Organic Reactions

VOLUME 36

Organic Reactions

VOLUME 36

EDITORIAL BOARD

ANDREW S. KENDE, Editor-in-Chief

ENGELBERT CIGANEK

SAMUEL DANISHEFSKY

HEINZ W. GSCHWEND

STEPHEN HANESSIAN

STEVEN V. LEY

LARRY E. OVERMAN

LEO A. PAQUETTE

GARY H. POSNER

HANS J. REICH .

MARTIN SEMMELHACK

ROBERT BITTMAN, Secretary

Queens College of The City University of

New York, Flushing, New York

JEFFERY B. PRBSS, Secretary

Ortho Pharmaceuticals Corp., Raritan, New Jersey

EDITORIAL COORDINATOR

ROBERT M. JOYCE

ADVISORY BOARD

JOHN E. BALDWIN

VIRGIL BOEKELHEIDE

GEORGE A. BOSWELL, JR.

T. L. CAIRNS

DONALD J. CRAM

DAVID Y. CURTIN

WILLIAM G. DAUBEN

JOHN FRIED

RICHARD F. HECK

RALPH F. HIRSCHMANN

HERBERT O. HOUSE

BLAINE C. MCKUSICK

JAMES A. MARSHALL

JERROLD MEINWALD

HAROLD R. SNYDER

BARRY M. TROST

ASSOCIATE EDITORS

PAT N. CONFALONE

ROBERT ENGEL

EDWARD M. HUIE

THE LATE JAROSLAV MÁLEK

FORMER MEMBERS OF THE BOARD, NOW DECEASED

ROGER ADAMS

HOMER ADKINS

WERNER E. BACHMANN

A. H. BLATT

ARTHUR C. COPE

Louis F. Firms

JOHN R. JOHNSON

WILLY LEIMGRUBER

FRANK C. MCGREW

CARL NEMANN

Published by John Wiley & Sons, Inc.

Copyright © 1988 by Organic Reactions, Inc.

All rights reserved. Published simultaneously in Canada.

Reproduction or translation of any part of this work beyond that permitted by Section 107 or 108 of the 1976 United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to the Permissions Department, John Wiley & Sons, Inc.

Library of Congress Catalog Card Number 42-20265

ISBN 0-471-85748-3

Printed in the United States of America

PREFACE TO THE SERIES

In the course of nearly every program of research in organic chemistry the investigator finds it necessary to use several of the better-known synthetic reactions. To discover the optimum conditions for the application of even the most familiar one to a compound not previously subjected to the reaction often requires an extensive search of the literature; even then a series of experiments may be necessary. When the results of the investigation are published, the synthesis, which may have required months of work, is usually described without comment. The background of knowledge and experience gained in the literature search and experimentation is thus lost to those who subsequently have occasion to apply the general method. The student of preparative organic chemistry faces similar difficulties. The textbooks and laboratory manuals furnish numerous examples of the application of various syntheses, but only rarely do they convey an accurate conception of the scope and usefulness of the processes.

For many years American organic chemists have discussed these problems. The plan of compiling critical discussions of the more important reactions thus was evolved. The volumes of Organic Reactions are collections of chapters each devoted to a single reaction, or a definite phase of a reaction, of wide applicability. The authors have had experience with the processes surveyed. The subjects are presented from the preparative viewpoint, and particular attention is given to limitations, interfering influences, effects of structure, and the selection of experimental techniques. Each chapter includes several detailed procedures illustrating the significant modifications of the method. Most of these procedures have been found satisfactory by the author or one of the editors, but unlike those in Organic Syntheses they have not been subjected to careful testing in two or more laboratories.

Each chapter contains tables that include all the examples of the reaction under consideration that the author has been able to find. It is inevitable, however, that in the search of the literature some examples will be missed, especially when the reaction is used as one step in an extended synthesis. Nevertheless, the investigator will be able to use the tables and their accompanying bibliographies in place of most or all of the literature search so often required.

Because of the systematic arrangement of the material in the chapters and the entries in the table, users of the books will be able to find information desired by reference to the table of contents of the appropriate chapter. In the interest of economy the entries in the indices have been kept to a minimum, and, in particular, the compounds listed in the tables are not repeated in the indices.

The success of this publication, which will appear periodically, depends upon the cooperation of organic chemists and their willingness to devote time and effort to the preparation of the chapters. They have manifested their interest already by the almost unanimous acceptance of invitations to contribute to the work. The editors will welcome their continued interest and their suggestions for improvements in *Organic Reactions*.

Chemists who are considering the preparation of a manuscript for submission to Organic Reactions are urged to write either secretary before they begin work.

CUMULATIVE CHAPTER TITLES BY VOLUME

Volume 1 (1942)

- 1. The Reformasky Reaction. Ralph L. Shriner
- 2. The Arndt-Eistert Reaction, W. E. Bachmann and W. S. Struve
- 3. Chloromethylation of Aromatic Compounds, R. C. Fuson and C. H. McKeever
- 4. The Amination of Heterocyclic Bases by Alkali Amides, Martin T. Leffler
- 5. The Bucherer Reaction, Nathan L. Drake
- 6. The Elbs Reaction, Louis F. Fieser
- 7. The Clemmenson Reduction, Elmore L. Martin
- 8. The Perkin Reaction and Related Reactions, John R. Johnson
- The Acetoacetic Ester Condensation and Certain Related Reactions, Charles R. Hauser and Boyd E. Hudson, Jr.
- 10. The Mannich Reaction, F. F. Blicke
- 11. The Fries Reaction, A. H. Blatt
- 12. The Jacobsen Reaction, Lee Irvin Smith

Volume 2 (1944)

- 1. The Claisen Rearrangement, D. Stanley Tarbell
- 2. The Preparation of Aliphatic Fluorine Compounds, Albert L. Henne
- 3. The Cannizzaro Reaction, T. A. Geissman
- 4. The Formation of Cyclic Ketones by Intramolecular Acylation, William S. Johnson
- Reduction with Aluminum Alkoxides (The Meerwein-Poundorf-Verley Reduction),
 A. L. Wilds

- 6. The Preparation of Unsymmetrical Biaryls by the Diazo, Reaction and the Nitrosoacetylamine Reaction, Werner E. Bachmann and Roger A. Hoffman
- Replacement of the Aromatic Primary Amino Group by Hydrogen, Nathan Kornblum
- 8. Periodic Acid Oxidation, Frnest L. Jackson
- 9. The Resolution of Alcohols, A. W. Ingersoll
- The Preparation of Aromatic Arsonic and Arsinic Acids by the Bart, Béchamp, and Rosenmund Reactions, Cliff S. Hamilton and Jack F. Morgan

