H. W. M. Hodges

# A Basic equipment and processes

## INTRODUCTION

A minimal amount of equipment is required to establish a laboratory to carry out the work required for the conservation and, if necessary, the restoration of cultural property. Elaborate or costly items are not necessary at the beginning and it should be kept in mind that most objects coming to the laboratory of a museum for examination and treatment can be taken care of readily. It is the badly deteriorated or potentially unstable object which may require the use of more advanced tools required for careful analysis before treatment can begin.

Hence, more important than equipment is the knowledge and experience—gained over a course of years—of the technician in charge. Programmes for systematic training of specialists exist in several parts of the world (see preceding chapter, p. 71). As laboratories acquire larger staffs it is natural that objects presenting greater difficulties are dealt with and, with increased competence it is natural that the laboratory begins to acquire more expensive items of equipment to aid the technician in assessing damage, its causes, the best methods of treatment, etc. In some instances it is possible for the museum or the monuments service to have an adequate budget for the purchase of equipment. But for most of the tropical areas this would mean the importation of laboratory apparatus requiring (frequently) foreign exchange, and the payment of high import duties. In many instances, however, they may count upon the aid or assistance of bilateral programmes, foundations, and international programmes.

## CONTAINERS

Everything in the laboratory should be in some kind of container. This is true not only of solutions and reagents but also of the objects undergoing treatment. Much damage can be done to an object left exposed on the workbench.

### *Stock solutions and solvents*

It is normal to keep stock solutions in glass bottles, and if required in large quantities in a glass aspirator; but for many such solutions polythene containers are preferable since they are lighter and less prone to damage. Many polythene containers originally manufactured for other purposes (e.g., domestic or camping uses) are perfectly suitable. Thus, large polythene jerrycans may be used to hold many stock solutions commonly used in conservation work.

### *Dry stock*

Here again, most chemicals and other materials, such as kaolin and plaster, can most conveniently be stored in polythene containers. For large quantities dustbins are ideal.

*Working containers*

For many purposes, glass vessels, especially beakers, are to be preferred. But glass is brittle and for some processes other materials may be superior. Thus, for processes to be carried out in the cold, polythene beakers, or even polythene domestic vessels are ideal; but they cannot, of course, be heated. Where a vessel must be heated, a suitable glass must be used, and it is often more economical when dealing with large volumes to buy domestic glass ovenware than large containers designed for laboratory use. An alternative may be aluminium or stainless steel vessels. Both types are easily made from the sheet metal but it must be remembered that aluminium is rapidly etched by alkaline solutions. Although it is customary to use glass or stoneware vessels for large-scale operations such as electrolysis, a wooden box lined with a heavy grade of polythene is just as durable and far less expensive. Many synthetic adhesives and consolidants are difficult to clean from their containers. Where such materials are being used, a supply of paper cups will be found useful.

*Containers for objects*

Small objects should be kept in boxes, ideally with a transparent lid. Many manufacturers now produce plastic boxes with hinged, transparent lids, and these are very suitable, although rather expensive. Larger objects are more difficult to box satisfactorily, but may be kept under glass or plastic covers designed to protect food.

*Labels*

No container should be without a label showing its contents. Toxic and poisonous materials, and all inflammable material, should be marked as such, preferably in red capital lettering. Labels on containers for solutions must state both the concentration of the solution and the solvent used. Unless the object itself bears a label, the container should at all times be labelled with at the very least, the object's number (see 'Administration' below)

MEASURES WEIGHING AND SOLUTIONS

*Scales and balances*

Two types of weighing device are advisable. For weighing large quantities kitchen scales are ideal, although laboratory scales are generally more accurate. For smaller weighings a laboratory balance is essential. Weighing devices when not in use must be kept covered, and at all times they must be kept scrupulously clean. Great care should be taken in levelling and adjusting balances, after which they should not be moved. At no time should weights or pans be handled other than with forceps provided for this purpose. When weighing, the weights used to achieve the final point of balance should be checked twice before removal from the pan. With all chemical balances the manufacturer's instructions must be followed to the letter.

