**Safety at school / Department of Education and Science.**

# Safety at School



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# Preface

This pamphlet succeeds and replaces Education Pamphlet No. 13 *Safety Precautions in Schools* first published in 1948. No claim can be made for comprehensiveness in the subjects which are considered, nor are the contents intended for use in any legal connection. The pamphlet attempts to describe those safety measures which are considered advisable in schools at the present time. It is hoped that it will be useful to education authorities and teachers for reference and in colleges of education for introducing students to an important problem.

In view of the developments which continue to take place the chapters dealing with safety in science laboratories, including the use of electricity, workshops and workshop activities, and safety afloat have been rewritten and brought up to date. In addition a new chapter, "Safety in the Air," and Appendix A, "Precautions in the use of Electricity", have been added.

The Department of Education and Science acknowledges the advice given by:

The Home Office
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The Medical Commission on Accident Prevention
The National Road Safety Advisory Council.
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# Contents

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# Safety at School

## Safety; the positive and negative sides

All life is beset with dangers, and trial and error form an essential part of the process of learning. The aim of safety precautions is not to eliminate every possibility of accident, which could only be achieved by stifling a child's natural tendency to be venturesome and independent. It is rather to avoid unnecessary risks and to enable the child to face sensibly and confidently those that cannot, or should not, be avoided.

The positive side of carefulness needs to be emphasised. As was said in the Department's Publication *A Handbook of Health Education*[1].

> 'carefulness is not an enemy of courage but rather an invaluable ally. At no point does real carefulness ever consist of merely "taking care"; it embraces consideration for others such as is shown by mountaineers roped together on a difficult pitch or, less dramatic but also important, the considerateness with which a responsible person will avoid leaving bottles or empty tins lying about where they might hurt other people. . . . It also involves good technique and craftmanship; one need only watch a really good driver or an expert craftsman to realise that first-rate technique includes and embodies the finest safety training of all. . . . Throughout life carefulness, consideration for others and good craftsmanship represent different aspects of the same virtue. To cultivate them at home and at school should be not merely the best form of accident prevention, but also part of a good general education'.

## The role of the schools

Carefulness and a sense of responsibility largely depend on developing the right attitudes of mind. How can the schools help over this? They start with the advantage that childhood is the time when life-long habits and attitudes can be formed most easily and when the force of example is very strong. Teachers and other members of

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[1] *A Handbook of Health Education* (pp. 148–149), H.M. Stationery Office, 1968, price 15s. net.

school staffs, such as caretakers' influence children by their actions even more than by their words. It is important that their example should be a good one; carelessness and lack of consideration for others are inexcusable in a school.

Opportunities will occur in the work of schools for giving direct education in safety. The words of visiting experts such as police, fire officers and factory inspectors may make a profound impression and be repeated in many homes. Probably, however, the most effective lessons in safety that a school gives are those which are incidental and form part of the teaching of a practical process. For instance, in all practical subjects and many sports and games there are opportunities for acquiring good techniques and skills. In learning how to do a job properly a child learns how to do it safely. This can however be overdone. Undue emphasis on safety precautions may make a child anxious about accidents.

**Accidents**

Many school accidents are trivialities—bruises, minor sprains, cuts and the like. More serious accidents are comparatively infrequent, thanks mainly to the faithful carrying out of safety precautions and to the control and commonsense exercised by teachers. Any relaxation, however, might have dire results; care and forethought must continue to be exercised. Even a minor injury can cause a disproportionate shock and a serious waste of time, and some foolish actions involve an innocent companion who need never have suffered.

When accidents do occur, a report should be prepared in accordance with any procedure laid down by the school or by the local education authority. Serious complications may follow what at first sight appears to be a minor injury. If the legal responsibility for an accident has to be decided, that is a matter for the courts; but the moral responsibility for the safety of its pupils lies with the school. Children differ widely in the frequency with which they appear to be involved in the kind of action which leads to an accident. It is important that teachers should bear in mind this weakness of certain children.

The playground continues to be the scene of collisions and falls, which are occasionally serious, and it is not uncommon to find that a large proportion of the accidents on school premises occur there. Teachers know from experience of playground duty how unavoidable some of these mishaps appear to be, especially among younger children.

The number of playground accidents is likely to be reduced if the time-table for recreation is arranged to allow boys and girls of different ages to make use of the playground space at different times. Broader educational developments are also having their effect. Nowadays children move about more both inside their classrooms and inside the school buildings and may therefore tend less to surge wildly into the playground. One of the results, too, of establishing standards of courtesy and consideration for others in a school will be evident in more unhurried movement about the corridors and in the playground.

A danger too often disregarded is the practice of allowing pupils to carry heavy pots full of scalding liquid between various points in the school.

