

$n_4/n_1 = 1 + (2\Delta - 2\delta)/kT$  at equilibrium, where  $\Delta = \frac{1}{2}\gamma_e\hbar H_0$ . Inasmuch as  $\Delta/\delta \cong 660$ , this may give rise to a large negative value of  $P_n$  which, if carried over to the product, would result in stimulated emission. The predominance of  $W_{\pm\pm}$  may occur in butyl radicals as a result of the dipole-dipole interaction<sup>6</sup> between the unpaired electron and the protons at the 1 and 2 positions of the radical. This could account in part for the emission lines observed in 1-butene. Where  $W_{\pm\pm}$  is the predominant relaxation pathway, states 3 and 4 become overpopulated relative to 1 and 2, and enhanced absorption results. This situation may arise from a time-dependent scalar coupling<sup>7</sup> between a proton and the unpaired electron. This may occur for the protons at the 2 position of butyl radical as a consequence of methylene group rotation which modulates the angularly dependent hyperfine splitting of protons  $\beta$  to an unpaired electron.<sup>8</sup> Such an effect may account in part for the enhanced absorption lines ascribed to 1-butene.

The above qualitative discussion is completely borne out for the one-electron, one-proton case by solution of the classical equations of motion for level populations in  $HR'$  and  $HR''$  in a manner analogous to that

(6) A. Abragam, *Phys. Rev.*, **98**, 1729 (1955).

(7) A. W. Overhauser, *ibid.*, **92**, 411 (1953); T. R. Carver and C. P. Slichter, *ibid.*, **102**, 975 (1956).

(8) R. W. Fessenden and R. H. Schuler, *J. Chem. Phys.*, **39**, 2147 (1963).

employed in treating the steady-state Overhauser effect.<sup>3,9</sup> It is clear, however, that many aspects of both the chemistry and physics of CIDNP remain to be explained. Among other things, the two-spin model cannot explain both emission and enhanced absorption lines from the proton at the 2 position of 1-butene, the presence of enhanced absorption lines from the protons at the 1 position of 1-butene, and the apparent simultaneous emission and enhanced absorption from the isobutylene multiplet.<sup>2</sup> Preliminary calculations<sup>10</sup> make it appear that these effects cannot be explained by a simple extension of the two-spin treatment. Further experimental and theoretical studies of CIDNP phenomena promise to be particularly fruitful because of the predicted sensitivity of these effects to the chemically significant rate constants  $W_i$  and  $W_r$ .

**Acknowledgment.** Helpful conversations with J. C. Baird and P. H. Rieger are gratefully acknowledged.

(9) R. G. Lawler, unpublished results.

(10) P. H. Rieger and R. G. Lawler, unpublished results.

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*Received August 3, 1966*

## Book Reviews

**Developments in Inorganic Nitrogen Chemistry.** Volume 1. Edited by CHARLES B. COLBURN, Rohm and Haas Redstone Research Division, Huntsville, Ala. American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York, N. Y. 1966. vi + 583 pp. 17.5 × 25 cm. \$32.50.

In the Editor's words, "Developments in Inorganic Nitrogen Chemistry" is planned as a two-volume work which "will review in considerable detail the chemical status of one of (the) . . . relatively neglected elements—nitrogen." Volume 1 contains chapters entitled "Bonding in Nitrogen Compounds" (Chapter 1, Michael Green), "The Inorganic Azides" (Chapter 2, A. D. Yoffe), "Developments in the Inorganic Chemistry of Compounds Containing the Sulfur-Nitrogen Bond" (Chapter 3, Margot Becke-Goehring and Ekkehard Fluck), "Nitrogen Ligands" (Chapter 4, W. P. Griffith), "Phosphorus-Nitrogen Compounds (*sans* Cyclic Phosphoronitrilic Compounds)" (Chapter 5, Morris L. Nielsen), "Nitrogen Compounds of Boron, Aluminum, Gallium, Indium, and Thallium" (Chapter 6, John K. Ruff), and "Inorganic Reactions in Liquid Ammonia" (Chapter 7, G. W. A. Fowles). For the most part, the contributions are welcome additions to the review literature since they cover subjects that have not been extensively reviewed relatively recently; however, there are sections in some of the chapters (*e.g.*, Chapter 3) that are essentially repetitions of reviews that are already in the literature. Several of the authors possessed the good judgment to refer to recent reviews which covered subjects that would normally be expected to fall within the purview of their chapter (*e.g.*, the omission of a detailed discussion of borazine chemistry from Chapter 6, the nature of metal-ammonia solutions from Chapter 7, and the phosphoronitrilic compounds from Chapter 5). This is a commendable attempt by the authors to keep from duplicating recent reviews or portions of reviews, especially in view