*Volumetric measures*

For measuring large quantities of fluids, kitchen glass graduated measures are usually suitable, or for really large quantities even graduated polyethylene buckets For smaller quantities it is advisable to have available a variety of graduated cylinders (50, 100, 250 and 500 ml). For very small quantities burettes and pipettes are used and the reading taken from the bottom of the meniscus (the curved surface) of the fluid being measured.

*Making solutions*

*From two or more fluids.* Particular care is required when preparing dilute acid solutions. Concentrated sulphuric acid, in particular, will heat violently should water be added to it, to such an extent that it will 'spit' and the operator may well be sprayed with the concentrated acid. The following procedure should be used. The required volume of water should be placed in an open container, such as a polythene bucket (preferably not glass, and *never* a bottle) which should be stood in a sink. The acid should then be added little by little with constant stirring, using a glass or polythene stirrer. The outside surface of the container should be felt from time to time to ensure that the solution is not overheating. Should it do so, add no further acid until it cools. Allow to cool before transferring to bottles.

*From a fluid and a solid* Many solid materials will not easily go into solution, and instead may form either a cake or a gelatinous deposit at the bottom of the container. This can to some extent be averted by reducing the solid to a fine powder, adding it slowly while stirring continuously by hand or mechanically. Even so, many organic materials are still difficult to put into solution this way, and it will often be found more effective to suspend the solid in a nylon bag in the solvent. Discarded nylon stockings are ideal for this purpose.

### *Solution strength*

Solution strengths are usually given as a percentage. Where the solute is normally a fluid, such as nitric acid, the percentage stated is volumetric. For example, a 10 per cent nitric acid solution means 1 volume of nitric acid in 9 volumes of water. Where the solute is commonly a solid, solution strength refers to weight per volume For example, a 5 per cent caustic soda solution would be obtained by dissolving 5 g of sodium hydroxide in 100 ml of water. Solution strengths may also be quoted as *M* (molar) or *N* (normality), or multiples or fractions of *M* or *N*, as for example 5*N* (normality × 5) or *M*/2 (Molar : 2) The meaning of these terms, together with *M* and *N* solution strengths, will be found in any good practical manual of chemistry.

## WATER

### *Tap water*

The conservation laboratory must have a copious supply of tap water. Tap water varies enormously from area to area, depending upon its source, but it always contains some impurities. Before beginning operations the conservator must determine the principal impurities in the local water supply and plan accordingly.

Hard water, usually containing in solution the bicarbonates and sulphates of calcium and magnesium, will form a scum with soap, and will require treatment before it can be used for cleaning such materials as textiles. While, in principle, washing soda may be used to alleviate hardness, in practice it is advisable either to use distilled water or to install an ion-exchange water softener.

Nearly all city water supplies are now chlorinated to kill germs. Excellent as this is from the point of view of public health, it must be remembered that chlorides are extremely corrosive to most metals, and here again for washing metals only purified water should be used.

### *Drainage*

A continuous water supply must be matched by an adequate drainage system, but this is often overlooked. Washings from the conservation laboratory usually contain both corrosive materials and a high proportion of sediment. The drainage system must, therefore, be resistant to corrosion and have sufficient 'traps' in which to collect and remove sediment. In practice, polyethylene fittings and a 'trap' to each sink, with a further main 'trap' for the whole laboratory effluent has been found the most effective system.

Some materials must never be allowed to enter the drainage system. Plaster of paris will set in time and block the piping. Solutions of cellulose or polyvinyl acetate will form gelatinous lumps in contact with water, with the same result. Corrosive materials should only be put down the drain when greatly diluted.

*Pure water: distilled and de-ionized*

Distilled water may be bought in large containers. This is normally most uneconomic, and it is preferable to install either a still or a de-ionizing column. Where the tap water contains a high proportion of impurities, a still is the obvious choice. An electrically heated still gives the least trouble in operation, but attention must be given to regular cleaning out of 'scale', the calcareous deposit in the heating chamber. Even under the most favourable conditions this must be removed at least once a year, and often more frequently. In many countries legal permission is required for the operation of a still.

