$3N$-dimensional normal coordinates (where N is the number of atoms involved in the stoichiometric reaction): normal coordinates based on reactants, those based on the saddlepoint, and those based on products. The first choice of coordinates for setting up the rate expression corresponds to collision theory and the second choice to transition state theory. "So far, no one seems to have proposed a special name for using the normal coordinates of the products to describe the rate; but if one hurries, perhaps this theory can be named after one's paternal grandfather."

There are many interesting insights scattered throughout the book, careful attention has been given to continuity of thought, and chapter 16, on the theory of complex reactions, underlines very effectively certain hazards inherent in the "rate-determining step" concept. Anyone who has ever worried about whether the ordinate is potential energy, enthalpy, or really free energy on a two-dimensional plot of a multistep chemical reaction where the abscissa is the "reaction coordinate" will be fascinated by this chapter.

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Molecular Structure

The Structure of Inorganic Radicals. An Application of Electron Spin Resonance to the Study of Molecular Structure. P. W. ATKINS and M. C. R. SYMONS. Elsevier, New York, 1967. 290 pp., illus. $21.75.

The first three chapters of this book present a historical review of electron spin resonance and other techniques used in the study of radicals, as well as methods of trapping, an introduction to the principles of ESR, and an introduction to the "formation and trapping of radicals."

It is difficult to tell to what audience chapters 2 and 3 are directed. They are far too brief and lacking in detail to be easily understood by the beginner in ESR and inorganic radical studies. The figures, although beautifully done, lack the necessary description in both the captions and text to make them meaningful to anyone but the most experienced workers in this field. If the chapters are written for the expert, they are far too elementary and would better have included the technical material that has been relegated to appendices.

It is not until chapter 4 that the authors get to the heart of their subject. Chapter 4 deals with the results of ERS studies on trapped and solvated electrons, F-centers, alkali metals, and metal amines. Chapter 5 deals with atomic species, H atoms in particular, and matrix effects. Studies of alkali metals, silver atoms, group V elements, oxygen atoms, and the halogens are also included. Chapter 6 discusses diatomic radicals, especially π radicals such as hydroxyl, $NH^{\pm}$, NO, N_2-, O_2-, ClO, CN, F_2-, Cl_2-, and FCl^-. Chapter 7 deals with triatomic radicals, chapter 8 with tetra-atomic radicals, chapter 9 with penta-atomic radicals. The final chapter presents a summary and conclusion and discusses the assumptions made in order to understand the ESR data of the previous chapters and what some of the problems are in the interpretation and understanding of ESR spectra.

It is chapters 4 through 9 that make this book a really worthwhile addition to the library of any physical chemist interested in inorganic systems. The approach in each chapter is first to discuss the structural aspects of the radicals and then to give a more detailed interpretation of the ESR data in terms of these structural considerations. This is very well done. Each chapter contains a good and comprehensive bibliography.

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Cell Biology by Computer

Analysis of Normal and Abnormal Cell Growth. Model-System Formulations and Analog Computer Studies. FERDINAND HEINMETS. Plenum Press, New York, 1966. 302 pp., illus. $12.50.

The development of molecular biology has made it possible to use computer techniques to analyze mathematically the metabolism of cellular systems and its regulatory mechanisms. Heinmets's fundamental procedure begins with the postulation of four groups of genes, G_P, G_E, G_B, and G_C, which are indispensable in considering a functioning system. G_P and G_E code for the synthesis of messenger RNA and G_B and G_C for the synthesis of ribosomal and transfer RNA, respectively. The processes, including enzyme synthesis, are formulated mathematically in 19 simultaneous differential equations of kinetics. There are 31 rate constants to be determined, and this is a very laborious task. If the values are not properly selected, then the system may become disorganized. A sustained functioning system is sought such that its size after cell growth is twice its initial size. The behavior of this model is studied with the use of a high-speed analog computer by changing the external pool or the rate constants or adding inhibitor and other agents to the system. Mathematical processes corresponding to injury or death are also studied. By an understanding of normal cellular processes one can gain insight into phenomena such as malignancy, cell alteration during aging, drug action, and radiation effects. Such insight may provide a basis for therapy for various cellular abnormalities.

The results of the computer experiment are given in part 1 of this book. In part 2 more elaborate models are proposed. To analyze various phenomena Heinmets has established two models. The first is used for the computer experiment on cell growth, but does not take into account cell division. The second is a descriptive one. In part 2 the problems that can be dealt with according to this second model are discussed. In part 3 information that may have a bearing on problems of cancer is reviewed.

If we take the metabolic map in detail, then a mathematical system complicated enough to represent a living organism cannot be dealt with by even the largest computer in the world. However, we can reduce the number of variables by means of grouping. The way in which such a reduction is made depends on the problem in which one is interested. This accounts for the differences between Heinmets's model system and those of Chance and Garfinkel, for instance. Another important computer study is that of Stahl, whose automaton theory may be close to Heinmets's second model. It is desirable that many more biologists use the computer to study the problems that interest them, for we might from a multiplicity of individual results be able to put together a montage picture that would enhance our understanding of living things. For this reason Heinmets's book is of great importance.

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