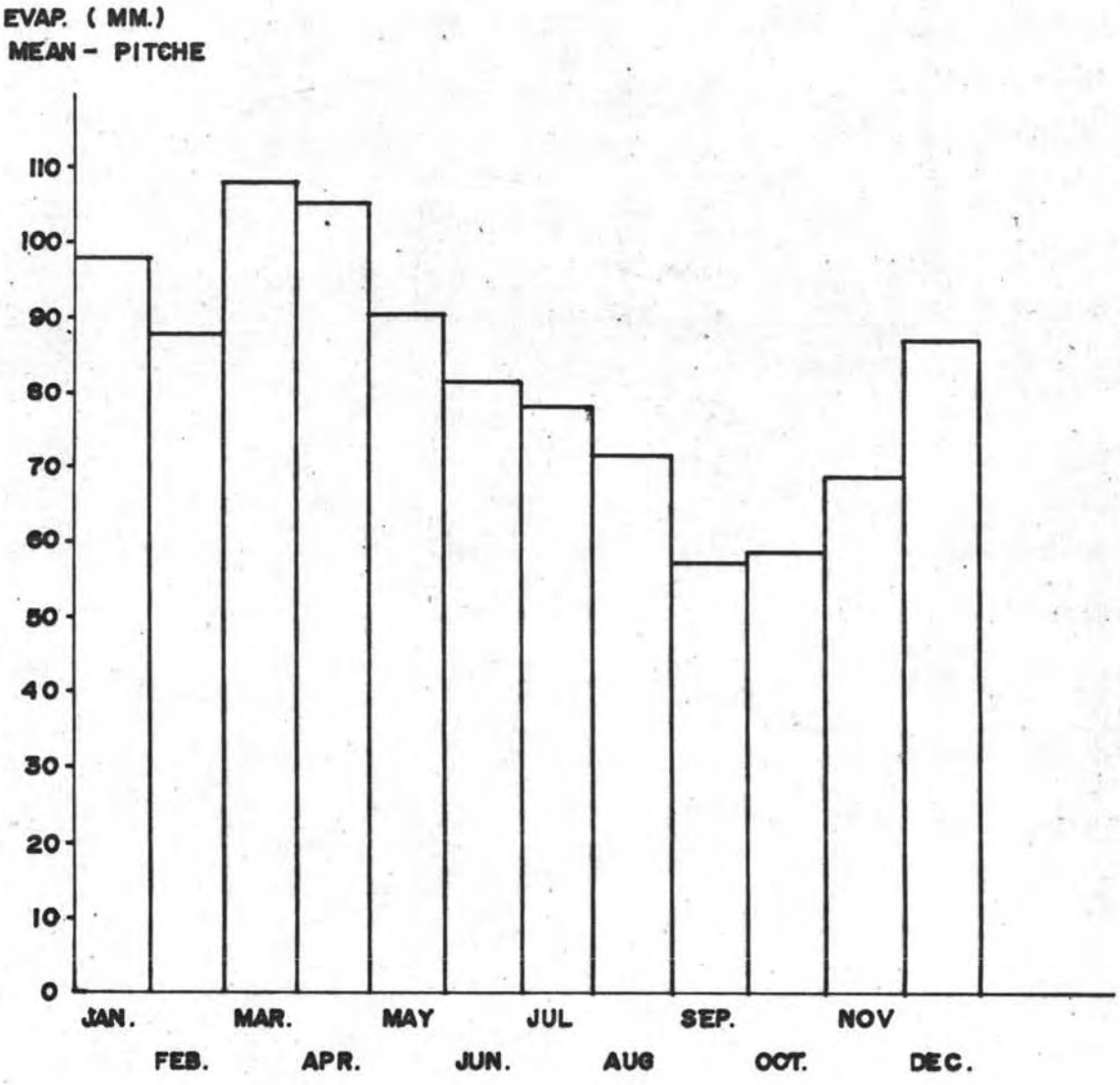


Figure 1.3.5 Illustrating the maximum evaporation pattern of Tha Chin estuary.