Volume 3 (1946)

- The Alkylation of Aromatic Compounds by the Friedel-Crafts Method, Charles C. Price
- 2. The Willgerodt Reaction, Marvin Carmack and M. A. Spielman
- 3. Preparation of Ketenes and Ketene Dimers, W. E. Hanford and John C. Sauer
- Direct Sulfonation of Aromatic Hydrocarbons and Their Halogen Derivatives,
 C. M. Suter and Arthur W. Weston
- 5. Aziactones, H. E. Carter
- 6. Substitution and Addition Reactions of Thiocyanogen, John L. Wood
- 7. The Hofmann Reaction, Everett S. Wallis and John F. Lane
- 8. The Schmidt Reaction, Hans Solff
- 9. The Curtius Reaction, Peter A. S. Smith

Volume 4 (1948)

- 1. The Diels-Alder Reaction with Maleic Anhydride, Milton C. Kloetzel
- 2. The Diels-Alder Reaction: Ethylenic and Acetylenic Dienophiles, H. L. Holmes
- 3. The Preparation of Amines by Reductive Alkylation, William S. Emerson
- 4. The Acyloins, S. M. McElvain
- 5. The Synthesis of Benzoins, Walter S. Ide and Johannes S. Buck
- 6. Synthesis of Benzoquinones by Oxidation, James Cason
- The Rosenmund Reduction of Acid Chlorides to Aldehydes, Erich Mosettig and Ralph Mozingo
- 8. The Wolff-Kishner Reduction, David Todd

Volume 5 (1949)

- 1. The Synthesis of Acetylenes, Thomas L. Jacobs
- 2. Cyanoethylation, H. A. Bruson
- The Diels-Alder Reaction: Quinones and Other Cyclenones, Lewis W. Butz and Anton W. Rytina
- Preparation of Aromatic Fluorine Compounds from Diazonium Fluoborates: The Schiemann Reaction, Arthur Roe
- The Friedel and Crafts Reaction with Aliphatic Dibasic Acid Anhydrides, Ernst Berliner
- 6. The Gattermann-Koch Reaction, Nathan N. Crouse
- 7. The Leuckart Reaction, Maurice L. Moore
- 8. Selenium Dioxide Oxidation, Norman Rabjohn
- 9. The Hoesch Synthesis, Paul E. Spoerri and Adrien S. DuBois
- The Darzens Glycidic Ester Condensation, Melvin S. Newman and Barney J. Magerlein

Volume 6 (1951)

- 1. The Stobbe Condensation, William S. Johnson and Guido H. Daub
- The Preparation of 3,4-Dihydroisoquinolines and Related Compounds by the Bischler-Napieralski Reaction, Wilson M. Whaley and Tuticorin R. Govindachari
- The Pictet-Spengler Synthesis of Tetrahydroisoquinolines and Related Compounds, Wilson M. Whaley and Tuticorin R. Govindachari
- 4. The Synthesis of Isoquinolines by the Pomeranz-Fritsch Reaction, Walter J. Gensler
- 5. The Oppenauer Oxidation, Carl Djerassi
- 6. The Synthesis of Phosphonic and Phosphinic Acids, Gennady M. Kosolapoff
- The Halogen-Metal Interconversion Reaction with Organolithium Compounds, Reuben G. Jones and Henry Gilman
- 8. The Preparation of Thiazoles, Richard H. Wiley, D. C. England, and Lyell C. Behr
- The Preparation of Thiophenes and Tetrahydrothiophenes, Donald E. Wolf and Karl Folkers
- 10. Reductions by Lithium Aluminum Hydride, Weldon G. Brown

Volume 7 (1953)

- 1. The Pechmann Reaction, Suresh Sethna and Ragini Phadke
- 2. The Skraup Synthesis of Quinolines, R. H. F. Manske and Marshall Kalka
- Carbon-Carbon Alkylations with Amines and Ammontum Salts, James H. Brewster and Ernest L. Eliel
- 4. The von Braun Cyanogen Bromide Reaction, Howard A. Hageman
- Hydrogenolysis of Benzyl Groups Attached to Oxygen, Nitrogen, or Sulfur, Walter H. Hartung and Robert Simonoff
- 6. The Nitrosation of Alighatic Carbon Atoms, Oscar Touster
- Epoxidation and Hydroxylation of Ethylenic Compounds with Organic Peracids, Daniel Swern

Volume 8 (1954)

- 1. Catalytic Hydrogenation of Esters to Alcohols, Homer Adkins
- The Synthesis of Ketônes from Acid Halides and Organometallic Compounds of Magnesium, Zinc, and Cadmium, David A. Shirley
- The Acylation of Ketones to Form β-Diketones or β-Keto Aldehydes, C. R. Hauser, Frederic W. Swamer, and Joe T. Adams
- 4. The Sommelet Reaction, S. J. Angyal
- 5. The Synthesis of Aldehydes from Carboxylic Acids, Erich Mosettig
- 6. The Metalation Reaction with Organolithium Compounds, Henry Gilman
- 7. **\(\beta\)-Lactones,** Harold E. Zaugg
- The Reaction of Diazomethane and Its Derivatives with Aldehydes and Ketones,
 David Gutsche

Volume 9 (1957)

- The Cleavage of Non-enolizable Ketones with Sodium Amide, K. E. Hamlin and Arthur W. Weston
- 2. The Gattermann Synthesis of Aldehydes, William E. Truce
- 3. The Baeyer-Villiger Oxidation of Aldehydes and Ketones, C. H. Hassall
- 4. The Alkylation of Esters and Nitriles, A. C. Cope, H. L. Holmes, and H. O. House
- 5. The Reaction of Halogens with Silver Salts of Carboxylic Acids, C. V. Wilson
- 6. The Synthesis of \$-Lactams, John C. Sheehan and Elias J. Corey

 The Pschorr Synthesis and Related Diazonium Ring Cloque Reactions, DeLos F. DeTar

Volume 10 (1959)

- 1. The Coupling of Diazonium Salts with Aliphatic Carbon Atoms, Stanley M. Parmerter
- 2. The Japp-Klingemann Reaction, Robert R. Philips
- 3. The Michael Reaction, Ernst D. Bergmann, David Ginsburg, and Raphael Pappo

Volume 11 (1960)

