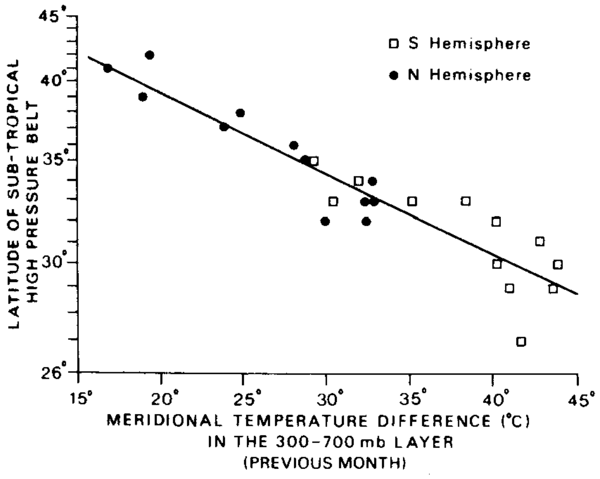

Figure 7.11 A plot of the meridional temperature difference at the 300 to 700-mb level in the previous month against the latitude of the centre of the subtropical high-pressure belt, assuming a constant vertical tropospheric lapse rate.

Source: After Flohn, in *Proceedings of the World Climate Conference*, WMO N0.537 (1979, p. 257, Fig. 2).

mean monthly pressure maps represent the passage of deep depressions across these areas downstream of the upper long-wave troughs. The mean high-pressure areas, however, represent more or less permanent highs. The intermediate zones located about 50 to 55°N and 40 to 60°S are affected by travelling depressions and ridges of high pressure; they appear on the mean maps as being of neither markedly high nor markedly low pressure. The movement of depressions is considered in Chapter 9F.

On comparing the surface and tropospheric pressure distributions for January (see Figures 7.3, 7.4 and 7.9, 7.10), it is apparent that only the subtropical high-pressure cells extend to high levels. The reasons for this are evident from Figures 7.1B and D. In summer, the equatorial low-pressure belt is also present aloft over South Asia. The subtropical cells are still discernible at 300 mb, showing them to be a fundamental feature of the global circulation and not merely a response to surface conditions.

B THE GLOBAL WIND BELTS

The importance of the subtropical high-pressure cells is evident from the above discussion. Dynamic, rather than immediately thermal, in origin, and situated between 20° and 30° latitude, they seem to provide the key to the world's major wind belts, shown by the maps in Figure 7.12. In the northern hemisphere, the pressure gradients surrounding these cells are strongest between October and April. In terms of actual pressure, however, oceanic cells experience their highest pressure in summer, the belt being counterbalanced at low levels by thermal low-pressure conditions over the continents. Their strength and persistence clearly mark them as the dominating factor controlling the position and activities both of the trades and the westerlies.

1 The trade winds

The trades (or tropical easterlies) are important because of their great extent, affecting almost half the globe (see Figure 7.13). They originate at low latitudes on the margins of the subtropical high-pressure cells, and their constancy of direction and speed (about 7 m s^{-1}) is remarkable. Trade winds, like the westerlies, are strongest during the winter half-year, which suggests they are both controlled by the same fundamental mechanism.

The two trade wind systems tend to converge in the *equatorial trough* (of low pressure). Over the oceans, particularly the central Pacific, the convergence of these airstreams is often pronounced and in this sector the term *intertropical convergence zone* (ITCZ) is applicable. Generally, however, the convergence is discontinuous in space and time (see Plate 24). Equatorward of the main belts of the trades over the eastern Pacific and eastern Atlantic are regions of light, variable winds, known traditionally as the *doldrums* and much feared in past centuries by the crews of sailing ships. Their seasonal extent varies considerably: from July to September they spread westward into the central Pacific while in the Atlantic they extend to the coast of Brazil. A third major doldrum zone is located in the Indian Ocean and western Pacific. In March to April it stretches 16,000 km from East Africa to 180° longitude and is again very extensive during October to December.

