Book Reviews

Vehicles as Particles

Kinetic Theory of Vehicular Traffic. ILYA PRIGOGINE and ROBERT HERMAN. Elsevier, New York, 1971. xx, 102 pp., illus. $12.50.

The subject of this book is a nonlinear integro-differential equation (Eq. 3.25, p. 25), its derivation, justification, solution, and especially its application to the mathematical theory of vehicular traffic flow. The branch of traffic flow theory characterized by this equation has been the creation of Prigogine and Herman, with a few coauthors. It occupies a curious position within the larger field, having been pursued systematically for more than a decade by two authors who, without exaggeration, must be considered the most celebrated and sagacious contributors to traffic theory, and yet having had little if any impact in terms of publications by other research workers.

The Prigogine-Herman theory—often called the "Boltzmann-like theory"—is based on an analogy between vehicles and the particles of classical physics. There has been so much discussion of the possible significance of the analogy that one must welcome this definitive statement by its authors of its status in 1971.

The book is ideal: compact (though expensive), complete, well referenced and indexed, lucidly and persuasively written. With regard to the theory, there seem to be three categories of nonbelievers: those who claim that it is demonstrably contradictory (the critics), those who challenge its adequacy to explain the phenomenon (the skeptics), and those who find it difficult to understand (the agnostics).

It is a pleasure to report that the gap separating Prigogine and Herman from the critics is nearly bridged. A comparison of pages 26–27 with the paper being rebutted shows that it is now only a question of whether or not "a queue of n vehicles with speed v and position x would be represented in our theory by a value of $f(x,v,t)$ that would be n times as high as for the case of one vehicle with the same x and v."

With regard to the skeptics the situation is a little more difficult. The theoretical and technical problems of testing any theory of traffic flow are acknowledged to be staggering. The demands for "validation," which have been a standard feature of congresses since 1959, have not been satisfied (except for the admitted special cases of tunnel traffic) until quite recently. Within the past two years a large contract with the Department of Transportation has made possible data collection and analysis of freeway traffic on an unprecedented scale. The first publication of data seems to indicate that the Prigogine-Herman theory is highly unsatisfactory, and the rebuttal given on page 32 seems rather unspecific: "It is regrettable that [the] verification techniques contain undesirable features that render [the] results inconclusive with respect to the assumptions and properties of the model." This is very probably only the beginning of an extended controversy, and it will be most interesting to see where it leads.

Finally, a word on behalf of the agnostics. Prigogine and Herman warn that readers "without the necessary background in physics" may form misconceptions of the theory. This is especially true in view of the fact that the fundamental equation of the theory is not so much derived as assembled.

An example of this tinkering approach is the following quotation: "A qualitatively similar effect can be achieved by adding to the kinetic equation a term of the general form

$$(\partial f/\partial t)_{\text{adj}} = \lambda(c)(1 - P)c[c\delta(v - \bar{v}) - f]."$$

It appears that the Prigogine-Herman theory will not find general acceptance, and bring forth useful research, until it is expressed in clearer arguments based less on analogy. Failing that, in another decade it will be considered idiosyncratic. Meanwhile, the present book should by all means be compulsory reading for serious students of traffic flow theory.

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Organometallic Compounds of Arsenic, Antimony, and Bismuth. G. O. DOAK and LEON D. FREEMAN. Wiley-Interscience, New York, 1970. xiv, 510 pp., illus. $25. The Chemistry of Organometallic Compounds.

The authors in writing this book set out to give examples of all of the methods that have been used to prepare organoarsenic, organoantimony, and organobismuth compounds but without covering all known compounds; to emphasize procedures that appear to be of most general utility; to cover the chemical reactions of each class of compounds; to discuss reaction mechanisms only when sufficient data are available to justify such discussions; and to review structure, spectra, and physical properties of these classes of compounds in considerable detail. All pertinent literature through the end of 1967 has been included, and a few important papers published in 1968 and 1969 are also discussed.

Within the limitations imposed by the literature itself, the authors have attained their objectives. It is doubtful whether the literature of any area of organic chemistry contains more errors and nonreproducible results than that of organoantimony chemistry (and possibly organobismuth chemistry). Thus, in the chapters devoted to organoantimony chemistry, the authors quite properly make many statements such as "it can only be concluded that aromatic stibonic acids exist as polymeric species of unknown structure" (p. 293), "there is little evidence that any of the proposed structures are correct" (p. 294), and "the exact structure of these compounds is not known" (p. 295). It is the experience of the reviewer that even some of the most highly regarded and most often cited work in organoantimony chemistry is nonreproducible, and no research worker in the field can accept much of the literature with complete confidence. Fortunately, most of this book is devoted to organoarsenic chemistry, and the literature of that field is relatively reliable.

As mentioned previously, the authors have not discussed mechanisms of reactions unless there is some valid evidence for the mechanisms under consideration. Unfortunately, relatively little attention has been paid by physical-organic chemists to mechanism studies in the areas covered by this book; consequently, most of the writing is of a descriptive nature. On the

whole, the discussions of mechanism, where given, are of good quality, with but few exceptions (among them the discussion of the hydrochloric acid–catalyzed racemization of optically active tertiary arsines found on p. 159, which is somewhat confused).

