drug daunorubicin. In this system coralyne gives approximately a 20% inhibition of RNA polymerase while daunorubicin gives a 90% inhibition. This finding presents an interesting comparison to in vivo testing results (cf. testing data in references 2 and 18) which indicate that the amount of coralyne required to produce a maximum inhibition of P388 leukemic cells in mice is nearly two orders of magnitude more than the amount of daunorubicin required to give maximum inhibition. At their concentrations of maximum inhibition, however, the two drugs have similar activity.[2,18]

In conclusion, coralyne, at low molar ratios of drug to DNA, can form an intercalated complex with DNA and, as the molar ratio is increased, forms a DNA-induced molecular aggregate stacked along the deoxyribose phosphate backbone. The electronic absorption spectra are quite different for unbound, stacked, and intercalated coralyne molecules. Preliminary results indicate that binding of the stacked form is more sensitive to ionic strength increases than the intercalated species, as would be expected for a complex stabilized primarily by electrostatic interactions.[6] In addition, the RNA polymerase inhibition studies suggest that complexation with DNA could be a factor in the antileukemic activity of coralyne. If so, the low inhibition values relative to daunorubicin could account for the reduced in vivo activity of coralyne relative to daunorubicin. Studies to determine a more exact structure for the stacked and intercalated coralyne complexes, the binding specificity, influence of molecular substitution, and effects of ionic strength are necessary in developing a detailed understanding of how DNA binding might be related to the biological effects of coralyne and are now in progress in our laboratory.

Acknowledgment. This investigation was supported in part by a grant from the Research Corp. The coralyne sample was generously supplied by Dr. Harry B. Wood, Jr., of the Drug Development Branch, Division of Cancer Treatment, National Cancer Institute. We thank Dr. L. S. Wilkerson for the PM-2 phage used to prepare the closed circular DNA.

References and Notes

(1) K. Y. Zee-Cheng and C. C. Cheng, *J. Pharm. Sci.*, **62**, 1572 (1973).
(2) K. Y. Zee-Cheng, K. D. Paull, and C. C. Cheng, *J. Med. Chem.*, **17**, 347 (1974); R. K. Y. Zee-Cheng and C. C. Cheng, *ibid.*, **19**, 882 (1976).
(3) K. Y. Zee-Cheng and C. C. Cheng, *J. Pharm. Sci.*, **61**, 969 (1972).
(4) A. K. Krey and F. E. Hahn, *Science*, **166**, 755 (1969).
(5) E. J. Gabbay, D. Grier, R. E. Fingerle, R. Reimer, R. Levy, S. W. Pearce, and W. D. Wilson, *Biochemistry*, **15**, 2062 (1976).
(6) M. J. Waring, "The Molecular Basis of Antibiotic Action", E. F. Gale, E. Cundliffe, P. E. Reynolds, M. H. Richmond, and M. J. Waring, Ed., Wiley, London, 1972, pp 173–277.
(7) L. S. Lerman, *J. Mol. Biol.*, **3**, 18 (1961).
(8) E. J. Olmstead, J. W. Panter, D. W. Boykin, and W. D. Wilson, *Biochemistry*, **14**, 521 (1975).
(9) M. J. Cho, A. J. Repta, C. C. Cheng, K. Y. Zee-Cheng, T. Higuchi, and I. H. Pitman, *J. Pharm. Sci.*, **64**, 1825 (1975).
(10) D. F. Bradley and M. K. Wolf, *Proc. Natl. Acad. Sci. U.S.A.*, **45**, 944 (1959); R. Armstrong, T. Kurucsev, and U. Strauss, *J. Am. Chem. Soc.*, **92**, 3174 (1970).
(11) A. Blake and A. R. Peacocke, *Biopolymers*, **6**, 1225 (1968).
(12) M. J. Waring, *J. Mol. Biol.*, **54**, 247 (1970).
(13) M. W. Davidson, B. G. Griggs, D. W. Boykin, and W. D. Wilson, *Nature (London)*, **254**, 632 (1975).
(14) J. Saucier, B. Festy, and J. B. Le-Pecq, *Biochimie*, **53**, 973 (1971).
(15) G. Cohen and H. Eisenberg, *Biopolymers*, **8**, 45 (1969).
(16) W. Müller and D. Crothers, *J. Mol. Biol.*, **35**, 251 (1968).
(17) W. D. Wilson, D. Grier, R. Reimer, J. D. Bauman, J. F. Preston, and E. J. Gabbay, *J. Med. Chem.*, **19**, 381 (1976).
(18) G. Tong, W. Lee, D. R. Black, and D. W. Henry, *J. Med. Chem.*, **19**, 395 (1976).

W. David Wilson,* Alice N. Gough, James J. Doyle

Department of Chemistry, Georgia State University University Plaza, Atlanta, Georgia 30303

Michael W. Davidson

Department of Molecular Biology, Vanderbilt University Nashville, Tennessee 37235

Received June 3, 1976

Book Reviews

Quantitative Analysis by Gas Chromatography. Volume 5. By Joseph Novak. Chromatographic Science Series. Marcel Dekker, New York, N.Y. 1975. ix + 218 pp. 15 × 22.5 cm. $16.75.

