The ever-present personal wrangles which are an important part of the field of Polynesian studies are incompletely camouflaged. Perhaps the most remarkable example is Danielsson's statement, in his biographical sketch of Emory, that the well-known Emory-Stimson controversy was based completely upon scholarly disagreement and was finally settled with Emory's complete vindication. The origins of this unfortunate controversy are to be sought mainly in areas other than scholarship. There is no right or wrong in this matter, nor will there be any one-sided vindication when Stimson's voluminous writings and correspondence are adequately published at last.

In summary, Kenneth P. Emory's lengthy, diversified, and productive career might well have received a more fitting monument than that represented by this volume.

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Matter in Space

Interstellar Grains. N. C. WICKRAMASINGHE. Chapman and Hall, London, 1967 (distributed in the U.S. by Barnes and Noble, New York). x + 154 pp., illus. $11.75. International Astrophysics Series, vol. 9.

Although it is now well established that an appreciable amount of matter in the form of gas and solid particles exists between the stars, as recently as 40 years ago it was still an open question whether dark markings in the Milky Way were holes between the stars or were due to obscuring matter. The discovery of interstellar polarization by Hall and Hiltner in 1949 raised further questions concerning the grains and galactic structure. According to present theories, polarization is produced by aligned grains, the alignment presumably being due to extensive but certainly quite small ($B \lesssim 10^{-5}$ gauss) galactic magnetic fields. An investigation of grain growth by condensation out of the interstellar gas made by J. H. Oort and H. C. van de Hulst in 1946, following the suggestion of B. Lindblad, led to the general acceptance of a theory of "dirty ice" grains thought to consist primarily of frozen water, methane, and ammonia with impurities of the common metallic elements (Fe, for example). Qualitative theoretical considerations of polarization led to the proposal by Cayrel and Schatzman in 1954 that there may exist graphite flakes as one of the components in interstellar space. Subsequently, Hoyle and Wickramasinghe in 1962 took up the theory of graphite grains and described a mechanism which could explain their origin in the atmospheres of certain types of stars. This work has been pursued by Wickramasinghe and others, and a complete summary of the theories of graphite as a basis for explaining the optical manifestations of interstellar grains is now presented by Wickramasinghe in *Interstellar Grains.*

Approximately one-third of the book is devoted to a collation of the main observational characteristics of the interstellar grains, namely, interstellar extinction, interstellar polarization, reflection nebulae, and diffuse galactic light. Curiously, however, there is no mention of the unexplained diffuse interstellar lines which most astronomers believe to be intimately associated with the grains.

The five main types of models considered in the book are (a) iron particles, (b) dirty ice grains, (c) large complex molecules (proposed by Platt), (d) graphite grains, and (e) graphite core-ice mantle grains with emphasis on (e), (d), and (b) in that order. All presently proposed models have some uncertainties associated with their general acceptance. Where the theories are not well supported or are approximate, it is critical that their limitations be clearly stated. From the standpoint of a balanced presentation the book falls far short of this scientific mission. Furthermore, there are several serious inconsistencies and errors in the theoretical analysis, some of which are mentioned here.

One of the key criteria used to determine the acceptability of a particular grain model is whether the required magnetic field for orientation is so large ($B \gtrsim 10^{-4}$ gauss) as to be inconsistent with considerations of galactic dynamics. The author has made a fundamental error in the direction of favoring the orientability of graphite. He is apparently unaware of the fact that there are two sources of its magnetic susceptibility, and he calculates (on p. 139) the out-of-phase component incorrectly by combining the relaxation of the paramagnetic electron spin system with the diamagnetic electron orbital part.

The author has applied the Davis-Greenstein theory of magnetic orientation in its original form. However, the more recent work of R. V. Jones and L. Spitzer, Jr., extending this theory, is actually more pertinent to the orientation of dirty ice grains and to the graphite core plus ice mantle grains, the latter being suggested by the author as the most likely candidate for representing interstellar grains. The Spitzer-Jones theory is appropriate to problems involving intermediate degrees of orientation as well as to nearly complete and nearly incomplete orientation. In application to the core-mantle and dirty ice particles it gives results which are quite at variance with those of the author.

Wickramasinghe should have made clear that the uncertainties in his approximate theoretical calculation of polarization by graphite and by graphite core plus dielectric mantle grains are considerably greater than the uncertainties in the observations of the wavelength dependence of polarization with which they are compared. The calculations of extinction by spherical grain models both homogeneous (Mie theory) and core-mantle (Guttler theory) are carefully performed and conveniently tabulated in appendices. There is nevertheless an important objection which may be raised regarding the interpretation of extinction by the core-mantle particles. Whereas the optical properties of graphite are studied in considerable detail, the optical properties of the dirty ice are perfunctorily described by a constant index of refraction over the spectral range from the infrared to the rocket ultraviolet. Since the author correctly lays much stress on the importance of recent astronomical investigations in the ultraviolet, this is a serious omission, particularly in view of the fact that the use of published measurements on the absorptivities of frozen water, methane, and ammonia in the ultraviolet would lead to a considerable revision in the comparison between theory and observation presented in chapter 10 (particularly figure 10.17).

There is real merit in the research Wickramasinghe has done on some of the important problems of interstellar grains. He has delved into the very difficult problems of nucleation and growth of grains and brought forth a number of interesting and new thoughts on physical interactions. On the whole, however, the book does not fulfill its function as a comprehensive and up-to-date survey of interstellar grains.

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