Protein polymerisation

Thermodynamics of the Polymerization of Protein. (Molecular Biology: An International Series of Monographs and Textbooks). By Fumio Oosawa and Sho Asakura. Pp. viii+204. (Academic: London and New York, March 1976.) £6.80; $16.75.

NATURE constructs the elementary blocks composing the constituents of living matter from small inanimate molecules which abound in our environment. The synthesis of the building blocks as well as of the highly specific functional macromolecules which they eventually form, is a complex process. It proceeds with the aid of elaborate machinery, specific templates and an ample supply of energy. Classical biochemistry and molecular biology study this elaborate process of creation and of disposal of biological macromolecules. It may have come as a surprise that spontaneous assembly of biological structures, unassisted by accessory means, could proceed as well. Indeed there exists an enormous variety of structures which form spontaneously from simpler protein constituents. For this process, which is often reversible and satisfies the laws of thermodynamics, Caspar and Klug have coined the term self-assembly.

The book by Oosawa and Asakura illustrates the impressive contribution of the Nagoya school to the problem of protein polymerisation. In addition to thermodynamics, kinetics, structural requirements, allosteric control, polymorphism and internal motility and flexibility of assembled structures are treated as well. Unfortunately, the bulk of the discussion is restricted to studies of actin and flagellin polymerisation from the authors' and other, not too distant, laboratories. About 76 entries in the authors' index are only perfunctorily listed in the list of references at the end of the volume. Although this represents a useful sectioned compilation, it does not provide the critical discussion (on varied approaches to an interesting problem) one expects from an authoritative monograph. For instance, on page 60 it is stated that in the trimer–disk transformation of TMV protein the enthalpy increases by about 77 kcalorie mol^{-1}, and another experiment gives 14–38 kcalorie mol^{-1} for the same process. The possible causes of this discrepancy, deriving from the analysis of the dependence of equilibrium constants on temperature on the one hand and calorimetric measurements on the other hand, are not discussed.

In chapter 10, the reader not familiar with the subject may be misled with respect to the chronological development of the use of quasi-elastic light scattering in the study of the dynamics of macromolecular structures. I have doubts whether the reader to whom this monograph is addressed will easily follow the calculations in chapters 6 and 10, and appreciate their significance in terms of the experiments performed. The symbols in Table 3 on page 87 are intelligible to crystallographers and the statement on page 97—"Thermodynamic analysis of the polymerisation equilibrium of sickle cell hemoglobin is not enough to be compared with the above result"—is cryptic.

There are some printing errors, but not excessively many. The illustrations are clear and attractive. The cost is reasonable and should not prevent interested libraries as well as individuals from acquiring this compact, if somewhat one-sided, introduction to a topical field.

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Below 1 K

Refrigeration and Thermometry below One Kelvin. By D. S. Betts. Pp. x+283. (Sussex University: Sussex, 1976.) £8.00.

ONE of the most surprising things about research at very low temperatures, to the uninitiated, is its continuing interest and richness. With each further improvement in technology, enabling physicists to push even closer to their unattainable goal of the absolute zero of temperature, there have emerged new and fascinating phenomena to be observed, quantified, and pondered about. The most significant area of technical development over the past decade has undoubtedly been that of ^{3}He–^{4}He dilution refrigeration, which has now reached the point where commercially available machines are capable of maintaining a sample indefinitely at temperatures near 10 mK, thus providing a convenient starting temperature from which the 1 mK region becomes immediately accessible through the addition of, for example, an adiabatic demagnetisation stage. Near 1 mK, of course, are the extraordinarily complex 'new phases' of liquid ^{3}He which, with their superfluidity, magnetism and anisotropy, will continue as a challenge to the physicist for many years to come. At still lower temperatures, in the as yet virtually unexplored region around 0.1 mK, there is the beckoning prospect of nuclear ferromagnetism.

Dr Betts' book, explaining how to do the experiments, is intended as an introduction for MSc and PhD students, and other beginners whose research involves making measurements below 1 K. The first half of the book describes how to achieve these low temperatures, and consists of six chapters covering ^{3}He and ^{4}He evaporators, ^{3}He–^{4}He dilution refrigerators, Pomeranchuk cooling, and the adiabatic demagnetisation of paramagnetic salts and nuclei. Less popular techniques such as vortex refrigeration have (not unreasonably) been omitted. Having produced a low temperature the next problem is, of course, that of measuring it. Accordingly, the second half of the book is devoted to a detailed survey of the numerous methods which are available, involving measurements of vapour pressure, paramagnetic susceptibility, nuclear magnetic resonance, electrical resistance, capacitance, thermoelectric e.m.f., electrical noise, the Mössbauer effect, and anistropic radioactive decay.

The various techniques are outlined with impressive clarity, including a useful amount of mathematical detail, and there are copious references both to review articles and also to the original literature. To keep one's feet firmly on the ground, the book is permeated with valuable numerical information both in graphical and in tabular form, the extensive compilation of data on commonly used paramagnetic salts being a particularly striking example. The index is skimpy, but the careful and logical arrangment of material means that elusive topics can usually be traced fairly rapidly by consulting the table of contents. There is inevitably a substantial overlap in coverage with O. V. Lounasmaa's *Experimental Principles and Methods Below 1 K* (Academic, London 1974.) Quite apart from its somewhat different style and emphasis, however, Dr Betts' book has the advantage of being two years more up to date, a factor not to be ignored in this rapidly developing field.

The book succeeds admirably in its stated purposes. It will also be a valuable source of reference for everyone working below 1 K, and most especially for those aspiring to join, in Dr Betts' phrase, "the new army of nuclear coolers... marching into the submillikelvin region."

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