omitted. Nonetheless, there is no volume that provides a better collection of ideas on mate choice. If you are interested in mate choice you must read this book.

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The Plasma State

Physics of Ion-Ion and Electron-Ion Collisions. F. BROUILLARD and J. W. MCGOWAN, Eds. Plenum, New York, 1983. xii, 538 pp., illus. $69.50. NATO Advanced Study Institutes Series B, vol. 83. From an institute, Baddeck, Nova Scotia, Canada, Sept. 1981.

The study of matter in the ionized and plasma state encompasses a wealth of interesting problems associated with the various subfields of physics. It exhibits its closest connection with atomic and molecular physics, and the present book establishes that connection quite firmly by illustrating how atomic and molecular physics provides the key to understanding the structure and underlying collisional energy pathways of the plasma state.

The book serves as another excellent reminder of the significant advances that have been made in the past 25 years in the field of atomic and molecular physics and of the contribution the field has made to the study of astrophysics, controlled thermonuclear fusion, and lasers. It provides a clear review of the ionized state in astrophysics and in thermonuclear fusion, together with detailed discussions of the appropriate theoretical quantum mechanics and laboratory experiments for the rates and cross sections of certain specific collisional mechanisms.

Not only does the formation of a plasma in the laboratory represent a complex sequence of atomic and molecular energy-change processes, the plasma state, which may last anywhere from a few microseconds in some high-energy plasmas to a few hours (as in a low-density glow discharge), is controlled by a dynamic balance of various recombination-dissociation processes.

The recombination of electrons and of ions to form neutralized species, or other ion-pair systems, determines the ionization structure of plasmas. The analysis of the recombination spectrum associated with the removal of the excess energy of recombination by the emission of radiation is a powerful diagnostic probe of the physical environment in which the emitting species resides. The formation of ion pairs H^+ and H^- by dissociative recombination between electrons and hydrogen molecular ions has attracted considerable attention from the thermonuclear fusion community, which is interested in producing high-current H^- ion sources for neutral beam injectors.

Dalgarno sets the astrophysical scene in a particularly interesting, lucid, and engaging chapter on the roles of electron-ion and ion-ion collisions in astrophysics. The physical conditions here range from the cold, weakly ionized molecular clouds associated with gaseous nebulas (for which the sources of ionization are energetic cosmic rays) to the hot, highly ionized solar and stellar corona (for which the sources of ionization are thermal electrons heated by shocks driven by supernova explosions in the disk of the galaxy, supplemented by absorption of x-ray and ultraviolet photons associated with the recombination spectrum) and comets and planetary atmospheres (which are ionized by solar ultraviolet radiation). The chemical energy-change pathways appropriate to the various physical conditions are concisely described by Dalgarno.

Post then provides a comprehensive account of the role of atomic collisions in magnetic and inertial controlled fusion research. He discusses the hot central plasma, where fusion reactions occur; the plasma edge, where the plasma interacts with the external environment; methods for the production of the hot plasma; and techniques for the diagnosis of the physical properties of the plasma. Both Dalgarno and Post furnish fairly exhaustive lists of references.

The subsequent ten chapters deal with the theoretical and experimental methods required to yield detailed cross-section information on specific collisional mechanisms, such as electron impact excitation and ionization of atoms and ions, electron-ion and ion-ion recombination, and ion-atom charge transfer collisions.

Although quantum mechanical scattering theory is in principle a well-documented subject, extensive theoretical development is still required for implementation of the various working models associated with the various collisional mechanisms. Also, the recent advent of intersecting beam ion traps and laser excitation techniques has provided much more sensitive and wide-ranging approaches to recombination experiments than were previously available.

The present vigor of the field is well characterized by the theoretical developments and new experimental techniques discussed in this book. Although the list of processes discussed is fairly complete, a few chapters, particularly those dealing with high-energy collisions, are quite routine and could have been replaced by chapters dealing with current research on the theory, say, of ion-molecule state-to-state collisions and reactions at thermal energies and of ion-ion recombination in dense plasmas. The inclusion of such work would have been more appropriate to the chemistry of the interstellar medium and would have provided greater balance to the book.

My enjoyment in reading the book was somewhat marred by the well-above-average number of typographical errors. All in all, however, the book is thoughtful and stimulating. It would prove invaluable not only to active researchers in the appropriate fields but also to those interested in reviewing the great contribution that atomic and molecular physics has made to astrophysics and to fusion programs.

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The Planet Venus

Venus. D. M. HUNTEN, L. COLIN, T. M. DONAHUE, and V. I. MOROZ, Eds. University of Arizona Press, Tucson, 1983. viii, 1143 pp., illus. $49.95. Space Science Series.

Venus is closer to the sun than Earth is, yet it absorbs less sunlight than Earth. In spite of this, its surface temperature is maintained at a baking 730 K because of effective blanketing by a thick atmosphere that blocks the loss of thermal radiation to space. The atmosphere contains an opaque cloud deck whose major constituent is sulfuric acid. Photochemical production of the acid at high levels is balanced by destruction in the lower atmosphere, or perhaps even by a cycle that involves the planetary surface and geological processes. The solid body of the planet rotates very slowly (period 243 days) in a retrograde direction, but the atmosphere at the level of the cloud deck rotates at the robust rate of about once every four days. Although very similar to Earth in mass and size, Venus possesses only a trace of the volatile compound most abundant on Earth, water. It shows no evidence yet discernible of the kind of tectonic activity that dominates terrestrial surface geophysics.

Altogether, Venus is an interesting planet and provides a humbling example of the diverse consequences of the laws