scientific institutions and in education, and a lack of trained technicians. He insists correctly that the basic problem is one of trained manpower; the problem of material means is not the essential problem. He gives some correct arguments on the brain-drain problem and especially on the lack of a critical elaboration regarding the problem of science development in an indifferent and sometimes even hostile environment. He criticizes correctly the international bureaucracies like UNESCO.

Moravcsik's errors and omissions, unfortunately, are also important. There are errors about the general scheme of science development, shortcomings regarding themes that are inadequately presented or not touched on at all and wrong views about the place of science and scientists in society, especially with respect to scientists' possible political role. There are even points in which the author falls into triviality and naiveté.

On the problem of science development itself, the author does not see that the emphasis on basic research, generally unrelated to any local needs, that prevails in underdeveloped countries is a result of cultural colonialism plus bad local tradition. Also, his viewpoint on science development is absolutely elitist. Moravcsik relies on the star system and thinks that an adequate science development could be implemented by good public relations, which are understood as devices for keeping good relations with the "politicians." This means that people such as the Argentine Nobelist Bernardo Houssay or Abdus Salam in Pakistan raise local morale, particularly that of the local scientists; therefore the organizations in charge of science planning should be formed by highly qualified scientists. If Pakistan spends ten times more on nuclear research than on research on textiles or fishing, it is because the scientists interested in these latter subjects do not have an outstanding spokesman like Salam. However it can be argued that Houssay, apart from his own contribution to science and the role he played in educating his students, played a deplorable role for the development of Argentine science when he was president of the National Research Council—in his servility to semi-Fascist rulers like General Onganía, and in his total lack of solidarity with his victimized colleagues. On the other hand, Sábato, who called himself "a third-rate physicist," played a very positive role.

Neither does it occur to Moravcsik that the problem of inadequate distribution of funds may result from a structural problem and may not have to do with public relations. There might be an implicit or explicit development model being followed in most underdeveloped countries, a model in which there is no place—or at least no important place—for the development of an autonomous scientific and technological system. Also, Moravcsik assumes that one might develop a science policy restricted to "policy within science" while leaving outside the discussion "policy with science," or what to do with science. Varsavsky argued for the opposite point of view, namely that one had to start with a policy for the use of science and from this policy develop a "policy within science." The policy for the use of science has to be developed from a model of development for the country one wishes to construct. From this model, which implies essentially a political problem, one would have to define a policy for technology and a policy for science.

The most significant shortcoming of Moravcsik's work, in my opinion, lies in the fact that he sees science in a vacuum. If science develops in a vacuum, unrelated to real needs and not tied to a general development policy, which means a policy that would stop the waste of human and natural resources, then science will be of little use. For instance, whatever benefits Mexico might have from the development of science will be worse than neutralized if by the year 2000 Mexico City has a population of 25 or 30 million; whatever benefits the development of science produces in Nigeria might be more than offset by an irrational transportation system that produces losses of hundreds of millions of dollars each year, and so on.

Other shortcomings are the importance given to recognition by the international scientific community (that is, the scientific community of the advanced countries) and the lack of importance attached to recognition by the local society. Importance is given to the need to talk to politicians, while nowhere is it said that it is important to shape an informed public opinion or that politicians might misuse science for arms production while forgetting about important social needs—they have done so in advanced countries and are starting to do so in Argentina, Brazil and India. There is an implicit view that scientists should keep their mouths shut about human rights—which they need as much as the general population—in order to avoid alienating the politicians; this appears to me to be a doubtful proposition. An important event, the purge of Argentine scientists in 1966 and the subsequent expulsion of some of them from Chile in 1970 (under the Christian-Democratic government of Frei) under the ridiculous accusation of spying, is given just a few passing—and misleading—words. The situation of science in India is treated with groundless optimism, while in China scientists appear to live in terror of the hordes of Red Guards. Political activity in the universities is treated in a rather prejudiced way; Moravcsik does not take into account the real situation of universities and their place in society in less developed countries.