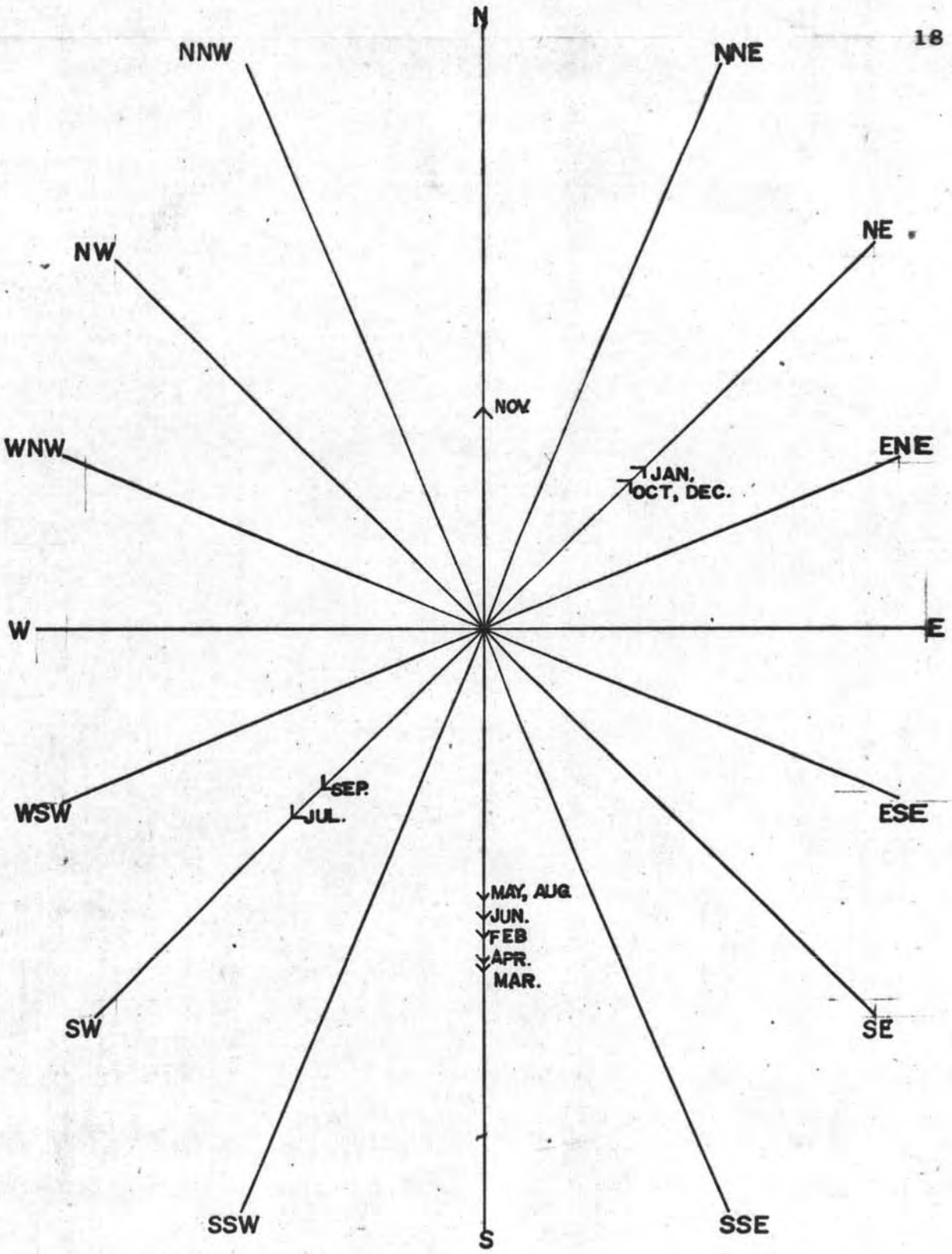


Figure 1.3.6 Windrose illustrating the direction and speed of the prevailing wind throughout the year.

