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R. Kerner: Models of Agglomeration and Glass Transition

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A significant blurring of boundaries between the dynamic behavior of deterministic systems and those of random systems is one of the major achievements of modern statistical physics. Indeed, the phenomenon of deterministic chaos demonstrates stochastic behavior in nonlinear deterministic systems, while stochastic resonance implies its converse; deterministic phenomena in random systems.

In a similar manner, the book here being reviewed softens the difference between crystalline and amorphous configurations through its discussion of "intermediate" self-similar structures. The latter of these are characterized by the property that at different scales similar structures are found which differ from respective atomic structures in crystals, as well as from entirely different structures in amorphous materials. In addition to known glass systems, a new experimental impetus for studying these materials was stimulated by the recent discovery of quasicrystalline lattices and fullerene C60 molecules. Due to the many possible local possible arrangements of these systems one has necessarily to use a statistical rather than a deterministic description to fully describe their properties.

As the author states in a lively Introduction reviewing the history and basic features of the large field of condensed matter physics being discussed the main goal of the book is to present a unified and coherent approach to explaining general features of agglomeration and growth of local atomic structures. The novelty of the proposed approach to modeling various atomic structures appears to be in using mathematical models applied in very different fields of physics, exemplified by the theory of dynamical systems and field theory. The approach is sufficiently general to give rise to mathematical models of agglomeration and growth of different structures, including those of quasicrystals, fullerenes and glasses, and for the latter, to discuss phenomenological models of glass transitions.

The general properties of atomic and molecular networks are considered in Chapters 2–5, including their topological and stochastic properties, stochastic agglomeration and

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types of bonds and interactions. Chapters 6–8 deal with the special examples of quasicrystals, fullerenes and viruses. Finally, a substantial part of the book (Chapters 9–14) is dedicated to such different phenomena in glasses as their types and properties, appropriate models, agglomeration and glass transitions.

The book is written in a free, easily readable style, where calculations alternate with historical remarks relating to the history of glasses, the discovery of helium, and other similar material of a less technical nature.

The potential audience for this book would seem to be rather large since one can agree with the author that for understanding the book one needs a knowledge of the regular graduate curriculum. In particular, this book can also serve as a part of the course in the nowadays fashionable subject of nanotechnology.