One could criticize other aspects, such as the lack of any reference to the social sciences in spite of insistence on the need of science-policy studies, which are seen as arising in a vacuum. However Moravcsik's book has some good points, and it is the only book available in English on its important subject, which is still at an early stage of development. More work is needed by social and natural scientists from both advanced and underdeveloped countries.

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## Smoke, Dust and Haze: Fundamentals of Aerosol Behavior

**S. K. Friedlander**
317 pp. Wiley-Interscience, New York, 1977. $16.95

All gas-phase suspensions of particulate matter are aerosols. Though aerosols are very common under both natural and artificial conditions, usually their systematic treatment is overlooked because they arise in essentially independent domains such as air pollution, combustion, inhalation toxicology, interstellar grains, industrial-effluent cleaning, planetary atmospheres, metallic-cluster catalysis research and so on. Indeed, the very term "aerosol" has been appropriated in such a way as to obscure its relationship with anything but atmospheric air-pollution concerns. Quickly, however, the reader of this excellent senior- or first-year-graduate-level text will recognize the catholic nature of the material treated.

Sheldon Friedlander of Caltech is probably America's pre-eminent investigator of aerosols, by virtue of his theoretical and experimental work conducted in a variety of areas since the 1950's. As we should expect from the author of any book, he presents the material in a framework that reflects his personal synthesis of the field. Friedlander places his greatest emphasis upon the essential fluid-dynamic component of aerosol behavior and on solutions of the aerosol evolution equations, areas in which he has made important contributions. Chapters concerned with these subjects go into some detail, and a student unaccustomed to the parlance of fluid dynamics may have some difficulty without the necessary background material (readily accessible to any senior in physics). Aerosol kinetic theory, nucleation and thermodynamics all are treated in a somewhat more elementary fashion and should be entirely accessible to seniors. Instrumentation for aerosol measurement is introduced in a general way; the discus-

sion should suffice to familiarize the student with some of the principal methods currently employed. From the viewpoint of a physics student, only the chapter on light scattering is disappointing, but this should not be accounted a significant deficiency in the book. This topic plays no important role in aerosol behavior, and the author's ostensible purpose for introducing it at all is for its role in atmospheric turbidity and aerosol measurement.

Illustrative examples are worked throughout the book, and each chapter has numerous homework problems plus a set of references to the original literature. In accordance with the author's interests, air-pollution aerosols are emphasized.

*Smoke, Dust and Haze* is the first published book on aerosols written primarily for classroom use. It was written explicitly for chemical- and environmental-engineering first-year-graduate students but could serve excellently as a physics course to introduce students to the nature of applied science. The subject matter is highly interdisciplinary, with applications of the theory frequently mentioned but never dwelt upon at length. Overall objectives of the field *vis-à-vis* applications are made clear while interrelating various physical phenomena via the general dynamical equation for aerosol behavior. The roles of this equation and its approximate solutions are delineated in the case of air-pollution studies.

This book can serve both physics students and research workers as a source of intrinsically interesting research topics in a relatively poorly understood physical domain. In many cases Friedlander quite explicitly points to gaps in the field that need elucidation, while in others it is clear that the simplicity of the treatment bespeaks the absence of detailed understanding of the phenomena. In other, currently emerging or untreated areas that are not mentioned, the reader often may assume quite correctly that considerable work remains to be done.

