

8. **Region of moderate rainfall.** It includes mostly those areas between the Western Ghats which receive annual rainfall of 50-100 cm. Rainfall is comparatively low because it lies in the rain shadow area of the Western Ghats. The average temperature in winter is  $18^{\circ}\text{-}24^{\circ}\text{C}$  which rises to  $32^{\circ}\text{C}$  in summer. This region is represented by Hyderabad.

9. **The Konkan Coast.** Extending from Mumbai in the north to Goa in the south, the Konkan Coast receives over 200 cm annual rainfall brought by the Arabian Sea branch of the south-west monsoons. The temperature remains fairly high and vary from  $24^{\circ}\text{-}27^{\circ}\text{C}$ . Thus the annual range of temperature is very low; to the tune of  $3^{\circ}\text{C}$  only. Mumbai is the representative city of this region.

10. **The Malabar Coast.** It extends from Goa to Kanniyakumari and receives heavy annual rainfall of over 250 cm. The rainfall is mainly brought by the south-west monsoon winds coming from the Arabian Sea and continues for about nine months in a year. The temperature remains in the vicinity of  $27^{\circ}\text{C}$  and the annual range of temperature is only  $3^{\circ}\text{C}$ . This region is represented by Thiruvananthapuram.

11. **Tamil Nadu.** It includes Tamil Nadu and adjoining areas of Andhra Pradesh. The rainfall varies from 100 to 150 cm and is mainly caused by the retreating monsoons from north-east during November and December. The temperature remains somewhere around  $24^{\circ}\text{C}$ . There is not much change in summer and winter temperature and the annual range of temperature is only  $3^{\circ}\text{C}$ . Chennai is the representative city of this region.

## **Koppen's Climatic Regions**

Dr. Wladimir Koppen of the University of Graz (Austria) first published his scheme of classification of world climates in 1901 and subsequently modified it a number of times, the major revisions being in 1918 and 1931. His latest work was published in 1936 in which he presented a new scheme of climatic classification.

This classification is based upon annual and monthly means of temperature and precipitation. It accepts the native vegetation as the best expression of the totality of a climate, so that many of the climatic boundaries are based upon vegetation. Koppen has expressed the view that the effectiveness of precipitation in vegetation growth depends not only upon the amount of precipitation, but also upon the intensity of evaporation and transpiration. Much of the water obtained from precipitation is lost from the soil and plants by evaporation and transpiration and is not available for vegetation growth. Thus a certain amount of rain falling in hot and dry climate may not be as useful to vegetation as the same amount of rain falling in a cool and humid climate.

Koppen has suggested five major types of climate which correspond with five principal vegetation groups. Each climatic type is represented by a capital letter explained as under :

- ✓ A : Tropical rainy climate with no cool season. Temperature of the coolest month above  $18^{\circ}\text{C}$ . (Tropical)
- ✓ B : Dry climate in which there is an excess of evaporation over precipitation. (xeric/steppe)
- ✓ C : Middle-latitude rainy climate with mild winters. Average temperature of coldest month below  $18^{\circ}\text{C}$  but above  $-3^{\circ}\text{C}$ . Average temperature of warmest month over  $10^{\circ}\text{C}$ . (Mediterranean)
- ✓ D : Middle-latitude rainy climate with severe winters. Average temperature of coldest month below  $-3^{\circ}\text{C}$  and that of warmest month above  $10^{\circ}\text{C}$ . (Northern temperate)
- ✓ E : Polar climate with no warm season. Average temperature of the warmest month below  $10^{\circ}\text{C}$ . (Arctic)

The above mentioned major climatic types are further subdivided depending upon the seasonal distribution of rainfall or degree of dryness or cold. They are designated by small letters *a, c, f, h, m, g, s* and *w* each having a specific meaning as per details given below :

- a* : hot summer, average temperature of the warmest month over  $22^{\circ}\text{C}$
- c* : cool summer, average temperature of the warmest month under  $22^{\circ}\text{C}$
- f* : no dry season
- w* : dry season in winter
- s* : dry season in summer
- g* : Ganges type of annual march of temperature; hottest month comes before the solstice and the summer rainy season.
- h* (*heiss*) : average annual temperature under  $18^{\circ}\text{C}$
- m* (*monsoon*) : short dry season.

The capital letters *S* and *W* are employed to designate the two subdivisions of dry climate : semi arid or *Steppe* (*S*) and arid or *desert* (*W*). Capital letters *T* and *F* are similarly used to designate the two subdivisions of polar climate : *tundra* (*T*) and *icecap* (*F*).

Koppen divided India into nine climatic regions making use of the above scheme (Fig. 5.27).

- ✓ 1. **Amw (Monsoon type with short dry winter season)**. This climate is found in the western coastal region, south of Mumbai. This area receives over 300 cm of annual rainfall in summer from the south-west monsoons.
- ✓ 2. **As (Monsoon type with dry season in high sun period)**. This is the region in which rainfall occurs in winter and summer is dry. Coromandel coast experiences this type of climate. Coastal Tamil Nadu and adjoining areas of Andhra Pradesh are included in it. The amount of rainfall, mostly in winter is 75-100 cm and is received from the retreating monsoons.
- ✓ 3. **Aw (Tropical Savanah type)**. This climate is found in most parts of the peninsular plateau barring Coromandel and Malabar coastal strips. The northern boundary of this climatic region roughly coincides with the Tropic of Cancer. The average annual rainfall is about 75 cm which is received in summer season from the south west monsoons. Winter season remains dry.
- ✓ 4. **BShw (Semi-arid Steppe type)**. Some rainshadow areas of Western Ghats, large part of Rajasthan and contiguous areas of Haryana and Gujarat have this type of climate. Rainfall varies from 12 to 25 cm and most of it occurs in summer. Winter is completely dry. Some arid steppe vegetation is found here.