De-ionizing columns of synthetic resin which remove impurities have certain advantages where the water supply is not heavily contaminated, but where the tap water is very impure, the resins have to be regenerated at such frequent intervals that their use is impractical. Before installing de-ionizing equipment the following points must be considered:

1. Initial expense—the outlay is often considerable.
2. Whether the resins will remove the impurities present (different resins will remove different ions; a correct choice must be made).
3. Ease and cost of regeneration. Some resins must be returned to the suppliers for regeneration. The supplier must guarantee adequate service. Other resins may be regenerated in the laboratory. The cost of materials for regeneration may be so great that distillation is more economic.

WASHING

The term 'washing' takes on a number of different meanings in the laboratory, it seldom, if ever, implies a rapid rinse with soap under the tap. Indeed, in the laboratory, soap should be kept for washing one's hands only.

*Washing to remove dirt*

Only warm (not hot) water of adequate purity should be used, but if a wetting agent is required a non-caustic detergent may be used. Prolonged washing must follow the use of a detergent.

*Prolonged washing*

This implies rinsing with water of adequate purity to remove water-soluble materials such as salts or detergents. The process may be carried out by making repeated changes of water, or by allowing water to run through the wash-tank continuously. Prolonged washings can be considered as finished only when the wash-water has been tested and shown to contain none, or an acceptably small quantity of the material to be removed.

*Intensive hot washings*

This is essentially prolonged washing in which the water is maintained at a relatively high temperature (see below under 'Basic equipment', p. 89)

HEATERS

*External heaters*

Although the bunsen burner is the traditional laboratory heating apparatus, it is often ineffective or wasteful, and the domestic gas-ring is often to be preferred for heating large containers. However, electric heaters may prove less smelly and more easily controlled. Domestic hot-plates with thermostatic temperature control[1] are very effective for maintaining steady temperatures. For heating glassware, asbestos muffs with a built-in heating element can be obtained from laboratory suppliers.

*Internal heaters*

The possibility of using immersion heaters should not be overlooked. A wide variety of immersion heaters can be obtained for domestic and photographic purposes, often thermostatically controlled, and these may be built in to equipment instead of using an external heat source. For example, if it is required to keep a volume of wax at a steady temperature it is often better to design a tank with immersion heaters than to apply an external source.

*Ovens*

Ovens may be required for a wide range of purposes, and it is always advisable to have a chemical oven with a wide temperature range ready for use. However, laboratory ovens are expensive and for certain purposes domestic ovens may be far cheaper to install and just as suitable. Food warming cabinets, for example, will maintain temperatures just below boiling-point and are suitable for intensive hot washing.

*Furnaces* (see below, 'Basic equipment', p. 89).

*Blowers*

A hot-air blower is ideal for many heating purposes. Although the hand-held, electric hair-drier can be used, such devices are not always very sturdy, and being largely constructed externally of plastics they may be damaged by contact with some organic solvents. Light industrial blowers are normally stronger and give more heat.

*Infra-red lamps*

Infra-red lamps which give a steady heat are very suitable for purposes such as drying or maintaining thermosoftening materials in a fluid state. On the other hand, infra-red lamps can be dangerous, and one should be careful not to work with one's hands under infra-red radiation for more than a very short time.

HEATING

*Glassware*

*Chemical glassware* Although chemical glassware may be used either on a hot plate or in an open flame, it must never be put on a surface that is already hot, or plunged suddenly into the hottest part of the flame: inevitably the glass will crack. Fluids heated in small beakers and test-tubes may tend to spit when hot; this can be avoided to some degree by placing glass beads at the bottom of the vessels.

*Domestic ovenware* Domestic ovenware should never be used on an open flame, or hot-plate. It should be placed in the oven when cool and brought up to top heat, rather than placed directly in a hot oven.

