Synoptic Meteorology

Atmospheric Circulation Systems. Their Structural and Physical Interpretation. E. PALMÉN and C. W. NEWTON. Academic Press, New York, 1969. xviii + 606 pp., illus. $26. International Geophysics Series, vol. 13.

Synoptic meteorology—the analysis of the atmosphere into recognizable systems with typical structures and behaviors—flourished during and between the two World Wars, and formed the basis for most weather forecasts. With the advent of digital computers, it became fashionable to regard atmospheric states as mere arrangements of wind, pressure, temperature, and moisture. To those who think that this practice, though it has revolutionized forecasting, has contributed little to physical understanding, this work by two internationally known synoptic meteorologists will be most welcome.

The circulation systems described in detail include thunderstorms, squall lines, fronts, waves in the easterlies and westerlies, tropical and extratropical cyclones, anticyclones, intertropical convergence zones, jet streams, and the global easterlies and westerlies. The authors aim in addition to show how these systems fit into the total picture, and particularly how they contribute to the global balance of angular momentum and energy; this emphasis is perhaps the work's distinguishing feature.

The book is not for the beginner; to appreciate even the opening pages one must understand such terms as "geostrophic balance" and know that "200 mb" denotes an elevation of about 12 kilometers. Meteorological knowledge equivalent to a one-semester elementary course will be a sufficient background. About one page in four contains mathematical formulas, intelligible to anyone familiar with partial derivatives. Meanwhile there is plenty for the nonmathematical reader.

In chapter 4 the authors see fit to classify air masses into only three types —a simplification that might surprise but perhaps please students of yesterday. Chapter 8, devoted to jet streams, includes the low-level jet of the central United States.

In keeping with their special emphasis, the authors devote little space to the structure of tornadoes, and waterspouts and dust devils receive no mention. Land and sea breezes fare no better. There is no discussion of weather forecasting, let alone weather modification. The potential reader may therefore wonder why the book requires 600 pages. This is partly because, despite warnings that they cannot adequately do so, the authors frequently present several viewpoints on controversial matters. The discerning reader will readily acquire a feeling for what is and is not yet understood.

The book is too specialized to be a text in elementary synoptic meteorology. For an advanced course treating certain aspects in depth, it will serve admirably. It will also answer the needs of the professional or amateur who wishes to update his knowledge of such phenomena as jet streams and tropical cyclones.

EDWARD N. LORENZ
Department of Meteorology, Massachusetts Institute of Technology, Cambridge

Molten Metal Compounds

Liquid Semiconductors. VASILII M. GLAZOV, SVETLANA N. CHIZHEVSKAYA, and NATAL'YA N. GLAGOLEVA. Translated from the Russian edition (Moscow, 1967) by Albin Tybulewicz. Plenum, New York, 1969. xii + 364 pp., illus. $22.50. Monographs in Semiconductor Physics, vol. 2.

In 1960, Ioffe and Regel published a very extensive review of the properties of a class of materials designated as "liquid semiconductors" (*Progress in Semiconductors*, vol. 4, A. F. Gibson, Ed., Wiley). These include the molten oxides, sulfides, tellurides, and selenides of various metals. The main criteria for their designation as semiconducting, according to Ioffe, are (i) an electrical resistivity of 10^2 to 10^5 microohm centimeter, (ii) a negative temperature coefficient of resistance, and (iii) an anomalous composition dependence in resistivity, with resistance maxima at certain compositions suggesting nonstoichiometric doping effects.

The monograph by Glazov, Chizhevskaya, and Glagoleva is an extensive review of experimental research on liquid phases (most of which are true liquid semiconductors) produced on the melting of solid semiconductors, carried out in various laboratories throughout the world mainly over the ten years since the Ioffe-Regel review. Although the work and point of view of Russian investigators (especially those of the principal author and his colleagues) are stressed, almost half of the more than 600 references cited are from the non-Soviet literature. The material may be of interest to those who are concerned with the physicochemical properties of inorganic liquid mixtures: physical chemists, metallurgists, materials scientists, semiconductor technologists, applied solid-state physicists. It is also of possible interest to theoretical physicists and chemists who are tackling the presently incomplete formulation of a general theory of the liquid state from a statistical mechanical and quantum mechanical viewpoint. These latter will find the book useful not for the discussion of current theory of amorphous semiconductors (which is noticeably absent) nor for the presentation of critical experiments to test existing theory but because of the quantity of data presented—electrical resistivity, magnetic susceptibility, density, viscosity, and thermoelectric power—on systems ranging from elemental liquids (Si, Ge, Se, Te) to various binary (and some ternary) liquids which, for the most part, solidify to form solid semiconducting compounds at lower temperatures. These include compounds and liquid phases of the systems $A^{III}B^{V}$, $A^{II}B^{VI}$, CuI, $A_2^{III}Te_3$, Mg_2B^{IV}, $A^{IV}B^{VI}$, and $A_2^{V}B_3^{VI}$. Hall-coefficient data and direct structural data as determined from x-ray and neutron diffraction are understandably absent, in view of the limited number of investigations on the systems considered. The majority of data presented are the temperature dependences of the abovementioned properties through the melting transition of the compounds. A separate chapter entitled "Physicochemical analysis of liquid systems" includes data on the composition dependence of the electrical conductivity and the viscosity of A^{III}-Sb, Mg-B^{IV}, and various binary tellurium systems and on Ge(Si)-$A^{III}B^{V}$ quasibinaries.