- 1. The Beckmann Rearrangement, L. Guy Donaruma and Walter Z. Heldt
- The Demjanov and Tiffeneau-Demjanov Ring Expansions, Peter A. S. Smith and Donald R. Baer
- Arylation of Unsaturated Compounds by Diazonium Salts, Christian S. Rondestvedt, Jr.
- 4. The Favorskii Rearrangement of Haloketones, Andrew S. Kende
- Olefins from Amines: The Hofmann Elimination Reaction and Amine Oxide Pyrolysis, A. C. Cope and Elmer R. Trumbull

Volume 12 (1962)

- Cyclobutane Derivatives from Thermal Cycloaddition Reactions, J. D. Roberts and Clay M. Sharts
- 2. The Preparation of Olefins by the Pyrolysis of Xanthates. The Chugaev Reaction, Harold R. Nace
- 3. The Synthesis of Aliphatic and Alicyclic Nitro Compounds, Nathan Kornblum
- 4. Synthesis of Peptides with Mixed Anhydrides, Noel F. Albertson
- 5. Desulfurization with Raney Nickel, George R. Pettit and Eugene E. van Tamelen

Volume 13 (1963)

- Hydration of Olefins, Dienes, and Acetylenes via Hydroboration, George Zweifel and Herbert C. Brown
- 2. Halocyclopropanes from Halocarbenes, Edward E. Schweizer
- Free Radical Additions to Olefins to Form Carbon-Carbon Bonds, Cheves Walling and Earl S. Huyser
- Formation of Carbon-Heteroatom Bonds by Free Radical Chain Additions to Carbon-Carbon Multiple Bonds, F. W. Stacey and J. F. Harris, Jr.

Volume 14 (1965)

- 1. The Chapman Rearrangement, J. W. Schulenberg and S. Archer
- 2. a-Amidoalkylations at Carbon, Harold E. Zaugg and William B. Martin
- 3. The Wittig Reaction, Adalbert Maercker

Volume 15 (1967)

- 1. The Dieckmann Condensation, John P. Schaefer and Jordan J. Bloomfield
- 2. The Knoevenagel Condensation, G. Jones

Volume 16 (1968)

1. The Aidol Condensation, Arnold T. Nielsen and William J. Houlihan

Volume 17 (1969)

- The Synthesis of Substituted Ferrocenes and Other π-Cyclopentadienyi-Transition
 Metal Compounds, Donald E. Bublitz and Kenneth L. Rinehart, Jt.
- The γ-Alkylation and γ-Arylation of Dianions of β-Dicarbonyl Compounds, Thomas M. Harris and Constance M. Harris
- 3. The Ritter Reaction, L. I. Krimen and Donald J. Cota

Volume 18 (1970)

- Preparation of Ketones from the Reaction of Organolithium Reagents with Carboxylic Acids, Margaret J. Jorgenson
- The Smiles and Related Rearrangements of Aromatic Systems, W. E. Truce, Eunice M. Kreider, and William W. Brand
- 3. The Reactions of Diazoacetic Esters with Alkenes, Alkynes, Heterocyclic, and Aromatic Compounds, Vinod David and E. W. Warnhoff
- The Base-Promoted Rearrangements of Quaternary Ammonium Salts, Stanley H. Pine

Volume 19 (1972)

- 1. Conjugate Addition Reactions of Organocopper Reagents, Gary H. Posner
- Formation of Carbon-Carbon Bonds via π-Allylnickel Compounds, Martin F. Semmelhack

- 3. The Thiele-Winter Acetoxylation of Quinones, J. F. W. McOmie and J. M. Blatchly
- 4. Oxidative Decarboxylation of Acids by Lead Tetraacetate, Roger A. Sheldon and Jay K. Kochi

Volume 20 (1973)

- Cyclopropanes from Unsaturated Compounds, Methylene Iodide, and Zine-Copper Couple, H. E. Simmons, T. L. Cairns, Susan A. Vladuchick, and Connie M. Hoiness
- 2. Sensitized Photooxygenation of Olefins, R. W. Denny and A. Nickon
- 3. The Synthesis of 5-Hydroxyindoles by the Nenitzescu Reaction, George R. Allen, Jr.
- 4. The Zinin Reduction of Nitroarenes, H. K. Porter

Volume 21 (1974)

- Fluorisation with Sulfur Tetrafluoride, G. A. Boswell, Jr., W. C. Ripka, R. M. Scribner, and C. W. Tullock
- 2. Modern Methods to Prepare Monofluoroaliphatic Compounds, William A. Sheppard

Volume 22 (1975)

- 1 The Claisen and Cope Rearrangements, Sara Jane Rhoads and N. Rebecca Raulins
- 2. Substitution Reactions Using Organocopper Reagents, Gary H. Posner
- 3. Clemmensen Reduction of Ketones in Anhydrous Organic Solvents, E. Vedējs
- 4. The Reformatsky Reaction, Michael W. Rathke;

Volume 23 (1976)

- Reduction and Related Reactions of α,β-Unsaturated Compounds with Metals in Liquid Antmonia, Drury Caine
- The Acyloin Condensation, Jordan J. Bloomfield, Dennis C. Owsley, and Janice M. Nelke
- 3. Alkenes from Tosylhydrazones, Robert H. Shapiro

Volume 24 (1976)

 Homogeneous Hydrogenation Catalysts in Organic Synthesis, Arthur J. Birch and David H. Williamson

- 2 Ester Cleavages via S.2-Type Dealkylation. John E. McMurry
- 3 Arylation of Sense meated Compounds by Diazonium Salts (The Meerwein Arylation Reaction), Chamber S. Rondestvedt, Jr.
- 4 Selenium Dioxide Oxidation, Norman Rabiohn

Volume 25 (1977)

- 1 The Ramberg-Bäckland Rearrangement, Leo A. Paquette
- 2. Synthetic Applications of Phosphoryl-Stabilized Anions, William S. Wadsworth, Jr.
- Hydrocyanation of Conjugated Carbonyl Compounds, Wataru Nagata and Mitsuru Yoshioka

Volume 26 (1479)

- 1 Heteroatom-Facilitated Lithiations, Heinz W Gschwe id and Herman R. Rodríguez
- Intramolecular Reactions of Diazocarbonyl Compounds, Steven D. Burke and Paul A. Grieco

Volume 2" (1982)

- 1 Allylic and Benzylic Carbanions Substituted by Heteroatoms, Jean-François Biellmann A and Jean-Bernard Ducep
- 2 Palladium-Catalyzed Vinylation of Organic Halides, Richard F. Heck