*Other glassware* Other forms of glassware can only be used with heat when exceptional care is taken to raise the temperature slowly. There is a very great temptation to use, for example, old glass accumulator jars because of their size and shape. The thickness of the glass, however, can so easily result in cracking that the operation is never worth the hazard.

1. See 'Temperature control', p. 85.

*Inflammable materials*

*Solids.* Inflammable solids such as wax should never be heated over an open flame, but ideally should be warmed using a thermostatically controlled electric hot-plate or immersion heater. Even with these precautions, the molten material must never be left unattended, and a tight-fitting lid to the vessel should be at hand to cover it should the contents catch fire. If a hot-plate is used, it must be remembered that the material at the bottom will melt first, leaving a crust of solid material at the top. Injudicious prodding of this crust, particularly if it is not absolutely free of water, may cause the hot, molten material to splash over one's hand, with ensuing burns.

*Liquids.* Even greater care is required when inflammable fluids are to be heated. The work *must* be carried out in a fume cupboard, and any form of open flame is quite out of the question. It is always advisable to stand the vessel being heated in a water-bath.

## TEMPERATURE CONTROL

There is a critical temperature for many operations. For most purposes the normal laboratory thermometer will suffice for checking the temperature. Today much equipment is provided with thermostatic controls, and in theory one has only to set the dial to obtain an even, steady temperature of one's choice. In practice, it is sometimes found that the calibration falls very far short of requirements, and with new equipment in particular it is advisable to check the calibration against a thermometer reading. Temperatures above the range of a thermometer call for the use of a thermocouple. For any specific piece of equipment, it is advisable to use the thermocouple recommended by the manufacturer.

## DRYING

*Heating*

One is always tempted to dry objects by placing them in an oven. However, the oven must be adequately ventilated: a poorly ventilated oven can easily become a humidity chamber in which objects, although hot, remain moist. Small objects are often better dried using either an industrial hot-air blower or an infra-red lamp. In the latter case great care must be taken not to overheat and a thermometer should be left in contact with the object being dried.

*Alcohol drying*

Effective drying can be achieved by repeated changes of pure alcohol, followed by evaporation of the alcohol. The method is expensive and should be used only where complete elimination of all moisture is essential.

*Drying agents*

It may be necessary to store objects in the dry state before further treatment. Any airtight vessel will serve as a desiccator, although a glass vessel in which changes can be observed is to be preferred. Undoubtedly the most convenient drying agent for use in the desiccator is silica gel, especially the type with a coloured indicator that shows when the silica gel has become moisture-saturated. Should this be unobtainable, caustic soda pellets or dehydrated crystals of copper sulphate may be used to maintain a dry atmosphere.

## HUMIDIFIERS

It is sometimes necessary to maintain an object at a high relative humidity for some time. Specially designed humidity chambers may be bought for this purpose, but they are apt to be expensive. The essential features of a humidity chamber are the air-tight container, sources of heat and moisture, and a hygrometer to show how it is functioning. At its simplest such a chamber may be no more than a thermostatically controlled oven in which are placed a dish of water and a direct-reading hygrometer. Such a device, however, lacks the easy control of relative humidity obtainable with the manufactured chamber.

FUMIGATION

The toxic agents found useful in fumigating objects contaminated by moulds and by insects are fully discussed in Chapters 3 and 4. Fumes from any of the agents should never be inhaled. This also applies to volatile solids which might be used as fumigants, such as paradichlorobenzene, thymols, etc. They may also be severely irritating to the mucous membranes, the eyes, or to the skin, particularly when the climate is moist and humid and one perspires.

