

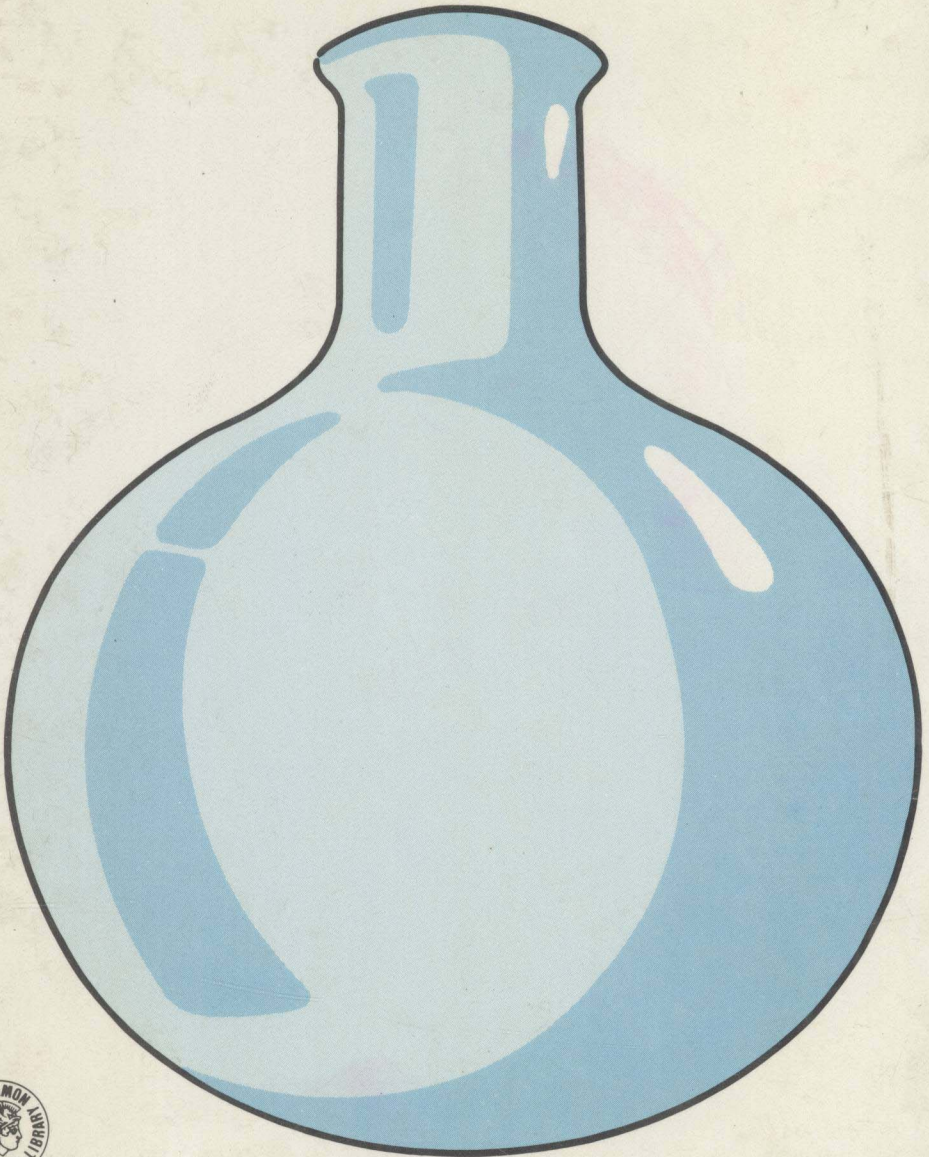
2nd Edition

Glassblowing for laboratory technicians

Including vacuum line accessories and their applications

R. Barbour

MNZIST Hamilton New Zealand



Glassblowing for Laboratory Technicians

*(including vacuum line accessories
and their applications)*

BY

R. BARBOUR

Member of the New Zealand Institute of Science Technicians (Inc.)

SECOND EDITION



PERGAMON PRESS

OXFORD

NEW YORK

TORONTO

SYDNEY

PARIS

FRANKFURT

U.K.	Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, England
U.S.A.	Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, New York 10523, U.S.A.
CANADA	Pergamon of Canada Ltd., 75 The East Mall, Toronto, Ontario, Canada
AUSTRALIA	Pergamon Press (Aust.) Pty. Ltd., 19a Boundary Street, Rushcutters Bay, N.S.W. 2011, Australia
FRANCE	Pergamon Press SARL, 24 rue des Ecoles, 75240 Paris, Cedex 05, France
FEDERAL REPUBLIC OF GERMANY	Pergamon Press GmbH, 6242 Kronberg-Taunus, Pferdstasse 1, Federal Republic of Germany

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First edition 1968

Second edition 1978

British Library Cataloging in Publication Data

Barbour, Robert

Glassblowing for laboratory technicians.—2nd ed.

