LABORATORY ORGANIZATION AND ADMINISTRATION

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BY

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FOREWORD

SCIENTIFIC endeavour is to-day accepted as an essential factor both in agricultural and industrial development and accordingly also for social advancement. The need for more scientists and technologists is fully realized and is being met by increasing both the number and size of the laboratories in schools, colleges of technology and universities; and the man-power so produced is being rapidly absorbed in the new and enlarged government and industrial research laboratories.

The planning of modern laboratories is becoming increasingly complex. Before the detailed plans for a new laboratory can be prepared the specialist requirements must be enumerated and the resulting specifications are demanding more attention than ever before. The design of laboratories for highly specialized requirements, such as radio-chemical operations, the specifications of the type of material for construction ranging from stainless steels to plastic cements, the lay-out of stores — these and related details cannot be left to an architect and are usually not readily available to a department head. It is doubtful if any laboratory has ever been built which has been found fully satisfactory to those who use it, and this state of affairs must arise from the lack of the necessary information.

The administration of a laboratory is the job of a specialist. The number of persons seeking this channel of employment is not meeting the demand and the turnover of staff in junior positions is creating problems in training. It is accordingly important to have available some authoritative book by means of which the beginner can acquaint himself with the many facets of his job, and the experienced technician can have ready reference to specialist aspects.

A book of this nature can never be complete because modern experimental techniques are always changing and new materials of construction constantly being introduced. This book does, however, contain a wealth of information of value accumulated over a number of years and should prove useful to the technical officer as well as to the scientific administrator. The different topics which form the subject matter of the various chapters are important aspects of the complex problem of planning and administering scientific laboratories and from this aspect the book makes a real contribution.

The author of this book received his early training in London and was later Chief Technician in the Chemistry Department of the Sir John Cass College. In South Africa he has assisted in the plans for the complete renovation and modernization of a large chemistry department and of new undergraduate and research laboratories.

It has been a pleasure to have had the services of Mr. Guy as Chief Laboratory Technician in this department during which time there has been development unparalleled in the fifty years of our history. It is very satisfying to see that the enormous amount of data which has had to be sifted during the last few years has been assembled and presented in its present form. I feel certain that this book will fulfil the purpose for which it was written, namely to assist all those who are concerned in the organization and management of scientific laboratories.

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September, 1961

INTRODUCTION

To satisfy the ever increasing demands of industry for scientists, technologists and technicians, unprecedented advances in technical education have been made in Britain during the past five years. The functions of the technical colleges have been extended and stronger links with industrial training have been forged. In addition, vast sums of money have been made available by the Government for new buildings, for the creation of colleges of advanced technology and for expansion of the universities. The national reorganization of technical education, which has been wisely coupled with special courses and part-time release systems, has given many more students an opportunity to avail themselves of improved study facilities, and as a result, there has been an enormous increase in the number of persons undergoing laboratory training.

The author hopes that this book, which is intended for persons who are at present, or who will be in the future, concerned with the organization and management of laboratories, will to some extent contribute to the advances in technical education which are taking place. An attempt has been made to present the material in such a manner that it will be helpful, not only to technicians for whom it was primarily written, but also to science teachers and technologists who, in the course of their studies, may not have received specific instruction in the management, design and care of laboratories and their equipment.

The chapters are designed to cover the syllabuses of the courses in Laboratory Technicians' Work which lead to the 'Certificate of the City and Guilds of London Institute' in conjunction with the Institute of Science Technology. They deal with the sections on 'Laboratory Organization' and 'Laboratory Organization and Administration' which occur in the intermediate and final syllabuses respectively. In some sections of the book the special regulations given may apply only in the United Kingdom, but since very similar regulations are in force in other countries, it is anticipated that technicians overseas will have no difficulty in interpreting them accordingly.

The author has made no attempt to concern himself with organization and management in the highest sense, but has simply endeavoured to present the practical aspects of the subject which are directly related to the laboratories themselves.

The laboratory operates to the best advantage when well designed and efficiently maintained. It is hoped, therefore, that this book, based on the author's personal laboratory and teaching experience, presents clearly and factually the ways and means of bringing about these conditions. If the book appears to deal more fully with teaching laboratories, this is due to the fact that the author's own experience was gained mainly in educational establishments.

PIETERMARITZBURG
September 1961

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Finally, I wish to thank my wife who devoted so much of her time to assist me with this book.