2 The equatorial westerlies

In the summer hemisphere, and over continental areas especially, there is a narrow zone of generally westerly winds intervening between the two trade wind belts (Figures 7.12 and 7.14). This westerly system is well marked over Africa and South Asia in the northern hemisphere summer, when thermal heating over the

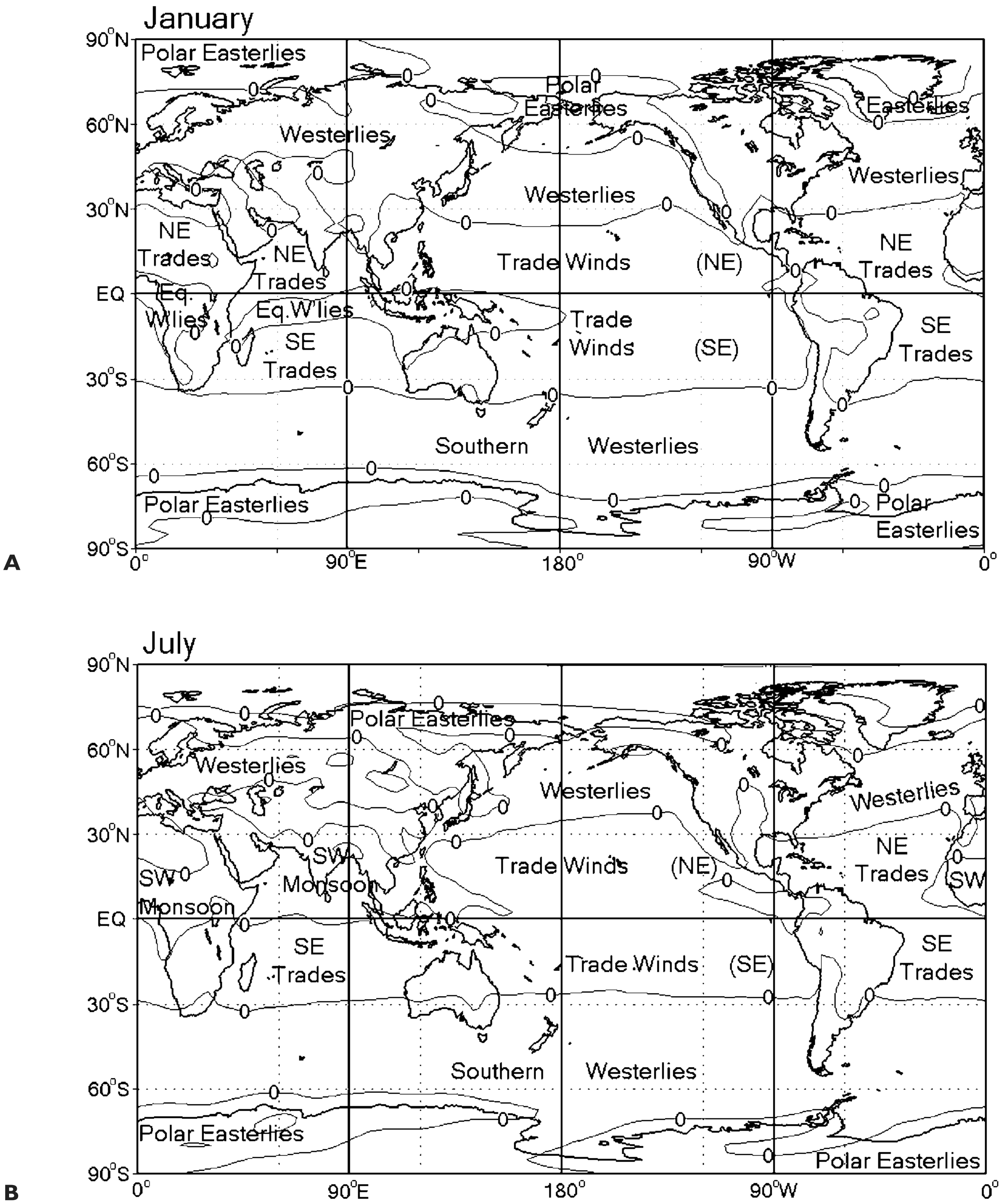

Figure 7.12 Generalized global wind zones at 1000 mb in January (A) and July (B). The boundary of westerly and easterly zonal winds is the zero line. Across much of the central Pacific the trade winds are nearly zonal. Based on data for 1970 to 1999.

Source: NCEP/NCAR Reanalysis Data from the NOAA-CIRES Climate Diagnostics Center.

