

As the completed work is to cover 1,500 species, it is evident that it goes far beyond the bounds of official medicine. The latitude taken allows the author to guide his readers through many entertaining by-ways of phytotherapeutic knowledge. It allows him to bring in the successful practitioner of Lyons who, having built himself a house, inscribed above the door, "Les concombres et les melons M'ont fait bâtir cette maison", and to recall the seventeenth-century executioner who, being of a tender heart, was unable to perform his duties until he had chewed a little catmint, "thanks to which, he was instantly seized with fury" and thirsted for blood.

Properties, methods of use and, where necessary as with garlic, drawbacks are also described at length. Anyone interested in the lore of medicinal plants cannot fail to derive both pleasure and profit from these pages, whether he is prepared to subscribe to their general background or prefers to leave it where it belongs.

W. O. JAMES

'OPEN SYSTEMS' IN PHYSICS AND BIOLOGY

Étude thermodynamique des phénomènes irréversibles

Par I. Prigogine. Pp. ix+143. (Paris: Libr. Dunod; Liège: Éditions Desoer, 1947.)

SINCE 1934, the present reviewer has advanced the conception of the organism as an 'open system'. So far, physical chemistry has been concerned almost exclusively with reactions and equilibria in closed systems, while living organisms are open systems, maintaining themselves in a continuous exchange of materials with environment. We have stressed the necessity for an extension of physical chemistry, stated kinetic principles, and demonstrated that the theory of open systems leads to the derivation of fundamental biological characteristics as well as to quantitative laws of biological phenomena¹. It has also been emphasized that "according to definition, the second law of thermodynamics applies only to closed systems, it does not define the steady state".

Prigogine's work, devoted to the extension and generalization of thermodynamical theory, is of outstanding importance for physics as well as for biology. As the author states, "classical thermodynamics is an admirable, but *fragmentary* doctrine; this fragmentary character results from the fact that it is applicable only to states of equilibrium in closed systems. Therefore, it is necessary to establish a broader theory, comprising states of non-equilibrium as well as those of equilibrium." Starting, on one hand, from the concept of open systems, on the other, from thermodynamics of irreversible processes, founded by De Donder and the Brussels School and in his own previous work, Prigogine derives the generalized thermodynamics for the whole realm of physical chemistry, including chemical reactions, electrochemistry, polythermic systems, diffusion, thermo-electricity, etc. These considerations lead to the solution of many problems where, as in electrochemistry, osmotic pressure, thermodiffusion, Thomson and Peltier effects, etc., classical theory has proved to be insufficient. We must restrict ourselves to mentioning a few of the most important, and partly revolutionary, consequences. Irreversible processes in open systems cannot be defined by entropy but only

by the approach of a minimum entropy production. Entropy may decrease in such systems; or, in other words, such systems may spontaneously develop towards a state of greater heterogeneity and complexity. The far-reaching significance of this statement is apparent, since it was often considered an essential difference between inanimate and animate Nature that, according to the second law, physical events appear to be directed towards a levelling down of differences and states of maximum disorder, while in organic development and evolution a transition towards states of higher order and differentiation seems to occur. The principle of Le Chatelier applies not only to closed but also to open systems. The consideration of irreversible phenomena leads to the conception of a thermodynamical, as opposed to astronomical, time.

Prigogine's pioneering work is a most important contribution towards new conceptions, the bearing of which on physics as well as on biology can scarcely be estimated. Not since de Vries' and Pfeffer's work on osmosis have essential developments of physical theory been instigated by biological considerations. The new thermodynamics shows that it is necessary not only for biological theory to be based upon physics, but also that biological points of view can open new pathways in physical theory as well.

LUDWIG VON BERTALANFFY

¹ v. Bertalanffy, L., *Naturwiss.*, 28, 522 (1940); "Theoretische Biologie", 2 (Berlin, 1942); further work by Burton, Spiegelman and Reiner, Dehlinger and Wertz, Prigogine and Wiame, and others.

PLASTICS ABSTRACTED

The Science of Plastics

A Comprehensive Source Book based on the Original Literature for 1942-1948. Edited by H. Mark and E. S. Proskauer, with the collaboration of P. M. Doty, V. J. Frilette and B. H. Zimm. Vol. 1. Pp. vii+632. (New York and London: Interscience Publishers, Inc., 1948.) 54s.

THIS book is rather unique in character and is a result of the rapid expansion of knowledge in one field of science during a period of very considerable transition (1942-46). In effect, it is a bound volume of abstracts. Since 1942 Interscience Publishers have issued a loose-leaf form of abstracts known as *Rubbers, Resins and Plastics* covering both the scientific and, to some extent, the technological aspects of the subject. These abstracts are of particular value to the worker in high polymers generally for two reasons: (a) they are much more extensive than those found in any issued form of chemical abstracts and include numerical results in considerable detail; (b) they cover a wider field than is normally found in chemical abstracts, picking out material from journals not normally read or accessible to those interested primarily in this science of high polymers. No doubt the success of these abstracts and the difficulty of obtaining back numbers have prompted the publishers to re-issue them in a much more convenient form. Thus the abstracts have been collected into systematic groups, so that the book takes on the character of a reference or source book of knowledge on these several topics.

The properties and evaluation of plastics claim a third of the volume, and the physical chemistry of high polymers in a state of equilibrium claims another third. The mechanism of polymerization