*

Valume 28 - 19821

- 1 The Reimer-Tiemann Reaction, Hans Wynberg and Egbert W Meijer
- The Friedländer Synthesis of Quinolines, Chia-Chung Cheng and Shou-Jen Yan
- 3. The Directed Aldol Reaction, Teruaki Mukaiyama

Volume 29 : 19831

- Replacement of Alcoholic Hydroxy Groups by Halogens and Other Nucleophiles via Oxyphosphonium Intermediates, Bertrand R Castro
- Reductive Dehalogenation of Polyhalo Ketones with Low-Valent Metals and Related Reducing Agents. Ryoji Noyori and Yoshihiro Hayakawa
- Base-Promoted Isomerizations of Epoxides, Fack K. Crandell and Marcel Apparo

Volume 30 - 1984:

- Photocyclization of Stilbenes and Related Molecules. Frank B. Mellor, and Cleha W. Maliory
- Olefin Synthesis via Deoxygenation of Vicinal Diols. Frie Block

Volume 1. 19881

Addition and Substitution Reactions of Nitrile-Stabilized Carbanions Simeon Arseniyadis, Keith S. Kyler, and David S. Watt

Volume 32 (1984)

- 1 The Intramosecular Diels-Alder Reaction, Engelbert Ciganek
- Synthesis Using Alkyne-Derived Alkenyl- and Alkynylaturninum Compounds, George Zweifel and Joseph A. Miller

Volume ... 179051

- i Formation of Carbon-Carbon and Carbon-Heteroatom Bonds via Organoboranes and Organobe ates. Er-Ichi Negishi and Michael J. Idacavage
- The Vinylcyclopropane-Cyclopentene Rearrangement, Tomáš Hudlicky. Toní M Kutchan, and Saiyid M. Naqví

Volume 34 (1985)

- I. Reductions by Metal Alkoxyaluminum Hydrides, Jaroslav Málek
- 2. Fluorination by Sulfur Tetrafluoride, Chia-Lin J Wang

Volume 35 : 1987

- Fig. The Beckmann Reactions: Rearrangements, Elimination-Additions, Fragmentations, and Rearrangement-Cyclizations. Robert F. Gawley
- The Persulfate Oxidation of Phenols and Arylamines (The Elbs and The Boyland-Sims Oxidations), F. J. Behrman
- Fluorination with Diethylaminosulfur Trifluoride and Related Aminofluorosulfuranes, Miloš Hudlický

٠,

CONTENTS

CHA	APTER	PAGE
1.	THE [3 + 2] NITRONE-OLEFIN CYCLOADDITION REACTION Pat N. Confalone and Edward M. Huie	1
2.	PHOSPHORUS ADDITION AT Sp^2 CARBON Robert Engel	175
3.	REDUCTIONS BY METAL ALKOXYALUMINUM HYDRIDES. PART II. CARBOXYLIC ACIDS AND DERIVATIVES, NITROGEN COMPOUNDS, AND SULFUR COMPOUNDS Jaroslav Målek	249
Au	THOR INDEX, VOLUMES 1-36	591
Сн	APTER AND TOPIC INDEX, VOLUMES 1–36	595

CHAPTER 1

THE [3 + 2] NITRONE-OLEFIN CYCLOADDITION REACTION

PAT N. CONFALONE AND EDWARD M. HUIE

Central Research and Development Department, Experimental Station, E. I. du Pont de Nemours and Company, Wilmington, Delaware

CONTENTS

													PAGE
ACKNOWLEDGMENTS .													3
Introduction									, .				3
Preparation of the Nitr	ONE CO	MPONEN	Т.						Ė,				5
Oxidation of N,N-Disub	ostituted	Hydro	xyla	mine	S.				· .				5
Condensation Reactions	with C	arbonyl	Cor	mpou	ınds								6
Miscellaneous Methods								٠.					7
STABILITY OF THE NITRONE	Сомро	NENT											8
MECHANISM								/		•			9
REGIOSELECTIVITY AND STE	REOSELE	CTIVITY	OF 3	гне І	NTERN	4OLEC	ULAR	REA	CTIÓN				13
Aryl Monosubstituted C	lefins .							1.					13
Alkyl Monosubstituted	Olefins					_				-{	·		15
Electron-Deficient Mone	osubstitu	ated Ole	fins					1					16
Electron-Rich Monosub												·	20
1,1-Disubstituted Olefins	5							- (-	-			21
1,2-Disubstituted Olefins	š	_					Ċ	Ċ	·	•	į	•	23
Cyclic Olefins							÷			Ī	·	-	24
Acyclic Trisubstituted O	lefins .											:	26
Cyclic Trisubstituted Old										•	7	•	27
Tetrasubstituted Olefins							·		Ċ	·	·	•	29
Monosubstituted Acetyle	enes .									•	<i>i</i>	·	29
Disubstituted Acetylenes	· .					. 5		i		Ţ.	, * *	•	31
Stability of 4-Isoxazoline	. s									•		•	31
REGIOSELECTIVITY AND STE	REOSFLE	CTIVITY	OF T	HE D	NTRAN	OLEC	III AR	REA	· CTION	•	•	•	32
C-Alkenylnitrones .							CLITT		01101	•	•	•	32
Olefin Aldehydes an	d N-Su	bstitute	d H	vdrox	vlam	nes	•	•	•	•	•	•	32
Heteroatom-Linked							d Hu	drox	vlami	nee	•	,	39
Olefin Ketones and	N-Subs	tituted i	Hvd	mxvi	amine	**	~,	UIVA	y realiz	LICO	•	•	40
Heteroatom-Linked	Olefin 1	Ketones	and	1 N-S	inheti	hited	Hydi	ovel	amina		•	•	44
N-Alkenylnitrones .				• • • ~			11,0	ONJE	21111110	.	•		44
N-Alkenylhydroxyla	mines a	nd Alde	hvd	es.	•	•	•	z* -	•	٠	•		44
APPLICATIONS TO NATURAL					RSPS	•	•	. •		•	•.	•	46
Introduction		01/		. 17 1 3 1		•	•	•	• ,	•	•	•	46 46
Intramolecular Cycloadd	itions	:	•	•	1	•	į	•		•	•	•	40 47
Biotin (Vitamin H)		•	•	•	•	•	•	•	•	•	•	٠	47
Amino Glycosides	•		•	•	•	•	•	•	•	•	•	•	4/

