all yield from acetamidine hydrochloride, 2-phenyladenine (*Anal.* Calcd. for $C_{11}H_9N_5$: C, 62.6; H, 4.3. Found: C, 62.7; H, 4.3) in 81% over-all yield from benzamidine hydrochloride, 2,6-diaminopurine[10,16,17] in 70% over-all yield in two steps from guanidine carbonate, and isoguanine[9] in 54% over-all yield in two steps from urea. In a preliminary experiment, 2,6-diaminopurine was prepared in 71% yield *in one step* by heating a mixture of guanidine carbonate, potassium isonitrosomalononitrile, sodium hydrosulfite and formamide for one hour. Further investigations of the potential of this strikingly simple approach to purine synthesis are in progress.

(16) L. F. Cavalieri, A. Bendich, J. F. Tinker and G. B. Brown, This Journal, **70**, 3875 (1948).

(17) R. K. Robins, K. J. Dille, C. H. Willits and B. E. Christensen, *ibid.*, **75**, 263 (1953).

Frick Chemical Laboratory
Princeton University O. Vogl
Princeton, New Jersey E. C. Taylor

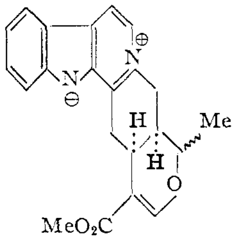
Received February 9, 1957

A GENERAL METHOD OF DETERMINATION OF THE STEREOCHEMISTRY OF CERTAIN INDOLE ALKALOIDS. THE STEREOCONFIGURATION OF SERPENTINE AND ALSTONINE[1]

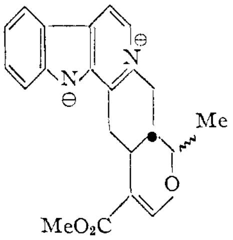
Sir:

The recently reported infrared method for determining the C-3 configuration of yohimbine- and ajmalicine-type alkaloids has permitted the ready classification of such compounds into two stereochemical categories: (1) *normal* or *allo*, and (2) *pseudo* or *epiallo* systems.[2] It is the purpose of the present communication to present a procedure for differentiating between *pseudo* and *epiallo* compounds, which, in view of the interconvertibility of (a) *normal* and *pseudo*, and (b) *allo* and *epiallo* products,[2,3,4] is also *the first general method for rapid elucidation of the relative configuration of all bridgehead hydrogen atoms, C-3, 15 and 20, of an indole alkaloid.*[5]

Palladium-maleic acid dehydrogenation of *epiallo* compounds proceeds at a rate appreciably lower than that of their *pseudo* analogs.[6] In view of the heterogeneous nature of the reaction and the irreproducibility of catalyst activity from one batch of catalyst to the next no absolute rate data were available. However semiquantitative relative rate results could be obtained by carrying out a series of simultaneous dehydrogenations on *epiallo* and *pseudo* derivatives, using the Majima method[6] under identical conditions, quenching the reactions at an arbitrary reaction time, based on a prior qualitative inspection of the catalyst activity, and undergoing an ultraviolet spectrophotometric comparison of the reaction mixtures with known standard mixtures of yohimbine and tetradehydroyohimbine. Thus (1) a four-hour run on 3-epi-α-yohimbine[7] and ψ-yohimbine[7] showed 25 and 90% oxidation, respectively, (2) an eight-hour run on 3-epi-α-yohimbyl[7] and ψ-yohimbyl alcohols [ψ-yohimbyl alcohol perchlorate, m.p. 290–291° (found: C, 56.33; H, 6.49; N, 6.46)] 65 and 90%, and (3) a four-hour run on *d,l*-epialloyohimbane[7] and ψ-yohimbane[2] 45 and 50%. Similar data on a number of combinations of *normal* or *allo* and *epiallo* derivatives also indicate the last to undergo dehydrogenation with the slowest rates. Finally, eight-hour runs on 3-isoajmalicine[2] and akuammigine,[7] showing 0 and 90% conversion, reveal them to be *epiallo* and *pseudo* products, respectively. Consequently, serpentine possesses structure I, while ajmalicine is its *allo* derivative.[8] Since the oxidation product of akuammigine, isolated as perchlorate, is identical with alstonine[7] perchlorate in infrared spectrum, melting point, 247–248° (no depression on admixture), and specific rotation $[\alpha]^{25}D + 152°$ (methanol), akuammigine can now be considered as 3-isotetrahydroalstonine, tetrahydroalstonine as having a *normal* configuration and alstonine as consisting of structure II.[9]