This is the fifth volume in a series of monographs in Chromatographic Science and is designed for those who have some experience with gas chromatography. The approach is strongly mathematical. The first five chapters deal with the basic theory. In Chapter 1, the author defines quantitative gas chromatography and expands upon this definition. Chapter 2, which deals with the concentration of the solute in the eluted chromatographic zone, interrelates the column and detector factors by mathematical treatment. Although the function of the detector can easily be imagined as independent of the chromatographic column, the on-line combination of the column and detector yields some new qualities typical of quantitative analysis by gas chromatography. Chapter 3 covers the major considerations in GC detection. The detectors are classified as concentration sensitive/nondestructive (CN), mass sensitive/nondestructive (MN), and mass sensitive/destructive (MD). These detector types are characterized directly in terms of the basic parameters in GC quantitation, i.e., the peak maximum solute concentration, total number of moles of solute, peak height, and peak area. In all cases, the equations relating response to GC parameters are derived and mathematical criteria are also given for the evaluation of the basic characteristics of the various detectors. In Chapter 4, the relationships between peak area and the amount of solute component in the chromatographic band are described. Within this general topic is included the analysis of the signal and response determining parameters of the various detector types, the theoretical and practical aspects involving linearity of response, the derivation of response equations for the various detector types relating the instantaneous amount of substance chromatographed in the sensing element and the detector response, and derivation of equations for the various detector types relating the total amount of the substance chromatographed passing through the sensing element and the time integral of the detector response. In addition, equations are derived relating the effect of an additional auxiliary gas stream on detector response. The molar and relative molar response correction factors are discussed and derived and the analytical significance of uncorrected quantitative parameters of the chromatogram are presented. Chapter 5 is the last chapter dealing with basic theory. It deals with the prediction of relative molar response and shows the possibility of theoretically estimating the relative molar response of the more important

detector types. Each detector is briefly described and theoretical values are compared with experimental data for each detector.

Chapters 6 and 7 are concerned with the methodological aspects of the problems. Chapter 6 presents a consistent survey of conventional working techniques. Each is discussed on the basis of mathematical expressions. The major areas included in this chapter are problem analysis, presentation of concentration, calibration techniques (absolute calibration, internal standardization, etc.), sample dilution, and experimental determination of correction factors. Chapter 7 is concerned with special techniques in sampling. The major areas discussed include the techniques of trapping components of gaseous samples, the extraction of liquid samples, and consideration of the calibration methods. Other topics discussed include multiple extraction techniques, head space gas analysis from a closed gas–liquid system, and gas analysis of nonfluidic materials (TLC spots, etc.). Applicable calibration methods are described.

Chapter 8 describes the problems and procedures of processing chromatograms. Manual techniques of peak area determinations are discussed and the methods of peak area calculations are presented with the advantages and limitations based on peak shape vs. accuracy of the measurement. Interpretation of chromatograms by peak height is discussed. Automatic processing of the chromatogram by mechanical disk integrators, electronic digital integrators and single purpose computers, and basic theory of the integration process is described. The problem of quantitating overlapping peaks is discussed with regard to the various methods available. The reliability of the chromatographic results is discussed in the final chapter, Chapter 9. Fundamental statistical definitions are given, sources of errors are discussed, and precision of results obtained by conventional techniques is presented.

The book concludes with a comprehensive list of references up to 1974. The author presents the material in a well-organized and logical order. I agree with the author's original premise that quantitative gas chromatography is a self-contained modern analytical discipline and think he has done an excellent job in interrelating the complex parameters in the quantitative process. I would recommend this text for anyone who is conscientiously involved in quantitative gas chromatography.

Milton Medical Laboratory **Joseph D. Musto**
Milton, Massachusetts 02187

The Botany and Chemistry of Hallucinogens. By Richard Evans Schultes and Albert Hofmann. Charles C Thomas, Springfield, Ill. 1973. xxii + 267 pp. $14.75.

There are very few definitive books concerned with natural hallucinogens. This work, although brief, has been written with authority by two acknowledged experts in the field, Richard Evans Schultes and Albert Hofmann.

The book is divided into five chapters. Chapter I, "Hallucinogenic or Psychotomimetic Agents: What Are They?", is a brief historical account (12 pp) from about 1855 of the major works and figures important to the subject matter of the book. This brief synopsis places in a capsule much information that is unavailable in any other single reference.

Chapter II, "The Botanical Distribution of Hallucinogens", is also very brief (4 pp) but clearly places in focus that the majority of hallucinogens are of plant origin.

The title of a very brief (5 pp) Chapter III entitled "The Chemical Distribution of Hallucinogens" is misleading, in that it simply gives the structures of the phenethylamine, tryptamine, β-carboline, lysergic acid, and other indole, tropane, isoxazole, and dibenzpyran hallucinogens, with a brief discussion of their interrelationships.

The true value of this book lies in Chapters IV and V. Chapter IV, "Plants of Hallucinogenic Use" (including fungi), in 178 pages, describes the botanical descriptions, history, methods of use, and active principles (where known) of 52 species in 26 genera and 13 families of higher plants, as well as six species of fungi. Of interest to the chemist is that the active principle(s) of several of these well-documented hallucinogenic plants remain unknown.

Chapter V, "Plants of Possible or Suspected Hallucinogenic Use" (24 pp), treats a large number of plants as in Chapter IV. Plants considered in this chapter are either not as well documented as hallucinogens or the active principles are unknown. This chapter presents a wealth of research projects to the natural products chemist interested in psychotomimetic compounds.

An excellent bibliography of 453 references is an invaluable feature of "The Botany and Chemistry of Hallucinogens", and the many pictures, line drawings, and illustrations cannot be found in any other reference source on this subject.

Finally, the paper used for this book is of excellent quality, the text is essentially free from error, and the price is attractive so that any person interested in the most remote manner in the subject of hallucinogenic plants must consider the book essential for his or her own private reference collection. Any library will surely want to include this classical treatment of natural hallucinogens in its holdings.

Department of Pharmacognosy and Pharmacology **Norman R. Farnsworth**
College of Pharmacy
University of Illinois at the Medical Center
Chicago, Illinois 60612