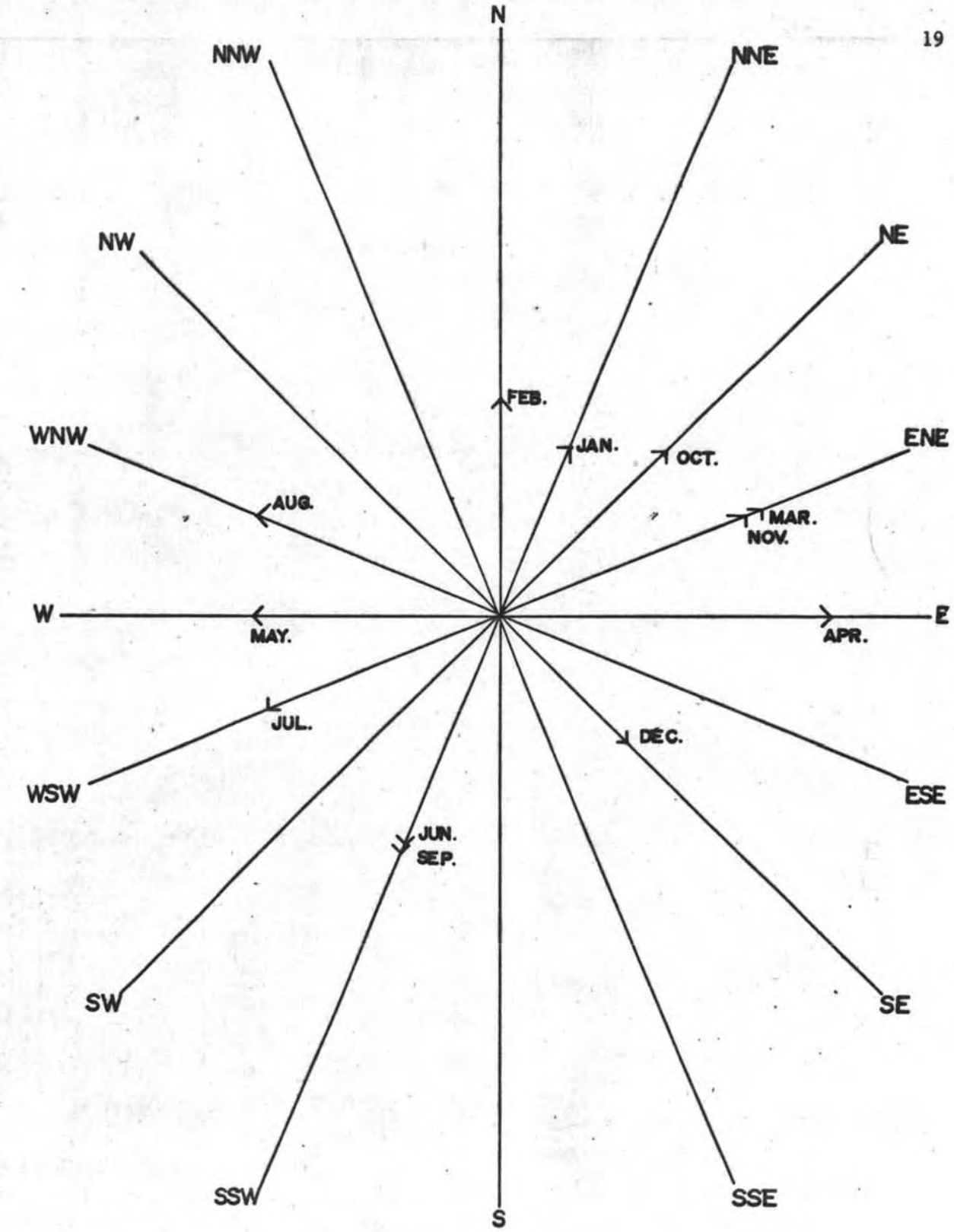


Figure 1.3.7 Windrose of the direction and maximum speed of the wind throughout the year.