—(Pergamon international library).

1. Glass blowing and working.

I. Title.

666'.122 TP859 77-30756

ISBN 0-08-022155-6 (Hardcover)

ISBN 0-08-022156-4 (Flexicover)

*Printed in Great Britain by Biddles Ltd.
Guildford, Surrey*

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Foreword

PRACTICALLY every scientist must, with greater or lesser frequency, use laboratory glassware. Most have attempted at least some of the elementary operations of glassworking. Both experiences lead him to an awareness of those qualities of glass which, on the one hand, place at his disposal artefacts combining indispensable utility with considerable aesthetic appeal, and, on the other, require for the fabrication of these tools the skill of the craftsman fashioning an intractable material. The nature of this craft is such that nothing will replace the relationship of master and apprentice, and I have observed with admiration the effectiveness of Mr. Barbour's work in training young people, and particularly in helping them to an early feeling of confidence in their capacity to achieve ultimate success. As he truly says: "Glassblowing ... is an art, and mastery of an art needs courage and an adventurous spirit. Art also demands from those who take it up a measure of humility and dedication." Today, however, there is need for increasing depth of knowledge and skill in design to marry art to the service of experimental science, and in the more advanced chapters the author brings a wealth of experience to the writing, particularly of the sections on vacuum technique and interchangeable ground-glass joints.

It is not easy to describe the techniques of glassworking or to acquire them from the reading of the printed word, but no beginner can fail to benefit from the wealth of practical information, set out in meticulous detail, contained in the earlier chapters and fully illustrated by the accompanying plates. Similarly, those conducting classes in schools and colleges will find much sage advice in the chapter on the organization of glassblowing classes. Finally, for those who may have doubts in this machine age on the professional future and rewards for the technician—

Foreword

craftsman, it may be comforting to savour the author's sad cynicism, rooted in a lifetime's experience in teaching institutions—"About half the burettes used in the elementary chemistry laboratory will be damaged in some way in the course of an academic year."

The number of works devoted exclusively to scientific glassblowing must be quite small, and it is therefore an added and special pleasure to write this brief foreword and to commend this book to all who may be concerned with either the training of glassblowers or with glassblowing.

December 1965

S. N. SLATER

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Victoria University of Wellington,
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Preface to the Second Edition

THIS is a reprint of the first edition except that some errors have been corrected and the section on refrigerants has been brought up to date. Parts of a few chapters have been rewritten in the hope that ambiguities have been removed.

In 1970 the author moved to a new base in the University of Waikato, Hamilton, New Zealand. Here the glassblowing workshop services the School of Science, composed of Earth Sciences, Biological Sciences, Physics and Chemistry. Foreseeably Chemistry, which teaches organic, inorganic, physical and stable isotope chemistry, and in recent years, biochemistry, has made the greatest demand on the service.

The teaching staff in the School, drawn from Britain, America, Australia, Africa, Germany, Canada and from most of the other universities in New Zealand, brought with them a broad experience of glassware and accessories together with an impressive willingness to innovate and to develop new apparatus incorporating a wider range of materials than were previously available in New Zealand.

Since the first edition attracted comments from readers beyond those engaged in technical work, it seems timely to include an appendix to the second edition in which some of the glassware, recently developed, is described. A list of the manufacturers and suppliers of accessories using the new materials is included.

The author is pleased to express thanks to staff members in the School of Science for help in the preparation of this edition. In particular Professor J. D. McCraw, Dean of Science, arranged for draughting and typing facilities to be available and gave unobtrusive support throughout the exercise. A. T. Wilson, Professor of Chemistry, whose need for novel glassware has influenced glassblowing in New Zealand for two decades,

Preface to the Second Edition

stimulated many discussions on the removal of water from gas mixtures, and on the need for safety-consciousness in vacuum line laboratories. Dr. K. M. Mackay and Ann Mackay, answered many queries on the choice of words and their arrangement and made valuable comments on the draft of the manuscript and on units and measurements. Dr. A. Langdon discussed constant volume manometers and made useful suggestions. Mr. F. Bailey drew the figures in the appendix from very rough and disproportionate sketches.

Mrs. Margaret McLean and Mrs. Elaine Norton typed the manuscript and the repeats, corrected the errors and inserted the omissions.