The authors discount available theories as being "based on models which are far removed from real conditions." They therefore attempt to deduce semiquantitatively the constitution of the liquid state in terms of the concepts of binding (covalent, metallic, ionic) and molecular structure (short-range order, molecule and polymer formation). This is accomplished by analysis of the composition and temperature dependence of the measured properties; in the case of liquid germanium (only), the analysis is supported by structural data from x-ray diffraction. The open-

ing chapter provides the basis of this analysis by citing the early work (1936) of N. S. Kurnakov. There we are introduced to the "continuity principle" and "correlation principle" which are to be used subsequently. To those of us who are committed to this approach in our own research, it comes as rather a surprise to learn that we have been practicing "physicochemical analysis" as long ago proposed by Academician Kurnakov. With some effort, this bit of nationalistic parochialism can be tolerated, and the main questions that need to be answered can be considered. These are: (i) the relationship between the structure and binding in the solid phase and the structure and binding in the liquid; (ii) the extent and occurrence of continuous transitions from "solid" structure to "liquid" structure below and above the normal melting point (that is, "pre-melting" and "post-melting" phenomena); and (iii) the relationship between the composition dependence of measured properties and the equilibrium phase diagram.

The conclusions for each class of systems are summarized briefly at the end of each chapter or subsection. A variety of behavior is demonstrated for different systems. For example, for Ge and Si, the analysis of conductivity, magnetic susceptibility, and thermoelectric power indicates a transition from covalent or directionally bonded structure to a more close-packed metallic structure on melting (semiconductor → metallic transition). However, both the susceptibility and the viscosity (treated on the basis of activated-state theory) show the persistence in the liquid of residual covalent bonds which are finally destroyed at higher temperatures. The practical ramifications of this for precrystallization behavior are mentioned by the authors. In contrast to this, the analysis of the electrical and magnetic properties of In_2Te_3 and Ga_2Te_3 indicates that melting does not greatly alter the structure and binding, and that the liquids continue to be semiconducting (semiconductor → semiconductor transition). However, considerable structural rearrangements of the persisting covalent bonds occur on continued heating as deduced from density and viscosity measurements.

In contrast to the current practical interest of glassy semiconductors, applications of true liquid semiconductors are at present very few. The authors refer to cascaded multistage thermoelectric converters as holding some promise for future development, and briefly discuss several design parameters for device construction. Nothwithstanding the lack of current applications, the information presented in this monograph will doubtless be of considerable value in future ones.

BARRY D. LICHTER
Department of Materials Science and Metallurigcal Engineering, Vanderbilt University, Nashville, Tennessee

A Geometrical System

Nicole Oresme and the Medieval Geometry of Qualities and Motions. A Treatise on the Uniformity and Difformity of Intensities Known as *Tractatus de Configurationibus et Motum.* Edited with an introduction, English translation, and commentary by MARSHALL CLAGETT. University of Wisconsin Press, Madison, 1968. xiv + 714 pp. + plates. $15. Publications in Medieval Science.

In this well-printed volume, Marshall Clagett has provided students of the history of science with a critical edition, which is also the first full printed edition, of the important treatise of Nicole Oresme (d. 1382) "on the configurations of qualities and motions." In this work Oresme presents a method of using rectangular coordinates, or, more exactly, two-dimensional closed figures, for the graphic representation of qualitative intensities varying with respect to the extension of the subject qualified. This technique is applied, in the second part of the treatise, to representing velocities as a function of time elapsed, in uniform and nonuniform motions, leading to a formulation, in the third part of the work, of the geometrical proof of the kinematic law of uniformly accelerated motion which Galileo utilized 250 years later in application to the case of free fall. Although Duhem's claim that Oresme anticipated Descartes's discovery of analytical geometry in this work is not sustained by the text, nevertheless Oresme's discussions reveal that the roots of 17th-century achievements in the mathematical analysis of motion, and even of the methods of differentiation and integration involved in the calculus, lay at least partially in this late medieval attempt to dimensionalize qualitative intensities and to develop a method of representing intensive magnitudes as functions of spatial or temporal extensions.

In establishing the text of Oresme's treatise Clagett collated all the known manuscripts, but based his edition primarily on two early versions found in Ms. Bruges 486 and Cod. Vat. lat. 3097. Variants from the other manuscripts are given to the extent that they yield significant alternative readings, and in making his choice of readings the editor gives primary weight to criteria of internal coherence and intelligibility. Diagrams based on those found in the manuscripts, but corrected where necessary to accord with the text, are provided in the English translation, which is printed on the pages facing the Latin text. As far as this reviewer can judge, the text appears to be soundly constituted and the translation accurate and intelligible. The commentary, following on the text and translation, is devoted chiefly to giving sources and historical antecedents which could have influenced Oresme, and it provides a rich assemblage of historical materials relevant to the subjects treated. An appendix gives texts and translations of some writings closely linked to the main treatise, including a portion of Oresme's earlier *Questions on the Geometry of Euclid*, in which the doctrine of configurations had been partially formulated.

In his introduction Clagett sketches Oresme's career and indicates some of his views and contributions in natural philosophy, and then discusses the doctrine of configurations contained in the treatise, considering the question of its originality and of its influence on early modern science. He also discusses the date of composition of the treatise, as relevant to the question of whether Oresme originated the method formulated in it, and ends the introduction with a description of the manuscripts utilized. A useful bibliography, an index of technical Latin terms, and a general index complete the volume. As an important and long-needed contribution to the documentation of late medieval developments in mathematics and physics, this volume will be welcomed by all who are concerned with the origins and development of early modern science, and its excellence as a complete work of documentation gives assurance that it will not need to be replaced in the future.

ERNEST A. MOODY
Department of Philosophy, University of California, Los Angeles