

**A LABORATORY MANUAL
OF ORGANIC CHEMISTRY
FOR MEDICAL STUDENTS**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649042807

A Laboratory Manual of Organic Chemistry for Medical Students by Matthew Steel

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

MATTHEW STEEL

**A LABORATORY MANUAL
OF ORGANIC CHEMISTRY
FOR MEDICAL STUDENTS**

A LABORATORY MANUAL
OF
ORGANIC CHEMISTRY
FOR
MEDICAL STUDENTS

BY


MATTHEW STEEL, PH.D.

PROFESSOR OF ORGANIC AND BIOLOGICAL CHEMISTRY, THE LONG ISLAND
COLLEGE HOSPITAL, BROOKLYN, NEW YORK.

FIRST EDITION

FIRST THOUSAND

NEW YORK

JOHN WILEY & SONS, INC.

LONDON: CHAPMAN & HALL, LIMITED

1916



5. A. 171

PRINTED BY
BRAUNWORTH & CO.
BOOK MANUFACTURERS
BROOKLYN, N. Y.

PREFACE

THIS manual was originally compiled as a laboratory guide in organic chemistry for the medical students of the Long Island College Hospital, Brooklyn, New York.

While writing these notes, the author kept one object constantly in view, namely, the selection of experiments that would be of real value to medical students.

The recent development of biological chemistry has created a demand for a much broader training in experimental organic chemistry than was formerly required of medical students. In this manual an attempt has been made to fulfill this need without burdening the student with a mass of unessential data.

In nearly every experiment definite quantities of chemicals have been specified, the object being twofold: to prevent the unnecessary waste of material, and to insure the success of the experiment.

Each student is expected to record his own observations, and for this reason alternate pages of the manual have been left blank.

To induce the student to correlate the facts observed in the laboratory with the theoretical matter taught in the lecture room and in the text-books, the experiments are accompanied with questions which the student is supposed to answer.

Much of the data contained in the chapter on alkaloids was obtained from Autenrieth's book "Detection of Poisons and Powerful Drugs." Authorized translation by W. H. Warren, Ph.D. (Blakiston). The author wishes to express his gratitude to Messrs. Blakiston &

Company for the courtesy shown in permitting the use of these data.

The author also wishes to acknowledge his indebtedness for many valuable suggestions obtained from the laboratory notes prepared for the use of medical students by Professor William J. Gies, of Columbia University, and from many standard texts on organic chemistry.

MATTHEW STEEL.

CONTENTS

(Figures refer to the numbers of the experiments.)

CHAPTER	PAGE
I. QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS	1
The detection of carbon and hydrogen, 1.—The detection of nitrogen in an organic substance, 2.—Tests for halogens, 3.—Tests for sulphur, 4.—Test for phosphorus, 5.	
II. PURIFICATION OF ORGANIC SUBSTANCES	8
Separation of a compound by precipitation and its purification by washing and recrystallization, 6.—Determination of the melting-point of solids, 7.—Separation of two or more solids by means of selective non-miscible liquids, 8.—Purification of liquids by distillation, 9.	
III. THE ALIPHATIC HYDROCARBONS	14
A. The Paraffins: Preparation and properties of methane, 10.—Fractional distillation of kerosene, 11.—Inflammability of kerosene, 12.—Inertness of the saturated hydrocarbons, 13.	
B. The Unsaturated Hydrocarbons: Preparation of ethylene, 14.—Properties of the unsaturated hydrocarbons, 15.—Preparation and properties of acetylene, 16.	
IV. HALOGEN DERIVATIVES OF THE HYDROCARBONS	22
Preparation of chloroform, 17.—Properties of chloroform, 18.—Preparation of iodoform, 19.	
V. ALCOHOLS	26
Preparation of ethyl alcohol by fermentation, 20.—Preparation of absolute alcohol, 21.—Properties of ethyl alcohol, 22.—Determination of the quantity of alcohol in an aqueous solution, 23.	
VI. ETHERS	32
The preparation of ethyl ether by the continuous process, 24.—Preparation of anhydrous ether, 25.—Miscibility of ether with other liquids, 26.—Solvent power of ether, 27.—Absorption of heat caused by evaporation of ether, 28.—Inertness of ether towards chemical reagents, 29.	
VII. ALDEHYDES AND KETONES	38
Preparation of formaldehyde, 30.—Detection of formaldehyde in milk, 31.—The resorcinol test for formaldehyde, 32.—Action of formalin on proteins, 33.—Preparation of acetaldehyde, 34.—Silver mirror test, 35.—Reduction of Fehling's solution, 36.—Forma-	

