um; to him or her the "traveling phenomena" are tiny energetic particles, and he or she is concerned with such things as rigidity spectra, particle acceleration mechanisms, and anisotropy measurements. Still others are more interested in the signatures left by these traveling phenomena on astronomical objects (planetary magnetospheres, comets) that happen to be in the sun's vicinity. Perhaps farther afield, one could regard the planets and asteroids, and solar radiation itself, as other forms of traveling interplanetary phenomena, whereupon it seems that the list could go on without end.

This book deals with the more substantive of the above types of traveling phenomena. It contains the invited papers that were presented at a symposium held in memory of L. D. de Feiter. A forthcoming report (*Contributed Papers to the Study of Travelling Interplanetary Phenomena/1977*) will complement the present volume.

The 20 self-contained papers in the volume under review span a broad range of topics, from the solar origins of, and attempts to model dynamically, interplanetary disturbances (papers by E. Hildner, R. P. Lin, and S. T. Wu *et al.*) to the current status of solar wind theory and observations (papers by W. I. Axford, S. Cuperman, D. S. Intriligator, E. J. Smith and J. H. Wolfe, and F. L. Scarf) and attempts to unravel the information contained in cosmic ray observations (papers by G. Wibberenz, E. C. Roelof and S. M. Krimigis, and T. P. Armstrong). The volume concludes with an intriguing discussion by H. Porsche of experimental opportunities, past and forthcoming, afforded by the Helios missions.

For the most part, the authors are distinguished and active workers in their respective fields, which may account for the tendency I noticed for them to stress their own work. In this context, the most objective paper is that by Axford on the three-dimensional structure of the interplanetary medium. I sensed that, had the symposium been more widely attended, the conclusions reached by certain of the other authors would have been critically questioned during the discussion session (which has purportedly been faithfully transcribed in this volume).

One aspect of the book that I found puzzling is that virtually no mention is made of the extensive investigations that have been carried out on responses in the planetary magnetospheres and ionospheres to interplanetary disturbances. Is not, for example, the modulation of decametric radio emission from the Jovian magnetosphere as reliable an indication of activity in the interplanetary medium as is the response of comet tails (to which three lengthy reviews are devoted)? And what about interplanetary effects on our own magnetosphere? Apparently the organizers of the symposium felt that these topics had already been adequately covered in the recent literature or would be the subjects of future symposia.

One can only be grateful that the editors chose to eliminate unnecessary delays in making this handsomely bound volume available. Nevertheless, certain benefits have been sacrificed in the process. A well-written summary, tying together the diverse topics covered in the book and establishing a consensus concerning both the overall state of the art and future goals, would have conveyed the true flavor of the symposium much more effectively than the present volume does. A subject index would have been useful, too; I can't imagine that the inclusion of one would have led to a significant publication delay.

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Researchers on Radioactivity

The Self-Splitting Atom. The History of the Rutherford-Soddy Collaboration. THADDEUS J. TRENN. Taylor and Francis, London, 1977. xii, 176 pp., illus. £6.

On 27 March 1901, Rutherford and Soddy debated the electron theory of matter before the McGill Physical Society. Neither lacked confidence. Soddy, aged 23 and fresh from Oxford, had sailed to Canada certain that he would be elected to a vacant chair of chemistry at the University of Toronto. He had had to settle for a demonstratorship at McGill. Rutherford, aged 29 and trained at Cambridge, the fount of the electron theory, had by his own admission discovered "1000 things undreamt of" about atoms during the three years he had been in Montreal. He looked forward to the match with Soddy. "Chemist" and "damn fool" were synonyms to him.

As Trenn describes it on the basis of Soddy's unpublished notes, the debate centered on whether evidence about the electron—about "bodies smaller than atoms"—required a change in the basic concepts of chemists. Not at all, said Soddy, who refused to allow electrons materiality: "I feel sure chemists will retain a belief and a reverence for atoms as concrete and permanent identities, if not immutable, certainly not yet transmuted." Rutherford countered with the evidence that electrons are bodies and that atoms constantly lose material parts via ionization.

Six months after the debate Rutherford asked Soddy to help him to discover the chemical nature of thorium emanation. According to Trenn, the investigation turned Soddy around: emanation appeared to be an inert gas arising spontaneously from a heavy metal, a product of natural alchemy. But it was also possible that the emanation was an impurity in the thorium, or a product or a constituent of an impurity. This last interpretation recommended itself when Soddy succeeded in separating from "thorium" something he called thorium X (^{224}Ra), which appeared to carry all the activity of the parent substance. Rutherford and Soddy soon discovered in the behavior of ThX a most powerful argument for transmutation. In a few days ThX lost all activity while the residual "thorium" regained its former power. The rise and decline went on at the same rate. It appeared that in natural thorium ThX was produced as rapidly as it decayed.

It took about a year for Rutherford and Soddy to move from this realization, which came a few months after their collaboration began, to the definitive disintegration theory. At first they distinguished the processes of radiation and transformation: the particles of ThX, for example, were supposed first to arise from thorium by "subatomic chemical change" and then to emit their characteristic radiation. The reasoning by which they came to associate the expulsion of an α or β particle with the chemical transformation is too intricate to be rehearsed here. It exploited, among other things, Rutherford's demonstration late in 1902 that the α ray, then usually assumed to be a species of x-ray, is a particle.

Trenn follows his team with skill and fortitude. He has used all the known extant documents, including laboratory notebooks and correspondence. He has succeeded in thinking himself into the problems as they may have presented themselves to Rutherford and Soddy. That required both an effort of will and a grasp of many points thought important during the work but now regarded as either error or insignificant detail.