Schools now have an appreciable amount of audio-visual aids equipment. The proper electrical maintenance of this equipment is of the greatest importance because it is used by so many different people and often no one person has a particular responsibility for it.

Guillotines are often found in schools and are highly dangerous. They should be adequately guarded when in use, and should be kept locked when not in use.

**Planning schools for safety**

There have been significant developments in recent year in making school buildings safer as well as more efficient places. New schools have embodied new ideas in methods of construction, materials and design. Those who have planned these schools have tried to make them safer places for the children who will use them. Teachers have been brought fully into consultation about the new ideas; and architects have been greatly helped by accounts given by teachers of what children do in school, what materials and tools they use and how they release their abundant energy.

Because schools are now being planned to suit modern teaching techniques and the natural behaviour of children, movement can take place with considerably less danger, but every minor hazard cannot be eliminated. Indeed, it could be strongly argued that to do so would be to deprive children of an environment in which they can learn to avoid some of the dangers to which they will be exposed in their life outside school.

Thorough investigation of serious accidents that have occured in schools has, however, sometimes disclosed the existence of un-

suspected dangers. Improvements in design have gone far to remove such causes of accidents as unnecessary projections outside buildings, slippery floors and places where congestion was likely. Other dangers were doors without adequate door-stops or with unsuitable glazing. A great deal of attention has also been devoted in the planning of new schools to the problem of escape in the event of fire. Factors previously unappreciated are now taken into account in the planning of a school, such for example, as the extent of children's reach in cloakrooms and libraries, the force of their impact against an obstruction, the dangers from unprotected low-level glass in gymnasia or rooms where children are physically active, and the amount of glare to which they would be subjected from the use of unsuitable materials on floors, walls and ceilings. It is also now realised that tables and chairs should be designed to suit the physical needs of children and should be light enough to be moved easily by them.

**The wider effects of safety training**

The habits which children acquire in school are not dropped when they go out through the school gates. The ways of doing things, such as the correct way to lift, hold and carry heavy articles, the use of tools and household appliances, which children learn at school are frequently put into practice at home, in employment and in later life. Chapter 9 on road safety again refers to the increased dangers which children face, either as pedestrians or as cyclists, because of the inevitable growth of traffic. These traffic dangers which schools help children to guard against occur outside, not inside, school premises, and it is hoped that the acquisition of safe habits makes for safety everywhere.

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# Daily Precautions Against Fire

(This chapter consists of extracts from the Department's Building Bulletin No. 7, *Fire and the Design of Schools*, 3rd edition 1961).

**Fire-drills**

Although school buildings generally provide reasonable protection against fire, the premises can quickly become dangerous unless there is some foresight and attention to detail in their day-to-day use. Only the teachers can ensure that everyone knows what to do if there should be a fire. Periodic fire-drills (by which is meant practice evacuation of the building, not fire-fighting practice) should be carried out in every school.

**Stairways and doors**

Stairways and exit doors must never be obstructed, and all exit doors must be capable of being opened easily and immediately from the inside while there is anyone in the building. Stairways and exit doors should be kept in good repair. Nothing should be stored or allowed to accumulate in the stairway enclosures. Ideally, doors across escape routes should not be fitted with locks but, where they are fitted, it is essential that they should be kept unlocked the whole time the building is occupied.

The purpose of 'fire-resisting' doors into stairways enclosures and across escape routes and the importance of closing them quickly in the event of fire in any part of the buildings should be explained to all the occupants of a school. 'Fire-resisting' doors should be closed at night and during the weekends and holidays so that if there is an outbreak of fire its spread will be reduced.

**Storage**

It is important that accommodation for stores of all kinds should be adequate and used in an orderly manner. This applies particularly where combustible materials are stored for laboratory, craft-room and workshop use and where quantities of stationery and books are kept.

**Rubbish and combustible waste**

Rubbish and combustible waste matter should not be allowed to accumulate, particularly in laboratories, workshops, craftrooms and boiler rooms. The common practice of storing firewood close to boilers to keep it dry should be discouraged. Quantities of cleaners' oily rags are a potential source of danger as they may be liable to spontaneous ignition. They should be placed in a metal or other non-combustible container and disposed of daily outside the building.

**Fire guards**[2]

Every open fire (gas, electricity or solid fuel) must be provided with an efficient type of fire guard, and there should be some means of fixing it in position.

**Temporary decorations**

Paper or flimsy materials should never be used for decorations or for costumes where heating is by any kind of open fire unless they have been treated to make them flame-resistant[3]. Such decorations, and also evergreens, should not be suspended from light fittings; fire occurring in suspended and highly flammable materials spreads rapidly and blazing pieces may drop over a wide area before everyone in the room has a chance to escape. Cotton wool should never be used for these purposes.