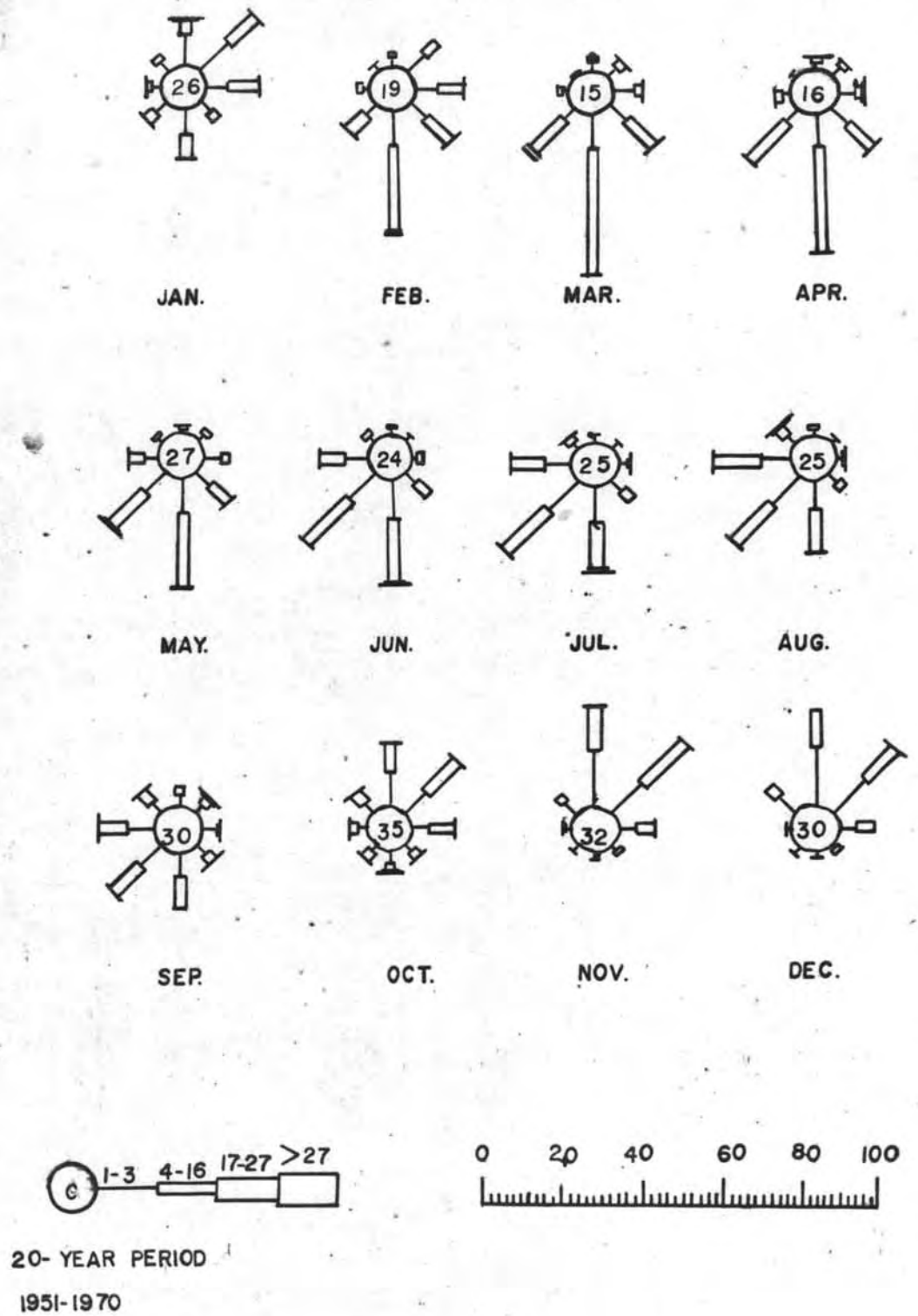


Figure 1.3.8 Windrose with the wind intensity frequency of Tha Chin estuary in 20 - year period (Data obtained from the Meteorological Department, the height of windvanes is 39.4 m above the M.S.L.).

previously undertaken at Tha Chin river were coastal area management in Samut Sakorn and Samut Songkram provinces and water characteristics in irrigation canals for agricultural use in Samut Sakorn province. Both were done by Coastal Land Development Division, Land Development Department in 1976. The feasibility study on tidal land reclaimation was carried out by FAO/Land Development Department during 1971-1972. Another survey has been done by Industrial Environment Division, Department of Industry under the project "Conservation of Tha Chin river" in 1978. In addition, some related investigations and pollution studies undertaken by Tarnbuppa & Lulitanont (1976), Sittichokphan (1977), Hungspreugs & Wattayakorn (1978), Lohwongwatana (1979) and AIT (1979) had in part concerned with Tha Chin river.