manium, and tin chemistry are included in discussions, the book will interest a larger number of persons than it would if it were restricted to inorganic silicon compounds. It was therefore necessary to make somewhat arbitrary decisions about the parts of organometallic chemistry that should, or should not be included, and the reader may disagree at times with the relative importance of certain of the material selected.

There are more typographical errors than one would expect to find, but otherwise this book presents a careful, well-written picture of silicon chemistry. It should be of particular value to the advanced student and to those concerned with any phase of research that involves silicon.

ALAN G. MACDIARMID
John Harrison Laboratory of Chemistry, University of Pennsylvania, Philadelphia

Mathematical Analysis

Linear Partial Differential Operators. Lars Hörmander. Springer, Berlin; Academic Press, New York, 1963. viii + 287 pp. Illus. $10.50.

In the late 1940's Laurant Schwartz devised the theory of distributions, a formulation of some of the important classical concepts of mathematical analysis in the modern language of topological vector spaces. At the time many analysts were skeptical of the interest this work attracted, a typical comment being that Schwartz was acting like a linguist and not like a mathematician. Yet, during the 15-year interval, the theory has had a profound effect on partial differential equations and on some branches of physics and has, to a great extent, revolutionized some important trends in these fields. *Linear Partial Differential Operators*, by Hörmander, represents the progress that has been made in partial differential equations as a result of this new viewpoint. The author himself is a major contributor to that progress.

The concepts of irrational and complex numbers were introduced into mathematics primarily to better our understanding of rational numbers. Similarly, distributions are generalized functions whose *raison d'être* is that they help us to study ordinary functions. Of course, generalized functions are not new to mathematics. Their beginnings can be traced to Riemann, and they are found in all modern treatments of integration theory; the L_p spaces are spaces of generalized functions. But Schwartz has given a greater generalization, one that allows iterated differentiation and thus provides the freedom that is needed. In studying the function solutions of partial differential equations, it is often important to introduce distribution solutions, the most important being the fundamental solution. Hörmander begins by studying the fundamental solution of partial differential equations and ends with a study of fundamental solutions to elliptic boundary value problems. One of his principal tools is the associating of mappings to the problems in question. Thus, for example, for a boundary value problem we have the map $f \rightarrow (Df$, boundary date of $f)$ where D is the operator. Then we can study the adjoint of this map which involves distributions.

The most important topics treated in the book can be divided into three parts: (i) Inhomogeneous problems (under what conditions can the inhomogeneous equation $Df = g$ be solved for f?) (ii) hypoelliptic operators (those D for which the solutions of $Df = 0$ must be smooth); and (iii) existence and uniqueness questions for Cauchy's problem, and for elliptic boundary value problems.

Linear Partial Differential Operators contains very deep results. It is lucid and extremely readable, and it should become one of the classics in the field.

L. EHRENPREIS
Department of Mathematics, Courant Institute, New York

Bacteriology

The Life of Bacteria. Their growth, metabolism, and relationships. Kenneth V. Thimann. Macmillan, New York, ed. 2, 1963. xviii + 909 pp. Illus. $17.50.

My old friend, *The Life of Bacteria* [which I reviewed in *Science* **126**, 455 (1957)], has put on some weight in the past 8 years! Does this increment represent an uncontrolled obesity, a malignant neoplasm, a teratological or psychological macrocephaly, or the well-distributed growth that is a concomitant of a healthy development? After considerable scrutiny and reflection, I favor the latter diagnosis.

During the past decade, bacteriology has suffered an information explosion of unprecedented magnitude. New continents, indeed new planets and galaxies, have been discovered, explored, populated, and interconnected by an imaginative communication system. Kenneth Thimann has done a magnificent job of depicting this dynamic development. It is a testimonial to his unsurpassed literary and critical skill that he has been able to do so within the framework of a single volume—beautifully ordered, clearly written, excellently illustrated, admirably indexed, and heavily documented by well-chosen references to the original literature.

Conceptually, this second edition of Thimann's book is an eminently successful "attempt not only to see bacteriology as a whole—that is, as a branch of biology—but also to see it in its perspective as a development from the past and as an active area of modern investigation." The organization once again is tetrapartite: Morphology and General Physiology, Nitrogen Cycle, Carbohydrate Metabolism, and Growth and Synthesis. Within this framework are grouped 26 chapters, essentially all of them reworked, rewritten, or new since the original edition was published in 1955.

Thimann notes that "the greatest change is the swing in interest toward the synthetic processes in bacteria . . . which have taken over much of the center of the stage, where formerly the destructive actions exerted by bacteria on their surroundings were dominant." The marvel of his presentation permits this change of emphasis to be depicted clearly, without losing sight of the contemporarily unfashionable aspects of bacteriology. Somehow, he has managed to weave in sketches of diverse kinds of bacteria, including those unusual ones that may well provide the new directions of the future, because of structural or functional traits vastly different from the overstudied *Escherichia coli* sort.

Thimann need not have invoked Shakespeare's "Let me have men about me that are fat," to excuse the "corpulence" of his tome—*The Life of Bacteria* is not fat; it is rather a solidly muscled creature with a lean and hungry look.

MORTIMER P. STARR
University of California, Davis