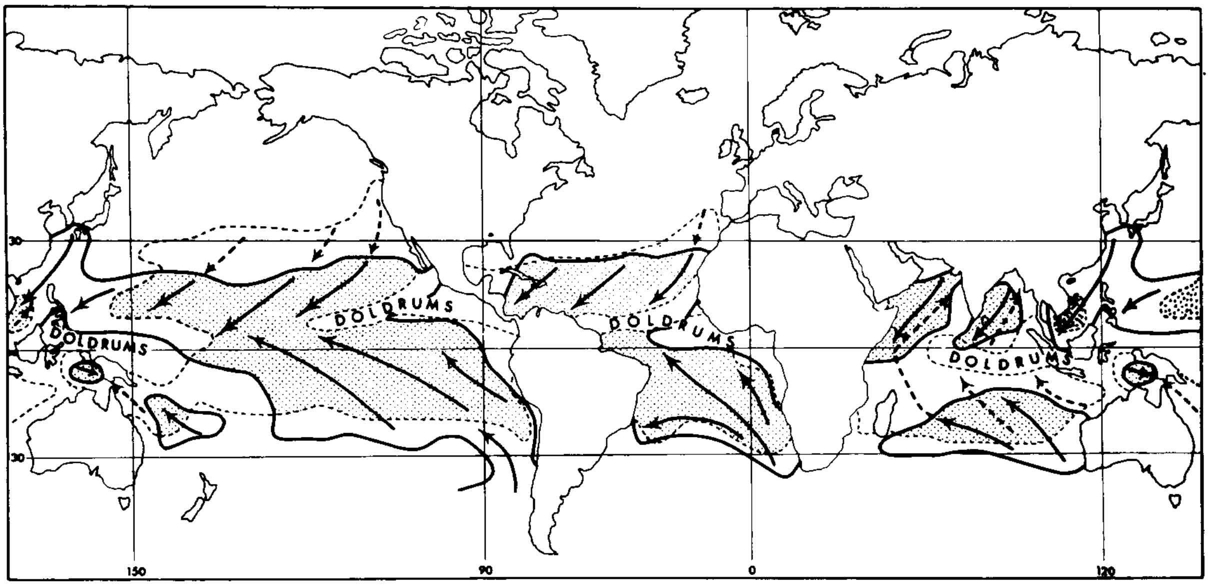

Figure 7.13 Map of the trade wind belts and the doldrums. The limits of the trades – enclosing the area within which 50 per cent of all winds are from the predominant quadrant – are shown by the solid (January) and the dashed (July) lines. The stippled area is affected by trade wind currents in both months. Schematic streamlines are indicated by the arrows – dashed (July) and solid (January, or both months).

Source: Based on Crowe (1949 and 1950).

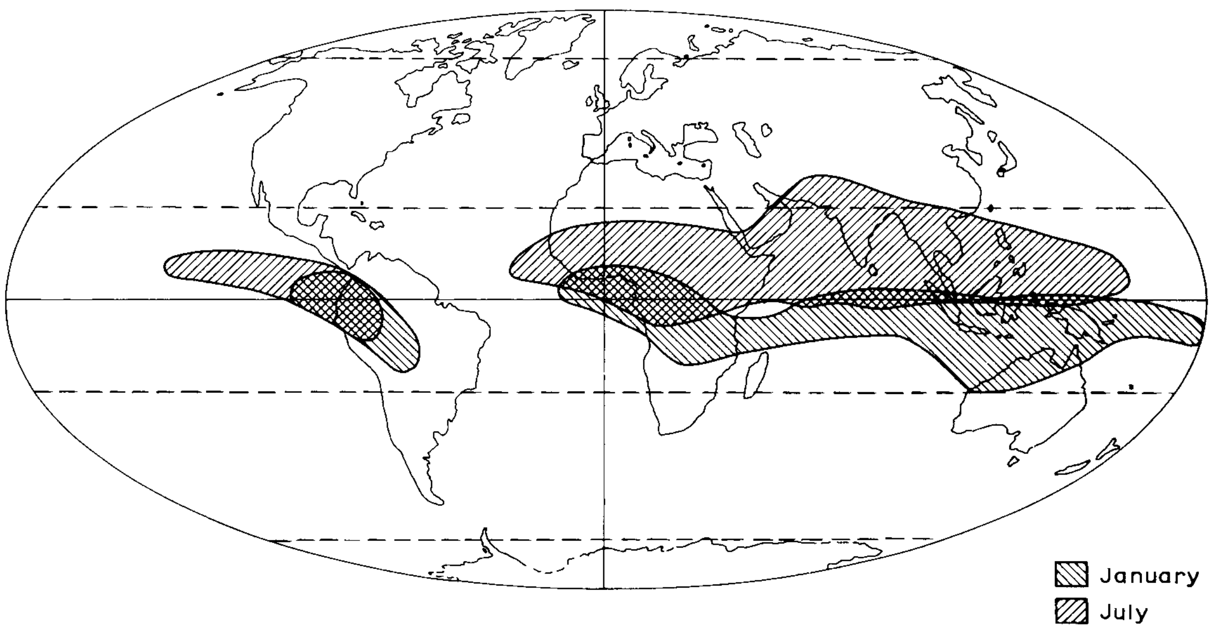

Figure 7.14 Distribution of the equatorial westerlies in any layer below 3 km (about 10,000 ft) for January and July.

Source: After Flohn in Indian Meteorological Department (1960).