Part IV
Simple Stellar Models

While accurate stellar models have to be computed with numerical programmes, for a deeper understanding of stellar properties, general rules and dependencies, and approximative relations, simple stellar models are very useful. They are often based on simplifications of the material functions discussed in Part III or by assuming similarity relations between stars. The polytropes of Chap. 19 were essential for the earliest models of stellar interior but have now gone out of fashion. Nevertheless, we present the definition and the basic properties for those interested in simple models. The homology relations of Chap. 20 are formulated very generally; one usually finds them in more simplified versions, where they are used to derive simple relations like the mass-luminosity-relation for main sequence stars. Simple relations also are useful in clarifying popular misconceptions about stars, such as the assumption that the solar luminosity depends on the nuclear reaction rates (see Sect. 20.2).

In the later sections of this part it will become evident how useful simplified models can be to capture basic principles of stellar structure and evolution. Of course, all these are obtained with high accuracy from numerical solutions, but understanding them is a different issue.