Nonetheless Trenn omits some matters that might fairly be considered to belong in a close account of an extended collaborative experimental research. One misses a description of the day-to-day work, of who did what, of change in roles over time, of the cost and procurement of apparatus, of the physical layout, of all the material aspects of the enterprise. How often did Rutherford and Soddy repeat their measurements? How accurate were their results? What did the three other investigations of radioactivity in which Rutherford was then engaged with his advanced students contribute? Trenn mentions only one of these lesser collaborations. This is not to hint that the true inventor of the disintegration theory was a graduate student, but that the range of questions against which the theory developed may have been wider even than Trenn suggests.

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Diamonds

The Mineralogy of the Diamond. YU. L. ORLOV. Translated from the Russian edition (Moscow, 1973). Wiley-Interscience, New York, 1977. xii, 236 pp., illus. $28.50.

This book is a timely contribution summarizing what is known of the physical and chemical properties of diamonds, their distribution, and what constraints their presence imposes on the genesis of kimberlite. In particular, the book provides the Western scientist with a review of the little-known and relatively inaccessible Russian literature on diamonds and kimberlites. About 40 percent of the close to 700 references are to Russian papers, and this proportion reflects the dominance during the past few decades of the Soviet researchers in this field. The weakest points are the spotty coverage of the most recent foreign papers and the glossing over of technical details, especially with respect to the nonconventional synthesis of diamonds referred to in the Russian literature. The "selective" coverage gives the reader the impression that the author had access to only a limited number of translated papers.

The text has suffered in translation: sentences are cumbersome, and time and place terms are used without regard to the context of the sentence. Good editing would have made the book more readable. I also fault the publisher for the use of unfamiliar units, the undefined notations and conventions, and the omission of reference standards for measurements; for example, the ΔC^{13} (sic) notation usually refers to the difference of carbon isotope abundance between two samples ($\delta^{13}C_1 - \delta^{13}C_2$), given in per mil rather than percent with respect to the Pee Dee Belemnite standard.

The ten chapters cover the varieties (based on crystal habit and form), structure, composition, structural defects, morphology (growth and dissolution features), properties, natural occurrence, paragenesis (syngenetic and epigenetic inclusions), synthesis, and genesis of diamonds. The chapters on composition, morphology, paragenesis, and genesis provide a good review of the literature; the chapter on morphology, in particular, has an excellent concluding summary. Perhaps the most important chapter is the first, which outlines the classification of diamonds into ten morphological varieties and sets the tone for comparing these with the chemical types of diamonds and the petrological conditions for their formation. The coverage in the chapter on the occurrence of diamonds in nature would be more complete if the author had incorporated data from the issue of *Physics and Chemistry of the Earth* devoted to kimberlites (vol. 9, 1975), which he cites. The chapter on diamond synthesis is disappointing, with an overemphasis on the work reported in Western literature and a rather sterile account of the Russian work.

I judge this book to be the best available on the mineralogy and petrology of diamonds, despite the flaws.

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Carbonate Deposition

Deep-Water Carbonate Environments. Papers from a symposium, Dallas, April 1975. HARRY E. COOK and PAUL ENOS, Eds. Society of Economic Paleontologists and Mineralogists, Tulsa, Okla., 1977. vi, 336 pp., illus. $14; to SEPM members, $12. SEPM Special Publication No. 25.

Deep-Water Carbonate Environments consists of a number of case histories detailing the facts and interpretations that lead the authors to consider that their particular carbonate sections were deposited in deep water. An introductory paper by the editors very nicely summarizes the volume.

Several of the 15 papers are of a general nature. Byers discusses a basinal biofacies model based on oxygen zonation with depth to explain alternating zones of burrowed shelly facies with zones lacking bioturbation and fossils. Fischer and Arthur have assembled a tremendous quantity of data from the JOIDES Deep Sea Drilling Project and from outcrop studies to develop a cyclic global model for the last several hundred million years. Cycles of approximately 32 million years' duration are characterized by alternations of times of high diversity of pelagic biota with times of low diversity. These cycles are believed by the authors to be the result of climatic variations. The editors rightly refer to this as a thought-provoking paper.

There are three papers that emphasize the shelf-to-basin transition from highly fossiliferous wackestone and grainstone of the shallow-water shelf to thinly-bedded-to-laminated, dark-colored wackestone and mudstone of deep-water basins. Truncation surfaces and broad, shallow channels are common in the basinal settings. All three papers describe this transition in Mississippian section, from the western Cordilleran of Utah, from the northern Rocky Mountains of Montana, and from New Mexico and West Texas.

The majority of the papers in the volume report on basinal sections that consist of widely distributed, laminated, dark-colored wackestone and mudstone with interbedded lens-shaped bodies of breccia and grainstone. The breccia and grainstone lenses are referred to by the various authors as having been transported from shallow-water settings into the basin by mass flow, turbidity currents, submarine slides, debris sheets, downslope displacement, debris aprons, and gravity flow. Petroleum geologists have been particularly interested in these lenses because they offer the possibility of porous reservoirs in an otherwise nonporous section. This fascinating combination of rock types has received considerable attention over the past 15 years, as is evidenced by the large number of papers on them and the diversity of geologic ages dealt with; Cambrian, Devonian, Pennsylvanian-Permian, Jurassic, and Cretaceous models are described in detail. Some authors point out, however, that the interpretation is still in question in some cases.

The editors have done an excellent job of organizing this group of papers from diverse authors. Their effort in preparing the extensive index will be appreciated by all those who use the book, which doubtless will be a basic reference on deep-water carbonate models for years to come.

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