Fancy dresses and costumes for school dramatic productions are often, by their very nature, highly flammable, and wherever possible flame resistant fabric should be used for their construction. The greatest care should be exercised when school plays or parties are being held; at such times it is particularly important that open and portable fires are adequately protected with fire guards in accordance with the *Heating Appliances* (*Fireguards*) *Regulations 1953*, and in order to minimise the risk of dresses and costumes catching alight, mirrors should not be placed above fires.

**Electrical supply and fittings**

Fuses that have blown must be replaced only with fuse wire of the correct rating, never with wire of a higher rating or, as sometimes

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[2] *Heating appliances* (*Fireguards*) *Regulations*, 1953—S.I. 1953 No. 526.
B.S. 1945: *1953 Fireguards for heating appliances.*
B.S. 1945: *1953 Supplement No. 1—1956—Fireguards for heating appliances* (*gas, electric and oil burning*).
B.S. 2788: *1956 Fireguards for solid fuel fires.*

[3] Fire Protection Association, Booklet No. 14—*Fire Precautions in small halls used for entertainment purposes.* (revised 1962).

happens, with thick copper wire. Flexible cable to fittings should be as short as possible and should be inspected regularly and replaced immediately if worn. Additions or alterations to wiring should be undertaken only by a competent electrician. Special care should be taken when fairy lights or other types of lighting are used for decorative purposes.

**Fire warning systems**

Electric fire warning systems should be tested once a week, and any faults should be rectified immediately.

**Fire extinguishers**

Fire extinguishers should be maintained and recharged according to the manufacturer's instructions. When in position they should be well away from any fire, radiator or heat producing appliance and should not stand in direct sunlight. Spare extinguishers and refills should be stored in a cool, dry place and never in storerooms attached to classrooms.[4]

[4] B.S.C.P. 402: *Part 3: 1964—Fire-fighting installations and equipment—Portable fire extinguishers for buildings and plant.*

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# Safety in Science Laboratories

The purpose of paying attention to safety precautions is to foster proper and lasting attitudes of mind to safety and to increase the confidence of all who work in laboratories. It is the duty of those who design laboratories to do so with safe working in mind. Teachers and laboratory staff should attend to regular maintenance, and staff and pupils be alert to potential hazards so that they may be avoided. However, while known hazards can be guarded against there is always an element of unforeseen danger which calls for thoughtful and deliberate attitudes to laboratory work and the setting of good examples by teachers.

Teachers must be thorough in preparation and alert in supervision. The importance of trained laboratory assistance cannot be too strongly emphasised. Such assistance can do a great deal to forestall accidents by removing their causes.

**Safety factors.** The various aspects of safety can conveniently be considered under six headings:

Laboratory design and furniture
Electricity
Fire
Chemical hazards
Hazards which may arise from the use of ionising radiations
Hazards which may arise in particular operations.

## LABORATORY DESIGN AND FURNITURE

A potential cause of accidents is overcrowding of laboratories either at the working benches or around the demonstration bench. Rooms must therefore be large enough, or classes small enough, to avoid this. Flexibility in the design of laboratories enables a teacher to make 'safe' arrangements, particularly for demonstrations. The provision of a space round a demonstration bench is especially important. All laboratories, and particularly chemistry laboratories, should be well ventilated. High-opening windows and ventilators

should be accessible and easily controlled and it should not be necessary for either a teacher or a pupil to stand on a bench top in order to reach them. Sound planning can usually greatly reduce the amount of walking, especially when carrying apparatus. There should obviously be no running! Nevertheless, some movement in the laboratory will be necessary and gangways must be wide enough to allow for it. There should be no obstacles on the floor or unnecessary protrusions from walls or benches. Floors should not be slippery. Taps which spray water around are an avoidable hazard. It commonly happens that school bags, or quantities of books required for other lessons, are taken into science lessons and proper provision should be made for this.

Fume cupboards are needed in all laboratories where chemistry is taught. The number required will vary according to the nature of the laboratory, but in chemistry laboratories proper, there should not be fewer than two, and they are unlikely to be used for the same purpose. One of them is likely to be used for keeping the apparatus for generating noxious gases and for storing substances which give off noxious vapours. The other type will be used for experiments which present a particular hazard or, sometimes, for experiments which require to be left running. The second type in particular should be constructed of fire resistant material.

Laboratories should be kept locked at times when no one is authorised to use them. A duplicate key should hang outside the door of the laboratory in a locked box with a thin glass front which can be broken in emergency. There should be at least two recognised ways of exit, not necessarily always doors although suitably sited doors are to be preferred, and these should at all times be readily available for use in case of emergency. A means of escape which is not also a familiar means of entry should be conspicuously indicated. On any escape route the doors should be immediately openable from either side, particularly where an alternative means of escape is through an adjoining room.

