Book Reviews

Mesophases

The Physics of Liquid Crystals. P. G. DE GENNES. Clarendon (Oxford University Press), New York, 1974. xii, 334 pp., illus. + plates. $32.50. International Series of Monographs on Physics.

It is commonly agreed that mesophases were first properly identified by Reinitzer in 1888. When Friedel classified the various phases as nematic, smectic, and cholesteric, in 1922, a considerable body of data on their simpler physical properties and the relationships between their molecular structure and their behavior had already been accumulated. There was, indeed, even the beginning of a theory.

This early progress was reported in a series of papers that appeared in one of the "Discussions" of the Faraday Society (1933). In those papers, the theory and the experiment were spelled out in a manner so convincing and so nearly exhaustive that interest in the field subsequently waned. In rereading those "Discussions" recently I was startled by the clarity, the brilliance even, of Oseen's now celebrated paper.

It was not until this past decade that the subject reemerged and progressed to a point well beyond the apex of 1933. Several reasons can be advanced to account for this rush of activity, not the least of which is the possibility, pointed out by Fergason in his persuasive essay in the *Scientific American* (Aug. 1964), that a considerable market exists for stable liquid crystal display devices. To an experimentalist, liquid crystals are attractive because they offer excellent systems on which to employ the rich assortment of experimental techniques that have grown to maturity in the past two decades—laser light scattering, nuclear magnetic resonance, electron spin resonance, and ultrasonic dispersion and attenuation, for example. The theorist interested in the physics of anisotropic fluids is attracted by the prospect of yet another variety of phase transitions on which to test the ideas that have begun to provide some deeper insight into the universal nature of critical phenomena. Then, too, lyotropic mesophases, which undoubtedly play a significant role in the structure of lipid bilayers and in solutions of biopolymers, are of increasing interest to biologists and biophysicists.

No wonder, then, that the Fifth International Liquid Crystal Conference held in Stockholm in June 1974 was attended by a wide cross section of the scientific community. A large number of the participants were from the "French school," which centers about de Gennes, whose work in recent years has had a strong influence on the subject. This book is more than a recital of the accomplishments of the Orsay group, but it is strongly influenced by them and tends to be somewhat deficient in areas they have not cultivated. Very little attention is paid, for example, to the statistical theory of mesophases. In particular, those developments that owe their origin to the classic paper of Onsager, go by the name of "hard-rod theories," and emphasize the role of the short-range repulsive force are treated too briefly to be appreciated by any general reader, and a few misstatements appear in the treatment.

Other deficiencies include an incomplete discussion of the subject of mixtures and inadequate consideration of the possibilities for tricritical points in mesophase systems. A better account of the relationships between molecular structure and phase stability would have been helpful, since these issues are by no means settled and are of interest to both experimentalists and theorists in both physics and physical chemistry.

This book almost certainly is intended for a limited audience, principally physicists, for whom the style, the appeal to analogs in ferromagnetism, and the use of modern ideas about critical phenomena will seem straightforward and natural. For other readers, including students, I suspect, the going will not be easy. What will be found here, nevertheless, is a rather broad account of liquid crystal physics that is well written, entertaining, frequently provocative, and at its best, for example in the chapter on dynamical properties of nematic mesophases, remarkably good. That chapter will no doubt be of particular interest for the discussion it provides of the hydrodynamic problems presented by the nematic mesophase. Used in conjunction with a volume emphasizing structure and giving a fuller account of the experimental situation, this book could serve as a valuable introduction to liquid crystal physics.

ANDREW G. DE RÒCCO
Institute for Molecular Physics, University of Maryland, College Park

Plasma Physics

Theory of Plasma Instabilities. A. B. MIKHAILOVSKII. Translated from the Russian edition (Moscow, 1971) by Julian B. Barbour. Consultants Bureau (Plenum), New York, 1974. Two volumes, illus. Vol. 1, Instabilities of a Homogeneous Plasma. xviii, 290 pp. $32.50. Vol. 2, Instabilities of an Inhomogeneous Plasma. xviii, 314 pp. $32.50. Studies in Soviet Science.

Much of the original work on the theory of plasma instabilities has been carried out in connection with the controlled thermonuclear fusion program. Although much of the theory has been widely used, particularly in astrophysics and space physics, it has been the perplexingly anomalous behavior of experimental plasmas in fusion machines that has provided the impetus for the theoretical analysis of plasma stability on the basis of increasingly sophisticated physical models. It is surely then of some significance that essentially no new types of instabilities have been discovered in the controlled fusion program over the last five years. Most of the current theoretical work in fusion is concerned with analyzing geometrical effects on known instabilities, investigating nonlinear saturation of instabilities, and exploring the possibilities for using waves and instabilities for the heating of laboratory plasmas. We must conclude that the theory of plasma instabilities, at least in their linear regime, is fairly mature. Accordingly, this translation is a welcome and timely contribution to the literature.

The anomalies of plasma behavior take the form both of enhanced nonclassical velocity-space scattering of non-Maxwellian, but apparently col-