The compilations and discussions of spectral data, bond lengths, bond strengths, dipole moments, ionization constants, and related matters are a valuable feature of this book. The nature of bonding in some of the different types of compounds is brushed off too lightly, however. Also, some of the structural formulas are of poor quality. Irrespective of such minor faults, the book will be of great value to all research workers in the fields covered.

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Ontogeny of Immunity

Foetal and Neonatal Immunology. J. B. SOLOMON. North-Holland, Amsterdam, and Elsevier, New York, 1971. xvi, 382 pp., illus. $23. Frontiers of Biology, vol. 20.

It is probably inevitable in science that the most successful conceptual advances, while stimulating a flood of productive experiments in some areas, tend also to inhibit progress in others. This has been true in immunology, where Burnet's clonal selection theory of antibody formation and the concept of immunological tolerance proposed by Burnet and by Medawar and his colleagues appeared for a long period almost to require that the fetus *in utero* or *in ovo* be immunologically incompetent. These concepts have now survived the loss of one of their supposed foundation-stones: as is made abundantly clear by the present volume, the fetus exhibits a variety of immunological activities.

This book contains much of specific interest to the immunologist and of more general interest to the developmental biologist. Despite some large gaps in our knowledge, Solomon has done an admirable job of putting together and in some instances evaluating the surprisingly large body of data that have accumulated, in great measure during the past decade. Thus, although the chapter devoted to the maturation of reticuloendothelial function is perforce somewhat sketchy, lymphogenesis and, especially, the current theories of thymic and bursal control of lymphoid maturation are more fully explored, as are the structure and function of the placental barrier between mammalian mother and fetus and the manner in which the fetus and newborn benefit from passively acquired maternal antibody. A discussion of the phenomenology and implications of immunological tolerance then leads into chapters on the ontogeny of immunoglobulin synthesis and on active immunity in birds and mammals and their resistance to fetal and neonatal infections.

One of the great strengths of this book is its comparison, based on data gleaned in bits and pieces from a large variety of animal species, of mammalian immunogenesis and that observed in birds, the latter being a phenomenon the author himself has done much to elucidate. The more general reader will also benefit from the occasional excursions into one or another of the interesting immunobiologic byways that have so enriched this field, such as the human immunologic deficiency diseases, the hazards that may accompany fetal or neonatal receipt of the normally protective maternal antibodies, or the curious role of the mammalian fetus as an alien homograft within what should be, but is not, an inhospitable maternal uterus.

If this book suffers from a defect, it is one that stems directly from one of the strengths of the author's approach, his attempt to consolidate so disparate a set of data. Solomon argues, reasonably, that one should not be surprised that the young of some species may achieve immunological competence relatively early in gestation whereas in other species such competence does not appear until after birth, since the degree of maturity at birth among mammalian species (and other vertebrates as well) is such that some newborns are still virtually embryos at birth whereas others are almost adult in their capacities. A strong argument is therefore made throughout this book that the variations in fetal and postnatal immunology among different species may be unified in terms of the "age-equivalence" of the developing young, as estimated by the time of appearance of certain embryonic features, the time of attainment of puberty, or, most significant in the author's view, the rate of increase of weight gain (weight velocity). Although age-equivalence has proved to be a useful concept in many areas of developmental biology, and indeed serves to remove much of the mystery from developmental immunology, its application has been questioned in many specific areas (for example, brain development and myelination). In the present context, the author seems to have been so carried away by his hypothesis as to discount certain data that do not accord with it. Moreover, the hypothesis that there is *an* age at which the immunologic apparatus matures appears to be too rigid, in view of the increasing body of evidence that immunologic competence matures in a stepwise fashion, immune responses to some antigens appearing early in development and to other antigens only much later. It should be understood that this criticism is not intended as a *caveat emptor* for the specialist, but rather as a *caveat lector* for the generalist, since the book will prove interesting and useful to all.

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Spermatozoan Structure

Comparative Spermatology. Proceedings of a symposium, Rome and Siena, Italy, July 1969. BACCIO BACCETTI, Ed. Accademia Nazionale dei Lincei, Rome, and Academic Press, New York, 1971. xii, 572 pp. + plates. $22.50.

A statement by R. H. Bowen, "The sperm seems never to transgress the few rules which govern the production of its fundamental parts, but in the arrangement of these parts every sperm (flagellate or non-flagellate) seems to be a law unto itself," quoted by Afzelius in the concluding chapter, would serve well as the motto of the Symposium on Comparative Spermatology. The papers presented at the conference deal with the structure of spermatozoa or parts thereof from most phyla of the animal kingdom, from Cnidaria to Vertebrata. (Two chapters present the structure of spermatozoids of lower plants.) Although in most cases the reader has to make the comparisons for himself, there are chapters that are truly comparative—by Fawcett and Phillips on mammals, Nicander on vertebrates, Billard on fishes, Baker and Baker on urodeles, Furieri on reptiles, Brown on crustaceans, Rosati *et al.* on arthropods, and Manton on lower plants; however, with the exception of Nicander's few electron micrographs and brief com-