Ergot Alkaloids .										. 4
Lycopodium Alkaloids										. 5
Tropane Alkaloids .										. 5
(+)-Adaline .										. 5
Nitrogen-Free Systems										. 5
Intermolecular Cycloaddition	Syntheses	Based	on 1-Py	rrolir	ie-1-c	oxide				. 5
Elaeocarpus Alkaloids										. 54
Pyrrolizidine Alkaloids										. 50
Syntheses Based on 2,3,4,5-Te	trahydrop	yridine-	1-oxide	(THI	PO)					. 5
Quinolizidine Alkaloids										. 5
Quinolizidine Alkaloids Miscellaneous Alkaloids										. 5
Miscellaneous Intermolecular										
Amino Acids										
										. 62
EXPERIMENTAL PROCEDURES.										. 6.
2-Butyl-3-methyl-5-cyanoisc						with	an El	lectro	n-De	
cient Monosubstituted Olef										. 62
5-Ethoxy-2-methyl-3-phenyl	lisoxazolid	line (Re	action o	f a Ni	trone	with	an E	lectro	n-Ric	:h
Monosubstituted Olefin)										. 6
2-Phenyl-3-n-propylisoxazo			rboxvlic	Acid	i N.	Phen	dimic	le.(R	eactio	
of a Nitrone with a Cyclic I	Disubstitus	ted Ole							CHUCIT	. 6
Ethyl 4-Cyano-2-phenyl-3,									on of	
Nitrone with an Acyclic Tri						-		·		. 6
4-(9-Acridinyl)-2,3-diphenyl-										
13-Methyl-12-oxa-13-azatric										
of a Keto Olefin and an N-										. 64
1,11\$-Dimethyl-2a\$,3,4,5,5a		a tryan	Oxylanıı	неј					•	. 0
		a = 11h	llaf da	danak	udea	241		مام		
									اممطط	12
[5,4,3-k,I]benzo[b]quinoliza	n-6-one (H	leteroat	tom-link	ed C	-Alke	nylni	trone	Сус		
[5,4,3-k,1]benzo[b]quinolizii tion of a Keto Olefin and a	n-6-one (H n N-Subst	leteroat ituted I	tom-link Hydroxy	ed C	-Alke 1e)	nylni	trone	Сус		. 64
[5,4,2-k,1]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe	n-6-one (H n N-Subst enylphenar	leteroat ituted I nthro[9	tom-link Hydroxy ,10-c]isc	ed C lamin	-Alke ie) le (C-	nylni Alke	trone nylnit	Cyc 	Cycle	, 64 o-
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok	n-6-one (H n N-Subst enylphenar efin and a	leteroat ituted I nthro[9 n N-Sul	tom-link Hydroxy ,10-c]isc bstitutec	ed C lamii xazo l Hyo	-Alke ne) le (C- lroxy	nylni Alke lamir	trone nylnit e)	Cyc rone	Cycle	. 64 o- . 63
[5,4,3-k,I]benzo[b] quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ole 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa	n-6-one (H n N-Subst enylphenarefin and an hydro-2-b	leteroat ituted I nthro[9, n N-Sul xenzyl-2	tom-link Hydroxy ,10-c]isc bstituted 2H, 3E	ed Claminoxazo Hyd I Hyd I-thie	-Alke ne) le (C- lroxy no[3'	Alke lamin	trone nylnit e) 3,3a,4	Cyc rone	Cycle lohep	, 64 0- , 63 t-
[5,4,3-k,I]benzo[b] quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ole 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d] isoxazole (Heteroatom-1	n-6-one (Hon N-Substant) nylphenare fin and and and hydro-2-banked C-	leteroat ituted I nthro[9, n N-Sul enzyl-2 Alkenyl	tom-link Hydroxy ,10-c]isc bstituted 2H, 3H Initrone	ed C lamin xazo l Hyd l-thie Cycl	-Alkene) le (C- lroxy no[3' loadd	Alke lamin	trone nylnit e) 3,3a,4	Cyc rone	Cycle lohep	. 64 0- . 6: t- le
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted	n-6-one (Hen N-Substenylphenare efin and an hydro-2-trinked C-1 Hydroxy	leteroat ituted I nthro[9, n N-Sul enzyl-2 Alkenyl lamine)	tom-link Hydroxy, $10-c$]isc bstituted 2H, $3HInitrone$	ed C lamin exazo I Hyd I-thie Cycl	-Alke ie) le (C- lroxy no[3' loadd	Alke lamin ,4',5'	trone . nylnit e) 3,3a,4 of a	Cyc rone 4]cyc n Al	Cycle lohep dehyc	. 64 o- . 6: t- le . 6:
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azato	n-6-one (Henn N-Substemylphenare of and	leteroat ituted I nthro[9, n N-Sul enzyl-2 Alkenyl lamine) 5.3.1.1.2	tom-link Hydroxy ,10-c]isc bstituted 2H, 3H Initrone	ed C lamin exazo I Hyc l-thie Cycl	-Alke ie) le (C- lroxy no[3' loadd	Alke lamin ,4',5': lition	trone . nylnit e) 3,3a,4 of a . cenyli	Cyc trone 4]cyc n Ale	Cycle . lohep dehyc	. 64 0- . 6: t- le . 6: y-
[5,4,2-k,I]benzo[b] quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ole 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa[d] isoxazole (Heteroatom-1 Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl	n-6-one (Honor of N-Substant) In N-Substant) In N-Substant of N-Substant of N-2-t Inked C-1 Hydroxy In N-Substant of N-Substant	leteroat ituted I hthro[9, n N-Sul penzyl-2 Alkenyl lamine) 5.3.1.1.2 mine a	tom-link Hydroxy ,10-c]isc bstituted 2H, 3H Initrone 1 150 ^{3.9}]do nd an A	ed C lamin xazo i Hyd t-thie Cycl odeca ldehy	-Alkene) le (C- lroxy no[3' loadd . ne (a	Alkelamin ,4',5': lition	trone nylnit e) 3,3a,4 of a cenyli	Cyc trone 4]cyc n Al	Cycle . lohep dehyc	. 64 0 65 t- le . 65 y 65
[5,4,3-k,I]benzo[b]quinolizition of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ole 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa[d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey.	n-6-one (Honor Company) n N-Substanylphenare of and an and an and an and an and archiver of the company of the	leteroat ituted I nthro[9, n N-Sul penzyl-2 Alkenyl lamine) 5.3.1.1.2 umine au	tom-link Hydroxy, 10-c]isc bstituted 2H, 3H Initrone 150 ^{3.9}]do nd an A	ed C lamin xazo I Hyd I-thie Cycl odeca ldehy	-Alke ie) le (C- lroxy no[3' loadd ne (s'de	Alkerlamin ,4',5'. lition	trone nylnit e) 3,3a,4 of a cenyli	Cyc trone 4]cyc n Al	Cycle . lohep dehyc	. 64 0- . 6: t- le . 6: y-
