spectrum was unchanged, with the doublet appearing at τ 7.79 and the triplet at τ 8.98. In both solvents the coupling constant was 4.3 c.p.s. However, addition of deuteriotrifluoroacetic acid to the deuterium oxide solution reduced J to 3.9 c.p.s. without otherwise affecting the spectrum.

As expected, the infrared spectrum of quadricyclanone (I) in carbon tetrachloride indicated only cyclopropane-type hydrogens[3] with a single maximum at 3065 cm.$^{-1}$ in the C–H stretch region. The carbonyl stretching frequency was exceptionally low, occurring at 1746 cm.$^{-1}$ (5.73 μ). By comparison, the maxima of nortricyclanone,[2] 7-norbornone,[4] and 7-norbornenone[4,5] are reported at 1753 cm.$^{-1}$ (5.70 μ), 1780 cm.$^{-1}$ (5.62 μ), 1745 cm.$^{-1}$ (5.73 μ), and 1780 cm.$^{-1}$ (5.62 μ), respectively. Other significant maxima of I were observed at 1230, 996, 933, 898, and 846 cm.$^{-1}$.

Oxidation of 10 g. of 7-quadricyclanol (II)[1a] with 11 g. of t-butyl hypochlorite[6] in 9 g. of pyridine and 25 ml. of carbon tetrachloride according to the general procedure of Grob and Schmid[7] yielded 4.7 g. of crude product after short path distillation, b.p. 40° (2 mm.)–85° (0.5 mm.) Redistillation yielded 1.7 g., b.p. 50–55° (2 mm.), of still impure product containing 85% quadricyclanone (I) (14% yield) by g.p.c. analysis. The major impurity was unreacted quadricyclanol (II), b.p. 50–52° (2 mm.). The ketone (I) was purified by g.p.c. or by crystallization from pentane, m.p. 45–47°(cor.). *Anal.* Found for C_7H_6O: C, 78.64; H, 5.72. The melting point of I was unchanged after heating to 50° and resolidification in a partially evacuated capillary tube. On continued slow heating, the colorless liquid began to yellow at 140°. At 170° the dark red liquid began to bubble and at 200° only a dark tar remained. I reacted rapidly to form a 2,4-dinitrophenylhydrazone, m.p. 156–159° dec..

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(3) K. B. Wiberg and B. J. Nist, *J. Am. Chem. Soc.*, **83**, 1226 (1961).
(4) P. G. Gassman and P. G. Pape, *Tetrahedron Letters*, **No. 1**, 9 (1963).
(5) R. K. Bly and R. S. Bly, *J. Org. Chem.*, **28**, 3165 (1963).
(6) H. M. Teeter and E. W. Bell, *Org. Syn.*, **32**, 20 (1952).
(7) C. A. Grob and H. J. Schmid, *Helv. Chim. Acta*, **36**, 1763 (1953).

BELL TELEPHONE LABORATORIES, INC. PAUL R. STORY
MURRAY HILL, NEW JERSEY SUSAN R. FAHRENHOLTZ

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An Active Center Histidine Peptide of α-Chymotrypsin

Sir:

Through the work of Balls and Jansen,[1] Oosterbaan, *et al.*,[2] and others,[3] it has been established that a unique serine residue of α-chymotrypsin is the ultimate site of acylation and phosphorylation with several quasi-substrates and inhibitors. Peptides with substituted serine residues have been isolated and their structures have been determined. This work gives strong evidence for the participation of a serine hydroxylic group in the catalytic mechanism of this enzyme. A histidine residue was also thought to have an important function in the hydrolytic mechanism, but could not be identified until the recent development[4] in this laboratory of a new, specific, active center reagent for chymotrypsin, TPCK, L-1-tosylamido-2-phenylethyl chloromethyl ketone, which has now been isolated as a peptide derivative from the inhibited enzyme.

TPCK, a chloromethyl ketone derived from L-phenylalanine, inactivates chymotrypsin by a stoichiometric alkylation judged to be at histidine from the observed loss of one residue of this amino acid on acid hydrolysis.[4] The two histidine residues present in α-chymotrypsin are both in the B-chain; consequently, to locate the inhibitor, degradative studies were carried out on the B-chain isolated from chymotrypsin, inactivated by TPCK-C^{14}. Reductive cleavage of the disulfide bridges was accomplished by means of sodium sulfite and Cu^{+2} in 8 M urea,[5] and the S-sulfo derivatives then were separated on a DEAE-cellulose column according to the procedure of Desnuelle and coworkers.[6] The amino acid composition of the modified B-chain revealed the expected loss of one histidine residue.

