Book Reviews

Conformations of Macromolecules. By T. M. BIRSHTEIN and O. B. PTITSYN, Institute of High Molecular Compounds, Leningrad, U.S.S.R. Translated from the Russian Edition by SERGE N. TIMASHEFF and MARINA J. TIMASHEFF. Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1966. xiv + 350 pp. 15.5 × 23.5 cm. $14.50.

The properties of both synthetic and biological polymeric materials depend to a very considerable extent on the arrangement of the linear chain molecules of which they are composed. Each of these chains may be arranged in a great number of possible rotameric (rotational isomeric) states. Fortunately, general methods of analysis of polymer molecules by a rotameric model can be worked out in detail. These depend on two important unifying ideas: (1) the short-range interactions of a polymer may be described by a Markoff process; (2) transitions in polymer molecules, particularly biological polymer molecules, are special examples of a one-dimensional Ising lattice model.

The authors of this small treatise and other colleagues at the Institute for High Molecular Weight Compounds in Leningrad have themselves developed many of the ideas and methods presented here. Their book is primarily an exposition of the theory, in addition, drawing very heavily upon experimental results which bear on the subject. The titles of the chapters describe the subjects covered. These are:

1. Flexibility of Macromolecules and Their Physical Properties
2. Internal Rotation and Rotational Isomerism
3. Conformations of Macromolecules and Mechanism of Their Flexibility
4. Statistics of One-Dimensional Cooperative Systems
5. Theory of the Dimensions and Dipole Moments of Macromolecules: General Methods
6. Theory of the Dimensions and Dipole Moments of Macromolecules: Equations for Real Chains
7. Comparison of the Theory with Experiment and Conformations of Typical Macromolecules in Solution
8. Conformations of Macromolecules and Mechanical Properties of Polymers
9. Theory of Conformational Transitions in Polypeptide Chains
10. Effect of External Factors on Conformational Transitions in Polypeptide Chains
11. Theory of Conformational Transitions in Polynucleotide Chains

This book is exceptionally well done, the exposition is clear, the nature of the assumptions is directly stated, and the mathematical arguments are given in detail. The list of references seems to be complete including papers published as late as 1964.

For scientists who plan research in the statistics of polymer chains, this book is a godsend and a welcome substitute for an extensive study of the literature. For experimental workers who will be using the results of the rotameric theory of polymer chains or the results of the theory of polypeptide and polynucleotide transitions, the most direct and clear source of the analysis of the problem will also be found in this book. Graduate students will find it, alas, very expensive, though of primary importance if they plan investigations in this subject.

This excellent work extends and amplifies the earlier treatise "Configurational Statistics of Polymer Chains" by M. V. Volkenstein, a colleague of the present authors at the Institute in Leningrad.

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Polymerization by Organometallic Compounds. By LEO REICH, Picatinny Arsenal, Dover, N. J., and A. SCHINDLER, Camille Dreyfus Laboratory, Research Triangle Institute, Durham, N. C. Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1966. x + 740 pp. 16 x 23.5 cm. $25.00.

In all fairness a book should be judged by how close it comes to fulfilling the stated purposes of the author, even though it be bought for its ultimate utility.

According to the preface "A major objective of this book is to present, ... in an organized and categorized sequence, pertinent information derived from the literature ... on organometallic polymerizations. This book should be useful mainly to research workers and graduate students who have already been introduced to polymer chemistry and who desire to broaden their knowledge in the field of organometallic catalyzed polymerizations. This book is by no means directed toward a specialist in this field nor is it intended as a reference work." The authors have tried hard to meet these goals, but the book has several major faults in the eyes of this reviewer. The book reads as if the authors summarized a paper in a given field, picked up the next one and summarized it, and so on to the bottom of the pile. No attempt was made to collate the information, to analyze it, or to introduce any critical judgement about divergent "facts" or opinions. Having worked with organometallic catalysts, this reviewer is well aware of the difficulty of separating "facts from artifacts" in this field. If the book had been written for experts, a case could be made for including all references (the book does not) without comment, but when it is ostensibly written for the nonexpert, this approach is indefensible.

The second objection is a more practical one, and is related to the arrangement in the book. Broadly speaking, the authors chose to organize the book according to the organometallic part of the title and not the polymerization part. So one cannot open the book to read about the polymerization of butadiene, or isoprene, or methyl methacrylate, without frequent referral to the index. As a result, the nonexpert is bound to come away with the feeling that there is no mechanistic difference between the polymerization of an olefin and a diene with a Ziegler catalyst. He will read 150 pages on the importance of the nature of the surface of a Ziegler–Natta catalyst before he is told on p 266 that there are soluble catalysts for the polymerization of ethylene; this is not as bad as it sounds because the authors describe the Cp_2TiCl_2 catalysts as being very unreactive (they are actually among the most active catalysts known). He will read an excellent discussion on the base-catalyzed polymerization of styrene and α-methylstyrene, but will only discover that methyl methacrylate can be polymerized similarly when the authors wish to discuss termination, which they cannot do very well with the "living polymers."

The book is not limited to a discussion of Ziegler–Natta catalysis. The authors use the usual definition of organometallic (containing a carbon–metal bond); for purposes of inclusion, however, they ignore any mechanistic implications and require simply that such a bond be present initially in the catalyst. The extent of coverage is best gleaned from the table of contents: I. Historical Development (6 pp); II. General Theoretical Concepts of Polymerization (108 pp); III. Some General Considerations on Catalyst Activity (128 pp); IV. Mechanism and Kinetics of Polymerizations with Ziegler–Natta Type Catalyst Systems (159 pp); V. Alfin Catalysts (29 pp); VI. Metaloorganic Catalyst Systems Involving Free Radical Mechanisms (61 pp); VII. Anionic Polymerization (177 pp); VIII. Some Aspects of Cationic Polymerization (11 pp); IX. Copolymerization (27 pp). The second chapter is a hodgepodge of information, which serves mostly to outline the authors' interests; the reader would do better to read Billmeyer and Flory. The last chapter, in view of the recent apperance of an excellent monograph on the subject, could also have been omitted.

In summary, nonexperts will obtain an introduction of sorts to this fascinating area of polymer science by reading this book, and people who are knowledgeable in the field are bound to find interesting tidbits which they have missed in their own reading. But the scientific world has long awaited a definitive book on polymerization by organometallic catalysts, and I regret to say that the wait is not over.

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