less satisfactory. Thomson was far less sure of the validity of Carnot's theory between 1847 and 1850 than he appeared to be in print, and his objections to the mechanical theory of heat were philosophical and deep. Until they were resolved he would not publish on the mechanical theory, and he was beaten to this prize by William Rankine and Rudolf Clausius. Clausius's work is also not given its due by Steffens.

Despite these reservations this is a nice study in what it takes to be an "ingenious experimenter" and shows us that as much imagination and skill must go into the design and development of experiments as into theory.

ELIZABETH GARBER
History Department,
State University of New York,
Stony Brook 11794

Microbiology

Pesticide Microbiology. Microbiological Aspects of Pesticide Behaviour in the Environment. I. R. HILL and S. J. L. WRIGHT, Eds. Academic Press, New York, 1978. xx, 844 pp., illus. $73.65.

In considering how the effects of applied xenobiotic compounds can be adapted to and regulated, priority is often given to the visible effects of xenobiotics on plants and animals. Less attention is focused on interactions of pesticides with microorganisms, although such interactions, by upsetting biological equilibrium or by forming unexpected compounds through metabolic activity, may have a more serious and permanent environmental influence.

Pesticide Microbiology is successful in summarizing the research done before 1976 on microbiological aspects of pesticide behavior in the environment. It can be considered an important reference source and will be useful for both the beginner and the expert. However, one must be rather critical about the organization of the book, since a chapter on microbial transformation of pesticides (I. R. Hill) overlaps with chapters on the microbial degradation of insecticides (F. Matsumura and H. J. Benezet), herbicides (R. E. Cripps and T. R. Roberts), and fungicides, fumigants, and nematocides (D. Woodcock).

Most of the contributions on the transformation of the various groups of pesticides are well written and provide a good perspective of such issues as the value of experimental designs and the possibility of extrapolating laboratory experiments to field conditions. The latter issue, which is discussed from various viewpoints, is important, for the complexity of natural environments—especially of soil—has always presented numerous methodological problems to research workers investigating the in situ metabolic activities of the endogenous microflora. In spite of statements like "Microbial cultures grown in nutrient media, perfusion columns and soil suspensions do not provide data of relevance to agricultural conditions," most of the results reviewed in the book are obtained from laboratory, not field, experiments.

I. R. Hill and D. J. Arnold describe in one chapter the techniques used for the study of pesticide transformation in the environment by the pesticide manufacturing company for which they work, but very few findings of this type of research appear in the literature. Unquestionably the research that private industry does not publish causes a considerable gap in any summary of pesticidal fates in the environment.

The sections dealing with the effect of pesticides on various organisms differ greatly in their thoroughness. The chapter "Pesticides and the micro-fauna of soil and water" by C. A. Edwards contains considerably less information than the two elaborate and very carefully assembled chapters on pesticide effects on soil microorganisms by J. R. Anderson. The critical evaluation and extensive tables included in these two chapters may well be the most comprehensive in the literature.

The introductory chapters covering microbiological aspects of the soil, plant, aquatic, air, and animal environments do not provide an adequate framework for the subjects discussed in the book. In general, students, for whom the first chapters are apparently designed, can hardly afford the book, and experts will not find these chapters very informative.

There is justification for a book on pesticide microbiology, and this one provides valuable and comprehensive information on the subject. As indicated by the editors in their preface, however, interactions of microorganisms with pesticides in ecosystems are unlikely to be clearly defined or isolated from the influence of other factors controlling the fate and activity of pesticides in the environment.

JEAN-MARC BOLLAG
Laboratory of Soil Microbiology,
Department of Agronomy,
Pennsylvania State University,
University Park 16802

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Biosynthetic Products for Cancer Chemo-

(Continued on page 1423)