CONTENTS

1 DESIGNING THE LABORATORY

It is hoped that this introduction to laboratory design will bring to the attention of the potential laboratory designer some materials and methods in use to-day and that by the application of these he may be assured of value for the sum of money at his disposal. No attempt has been made to discuss the complications of larger building programmes and the constitution of planning committees which these might involve, nor other problems, such as the selection of sites, which are common to major projects.

The function of the laboratory designer is to assess the requirements of all the staff concerned and to present the information to the architect and builder in such a way that the completed laboratories are satisfactory to all concerned. Before beginning any planning the designer must be in possession of the following information:

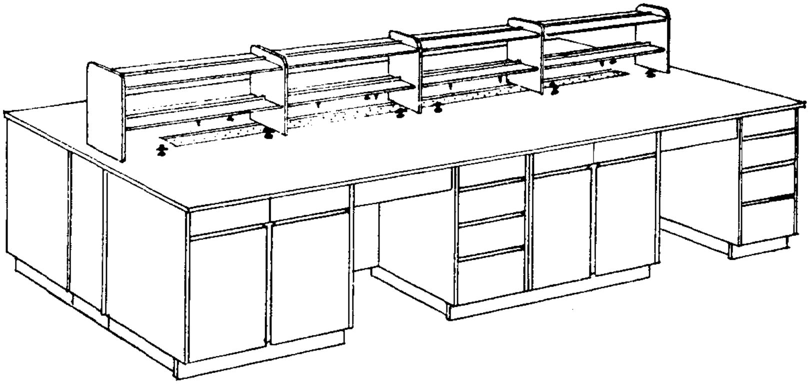
(*a*) The amount of money available.
(*b*) The kind of work to be done in the laboratories, and
(*c*) The number of persons that will use them at any one time.

The laboratory should first be considered in terms of its main features such as the walls, ceilings, floors and benches, and later thought must be given to the other requirements which will give it life. These include heating, lighting, ventilation (including fume extraction), drainage, and the supply services to benches and other furniture. These component parts of the laboratory must be incorporated into a plan by the designer and he must clearly indicate what he requires and the amount of money to be spent on the items concerned. From this information, the various craftsmen can advise how best to deal with his particular requirements. It must always be borne in mind that the cheapest materials are usually the worst for the job.

Laboratory Benches

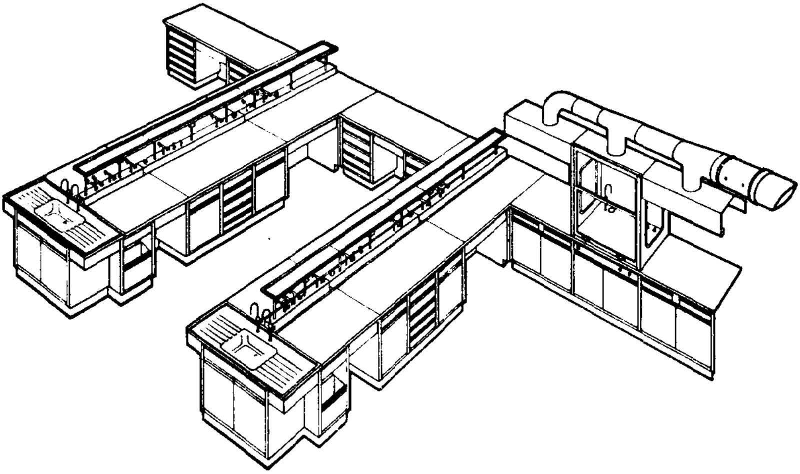
Laboratory benches may be divided into three main types and are known either as island, peninsular or wall benches (Figs. 1.1, 1.2, 1.3 respectively).

Formerly, benches were built into the laboratory in a permanent



(By courtesy of A. Gallenkamp & Co.)