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions	n-6-one (Hen N-Substenylphenaretin and analydro-2-bender C-1 Hydroxyetracyclo[1]	ituted Inthro[9, N-Sulpenzyl-2 Alkenyllamine) 5.3.1.1.2	tom-link Hydroxy, 10-c]isc bstituted EH, 3E Initrone	ed C lamin exazo I Hyd I-thie Cycl odeca ldehy	-Alkene) le (C-lroxy no[3' loadd . ne (ade	Alkerlamin ,4',5': lition	trone . nylnit .e) 3,3a,4 of a . cenyli	Cyc	Cycle lohep dehyc ne C	. 64 co 6: t- le . 6: y 6: . 66 . 66
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions Table I. Aldehyde-Derived	n-6-one (Hen N-Substenylphenaretin and analydro-2-benediction of the contraction of the c	ituted I ituted I ituted I ituted I inthro[9, n N-Sul penzyl-2 Alkenyl ilamine) 5.3.1.1.2 imine and and Mo	tom-link Hydroxy, 10-c]isc bestituted BH, 3H Initrone 1,503.9]dond an A	ed C lamin xazo i Hyc l-thie Cyclodeca ldehy	-Alkenie) le (C-lroxy no[3' loadd . ne (s'de	Alkerlamin ,4',5': lition N-All	trone . nylnit e) 3,3a,4 of a . cenyli	Cyc trone 4]cyc n Al	Cycle lohep dehyc ne C	. 64
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions Table I. Aldehyde-Derived Table II. Aldehyde-Derived	n-6-one (Hen N-Substenylphenaretin and an alphydro-2-benediction of the desired contraction of the des	leteroat ituted I inthro[9, n N-Sul penzyl-2 Alkenyl lamine, 5,3,1,1,2, mine and and Mo and 1,1	tom-link Hydroxy, 10-c]isc bstituted P.H. 3H Initrone of 303.9]do nd an A	ed C lamin exazo I Hyd I-thie Cyclodeca ldehy	-Alkene) le (C- lroxy no[3' loadd . ne (a' l Olei d Olei	Alkerlamin ,4',5': lition N-All	trone . nylnit e) 3,3a,4 of a . cenyli	Cyc trone 4]cyc n Ale	Cycle lohep dehyc ne C	. 64 co 6: t- le . 6: y 6: . 66 . 66
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table III. Aldehyde-Derived Table III. Aldehyde-Derived	n-6-one (Hen N-Substenylphenaretin and analydro-2-benedit (Hydroxylatracyclo) (Hydroxylatrones a Nitrones a Nitrones	leteroat ituted I inthro[9, n N-Sul benzyl-2 Alkenyl lamine, 5.3.1.1.2 imine and and 1,1 and 1,2	tom-link Hydroxy, 10-c]isc bstitutec H, 3H Initrone) .503.9]di nd an A nosubst -Disubs 2-Disubs	ed C lamin exazo I Hyc I-thie Cycl odeca ldehy ituted titute	-Alkene) le (C- lroxy no[3' loadd . ne (fide . l Olei d Olei d Cis	Alkerlamin ,4',5': lition N-All fins efins -Olef	trone . nylnit e) 3,3a,4 of a . cenyli	trone 4]cycin Ale	Cycle . lohep dehyc . ne C	. 64
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table III. Aldehyde-Derived Table III. Aldehyde-Derived Table IV. Aldehyde-Derived	n-6-one (Hen N-Substenylphenaretin and analydro-2-benediction of the control of t	leteroat ituted I inthro[9, in N-Sul enzyl-2 Alkenyl damine) 5.3.1.1.2 ind Mo and 1,1 and 1,2 and 1,2	tom-link Hydroxy, 10-c]isc bstitutec H, 3H Initrone) .503.9]di nd an A nosubst -Disubs 2-Disubs 2-Disubs	ed C lamin exazo I Hyc I-thie Cycl odeca ldehy itute stitute stitute	-Alke ne) le (C- lroxy no[3' loadd ne (de l Olei d Oleed cis	Alkelamin ,4',5': lition N-All fins efins -Olef	trone . nylnit e) 3,3a,4 of a . cenyli ins	e Cyc	Cycle lohep dehyd ne C	. 66 t- le . 65 y 66 . 68 . 68 . 68 . 79 . 83 . 84
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table III. Aldehyde-Derived Table III. Aldehyde-Derived	n-6-one (Hen N-Substenylphenaretin and analydro-2-benediction of the control of t	leteroat ituted I inthro[9, in N-Sul enzyl-2 Alkenyl damine) 5.3.1.1.2 ind Mo and 1,1 and 1,2 and 1,2	tom-link Hydroxy, 10-c]isc bstitutec H, 3H Initrone) .503.9]di nd an A nosubst -Disubs 2-Disubs 2-Disubs	ed C lamin exazo I Hyc I-thie Cycl odeca ldehy itute stitute stitute	-Alke ne) le (C- lroxy no[3' loadd ne (de l Olei d Oleed cis	Alkelamin ,4',5': lition N-All fins efins -Olef	trone . nylnit e) 3,3a,4 of a . cenyli ins	e Cyc	Cycle lohep dehyd ne C	. 66 t- le . 65 y 66 . 68 . 68 . 68 . 79 . 83 . 84
[5,4,3-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table III. Aldehyde-Derived Table III. Aldehyde-Derived Table IV. Aldehyde-Derived	n-6-one (Hen N-Substenylphenaretin and an alphydro-2-benedic Hydroxyla Hydroxyla Hydroxyla Nitrones a Nitrones Nitrones Nitrones Nitrones	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl damine) 5.3.1.1.2 ind Mo and 1,1 and 1,2 and 1,2 and 1,2	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H Initrone).503.9]do nd an A nosubst -Disubs 2-Disubs 2-Disubsisubstitu	ed C clamii oxazo I Hyc I-thie Cycl odeca citute stitute stitute stitute ted C	-Alke ne) le (C- lroxy no[3'doadd ne (de de de cise de cise d de cise de cise de cise de cise de cise de cise de cise de cise	Alke lamin ,4',5': lition N-All sefins -Olef nns-O	e) 3,3a, of a cenylining	e Cyc	Cycle lohep dehyd ne C	. 66 t- le . 65 y 66 . 68 . 68 . 68 . 79 . 83 . 84