Various types of containers may be used as fumigating cabinets for small objects. Yadon (1956) describes the construction in the museum metal shop of an air-tight chest which is 70 cm wide, 118 cm long and 88 cm high, equipped with rubber castors to permit mobility. The container is large enough to permit specimens to be kept inside their standard container during fumigation in the chest. Another convenient size is 2 metres long by 1 metre high and 1 metre wide. A museum workshop can build such a chest, which could be made of wood lined with sheet metal or made entirely of heavier gauge metal. It should be set above the floor and should be equipped with a stop cock and drainage pipe at the bottom, so that the fumes, which are heavier than air, can be led outside the building at a well-ventilated spot to ensure rapid dispersion of the gases. The cover should be gas-tight, using a gasket which will resist the corrosive effects of the fumigants. An effective fumigant would be a mixture of 3 parts by volume of ethylene dichloride with 1 part of carbon tetrachloride. Between 500 $cm^3$ and 1 litre of this mixture is placed in pans to volatilize within the container (Burns, 1941). Another effective fumigant, not unduly toxic, is methyl bromide.

Larger museums may install a gas chamber to treat many objects at once.

Following fumigation, the treated objects should be kept in quarantine apart from the collections for about a month before further cleaning and treatment.

VISION

*Lighting*

It is to be hoped that the days have gone when the curators of museums imagined that the laboratory should be housed in the darkest recess of the building. There is no substitute for daylight, and windows should be placed in such a manner that there is a good, even light throughout the room. The windows, furthermore, should have adequate shuttering against excessive direct sunlight. Even when these ideal conditions have been achieved, however, some artificial lighting will be essential. Here we must consider two sources (a) general over-all lighting, and (b) individual lighting for close work.

General over-all lighting should give, as far as possible, values similar to natural daylight. Fluorescent tube lighting is probably the best solution. Care must be taken, however, neither to under- nor over-illuminate the room, and a qualified lighting engineer should be consulted to ensure the correct number and placing of lights.

For individual lighting a number of adjustable stand lamps will be required. Ideally these should be of a type that will allow rapid change of the light source from one position to another, while directing the light in a fairly narrow beam. The normal desk reading lamp is not really suitable, although better than nothing at all.

*Magnification*

Many operations demand a considerable magnification, as, too, does the preliminary examination of most objects. Many people can manage quite comfortably with a watch-maker's eye glass, others cannot, in which case either a stand magnifying glass or head-band binocular magnifiers must be provided. These pieces of equipment are absolutely essential, and many would maintain that a binocular microscope is equally indispensable. Binocular microscopes are now obtainable with built-in illumination and a long arm to allow clearance at reasonably low cost, and no single piece of equipment can justify the money spent on it more than such a microscope. The magnification of many microscopes may be varied by changing eye-pieces or objectives, but if it is decided to buy a binocular microscope with fixed magnification, 20 times would be most suitable.

SAFETY PRECAUTIONS

*Ventilation: fume cupboards*

Obviously the laboratory must be well ventilated, but even good normal ventilation is inadequate when one is dealing with toxic and inflammable materials, so that a fume cupboard will be essential. Furthermore, a fume cupboard is quite useless if the extractor fan does not function correctly, or if the cover is closed so tightly that a good through draught is prevented. These are important matters and not always appreciated by the tyro in the laboratory.

*Inflammable solvents*

Most organic solvents are highly inflammable and should not be kept in bulk in the laboratory. For preference a shed, detached from the main building, should be provided for bulk-storage, or failing this a space open to the weather. Smoking should not be allowed near the store. The solvents in use in the laboratory should be kept in small bottles with screw tops. On a hot day a cork or stopper may easily be displaced from a bottle of ether, and a naked flame may then cause a fire.

*Gas installation*

The gas installation should be checked regularly to ensure that there are no leaks. Equipment that is found consistently to 'burn back', that is to say burn at the jet before the gas has been mixed with air, should be examined and, if faulty, adjusted correctly.

*Electrical installation*

Electrical installations should also be examined regularly. Frayed cables must be replaced, as too must plugs and switches that tend to arc. At all times care should be taken not to overload circuits. There is always a temptation to increase the number of socket outputs by using adaptors, but the point is soon reached where the circuit is overloaded and thus may cause a fire. The correct procedure is to ensure that sufficient plug-sockets are provided for the work undertaken.