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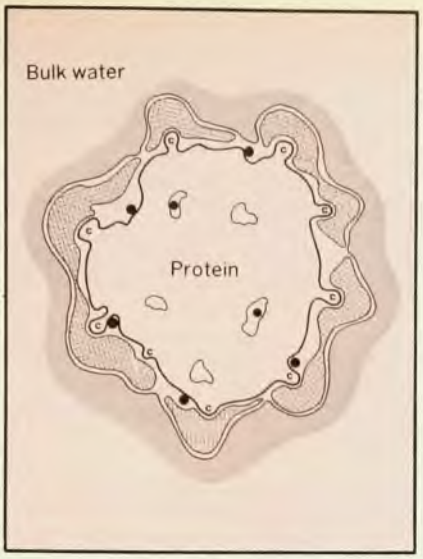
## Intermolecular Interactions and Biomolecular Organization

**A. J. Hopfinger**
395 pp. Wiley-Interscience, New York, 1977. $26.00

The organic molecules of biology interact with one another in distinctive and definite ways that are certainly an important part of the organization of a living system. The book's subject is still a complex one, because we do not yet feel confident of the unifying principles we could use to put order into our thinking. A fair amount of our present knowledge about intermolecular interactions is treated in this book, and the complexity is all too apparent. The surface conformations and the relationships between molecules are treated with confidence for those that can be dealt with; obviously there are many more, and the final realm of knowledge that may be needed to understand a living cell in these terms is staggeringly vast. It is so vast that one can not help wondering if this has to be the way.




**Protein–water organization.** In this cross-sectional view of a globular protein, black dots represent rigidly bound molecules, and c's are charged side chains. The crosshatched areas indicate bound water, while gray marks the transition region. From the book.

The early part of the book deals with the interactions of a number of small molecules with themselves and with the solvent. The interaction of water with proteins is treated next, and this leads to the interactions of drug molecules with proteins. Three chapters on DNA follow, treating hydration, intercalation and complexes with synthetic basic polypeptides. Two chapters on polysaccharides and their derivatives and interactions are next. A chapter on ions and biological molecules introduces the subject of biomolecular aggregation and association, then a chapter on theories of interactions is followed by a discussion of ultrastructural organization, and a chapter on generalizations and speculations ends the book.

The author has undoubted competence in his field. One is truly impressed by the amount and the diversity of the information that he has brought together. It is very difficult for a physically minded life scientist to fail to find some topic of interest; indeed, several are to be expected. So for a reference book this volume is clearly valuable. It is also refreshing to find a book like this written by one individual and thus characterized by the personal note.

On the negative side is the difficulty of reading the material. The writing is full of jargon, poorly defined sets of initials and sentences whose meaning one may only grasp after a second try. I found the book very hard to read, and thinking it must be my own obtuseness I consulted others—with no contradiction to my own impression. It is a real pity, because this is an area in which physicists may want to start to change their research area from more conventional physics to life-science physics. The book should have some appeal to such an individual, yet I doubt if very many will be able to make use of the very real expertise which has gone into putting it together. In particular the first chapter can "turn you off" fast. By determinedly ignoring this first chapter and reading ahead, I found the book to have real value.

If you are well up in the jargon of macromolecular physical studies, then this will be a most useful book; a lot of work went into it. If you are a physicist seeking to look at living systems as a change of interest, then I can not recommend it. In any event this is a sort of book that has a worthy place on library shelves, and a good many graduate students will find themselves working through specific parts of it.

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# book notes

**The Uncertainty Principle and Foundations of Quantum Mechanics: A Fifty Years' Survey.** W. C. Price, S. S. Chissick, eds. 572 pp. Wiley-Interscience, New York, 1977. $42.00

This collection of 25 papers published as a tribute to the late Werner Heisenberg commemorates his formulation, in the spring of 1925, of quantum mechanics. "The discoverer of the quantum theory and the uncertainty principle," says Hans Matthöfer in his Foreword, "was required to leave the solid ground of classical physics. One of the most significant changes in our comprehension of the universe . . . was wrought by the departure from the determinacy of physical phenomena and by far deeper-reaching relativization of the law of causality." Heisenberg himself took part in the book's organization before his death last year, and the first paper in the volume is his "Remarks on the Origin of the Relations of Uncertainty," a personal recollection. This and the other contributions are grouped under four headings: "Quantum Uncertainty Description," "Measurement Theory," "Formal Quan-