Thanks are also due to Pergamon Press whose officers worked hard to make the first edition attractive and to ensure its widespread acceptance.

To all those who reviewed the first edition, set out their comments and drew attention to errors, gratitude is expressed. The criticisms were stimulating, the praise was always heart warming.

October 1977

R. BARBOUR

Preface to the First Edition

MODERN teaching, research and industrial laboratories are engaged in work that necessitates the use of glass apparatus. The great bulk of this glassware is purchased from laboratory furnishers and, whenever possible, they are the best and most economical sources of supply.

Science, however, is never static. New and modified methods are continually being introduced and the experimental apparatus involved must be made, modified and maintained. To meet part of this need there has appeared on the broad vista of scientific endeavour the figure of the laboratory glassblower. Those who are privileged to read scientific papers, reports and theses, will have no doubts that the glassblower's service to science is an important and valuable one.

To be fully effective a glassblower must be familiar with the possibilities and limitations of glass. He must be able and willing to discuss apparatus design with scientists, to contribute his knowledge and experience to the discussions, to tackle techniques that are new or difficult, and to attempt, where necessary, seemingly impossible tasks.

The early chapters of this book cover fully the glassblowing requirements of the City and Guilds of London Institute syllabus 119 for laboratory technician's work.

They will also serve to introduce to students and other laboratory workers the important first steps in glassblowing techniques.

For the benefit of those taking examinations it is recommended that in glassblowing the student should aim to reach a standard of achievement higher than that required by the syllabus.

A well-prepared student will enjoy meeting the challenge of

Preface to the First Edition

an examination. At the other end of the scale, an ill-prepared student will be worried by the prospect of having to do work that has been but partly mastered, and harassed in the examination room if he is faced by tasks he has never previously performed.

Subsequent chapters are intended for those technicians who have acquired an interest in glassworking, and who have the opportunity to apply their skill to making more complex glassware.

It is worth noting that, in the writer's experience, laboratories that indulge in the luxury of a glassblower invariably increase the scope and tempo of their research work. Within a short time the part-time glassblower becomes a full-time glassblower, and the full-time glassblower becomes a very busy man.

The attention of the young lady who desires to take up glassblowing, either as a career or as a required subject for a technician's certificate, is drawn to the competency of the large numbers of lady glassblowers employed during the war years. There is no doubt that their numbers have increased considerably in the post-war period.

The writer fully acknowledges his debt to many sources of information: to books on glassblowing; glass-tube manufacturers' information circulars; laboratory furnishers' catalogues; to many glassblowers (some mature in wisdom and skill, some fresh and enthusiastic learners); to professional scientists, some no longer with us, for making available their theoretical knowledge and for making demands without which interest and progress would have atrophied.

The writer expresses his thanks to all those members of the staff of Victoria University of Wellington, New Zealand, who contributed to this work by giving their time to discussions and criticisms of the text. Special credit is due to B. C. Walsh, M.A., of the English Department, for his critical and invaluable reading of the drafts; to R. F. Gledhill of the Glassblowing Department, who devoted much care and patience to the preparation of the sketches and made many helpful suggestions; to M. D. King for the photography; to I. Crichton, the apprentice

Preface to the First Edition

glassblower, who performed many of the basic techniques to the instructions given in the text and helped to make them effective.

The writer acknowledges the prompt response to a request for information on fuel gases made by Professor R. W. Douglas of Sheffield University; the co-operation given by the officers of New Zealand Industrial Gases, who supplied data on liquid petroleum gases and who made their firm's products available, free of charge. He is indebted to Mr. K. Guy, F.I.S.T., of University of Natal, who suggested the preparation of this book and who has given much sound advice and guidance; to Professor S. N. Slater of the Chemistry Department, Victoria University of Wellington, for his encouragement during the preparation of the manuscript, and for his kindness in writing the foreword.

Finally, credit is due to Miss Rita Watts. She undertook to decipher and type the manuscript when she had very little time to spare.

*Wellington, New Zealand
December 1965*

R. BARBOUR

Contents

FOREWORD	ix
PREFACE TO THE SECOND EDITION	xi
PREFACE TO THE FIRST EDITION	xiii
CHAPTER 1. GLASS	1
The Composition of Glass	4
References	10
CHAPTER 2. GLASS TUBE AND ROD	11
Storing Tube and Rod	11
Dimension Tolerances in Tubes and Rods	12
Precision Bore Tubing	13
Coloured Glasses	14
Ordering Stock	16
Measuring Glass Tubing	17
References	18
CHAPTER 3. LABORATORY GLASSWORKING HAZARDS	19
Hazards Due to Glass	19
Burn Hazards	19
Eye Hazards	20
Emphysema	21
Mercury	21
Hazards Due to Repairable Glassware	21
Hazards Due to Gas	22
Cleaning Glass Tubing	23
Blowing	24
References	27
CHAPTER 4. THE WORKSHOP	28
Location	28
Lighting	28
Floor	29