tion of aldehyde resin, 37.—Repetition of the aldehyde resin test with formaldehyde, 38.—Schiff's aldehyde reaction, 39.—Oxidation of an aldehyde to an acid, 40.—Polymerization of aldehydes, 41.—Formation of hydrazone, 42.—Reducing action of chloral and chloral hydrate, 43.—Formation of chloroform from chloral hydrate, 44.—Preparation of acetone, 45.—Oxidation of acetone, 46.—Reduction of acetone, 47.—Formation of addition products, 48.—Formation of hydrazones by ketones, 49.—Sodium nitroprusside test, 50.—Salicylic aldehyde test, 51.—Iodoform test for acetone, 52.	
VIII. FATTY ACIDS.....	50
Reducing action of formic acid, 53.—Action of concentrated sulphuric acid on formic acid, 54.—Preparation of acetic acid by oxidation of ethyl alcohol, 55.—The basic acetate test for acetic acid, 56.—Action of sodium acetate on reducing agents, 57.—Freezing-point of glacial acetic acid, 58.—Inflammability of acetic acid fumes, 59.—Solubility of stearic acid, 60.—Formation of soap, 61.—The reaction of soaps, 62.	
IX. ACID CHLORIDES, ACID ANHYDRIDES, ESTERS AND MERCAPTANS. .	54
Action of water on acetyl chloride, 63.—Action of alcohol on acetyl chloride, 64.—Action of water on acetic anhydride, 65.—Action of alcohol on acetic anhydride, 66.—Preparation of ethyl nitrite, 67.—Preparation of potassium ethyl sulphate, 68.—Preparation of ethyl acetate, 69.—Hydrolysis (saponification), of ethyl acetate, 70.—Preparation of ethyl mercaptan, 71.	
X. AMINES, AMIDES AND CYANOGEN COMPOUNDS.....	60
Reactions of a typical primary amine, 72.—Reactions of the secondary amines, 73.—Reactions of the tertiary amines, 74.—Preparation of acetamide, 75.—Properties of acetamide, 76.—Preparation of carbamide (urea), 77.—Reactions of urea, 78.—Preparation of cyanogen, 79.—Preparation of hydrocyanic acid (prussic acid), 80.—Reactions of hydrocyanic acid, 81.	
XI. LIPINS.....	68
Solubility, 82.—Formation of crystals, 83.—Reaction, 84.—Emulsification, 85.—Reaction of fats with bromine, 86.—Acrolein test, 87.—Saponification, 88.—Reactions of glycerol, 89.—Properties of the fatty acids, 90.	
XII. CARBOHYDRATES AND GLUCOSIDES.....	74
Solubility of typical carbohydrates, 91.—Molisch's test (furfuraldehyde reaction), 92.—Action of strong hydrochloric acid, 93.—Tollen's phenylglucosinol test, 94.—Tollen's orcinol test, 95.—Formation of esters (alcohol reaction), 96.—Moore's test (aldehyde reaction), 97.—Action of concentrated hydrochloric acid on glucose, 98.—Reduction of metallic oxides in alkaline solutions, 99.—Phenylhydrazine reaction (osazone test), 100.—Fermentation test, 101.—Determination of the specific rotation, 102.—Properties of fructose,	

103.—Seliwanoff's special test for fructose, 104.—Properties of galactose, 105.—Mucic acid test, 106.—Properties of sucrose, 107.—Hydrolysis of a disaccharide, 108.—Properties of maltose, 109.—Properties of lactose, 110.—Preparation of starch from potato, 111.—Preparation of starch paste, 112.—Action of alcohol on starch paste, 113.—Action of iodine on starch paste, 114.—Action of iodine on starch granules, 115.—Action of tannic acid on starch paste, 116.—Action of basic lead acetate on starch paste, 117.—Diffusibility of starch paste, 118.—Action of Fehling's solution on starch paste, 119.—Hydrolysis of starch paste, 120.—Microscopical examination of starch granules, 121.—Properties of dextrin, 122.—Testing bread crust for dextrin, 123.—Preparation of glycogen from scallops, 124.—Iodine test, 125.—Action of Fehling's solution on glycogen, 126.—Hydrolysis of glycogen, 127.—Action of alcohol, tannic acid and basic lead acetate on glycogen, 128.—Solubility of cellulose, 129.—Formation of parchment paper, 130.—Reactions of salicin, 131. Tests for digitalin, 132.—Scheme for the identification of the most important carbohydrates, 133.	
XIII. MONOBASIC UNSATURATED ACIDS. SATURATED DIBASIC ACIDS, AND HYDROXY ACIDS.	106
Absorption of halogens by unsaturated acids, 134.—Eleidic transformation, 135.—Preparation of oxalic acid, 136.—Reactions of oxalic acid, 137.—Detection of lactic acid, 138.—Reactions of tartaric acid, 139.—Preparation of citric acid from lemons, 140.	
XIV. CARBOCYCLIC COMPOUNDS.	112
<i>A. Benzene and its Homologues:</i> Preparation of benzene, 141.—Reactions of benzene, 142.—Oxidation of side-chains, 143.	
<i>B. Phenols:</i> Preparation of phenol, 144.—Reactions of phenol, 145.—Properties of cresols, 146.	
<i>C. Aromatic Amines and their Derivatives:</i> Preparation of aniline from nitrobenzene, 147.—Bleaching-powder test for aniline, 148.—Formation of tribromaniline, 149.—Reaction of aniline, 150.—Preparation of acetanilide, 151.—Action of nitrous acid on aniline, 152.—Preparation of phenylhydrazine hydrochloride, 153.—Properties of phenylhydrazine, 154.	
<i>D. Aromatic Acids:</i> Properties of benzoic acid, 155.—Properties of salicylic acid, 156.	
<i>E. Aromatic Aldehydes:</i> Properties of benzaldehyde, 157.	
<i>F. Polysubstitution Products of Benzene:</i> Preparation of methyl salicylate, 158.—Preparation of aspirin, 159.—Ionization of picric acid in aqueous solutions, 160.—Properties of gallic acid, 161.—Properties of tannic acid, 162.	
XV. HETEROCYCLIC COMPOUNDS.	132
Preparation and properties of furfuraldehyde, 163.—Properties of pyridine, 164.—Detection of indole, 165.—Oxidation of indican, 166.	