Table 3·1 **The mean values of temperature, luminosity, mass and radius for particular types of star**

spectral class	temperature (K)	luminosity ($L_\odot$)	mass ($M_\odot$)	radius ($R_\odot$)
main sequence, luminosity class V				
O5	40 000	5×10^5	40	18
B0	28 000	2×10^4	18	7
A0	9 900	80	3	2·5
G2	5 770	1	1	1
M0	3 480	0·06	0·5	0·6
supergiant stars, luminosity class I				
B0	30 000	3×10^5	50	20
A0	12 000	2×10^4	16	39
G0	5 700	6×10^3	10	106
M0	3 000	3×10^4	16	500
condensed stars – white dwarfs, approximate values around A	10 000	0·01	0·7	0·01

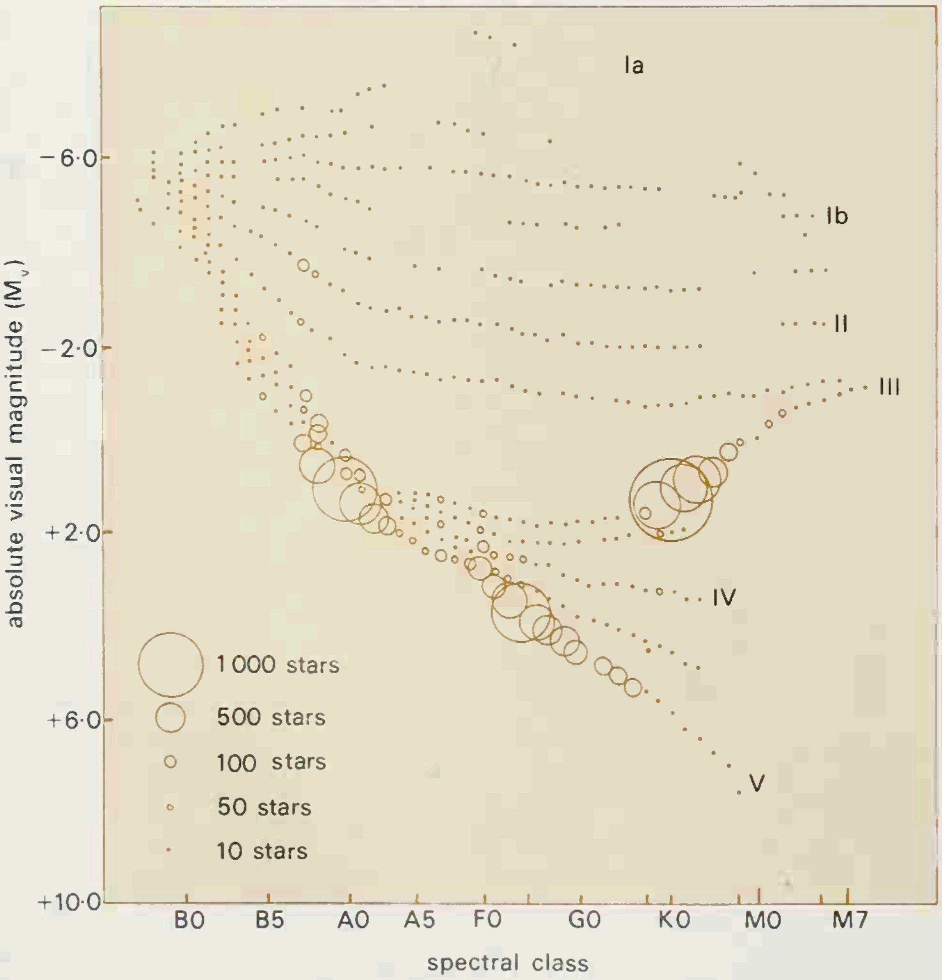
MK luminosity classification (Fig. 3·3). The current form of this scheme is that stars are grouped into seven classes, designated by a roman numeral after the spectral classification. These are as follows:

I (a) I (b)	supergiant
II	bright giant
III	normal giant
IV	sub-giant
V	main sequence dwarf
VI	sub-dwarf
VII	white dwarf

It should be noted, though, that not all stars may be classified into these distinct classes.

The nearby stars whose distances have been determined by direct means form a basis for the above scheme. It is interesting to compare the H-R diagrams for a selection of the nearest stars to that of the brightest stars we see. Tables 3·2 and 3·3 give data for some of the nearest and brightest stars and Figs. 3·5 and 3·6 show H-R diagrams for these categories. Figure 3·7 shows the nearest and brightest stars. It is immediately evident that virtually all the nearby stars are dwarfs and that the bright stars are quite distant, but because of their very high luminosities still appear bright in the sky. This could lead one to speculate that perhaps most of the stars in the Galaxy are dwarfs and this concept will be amplified in Chapter 6.

Fig. 3·8 H–R diagram revealing the number density of stars and their respective population zones. The size of each symbol is proportional to the number of stars included in each sample. Luminosity classes are also indicated on the diagram. It is very apparent how stars crowd along the main sequence and giant branch.



Stellar sizes and masses

We are now in a position to investigate the ranges of stellar sizes. This is usually expressed in terms of the solar radius ($R_\odot$) to give some feeling for their enormity. (Remember the radius of the Sun is 6·96 $\times$ 10^5km.) The range is truly phenomenal from white dwarfs of radii 0·01$R_\odot$ to red giants of radii up to 1 000 $R_\odot$ Antares (α Scorpii), an MI supergiant, has a radius 500 $R_\odot$ If we substituted Antares for the Sun in the Solar System, the atmosphere of the giant would extend to engulf all the inner planets, including Mars.

Although a star disc can not be resolved by any ground-based telescope, interferometric studies by the Michelson and speckle techniques (see Chapter 9) allow the sizes of one or two giant stars to be directly determined. The findings are in complete agreement with other methods. A more precise technique is to analyse the light curves of eclipsing binaries. If it is possible to calculate the lengths of their orbits, then the durations of the eclipses yield the diameters of the two stars. The only direct method of determining the masses of stars is through the study of the motions of individual stars in a binary or multiple system, where the stars are orbiting around each other. These, of course, must be observed under favourable conditions and, in general, the determination of stellar masses is a difficult process. For a binary star system, the two stars orbit around their common centre of mass. The orbital parameters are directly connected with the masses of the two stars by equations derived from the law of gravitation. If