The modified B-chain was digested with pepsin at 37° for 12 hr.; the resulting peptide mixture was prepurified on a column of Sephadex G-50 with 0.2 N acetic acid as eluent. Only one radioactive peak emerged from the column, and further fractionation was carried out on Dowex 50-X2 using volatile pyridine acetate buffers. Final purification was achieved on a column of DEAE-Sephadex. A pure radioactive peptide was obtained which had the amino acid composition shown in Table I which was determined by amino acid analysis according to the method of Spackman, *et al.*[7]

TABLE I

AMINO ACID COMPOSITION OF ACTIVE CENTER PEPTIDE DERIVED FROM α-CHYMOTRYPSIN-TPCK-C^{14}

Residue	μmoles	Number of residues	Keil, *et al.*[8] peptide no. 17
Asp	0.100	1.00	1.00
Thr	0.186	1.86	1.83
Ser	0.106	1.06	0.91
Gly	0.112	1.12	1.10
Ala	0.195	1.95	1.94
0.5Cys	0.091	0.91	0.94
Val	0.105	1.05	1.00
His	0	0	0.98
Inhibitor C^{14}	0.105[a]		

[a] Based on specific activity of TPCK-C^{14}.

Since the chemistry of the alkylation of histidine with TPCK is still unknown, no positive identification of a histidine derivative could be made. The radioactivity of this peptide which was introduced by means of TPCK-C^{14}, and the consistency of our finding that the modified histidine residue cannot be identified using the standard procedure for amino acid analysis, leave, however, no doubt about the significance of our results. As is obvious from Table I, additional strong support comes from the fact that the analysis of the isolated decapeptide is in excellent agreement with the composition of a histidine peptide as reported by Keil, *et al.*[8]

(1) A. K. Balls and E. F. Jansen, *Advan. Enzymol.*, **13**, 321 (1952).
(2) R. A. Oosterbaan, M. van Adrichem, and J. A. Cohen, *Biochim. Biophys. Acta*, **63**, 204 (1962).
(3) N. K. Schaffer, S. C. Nay, and W. H. Summerson, *J. Biol. Chem.*, **202**, 67 (1953).
(4) G. Schoellmann and E. Shaw, *Biochemistry*, **2**, 252 (1963).
(5) J. F. Pechere, G. H. Dixon, R. H. Maybury, and H. Neurath, *J. Biol. Chem.*, **233**, 1364 (1958).
(6) D. van Hoang, M. Rovery, A. Guidoni, and P. Desnuelle, *Biochim. Biophys. Acta*, **69**, 188 (1963).
(7) D. H. Spackman, W. H. Stein, and S. Moore, *Anal. Chem.*, **30**, 1190 (1958).
(8) B. Keil, Z. Prusik, L. Moravek, and F. Sorm, *Collection Czech. Chem. Commun.*, **27**, 2946 (1962).

More recently, the sequence of this peptide has also been described.[9] In the later paper, the authors changed the composition of the original reported peptide, replacing a threonine residue with a serine residue. Our results favor the composition as described in the earlier publication.[5]

From the present results and from the suggested primary structure of chymotrypsinogen[9] it is interesting to note that the histidine residue directly involved in the catalytic mechanism is linked to a cystine residue and, therefore, is subject to greatly restricted flexibility. The second histidine residue is held in the same general area due to an intrachain disulfide link, and an auxiliary role may exist for this residue in the catalytic mechanism of chymotrypsin, as seems to be the case in ribonuclease.[10] In the tertiary structure of chymotrypsin, the active center serine located in the C-chain must be spatially close to the histidine residue of the newly isolated peptide.

A detailed account of our results will be published later.

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(9) B. Keil, Z. Prusik, and F. Sorm, *Biochim. Biophys. Acta*, **78**, 559 (1963).

(10) A. M. Crestfield, W. H. Stein, and S. Moore, *J. Biol. Chem.*, **238**, 2421 (1963).

(11) Data taken from the dissertation to be submitted.

DEPARTMENT OF BIOCHEMISTRY ENG BEE ONG[11]
TULANE UNIVERSITY SCHOOL OF MEDICINE ELLIOTT SHAW
NEW ORLEANS, LOUISIANA 70112 GUENTHER SCHOELLMANN

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BOOK REVIEWS

Chemical Plant Taxonomy. Edited by T. SWAIN, Low Temperature Research Station, Cambridge, England. Academic Press, 111 Fifth Avenue, New York 3, N. Y. 1963. ix + 543 pp. 16 × 23.5 cm. Price, 110 s.

Perhaps the oldest method of classifying plants is based upon their chemical constituents even though these constituents could not have been recognized as chemical entities. But as our knowledge of plant constituents became more extensive, it became apparent that there was often more than a fortuitous relation between the chemical constitutents of plants and their interrelations.