*Poisons*

Even if none but the staff have access to the laboratory it is always advisable to keep poisonous materials under lock and key. Poisons left on an open shelf may be spilt or used in error.

*Fire-fighting equipment*

Every person in the laboratory should know what fire-fighting equipment is available, where it is kept, and where and when to use it. The following points are worth keeping in mind:

1. A fire in a container is most easily quenched by covering the container.
2. A fire on a table or bench is most easily quenched by covering with an asbestos blanket.
3. A person whose clothing has caught on fire should be wrapped in an asbestos blanket.
4. A jet of water directed against burning organic solvents is more likely to spread the fire than to put it out.
5. Widespread fire can be quenched with 'foam'.
6. If a fire is not quickly quenched, ring the alarm.

From this it will be seen that an asbestos blanket and a 'foam' fire extinguisher are the essentials for rapidly containing a fire: after that it becomes a job for an expert.

*First aid*

Every person in the laboratory should know the fundamentals of first aid, and every laboratory should be equipped with an adequate first-aid outfit. Most standard first-aid boxes contain sufficient materials for dealing with burns, cuts and abrasions, but in two features they are often lamentably lacking: (a) an eye-bath and a bottle of eye-wash must be included, made up to the correct concentration for immediate use; (b) a supply of self-adhesive dressings will be needed for dealing with small cuts and scratches. Regular inspection will be required to ensure that the stock of dressings has not been exhausted.

PERSONAL EQUIPMENT

All the equipment so far discussed has been of a general nature, allowing nothing to personal idiosyncrasy. In the choice and use of tools, however, individual tastes vary greatly and, within reason, one must allow everyone to make his or her own choice of tools and how to use them. What follows is a list of processes and the tools that may be found suitable by various workers. It is suggested that each worker should maintain his own kit of tools for his use alone.

*Handling*

Forceps will undoubtedly be required for handling small or delicate objects. For some operations a pair of forceps may be needed in each hand.

*Cutting*

A wide variety of scalpels and knives will be needed. The type of scalpel with replaceable blades is most suitable for delicate work, but sturdier scalpels with heavy, fixed blades may also be needed. There is an almost limitless choice of knives: two or three knives of various shapes and sizes may well be needed. A heavy and a fine pair of scissors will also be required. A hone will be needed for sharpening. A piercing saw may be required.

*Brushing*

Every worker should have a number of small and large brushes of natural hair or bristle. Glass-bristle brushes will also be needed.

*Spatulating*

Since many adhesives and filling materials require spatulating, palette knives, spatulae and tiles will have to be provided.

*Mechanical cleaning*

For the removal of corrosion products and concretions from the surface of objects, the worker may choose to make his own chisel-ended tools from lengths of steel rod, although it is simpler to mount steel needles in a pin-chuck for this kind of work.

Machine aids for this process include rotary burrs and engraving tools. Rotary burrs may be mounted either in a drill with a flexible arm, as used by dentists, or in a smaller hand-held motor. For the beginner, the latter being less powerful is to be preferred, although unless used with great care both types of burr tend to burnish the corroded or concreted surface rather than remove it.

Engraving tools with a vibrating arm, when fitted with a fine needle point, can be used for this work. As with hand-held tools, the point should always be held at right angles to the surface being removed, and never obliquely to it, as should the tool slip the underlying surface will become scarred.

### *Chemical cleaning*

For the local application of chemical reagents short lengths of glass rod and pipettes will be needed. These can easily be made from laboratory glass rod and tubing.

## INITIAL EXAMINATION

Some initial examination of objects under treatment will be essential, although the precise nature of such examination must depend upon the knowledge of the worker and the complexity of the antiquities under treatment. The following is the bare minimum of equipment required: (a) magnet; (b) Mohs' scale; (c) litmus and pH papers; (d) platinum wires mounted in glass rod and borax; (e) test tubes, test-tube brushes, test-tube holders, racks, funnels and filter papers; (f) reagent bottles and reagents.

