bonds as shown in eq 1 has been previously demonstrated for $(C_5H_5)_2Lu(t\text{-}C_4H_9)(THF)$.[15] The spectroscopic properties of that product, $(C_5H_5)_2Lu(\eta^2\text{-}COCMe_3)$, are consistent with a η^2-acyl ligand in which the carbon has substantial carbene or carbenium[16] character.[15] C–H addition to an adjacent carbene center as shown in eq 2 is also a precedented reaction.[17] Since this route is based on an assumed structure for II,[5,6] other mechanisms for forming III are quite possible.

The availability of substituted alkynes as synthetic precursors suggests this low-valent samarium-based alkyne CO condensation reaction could be of general use in the synthesis of polycyclic hydrocarbons. The generality of this system is under study.

Acknowledgment. We thank the National Science Foundation for support of this research and the Alfred P. Sloan Foundation for a Research Fellowship (to W.J.E.).

Supplementary Material Available: Tables of crystal data, bond distances and angles, final fractional coordinates, thermal parameters, and observed and calculated structure factor amplitudes and a fully numbered ORTEP plot (6 pages). Ordering information is given on any current masthead page.

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(15) Evans, W. J.; Wayda, A. L.; Hunter, W. E.; Atwood, J. L. *J. Chem. Soc., Chem. Commun.* **1981**, 706–708.

(16) Tatsumi, K.; Nakamura, A.; Hofmann, P.; Stauffert, P.; Hoffmann, R. *J. Am. Chem. Soc.* **1985**, *107*, 4440–4451.

(17) Kirmse, W. *Carbene Chemistry*; Academic Press: New York, 1971; Chapter 7.

Book Reviews

Dictionary of Chemistry and Chemical Technology. By H. Gross (Technische Universität, Dresden). Elsevier Science Publishers: Amsterdam and New York. 1984. German/English: 633 pp. $105.75. ISBN 0-444-99617-6. English/German: 717 pp. $105.75. ISBN 0-444-9418-4.

This is an unusually satisfying dictionary for its thoroughness and clarity. Most users of language-to-language dictionaries have been frustrated by the hordes of obvious or totally obscure terms but the absence of the terms they were actually looking for. This dictionary is an exception, in that the right words are there. it is also distinguished from the horde by the precision of its definitions, in which, for example, chemical formulas are often given in addition to names ("chromate red" is not only translated as "chromrot", "chromzinnober", or "Persischrot", but the formula $Pb(OH)_2 \cdot PbCrO_4$ is added). Synonyms and alternatives are given in abundance. the temptation to make literal translations, which are befuddling, has been stoutly resisted; "squirrel-cage disintegration", for example, is translated as "Schlagkorbmühle". The dictionary is also up to date, and antiquated terms are few, whereas terms of modern origin, such as "reprography", are well represented. There are, of course, some arcane entries, such as "Maul: inlet (of a jaw breaker)", but probably those with a need to look up such terms will understand what is meant.

Finally, it should be noted, the print is easily readable, unlike that in some dictionaries in which the publishers have tried to put too much on too few pages.

Treatise on Heavy Ion Science. Volume 6. Astrophysics, Chemistry and Condensed Matter. Volume 7. Instrumentation and Techniques. Volume 6: Edited by D. Allen Bromley (Yale University). Plenum Press: New York, 1985. xxii + 428 pp. $69.50. ISBN 0-306-41786-3. Volume 7: Edited by D. Allen Bromley (Yale University). Plenum Press: New York, 1985. xxi + 471 pp. $69.50. ISBN 0-306-41787-1.

Both of these volumes have the same preface. In fact this is the general preface for the entire series. In it the editor states that the field of heavy-ion science now requires an overview of the accomplishments and some "enlightened speculation" about what comes next. The volumes are aimed at workers in the field as well as those involved in neighboring fields—students and professional scientists. There is also the expressed hope that the volumes will be informative to a wider audience in other sciences and technologies. In order to accomplish the stated objectives the editor has enlisted the aid of internationally recognized authorities to write about their own areas of expertise and to write in a way that provides background for students and nonspecialists. He makes no claims for the completeness of the volume.

Volume 6 has 16 contributers. As is so often characteristic of such volumes the style of the contributions is varied and so is the amount of expertise required from the reader. Some of the pieces are tutorial and others written for people with some experience and prior exposure. The topics cover the following subjects: Heavy-ions Reactions in Nuclear Astrophysics, Heavy-Ions in Hot Atom Chemistry, The Stopping and Range of Ions in Matter, Ion Implantation, Heavy-Ion Channeling, The Electronic Polarization Induced in Solids Traversed by Fast Ions, Erosion of Surfaces by Fast Heavy-Ions, Heavy-Ion Damage in Solids, Analysis with Heavy-Ions, and Heavy-Ion Induced Fusion Power.