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions Table I. Aldehyde-Derived Table III. Aldehyde-Derived Table IV. Aldehyde-Derivec Table IV. Aldehyde-Derivec	n-6-one (Hen N-Substenylphenaretin and an alphydro-2-benedic Hydroxyla Hydroxyla Hydroxyla Nitrones a Nitrones i Nitrones i Nitrones i Nitrones i Nitrones i Nitrones	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl damine) 5.3.1.1.2 unine and and 1,1 and 1,2 and 1,2 and 1,2 and 1,4	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H Initrone of 303.9]do nd an A nosubst -Disubs 2-Disubs 2-Disubs substitucetylene	ed C lamin exazo I Hyc I-thie Cycl odeca Idehy itute stitute stitute testitute stitute	-Alke ne) le (C- lroxy no[3'doadd ne () de l Olei d Olei d Cise d cise d tra	Alker lamin ,4',5': iition N-All fins efins -Olef s s	e) 3,3a, of a cenylining	e Cyc	Cycle lohep dehyd ne C	. 66 t- le . 65 y 66 . 68 . 68 . 68 . 79 . 83 . 84
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII.	n-6-one (Hen N-Substenylphenaretin and an alphydro-2-benedic College of the colle	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl damine) 5.3.1.1.2 amine and and 1,1 and 1,2 and 1,2 and Tri and Ads and E	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H Initrone).503.9]do nd an A nosubst -Disubs 2-Disubs 2-Disubsisubstitucetylene Endocycl	ed C lamin oxazo I Hyc I-thie Cycl odeca Idehy itute stitute stitute ted C stitute stitue	-Alkeene) le (C-lroxy) no[3'doadd ne (Lode l Olei d Ole d cised cised tra	Alker lamin ,4',5': ilition N-All fins efins -Olef ans-O s	nylnitee) 3,3a,cof a cenylnites	Cyc	Cycle lohep dehyd ne C	. 66 t- le . 65 y 66 . 68 . 68 . 68 . 89
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derivet Table V. Aldehyde-Derivet Table VI. Aldehyde-Derivet Table VII. Aldehyde-Derivet Table VII. Aldehyde-Derivet Table VIII. Aldehyde-Derivet Table VIII. Aldehyde-Derivet	n-6-one (Hen N-Substanylphenaretin and analydro-2-benediction of the control of t	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl damine) 5.3.1.1.2 ind Mo and 1,1 and 1,2 and Tri and Ac and E es and E	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H Initrone).503.9]do nd an A nosubst -Disubs 2-Disubs 2-Disubs isubstitucetylene Endocycl Monocy	ed C lamin xazo i Hyo I-thie Cycl odeca ldehy itute stitute stitute ted C s.	-Alkeene) le (C-lroxy) no[3'doadd . ne (C-lde . l Olei d Okeed tra . lamin	Alkei Alkei lamin ,4',5': iition N-All efins -Olef s.	nylnitee) 3,3a,cof a cenylnites	Cyc	Cycle lohep dehyd ne C	. 66: 6: 6: 6: 6: 6: 6: 6: 6: 6: 6: 6: 6:
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derive	n-6-one (Hen N-Substanylphenaretin and analydro-2-beneding the Mitrones and Mitrone	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl damine) 5.3.1.1.2 ind Mo and 1,1 and 1,2 and Tri and Ac and E es and E	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H. Initrone of 303-9]do nd an A. nosubst -Disubst 2-Disubst 2-Disubst 2-Disubst 4-Monocycl Monocycl -Phenyl	ed C lamin xazo i Hyo I-thic Cycle odeca ldehy itute stitute stitute ted C s. iic En malei	-Alke ne) le (C- lroxy no[3' loadd ne (. de ded cis ed tra lamin Endoc mides	Alke: Alke: lamin ,4',5': iition N-All fins efins -Olef nns-O s es	nylnite e) 3,3a, of a cenyln ins considering Olefin	: Cyc	Cycle Cycle Iohep dehyc	. 66 t- 1 6: 4 5: 4 6: 4 6: 4 6: 4 6: 4 6: 4 6: 4
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl TABULAR SURVEY. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table X. Aldehyde-Derived Table X. Aldehyde-Derived	n-6-one (Hen N-Substanylphenaretin and analydro-2-benedin Aller (Hydroxylatracyclof Hydroxylatrones in Nitrones in	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl- lamine as ind Mo and 1,1 and 1,2 and Tri and Ac and Ees and Ees and N- and Ber	tom-link Hydroxy, 10-c]isc bstituted H, 3H Initrone) .503.9]di nd an A nosubst -Disubs 2-Disubs 2-Disubs (2-Disubs (2-Disubs) (2-Disubs) (3-Di	ed C laminoxazo i Hyd I-thie Cycl odeca didehy ituted titude tituted t	-Alke ne) le (C- lroxy no[3' loadd ne (. de ded cis ed tra lamin Endox mides mides	Alke: Alke: lamin ,4',5': lition N-All fins efins -Olef nus-O s ricyclic s Tricyc	nylnite e) 3,3a, of a cenyln ins lefins Olefi lic O	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- t- le . 65 y 66 . 68 . 68 . 79 . 83 . 84 . 87 . 91 . 92 . 96 . 98
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table XI. Aldehyde-Derived	n-6-one (Hen N-Substanylphenaretin and analydro-2-benedin Aller (Hydroxylatrones and Nitrones an	leteroat ituted I inthro[9, in N-Sul penzyl-2 Alkenyl damine) 5.3.1.1.2 ind Mo and 1,1 and 1,2 and Tri and Ac and Ees and Ees and Be and Be	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H. Initrone 1.503.9]do nd an A. nosubst -Disubs 2-Disubs 2-Disubsisubstitucetylene. Indocycl Monocy-Phenyl nzofusecridged B	ed Claminoxazo i Hyc I-thie Cycl odeca ldehy ituted titute stitute stitute stitute I Bi- ii- and	-Alke ne) le (C-Iroxy no[3'] loadd ne (il Olei ded cis ed tra lamin mides mides and T	Alke: Alke: lamin ,4',5': lition N-All fins efins -Olef nus-O s ricyclic s Tricyc	nylnite e) 3,3a, of a cenyln ins lefins Olefi lic O	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- le . 65 y 66 . 68 . 79 . 83 . 84 . 87 . 91 . 92 . 96