For well over a century chemists have amused themselves by examining plant material, but it is only during the last three or four decades that this activity has become the major one of an increasing body of chemists. It is little wonder, therefore, that plant chemists and taxonomists have finally cooperated in effective ways. The immediate result is not one book but two appearing in this year. The first has already been reviewed (R. H. Manske, *J. Am. Chem. Soc.*, **85**, 3532 (1963)) and the second is the subject of this review. It should be remarked here that, fortunately for readers and authors, the two volumes are in every sense complementary and both should be within the reach of every taxonomist as well as of every plant chemist.

The present volume is the outcome of a Symposium held in Paris in October, 1962, at which the reviewer was an interested and impressed spectator. The editor properly describes the spirit of the Symposium in the first paragraph of the preface. "Systems of classification do not necessarily embody implications of relationship in their structure, but in fact, all those concerned with plants do employ such concepts to the greatest possible extent compatible with existing knowledge and practical utility. The ultimate natural system would be one based on an infallible knowledge of the genealogy, from one ancestral type, of every member included in it and, despite the impossibility of deriving such knowledge this is the ideal towards which the more natural systems pretend. In this context, chemistry may have more to contribute than any morphological analysis, not only because of the relative evanescence of most plant tissues in geological deposits, but because the biochemistry of evolutionary processes can be deduced from existing forms."

The volume is in 16 chapters each written by an authority in that subject. Space does not permit detailed discussion of these but some comments are in order. The first three chapters (S. M. Walters, J. Heslop-Harrison, and R. D. Gibbs, respectively) concern modern concepts of taxonomy and give a clear account of this subject and how it may be affected by chemical knowledge. H. Erdtman in Chapter 4 discusses the scope and limitations of chemotaxonomy. Chapters 5 and 8 to 16 are devoted to the usefulness of flavonoids (E. C. Bate-Smith), alkanes (G. Eglinton and R. J. Hamilton), acetylenes (N. A. Sorensen), fatty acids (F. B. Shorland), polyols and cyclitols (V. Plouvier), glycosides (R. Paris), anthocyanins (J. B. Harborne), alkaloids (R. Hegnauer), alkaloids of Rutaceae (J. R. Price), and sulfur compounds (A. Kjaer), in determining possible relations in orders, families, genera, and species. Chapter 6 (A. J. Birch) is devoted to "Biosynthetic Pathways" and Chapter 7 (H. Flück) is addressed to the problems of "Intrinsic and Extrinsic Factors" as they affect production of natural products.

The over-all impression of this volume is one of competence, and we are grateful that so much knowledge has been so well correlated. Misprints are negligibly few and the printing and formulas are excellent.

DOMINION RUBBER CO. R. H. MANSKE
RESEARCH LABORATORIES
GUELPH, ONTARIO, CANADA

Katalyse in der Organischen Chemie. By B. N. DOLGOV. **Organischeprüparative Methoden.** Edited by DR. W. KIRSTEN. Band 1. VEB Deutscher Verlag der Wissenschaffen, Berlin. 1963. 782 pp. 16.0 × 23.0 cm. Price, DM 74.

This book which was translated and edited by P. Heitmann and K. Urban from the second Russian edition consists of 14 chapters. The first two chapters (162 pp.) deal with the fundamental behavior of catalysts, properties and preparation of catalyst, and with theory and mechanisms of catalytic reactions. The remaining chapters describe catalytic reactions, namely oxidation, dehydrogenation, cracking, hydrogenation and hydrogenolysis, dehydration, hydration and hydrolysis, isomerization of hydrocarbons, polymerization, alkylation and arylation syntheses with oxygen-containing gases, and halogenation.

Although there is a great need for a one-volume comprehensive treatise on catalysis as applied to organic chemistry, the present book does not meet this need. The book is not written critically, and the author did not make an attempt to show whether the various theories dealing with contact catalysis, and which he described in the second chapter, can be applied to explain the experimental observations. The material is presented in a descriptive rather than in a didactic manner.

The chapters pertaining to ionic types of catalytic reactions such as isomerization, alkylation, polymerization, etc., are handled in an isolated manner. The author did not show the relations between the various reactions catalyzed by strong acids. The author seems to confuse the reader by describing under the same heading the alkylation of alkanes and that of aromatic hydrocarbons. It is well known that these two reactions proceed by different mechanisms.

In the chapter dealing with catalytic hydrogenation, the author failed to indicate the importance of stereoselective hydrogenation and of hydrogen–deuterium exchange studies for the understanding of the mechanism of hydrogenation.

The chapter describing the aromatization of alkanes is outdated although the modern aspects of this reaction were already described in 1956.