of the spectrum of material which is covered in this volume. Unfortunately, these modest gains are lost elsewhere. There are a number of sections in different chapters which discuss exactly the same subjects (*e.g.*, the ammonolysis of the group III halides which occurs in Chapter 7 on page 538 and in Chapter 6 on page 472; the mechanism of conversion of transition metal-amine complexes into the corresponding amides which appears on page 560 of Chapter 7 as well as on page 250 of Chapter 4). While repetition is sometimes necessary to maintain continuity, a more adamant position by the Editor could eliminate most of this type of duplication. One of the contributions (Chapter 7) covers a subject which has been recently reviewed more extensively (*i.e.*, in "Chemistry in Nonaqueous Ionizing Solvents," J. Jander, Interscience, 1966; "Nonaqueous Solvent Systems," T. C. Waddington, Ed., Academic Press, 1965). The logistics of writing and publishing (being what they are) undoubtedly required that those portions of the various chapters which were, or have been covered, in other places (and that have subsequently been published) be included in this volume.

It appears to this writer that much of the review literature today is an exercise in rearrangement. Authors to contributed volumes become trapped in the delusion (shared on occasion by this writer) that they are really presenting their subject for a unique purpose whereas, in actual fact, they are just casting it in a slightly different light. Thus, the subject of water could appear in collected works devoted to the hydrides of the elements, the oxides of the elements, solvent systems, etc., and each review would probably contain the same basic material except for a slight rearrangement and a shift in emphasis. The price of this type of review gamesmanship is high, for the publisher, the contributors, and the consumer.

In view of this, it is unfortunate that the prospective purchaser is faced with the problem of weighing the positive contribution to the review literature against the material which is essentially repetitious.

The price of this volume will ensure that only the most dedicated inorganic nitrogen chemist and libraries will purchase it; most chemists interested in using it as a reference book will probably obtain it from the latter source.

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## BOOKS RECEIVED, August 1967

- ROY H. BIBLE, JR. "Guide to the NMR Empirical Method, A Workbook." Plenum Publishing Corp., 227 West 17th St., New York, N. Y. 1967. 305 pp. \$9.50.
- J. O'M. BOCKRIS and G. A. RAZUMNEY. "Fundamental Aspects of Electrocrystallization." Plenum Publishing Corp., 227 West 17th St., New York, N. Y. 1967. 155 pp. \$7.50.
- GEORGE EISENMAN, Editor. "Glass Electrodes for Hydrogen and Other Cations. Principles and Practice." Marcel Dekker Inc., 95 Madison Ave., New York, N. Y. 1967. 582 pp. \$24.75.
- A. J. GAIT. "Heavy Organic Chemicals." Pergamon Press Inc., 44-01 21st St., Long Island City, N. Y. 1967. 249 pp. \$6.00.
- J. K. GRANT, Editor. "The Gas Liquid Chromatography of Steroids. Proceedings of a Symposium held at the University of Glasgow on 4 to 6 April 1966." Cambridge University Press, 32 East 57th St., New York, N. Y. 1967. 294 pp. \$13.50.
- G. A. D. HASLEWOOD. "Bile Salts." Barnes and Noble, Inc., 105 Fifth Ave., New York, N. Y. 1967. 116 pp. \$5.00.
- WILLIAM L. JOLLY, Editor. "Preparative Inorganic Reactions." Volume 3. Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1966. 261 pp. \$12.00.
- IRVING M. KLOTZ. "Energy Changes in Biochemical Reactions." Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1967. 108 pp. \$5.95.
- F. A. LEWIS. "The Palladium Hydrogen System." Academic Press Inc., Ltd., Berkeley Square House, Berkeley Square, London, W.1, England. 1967. 178 pp. \$9.00.
- AHMED MUSTAFA. "Fuopyrans and Fuopyrones." Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1967. 376 pp. \$21.00.
- E. PUNGOR. R. A. CHALMERS, Translation Editor. "Flame Photometry Theory." D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 1967. 200 pp. \$10.50.
- ERIC N. SIMONS. "Guide to Uncommon Metals." Hart Publishing Co., Inc., New York, N. Y. 1967. 244 pp. \$12.00.
- R. STOCK and C. B. F. RICE. "Chromatographic Methods." Barnes and Noble, Inc., 105 Fifth Ave., New York, N. Y. 1967. 206 pp. \$7.50.
- HERMAN A. SZYMANSKI, Editor. "Raman Spectroscopy, Theory and Practice." Plenum Publishing Corp., 227 West 17th St., New York, N. Y. 1967. 255 pp. \$12.50.
- CHARLES W. TOBIAS, Editor. "Advances in Electrochemistry and Electrochemical Engineering." Volume 5. "Electrochemical Engineering." Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1967. 325 pp. \$14.50.