## BASIC EQUIPMENT

Specialized equipment has been described in the appropriate chapters. The following is a list of equipment of fairly universal application that will probably be required.

### *Equipment for soldering*

Soldering is required for the repair and maintenance of laboratory equipment and during the making of electrotypes: its application to antiquities should be severely limited. Solder, flux, a soldering iron and a small jet blow-lamp will be needed.

### *Equipment for intensive hot-wash*

Apart from an oven (see above, p. 84) a conductivity bridge and dip-cell will be required. Care should be taken when ordering a conductivity bridge to ensure that the suppliers can guarantee adequate servicing.

### *Furnaces*

Either gas or electric furnaces may be used, although electric furnaces are normally cleaner and simpler to operate. When ordering, it is essential to ascertain that the capacity and temperature range and control are adequate for the work to be done. Great care should be taken over installation and, for preference, furnaces should be sited either outside the main laboratory or in such a position that their operation will not present a fire hazard.

### *Sources of direct current*

Since most electricity mains supply alternating current (A.C.) at a fairly high voltage (usually 110 or 250 volts) a source of direct current (D.C.) of low voltage will be needed for electrolysis, electroplating and small power tools. A single source may be used for all these purposes, but on the whole it will be found simpler in operation to have separate sources for each group of equipment. Each source must comprise a transformer, a rectifier and some means of controlling output, either a variac or variable resistance. A qualified electrician should always be consulted to supervise the design, building and installation of such sources.

*Impregnation equipment*

Where large quantities of very friable materials are being dealt with, equipment may be needed for impregnation. A small but effective unit has been described by Burgess (1954), and a more elaborate unit by Rees-Jones (1963).

*Carpenter's and metal-worker's equipment*

It will be found convenient to have at hand a number of wood and metal-working tools. The following are of general application: a vice, tenon and hack-saws, chisels, small planes or smoothers, sandpaper and emery paper of different grades, hand-operated and electric drills with various bits, files, pliers, pinchers, and tin-snips, screwdrivers (carpenter's and insulated).

SEATING AND BENCHES

Considerable thought should be given to the subject of bench space and seating. It is advisable that every person in the laboratory should have his own seat and work bench as well as a locker or cupboard in which to keep personal equipment. Ideally, bench height and seating should be adjusted to suit the individual, for no one can be expected to do good work when cramped or otherwise uncomfortable. Other benches will be required for specific purposes, and on the whole laboratory benching and stools of standard height will be found suitable. In planning a laboratory, however, care should be taken not to so fill the space with benching that it becomes cluttered, leaving no room for movement or equipment. It is on the whole advisable to leave plenty of open floor space in which temporary benching can be placed as and when required.

ADMINISTRATION

*Records*

A day-by-day record must be kept of all work undertaken. Records should be filled in as the work is done. It is an advantage to maintain a standard system for recording, each object being given its own record sheet or card. Every process carried out, complete with all the essential data (materials used, temperatures, readings and so on) should be entered. Failure to keep adequate records will result in chaos.

*Cleaning*

A laboratory will not keep clean and tidy of its own accord, and a dirty laboratory is usually an indication of poor organization and poor workmanship. Cleaners may be employed to attend to the floors and windows, but they must be told where their duties begin and end. It is totally wrong to ask cleaners to attend to things that they do not fully understand: equipment, shelves and benches must be left alone by the cleaners and dealt with by the laboratory staff. Any member of the laboratory staff who adopts the attitude that keeping his own laboratory clean is beneath his dignity is a parasite without whose services the museum would do much better.

BIBLIOGRAPHY

BURGESS, M. 1954. *Museums journal, London*, vol. 54.

BURNS, N. J. 1941 *Field manual for museums*. Washington, D.C., United States National Parks Service.

REES-JONES, S G 1963. *Studies in conservation*, vol 8. London.

YADON, V L. 1956 A portable fumigation chamber for a small museum. *Museum news, Washington*