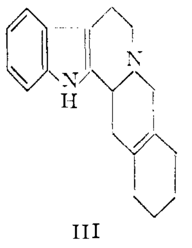


I

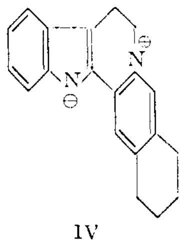


II

Catalytic ring C dehydrogenation has been found to be of general applicability and hence more useful than lead tetracetate oxidation.[7] Compounds as varied in stereochemistry and substituents as ajmalicine, yohimbone and deserpidine are transformed into serpentine, tetradehydroyohimbone [nitrate, m.p. 275–277° (found for $C_{19}H_{18}ON_2\cdot$



III



IV

---

[1] This work was supported in part by a research grant (M1301) from the National Institutes of Health, Public Health Service, Department of Health, Education and Welfare.

(2) E. Wenkert and D. K. Roychaudhuri, This Journal, **78**, 6417 (1956).

(3) F. L. Weisenborn and P. A. Diassi, *ibid.*, **78**, 2022 (1956).

(4) E. Wenkert and D. K. Roychaudhuri, *J. Org. Chem.*, **21**, 1315 (1956).

(5) The method is most useful for ring A unoxygenated ajmalicine-type alkaloids since the stereochemistry of yohimbine-type compounds can be ascertained equally well by application of the Oppenauer degradation to known yohimbone stereoisomers.[7]

(6) The Majima method of catalytic dehydrogenation [R. Majima and S. Murahashi, *Proc. Imp. Acad.* (*Tokyo*), **10**, 314 (1934)] was first used as a stereochemically diagnostic tool by E. Wenkert and L. H. Liu, *Experientia*, **11**, 302 (1955), in their structure analysis of deserpidine and related alkaloids.

(7) For a recent review on the stereochemistry of indole alkaloids *cf.* J. E. Saxton, *Quart. Rev.*, **10**, 108 (1956).

(8) Recently Chatterjee suggested the same configuration and an axial 19-methyl group for ajmalicine on the basis of the reported inertness of the ring E enol ether toward 2,4-dinitrophenylhydrazine in contrast to ready hydrazone formation by tetrahydroalstonine [A. Chatterjee and S. K. Talapatra, *Science and Culture*, **20**, 568 (1955)]. However her interpretation of this difference of reactivity in terms of the presented stereoconfiguration left much to be desired.

(9) Mayumbine[7] must be a C-19 epimer of either ajmalicine or tetrahydroalstonine.

$HNO_3·CH_3OH$: C, 62.42; H, 5.91; N, 10.96)], and tetradehydrodeserpidine [perchlorate, m.p. 190–192° (found: C, 56.66; H, 5.67; N, 4.27)], respectively. However, *d,l*-$\Delta^{15(20)}$-yohimbene (III),[10] m.p. 196–197° (found: C, 81.57; H, 7.72; N, 9.93), obtained by sodium borohydride reduction of sempervirine, is converted into a ring D dehydro product (IV) [nitrate, m.p. 305–306° (dec.), λ_{max}^{EtOH} 223,320 mμ (log ϵ 4.58, 4.33), λ_{min} 276 mμ (log ϵ 3.85) (found: C, 68.06; H, 5.60; N, 12.27)].[11] Mercuric acetate accomplishes the same transformation. Sodium borohydride reduction reverts IV into III, while hydrogenation of IV, at *p*H 10, leads to *d,l*-alloyohimbane.[12]

DEPARTMENT OF CHEMISTRY
IOWA STATE COLLEGE
AMES, IOWA

ERNEST WENKERT
DILIP K. ROYCHAUDHURI

RECEIVED JANUARY 21, 1957

---

[10] For the chemistry of the N_α-methyl derivative, see B. Witkop, THIS JOURNAL, **75**, 3361 (1953).

[11] Professor Elderfield has kindly informed the authors that tetrahydroalstoniline,[7] in essence also a $\Delta^{15(20)}$-dehydro compound, likewise undergoes ring D dehydrogenation, yielding alstoniline.[7]

[12] The authors are most grateful to Sir Robert Robinson, and Drs. Aghoramurthy, Diassi, Huebner, Lucas and MacPhillamy for a generous supply of alkaloids and their derivatives.