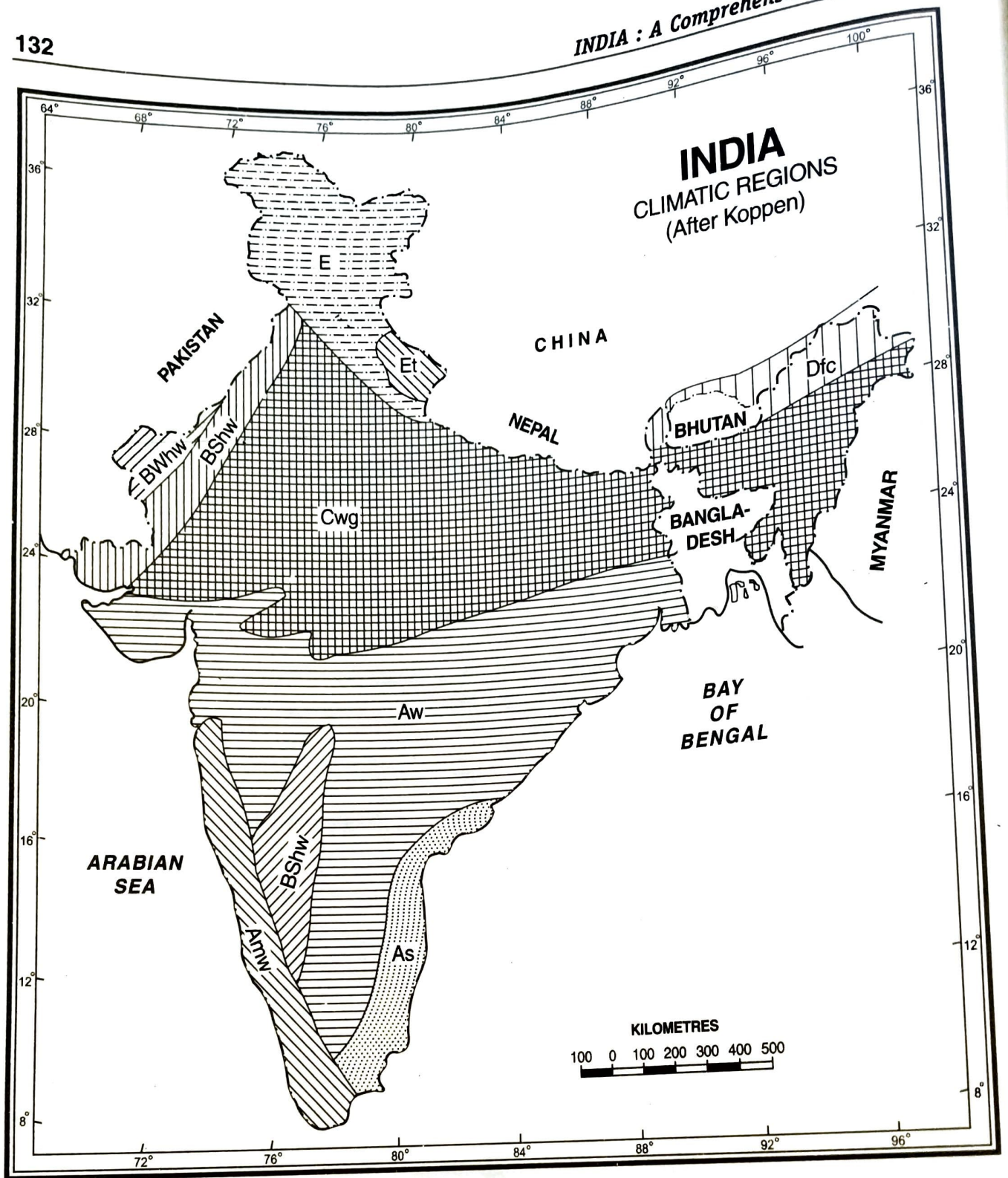


FIG. 5.27. Koppen's Climatic Regions

5. **BWhw (Hot desert type)**. Most of western Rajasthan has hot desert type of climate where the amount of annual rainfall is less than 12 cm. Temperatures are very high in summer. Natural vegetation is almost absent.
6. **Cwg (Monsoon type with dry winters)**. This type of climate is found in most parts of the Ganga Plain, eastern Rajasthan, Assam and in Malwa Plateau. The summer temperature rises to  $40^{\circ}\text{C}$  which falls to  $27^{\circ}\text{C}$  in winter. Most of rainfall occurs in summer and winter is dry.
7. **Dfc (Cold, humid winters type with shorter summer)**. Some of the north-eastern states such as Sikkim, Arunachal Pradesh and parts of Assam have this type of climate. Winters are cold, humid and of longer duration. The winter temperatures are about  $10^{\circ}\text{C}$ . Summers are short but humid.
8. **Et (Tundra Type)**. This climate is found in the mountain areas of Uttaranchal. The average temperature varies from  $0$  to  $10^{\circ}\text{C}$ . There is fall in temperature with altitude.

9. **E (Polar Type)**. The higher areas of Jammu & Kashmir and Himachal Pradesh experience polar climate in which the temperature of the warmest month varies from  $0^{\circ}$  to  $10^{\circ}\text{C}$ . These areas are covered with snow for most part of the year.

### **Thornthwaite's Climatic Regions**

Following Koppen, Thornthwaite presented his classification of climates in 1931 and revised it in 1933 and 1948. Though his first two classifications are more or less similar to Koppen's, his third one is quite different.