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azato cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table XII. Aldehyde-Derived Table XIII. Aldehyde-Derived Table XIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	n-6-one (Hen N-Substanylphenaretin and an alphydro-2-bened C-1 Hydroxyla Nitrones a Nitr	leteroat ituted I ithro[9, in N-Sul penzyl-2 Alkenyl lamine, 5,3,1,1,2 ind Mo and 1,1 and 1,2 and Tri and Ac and Tri and Ac and E es and and N and Be and Be and B s and E	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H. Initrone 1-303-9]do nd an A. nosubst -Disubst 2-Disubst 2-Disubst 2-Disubst 4-Monocycle Monocyclinzofusecridged B. Sxocyclie	ed Claminoxazo i Hychthe Cycle Cycle codeca ildehy ituted titute stitute stitute stitute ildeh i	-Alkene) -Alkene) -Alkene) -Alkenee)	Alke: Alke: lamin A',5'; lition N-All fins efins Olef ans-O s Frieye	nylnite e) 3,3a, of a cenyln ins lefins Olefi lic O	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- le . 65 y 66 . 68 . 68 . 79 . 83 . 84 . 87 . 91 . 92 . 96 . 98 . 100 . 104
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table XII. Aldehyde-Derived Table XIII.	n-6-one (Hen N-Substanylphenaretin and analydro-2-benedin Altrones a Nitrones	leteroat ituted I ithro[9, in N-Sul penzyl-2 Alkenyl lamine, 5.3.1.1.2 imine an ind Mo and 1,1 and 1,2 and Tri and Ac and E es and E es and B es and E es and E es and I	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H. Initrone 1.503.9]do nd an A. nosubst -Disubst 2-Disubst 2-Disubst 2-Disubst 4-Monocy-Phenyl nzofusecridged B exocyclic Endocyclic Endocyclic	ed Claminoxazo i Hychthe Cycle Cycle codecalldehy ituted tituted tituted tituted tituted tituted iii Emmalei i Bi- ii and ii Olelic O	-Alke ne) le (C- lroxy no[3' loadd . ne () le de . l Oleid d Ole ded cis ed tra mide: mide	Alke: Alke: lamin, 4',5': lition N-All fins efins -Olef nns-O s Frieyclic	ins lefins Olefin Olefin .	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- le . 66 y 66 . 68 . 79 . 83 . 84 . 87 . 91 . 96 . 98 . 100 . 104 . 107
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table XII. Aldehyde-Derived Table XIII. Aldehyde-Derive	n-6-one (Hen N-Substanylphenaretin and analydro-2-below of Hydroxyla hydroxyla hydroxyla hitrones a Nitrones of Ni	leteroatituted Inthro[9, n. N-Sulpenzyl-2-Alkenyllamine) 5.3.1.1.2 and Mo and 1,1 and 1,2 and Triand Aris and Ees and	tom-link Hydroxy, 10-c]isc bstitutece. H. 3H. Initrone 10-303-9]dond an A. nosubst -Disubst 2-Di	ed Claminoxazo i Hychthe Cycl d-thie Cycl odeca ldehy ituted titute stitute stitute stitute ii En malei l Bi- ii and ii Oletylei Oletylei Oxetylei	-Alke ne) le (C- lroxy no[3' loadd . ne () le de . l Oleid d Ole ded cis ed tra mide: mide	Alke: Alke: lamin, 4',5': lition N-All fins efins -Olef nns-O s Frieyclic	ins lefins Olefin Olefin .	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- le . 66 y 66 . 68 . 79 . 83 . 84 . 87 . 91 . 92 . 96 . 98 . 100 . 104 . 107 . 115
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substitutec 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table XII. Aldehyde-Derived Table XIII. Aldehyde-Derived Table XIV. Ketone-Derived Table XV. Endobyclic Nitro	n-6-one (Hen N-Substanylphenaretin and analydro-2-benedin Hydroxylatracyclo[Hydroxylatrones i Nitrones i Nitro	ituted Inthro[9, n. N-Sulpenzyl-2 Alkenyllamine) 5.3.1.1.2 mine and Mo and 1,1 and 1,2 and Triand Ales and Ees	tom-link Hydroxy, 10-c]isc bstituted: H, 3H Initrone 10-303-9]dind an A nosubst -Disubst 2-Disub	ed Claminoxazo i Hychthe Cycl d-thie Cycl odeca ituted tituted	-Alke ne) le (C- lroxy no[3' loadd . ne () le de . l Oleid d Ole ded cis ed tra mide: mide	Alke: Alke: lamin, 4',5': lition N-All fins efins -Olef nns-O s Frieyclic	ins lefins Olefin Olefin .	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- le . 65 y 66 . 68 . 68 . 79 . 83 . 84 . 87 . 91 . 92 . 96 . 98 . 100 . 104 . 107 . 115 . 118
[5,4,2-k,I]benzo[b]quinolizii tion of a Keto Olefin and a 1,3,3a,11b-Tetrahydro-1-phe addition of an Aldehyde Ok 2aβ,4aβ,5,6,7,8,8aβ,8bβ-Octa [d]isoxazole (Heteroatom-I Olefin and an N-Substituted 12-exo-Phenyl-4-oxa-5-azate cloaddition of an N-Alkenyl Tabular Survey. Intermolecular Reactions. Table I. Aldehyde-Derived Table II. Aldehyde-Derived Table IV. Aldehyde-Derived Table V. Aldehyde-Derived Table VI. Aldehyde-Derived Table VII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table VIII. Aldehyde-Derived Table XII. Aldehyde-Derived Table XIII. Aldehyde-Derive	n-6-one (Hen N-Substanylphenaretin and analydro-2-benedin Aller (Hydroxylatracyclof Indicated Nitrones and Ni	leteroatituted Inthro[9, n. N-Sulpenzyl-2-Alkenyl-lamine, 5.3.1.1.2 mine and Mo and 1,1 and 1,2 and Triand Aris and Ees and Ee	tom-link Hydroxy, 10-c]isc bstituted: H, 3H Initrone 10-303-9]dind an A nosubst -Disubst 2-Disub	ed Claminoxazo i Hychthe Cycle Cycle codeca ituted ctitute cti	-Alke ne) le (C- lroxy no[3' loadd . ne () le de . l Oleid d Ole ded cis ed tra mide: mide	Alke: Alke: lamin, 4',5': lition N-All fins efins -Olef nns-O s Frieyclic	on one of the control	c Cyc	Cycle Cycle Iohep dehyc	. 66 t- le . 66 y 66 . 68 . 79 . 83 . 84 . 87 . 91 . 92 . 96 . 98 . 100 . 104 . 107 . 115