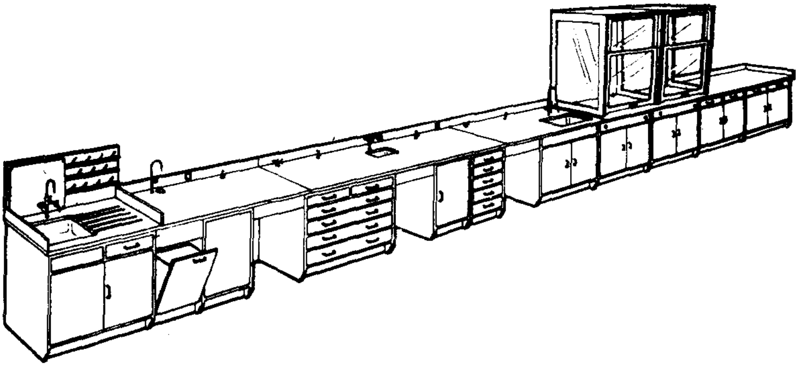
FIG. 1.1. Island Bench.



(By courtesy of Griffin & George Ltd.)

FIG. 1.2. Wall bench with two peninsular benches.

style, but to-day unit assembly has become very popular for it enables benches to be dismantled and reassembled in other ways. This allows a measure of flexibility which is an advantage particularly in those laboratories where the work carried out may change from time to time. Unit furniture, however, may prove initially to be slightly more expensive although now that it is being mass-produced it is unlikely that it will remain so.



(By courtesy of Griffin & George Ltd.)

FIG. 1.3. Wall bench.

DIMENSIONS OF BENCHES

Height

The heights of benches are governed by the average height of the persons using them and whether their work will be done mainly in the sitting or standing position. Much, too, depends on the nature of the work, but it is generally agreed that for standing work bench heights of between 2 ft. 6 in. and 2 ft. 9 in. for younger persons and 3 ft. high for adults are the most suitable. It is important to adjust the bench height for the difference between young persons and adults where work will be done standing, but is not so necessary if the work is done sitting. Adjustable seating should be considered as a means of overcoming difficulties which may be met in this connection, or where the nature of the work might vary. It is sometimes convenient if a part of the bench is made at a different height to that of the remainder. The author found that benches designed in this way for use by research workers met with considerable approval. In this particular instance, double-sided peninsular benches 10 ft. in length were extended out from a side wall and designed to accommodate two persons. A 7 ft. 4 in. length of the top was made 3 ft. high whilst the remainder (nearest the wall) was reduced to a height of 2 ft. 6 in. This provided a writing desk below which a knee space was left. In the centre of the bench top, between the two sitting positions, a low bookshelf was fitted.

Width

The effective working width of benches is reduced by the various service outlets, such as gas taps, and is governed largely by the necessity of having reagents and equipment on shelves or bench scaffolds which must be easily and safely reached. The main laboratory furnishers seem to have reached accord on bench sizes which are generally 3 ft. high (2 ft. 6 in. for sitting benches) and 2 ft. 3 in. wide for single-sided and wall benches. Wall benches, which are used for larger items of equipment, such as ovens, incubators or muffle furnaces and at the back of which wall shelves are not fitted, should be 2 ft. 6 in. wide. Benches made for work to be done on both sides should be 4–5 ft. wide. The actual size will be partially determined by the width of the centre shelves, the arrangement of sinks or centre troughs and service outlets. In most laboratories a 4 ft. 6 in. wide bench is suitable.

THE BENCH TOPS

In selecting materials for bench tops the availability of the material, its length of life, resistance to attack and cost must be considered. The cost must be estimated on the installed price for although certain materials may be initially cheap they are hard to work and the labour costs in making them up may be very high indeed.

The choice of material is determined by the nature of the work to be undertaken. The bench top might be called upon to withstand moisture, heat, attack by chemicals or pests and contamination. Certain other properties of the material may also be important such as its resilience, electrical properties, ease of cleaning and general appearance. The designer is required to consider all these properties before making his final decision.

Timber

Teak has for many years been the foremost material used for bench tops and to-day, in competition with hosts of new materials, because of its general suitability, it still occupies first place. It has many advantages for it is extremely durable, resists attack by chemicals and heat and has a pleasant appearance. On the other hand, teak is costly and not so readily available as was formerly the case. Consequently, other hardwoods with comparable qualities are now being used, such as afrormosia, mahogany, iroko and European oak, to mention only a few. Whatever timber is chosen it is essential that it has been carefully seasoned. The thickness of bench tops varies, according to the user's requirements, from 1⅛ in. up to 1⅝ in. After installation, the bench top may be treated with several applications of raw linseed oil and, thereafter, wax bench polish should be regularly applied. Waxing the bench top, however, gives it better protection and this treatment is undoubtedly the best for benches used in chemical or other laboratories where the