For the more expert reader many of the chapters represent a current review with a large number of references and for individuals from other disciplines some of the chapters are a useful introduction to the field of heavy-ions.

The impression that I formed about Volume 6 in this series was of a series or collection of essays about heavy-ions. The subject matter of Volume 7 on the other hand lends itself better to a systematic development. It concentrates on problems and techniques that are specific to heavy-ion studies. There are sections on the state of the art in the production of both positive and negative heavy-ions, the preparation of stripping foils for heavy-ion beams, and the preparation of heavy-ion targets. There are additionally sections on analytical instrumentation for the detection and measurement of heavy-ions. Many of the chapters are detailed, featuring useful drawings and schematics. This is a useful volume and again a source for references.

Isidore Adler, *University of Maryland*

Photophysics and Photochemistry in the Vacuum Ultraviolet. Edited by S. P. McGlynn (Louisiana State University), G. L. Findley (New York University), and R. H. Huebner (Argonne National Laboratory). D. Reidel Publishing Company: Dordrecht, Holland. 1985. xvi + 960 pp. $99.00. ISBN 90-277-1882-2.

This is the proceedings of a NATO Advanced Study Institute held in Lake Geneva, Wisconsin, in August 1982. It includes 28 papers by chemists and physicists on spectroscopy and photochemistry in the vacuum ultraviolet (VUV), i.e., states with six to several hundred electron volts in energy. The editors's aim has been "to construct a book which is pedagogically useful..., but which still serves as an introduction to state-of-the-art research on highly excited states of atoms and molecules." Indeed, the book is well-organized and a number of the individual papers were written with the contributions of other authors clearly in mind.

Rydberg states dominate many of the discussions, both in experimental and theoretical papers. These states whose energies form a hydrogenic series converging to an ionization potential of the molecule or atom are typically the sharpest states in VUV spectra. Their weak coupling to valence states makes them especially important intermediates in multiphoton photochemistry and ionization. Three tutorial papers by Rau, Lu, and Greene build up the quantum defect theory appropriate to a theoretical description of Rydbergs. It is a rare experimental paper that does not at least mention the states.

Two experimental developments have sharply increased interest in VUV spectroscopy. Synchrotron radiation is now available to investigators willing to travel. Synchrotrons provide a high brightness source of pulsed, polarized photons useful in a variety of absorption, reflection, and ionization spectroscopies. Lasers are also important. While several examples of direct laser emission in the VUV exist, high-resolution spectroscopy usually involves either the use of nonlinear processes to shift tunable visible lasers into the VUV or of nonlinear absorption by molecules themselves as in multiphoton ionization.

Beyond those topics already mentioned are included electron impact spectroscopy, negative-ion states, superexcited states, van der Waals dimers, excitons in rare gas solids, and electric and magnetic field effects, especially magnetic circular dichroism. In addition to purely spectro-

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*Unsigned book reviews are by the Book Review Editor.

scopic topics, several papers address the dynamics of VUV photochemistry and photoionization. While none too detailed, an index complements the book.

Charles L. Braun, *Dartmouth College*

Advances in Heterocyclic Chemistry, Volume 38. Edited by A. R. Katritzky. Academic Press: London and New York. 1985. ix + 374 pp. $87.50. ISBN 0-12-020638-2.

The year 1984 saw the appearance of three volumes of this valuable series, and one might reasonably suppose that the editor would require a much deserved respite. Perhaps he did take one, but it must have been very short (a weekend?), for here we have another volume, bearing a publication data of July.

The six chapters in this volume comprise two on sulfur heterocycles (Benzothiazoles and relatives, by M. Davis, and Benzothiazines and relatives, by C. Brown and R. M. Davidson), three on nitrogen heterocycles (Dihydroazines, by A. L. Weiss, Hydantoins, by C. Avendaño Lopez and G. Gonzâles Trigo, and Barbituric Acids, by R. Bojarski, J. L. Mokrosz, H. J. Barton, and M. H. Palachowska), and one on Heterocyclic β-Enamino Esters, Versatile Synthons in Heterocyclic Synthesis, by H. Wamhoff. This last chapter is concerned with heterocyclic rings of a wide variety of types having in common an amino group and an ester (or cyano) group situated on adjacent carbons of a heterocyclic ring with a double bond between the carbons; such compounds are thus enamines in which the double bond, but not the amino group, are part of a ring.

This volume embodies the characteristics and high quality of its predecessors. A cumulative subject index is promised for Volume 40.