Contents

Ceiling Height	30
Ventilation	30
Acoustics	30
The Bench	30
The Seat	31
Other Furniture	31
Sink Bench	32
Tools	32
Fuel Gases	45
References	53
CHAPTER 5. ANNEALING	54
Stress	55
Strain	55
Young's Modulus	56
The Thermal Strength of Glasses	60
Strainviewer	63
CHAPTER 6. ELEMENTARY GLASSWORKING	65
Cutting Glass Sheet	65
Hints	68
Drilling Glass Sheet	69
Basic Operations in Soda Glass	70
Pulling Points	79
Test-tube Ends	84
Blowing	85
Flat Ends	85
Blown Out or Flame Cut Ends	87
Bends	87
Sharp Bends	90
Joining Rods	92
Joining Capillary Tube	93
Joining Tubes	94
Spotting	96
T-joints	96
Y-pieces	98
Joining Tubes of Different Diameter	100
Side Tubes and Water Tubes	102
Bulb Blowing	106
Riffled Side Tubes or Water Tubes	111
Ring Seals, Multiple Seals or Internal Seals	113
A Saliva Trap	115
A Constant Level Device	118
A Simple All-glass Condenser	118
References	121

Contents

CHAPTER 7. GLASS-TO-METAL SEALS	122
Sealing Platinum Wire in Soda Glass	124
Sealing Platinum Wire in Borosilicate Glass	125
Sealing Tungsten Wire to Borosilicate Glass	127
Joining Glasses of Different Types	130
References	131
CHAPTER 8. INTERMEDIATE GLASSBLOWING	132
Repairs	132
Burettes	133
Stirrers	137
Calcium Chloride Tube	140
Thistle Funnel	140
Hero's Fountain	141
Hero's Engine	143
Spinning a Foot	144
Condenser Adaptors	145
Making Spiral Coils	146
Handlamp Work	150
Handlamp Joins	154
Liebig Condenser	159
Efficiency	161
References	162
CHAPTER 9. ADVANCED GLASSBLOWING	163
Glassworking Lathes	164
Basic Operations	167
Cartesian Manostat	175
A Mercury Diffusion Pump	177
References	180
CHAPTER 10. VACUUM TECHNIQUE	181
Types of Pumps	186
Vacuum Gauges	196
The Operation of a Vacuum System	209
References	210
CHAPTER 11. INTERCHANGEABLE GROUND-GLASS JOINTS, STOPCOCKS	211
Joint Design	214
Making Joints	214
Grinding	219
Ball and Socket Joints	221

Contents

Flat Flange Joints	222
Stopcocks	223
References	229
CHAPTER 12. THE ORGANIZATION OF GLASSBLOWING CLASSES	230
Elementary Classes	230
Handlamp Work	232
Classwork	232
Marking Examinations	235
Intermediate Glassblowing Classes	236
Advanced Glassblowing Classes	237
BIBLIOGRAPHY	239
APPENDIX	241
INDEX	261

CHAPTER 1

Glass

GLASS is a man-made material, and the date of its invention can only be estimated, but there is some evidence that it was first made about 4000 years ago.

There are many books on the art of glassmaking available in technical and other libraries. They are interesting and informative and their perusal will add much to background knowledge.

To make glass, accurately weighed quantities of finely ground materials are thoroughly mixed together. The carefully selected constituents are then melted in a refractory pot. When the glass is homogeneous, free from bubbles and foreign matter, it is shaped, while molten, by drawing, pressing, moulding or blowing into the desired shape. It should be noted that glass cannot be extruded through dies, as metals and plastic materials are extruded, since hot glass would adhere to hot dies and would be cooled and solidified by cold dies.

The tubes and rods used in the laboratory are made by one of three methods. The first, and oldest, method requires a team of skilled men, known as primary glassblowers. One member of the team uses an iron tube, approximately 5 ft long and fitted with a mouthpiece at one end and a small flange at the other end. The flanged end of this blow-pipe, as it is called, is repeatedly dipped into the molten glass and turned continuously until a gob of the desired size has been formed.

The blow-pipe is now passed to another member of the team. He shapes the gob by skilful manipulation and then blows an air bubble into the molten glass.

A third man now attaches the previously heated flange of a 5 ft metal rod to the end of the prepared glass. These two men