BOOK REVIEWS

Hydrogen Ions. Their Determination and Importance in Pure and Industrial Chemistry. Volume II. Fourth Edition, Revised and Enlarged. BY HUBERT T. S. BRITTON, D. Sc., London and Bristol, D.I.C., F.R.I.C., Professor of Chemistry and Director of the Washington Singer Laboratories, University of Exeter. D. Van Nostrand Company, Inc., 126 Alexander Street, Princeton, New Jersey. 1956. xix + 489 pp. 15 × 22 cm. Price, $12.50.

This second volume of the revised fourth edition is devoted for the most part to applications of *p*H measurements. The author is to be praised for his courage in assembling under one cover selections from a literature that has become enormous.

The general nature of the coverage is indicated as follows. Four chapters are devoted to precipitations of hydroxides, basic chromates, borates, carbonates, silicates, sulfides and phosphates. One chapter, each, deals with reactions between weak organic acids and inorganic bases, complex ions, analytical processes, detection of metals with organic reagents, electro-deposition of metals, sugar manufacture, pulp and paper manufacture, brewing, milk, eggs, baking, water purification and sewage disposal (including corrosion by waters), soils, ceramics, the dye and textile industries, ore flotation, and miscellaneous applications. Four chapters deal with the manufacture and tanning of leather. Notably lacking are reviews of applications in broad fields of biology such as biochemistry, physiology and bacteriology (except here and there). Relatively few applications in the broad field of organic chemistry are reviewed.

Several of the chapters may be characterized as annotated bibliographies and as such the necessarily limited bibliographies and the perspective provided by the notes will be useful to those who set about collecting all the information available in the literature.

The first chapter on oxidation-reduction potentials could be considered to be somewhat out of place in that the theory can be economically developed in direct connection with that of the special oxidation-reduction system H_2, H^+. However, it is used in connection with some important analytical methods. There are a few slips in this chapter but none of great importance except the lack of a comprehensive, systematic way of deriving the complex equations and failure to emphasize strongly enough the fact that two processes, which in the course of history were sometimes regarded to be distinct and separable, are often inseparably coupled. The reviewer, who was guilty of introducing the term rH for a strictly limited purpose, may be permitted to express regret that the author has used this term. It has become an unmitigated nuisance.

So far as a correlation between *p*H numbers and a given phenomenon is concerned it makes little difference how *p*H is interpreted theoretically. But one never knows when further theoretical treatment of the phenomenon may become confused by failure to recognize what an experimental method cannot reveal as well as what it can reveal. Many of the applications reviewed in this book have been formulated in terms of the activity of hydrogen ions (whatever these may be). Because it is impossible to determine precisely the activity of ions of a single kind, a concession has been made to those who follow the current trend of theory by defining *p*H in terms of activity while a trend toward formulations in terms of operations, with elimination of artificial definitions, is revealed in the arbitrary standardization of the *p*H scale. Accordingly the reader of volume II will have to refer to volume I to find the author's justification for his use of hydrogen ion *concentration*, for some clarification of the chapter on non-aqueous solutions and the "*p*H" numbers thereof and for interpretations of measurements made in odd ways of which several are mentioned. From this point of view it is a pity that theory and practice have been separated by the covers of two books. Some compensation is found in the fact that the index lists subjects in both volumes so that one finds juxaposition of *Activated sludge* and *Activity, Defecation of sugar juice* and *Degree of ionization, Eggs* and E_h, *Potatoes* and *Potentials*, etc.

The diagrams serve well particular purposes. However, one ordinate may be potentials referred to the normal calomel electrode, another potentials referred to the saturated calomel electrode, another potentials referred to the standardized, standard hydrogen electrode. The author may be excused because he takes over what he finds in the literature. There failure to reduce e.m.f. data to one standard is causing confusion in addition to that caused by the use of two opposing conventions regarding signs. It is to be hoped that in future editions Dr. Britton will help to unify the presentation of electromotive force data.

On the whole this book will serve well those interested in applications if only in providing annotated bibliographies.

DEPARTMENT OF CHEMISTRY
THE JOHNS HOPKINS UNIVERSITY
BALTIMORE, MD.

W. MANSFIELD CLARK

Light-Scattering in Physical Chemistry. By K. A. STACEY, Ph.D., Chester Beatty Cancer Research Institute. Academic Press, Inc., Publishers, 111 Fifth Avenue, New York 3, N. Y. 1956. viii + 230 pp. 14 × 25.5 cm. Price, $6.75.

"In the past decade the technique of light-scattering has seen a rapid development and its use extended to many branches of physical chemistry. Although the time is not yet ripe for an exhaustive or authoritative monograph on all its aspects the author felt that an attempt to review the