Organic Electronic Spectral Data, Volume XXI, 1979. Edited by J. P. Phillips, D. Bates, H. Feuer, and B. S. Thyagarajan. John Wiley & Sons: New York. 1985. xiii + 1071 pp. $120.00. ISBN 0471-83047-X.

The editors of this volume, who were also contributors to the text, were aided by contributions from three other chemists (L. D. Freedman, C. M. Martini, and F. C. Nachod) and the data were processed at the University of Louisville. The fruits of their efforts should bring them a reward of gratitude from all those whose work is made easier by this vast compilation, for a work of service such as this will certainly not make anyone rich. This is a work for reference libraries, and as is characteristic of the series, it presents tabular data in the form of λ_{max} and $\log_\epsilon$ listed in formula-index order, with references, abstracted from literature published in 1979.

Annual Reports in Organic Synthesis—1983 and 1984. Edited by M. J. O'Donnell and L. Weiss. Academic Press: London and New York. 1983: xiii + 493 pp. $29.00. ISBN 0-12-040814-7. 1984: xiii + 500 pp. $29.00. ISBN 0-12-040815-7.

These two volumes retain the same format, the editors have survived to fight the mounting tide of literature again, and the publishers have, commendably, managed to hold the line on price. The contents, consisting of equations with structural formulas and minimal essential information, is, as it always has been, designed for scanning and quick comprehension. The survey that is presented is derived from 47 journals, it represents a massive amount of work, and it is a comparably massive help to the organic chemist who must keep up with more literature than he can find time to read. These volumes are designed for personal purchase and will give a large return in value for their relatively low price.

Electron Correlation in Molecules. By S. Wilson (University of Oxford). Clarendon Press; Oxford University Press: Oxford and New York. 1984. xii + 281 pages. $36.00. ISBN 0-412-25850-1.

Although the title of the book is "Electron Correlation in Molecules", general background material on the electronic structure of molecules (Born-Oppenheimer approximation, relativistic effects, orbital theories, etc.) has been included in the first two chapters. This is necessary in order to *set the stage* for the discussion of electron correlation. In the third chapter the author provides a useful review of the *basics* of electron correlation: discussing the different types of correlation effects in the hydrogen molecule, defining and analyzing correlation effects in more complex molecular systems, and discussing the effects of electron correlation on molecular properties.

The fourth chapter, The Linked Diagram Theorem, is devoted to a presentation of the elements of perturbation theory and the linked diagram theorem. Since this is an important topic, it is discussed in some detail for the reader. Unfortunately, despite an informative review of the essentials of perturbation methods including a detailed discussion of diagrammatic techniques, this chapter falls short of its goal. For example, the cancellation of unphysical terms in the Rayleigh-Schroedinger perturbation expansion is asserted but not proven, "exclusion principle violating" terms are mentioned but their meaning is never fully explained: more detail is needed here.

The fifth chapter on Group Theoretical Aspects is interesting, if somewhat terse, but is only loosely connected to the remainder of the book.

Any discussion of electron correlation would be incomplete without a discussion of basis sets and the truncation errors due to basis set limitations. This the authors provides in the sixth chapter on The Algebraic Approximation. This chapter provides a general overview of the subject but only limited details, e.g., contracted basis sets are mentioned but contraction methods are never discussed; this is unfortunate, because virtually all molecular calculations employ contracted basis sets. The discussion of universal basis sets, on the other hand, could well have been omitted. (Does the author really believe in storing integrals over universal basis sets on multidimensional polyatomic energy surfaces for reuse with different nuclear charges?) Finally, it should be noted that eq 6.3.6 is simply wrong (it is, e.g., quite possible for E_0 to be above E_1^{exact}).

The final chapter, on Truncation of Expansions for Expectation Values, discusses the application of the configuration interaction method, the group function model, cluster expansions, and diagrammatic perturbation theory to molecular calculations (there is also a short section on valence bond approaches), with the emphasis on diagrammatic PT methods. This chapter provides a useful comparison of the different approaches. It is very critical of CI methods (and with some reason). However, the author (and readers) would do well to remember that *neither* limited CI *nor* PT based on a restricted Hartree–Fock wave function are size consistent, i.e., for the Hartree–Fock wave function $E(AB) \neq E(A) + E(B)$ as $R_{AB} \rightarrow \infty$; see eq 4.1.1. In fact, it is unfortunate that the author did not discuss applications of quasidegenerate PT in this chapter. This method, which permits the use of multireference zero-order wave functions, leads to an energy expression which is size consistent. This technique along with multireference coupled cluster techniques presently offer the only viable alternatives to multireference CI techniques for the calculation of potential energy curves and surfaces.

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