Laboratories should be equipped with an adequate supply of waste boxes, preferably of three distinctive kinds, one for dry waste, one for broken glassware and one for wet waste such as filter papers and biological material.

**Method of storage**

Where there are more than one or two laboratories, a separate main store should be provided. The main store may in some cases have to

be used as a combined store and preparation room but it should be of adequate size, certainly not less than 250 square feet. Because it is sensible to use trolleys for moving equipment about, not only must a parking space be provided for the trolley but the store, preparation room, laboratory and lecture/demonstration room should preferably all be on the same level. If a large central store is provided for all laboratories and the laboratories are on different floors a lift will be required and again the use of trolleys to and from the delivery point is to be recommended. It is highly desirable that lifts should be large enough to take an accompanied trolley.

Laboratory lifts should be enclosed by fire-resisting shafts with fire-resisting doors and the shafts should have permanent ventilation to open air at the topmost level. The doors should be kept closed except when actually in use, and should be marked to this effect.

Stores should be well ventilated. Wall-racking should be strong, firmly mounted and sufficient for all the apparatus and material. There is much to be said for metal racking which permits flexibility of shelf separation. Polyvinyl chloride floor-covering makes a very satisfactory shelf lining: it is inexpensive and easy to cut to shape. The range of colours in which this material can be obtained makes possible a colour-coding system but in any case shelves should be boldly labelled. If a non-slip covering, such as PVC, is not fitted it may be necessary to fit a coping to each shelf to prevent vibration causing bottles to slide off. However, if a coping is fitted great care must be exercised when taking bottles from the shelves. Bottles should not be stored in multiple ranks. Corrosion of metal shelves and the early stages of disintegration of wooden ones should be stopped and repaired long before the shelves are weakened.

Common volatile liquids which may cause fires by the ignition of their vapours include carbon disulphide, ether, petroleum ether, benzene, toluene, alcohol and acatone. Quantities of such substances, other than those required for immediate use, must be stored in a specially constructed store outside the laboratory. If this store is not sited outside the school building it must be designed to have at least one hour's fire resistance. The store should in any case be provided with external switchgear, have adequate ventilation, with the ventilation apertures so protected as to prevent the possibility of ignition of vapour by any outside agency, and have an explosion vent. It should have a sill or a sump capable of retaining the entire contents of the store, to avoid the possibility of any burning liquid running loose and causing a serious outbreak of fire. No more than 500ml. of any

one volatile flammable liquid should be kept in bottles on laboratory benches or shelves. All such bottles must be labelled 'Highly Flammable'.

The use of a colour code for supply lines, gas, electricity conduits, water and so on, has much to recommend it from a safety point of view and it is attractive as well as functional[5]. It is essential that low and high voltage electricity supplies be clearly distinguished with different sockets for the two supplies.

The main control taps for gas and water, and the main electrical supply switch should be easily accessible (preferably adjacent to one of the exits) and clearly labelled.

It often happens that the same experiment requires the use of a bunsen burner, an electric heater and other apparatus requiring a supply of electricity. Because several tubes across the working surface may be a hazard, it is recommended that all supply points should be at the back of the working surface, although it is often convenient to be able to control the gas supply from the front.

Laboratory stools which are not in use whilst experiments are being carried out should be arranged tidily so that they do not form obstacles for the unwary. They should be kept in good repair.

An untidy, littered laboratory encourages attitudes which may themselves result in accidents. Floors, shelves and benches should be kept free from dirt and from apparatus and chemicals not in use. Cleaning up should be done if possible after each step in an experiment.

A concise set of laboratory rules should be readily available to all pupils and they should be thoroughly understood.

A first-aid outfit should be kept in all laboratories and its contents should be checked frequently. The teacher and laboratory assistant should be familiar with its contents and their use. The actual number of first-aid outfits to be provided for a science department will depend to some extent on the disposition of the various laboratories, but in all cases the outfits should be positioned so that there is no avoidable delay in using them. Procedure for dealing with serious accidents is a matter for the decision of head teachers and it should be familiar to all science teachers and laboratory staff. Prominently displayed in

[5] See B.S.S. 1710 *Identification of Pipelines.*

all first-aid outfits should be the telephone number of the nearest doctor. The contents of the first-aid box might well be as recommended in Appendix B, page 100. A safety screen should be provided for use in demonstrations where there is risk of explosion or implosion.

**Electricity**

Electrical appliances are used in experiments by quite young pupils. There is risk of shock in handling any mains electrical wiring or equipment, and even though all such apparatus should have been designed to minimise the risk it should always be handled with caution. No such electric apparatus, lead or connection should be touched with damp or wet hands nor when standing on a wet surface. A dangerous current through the body might well be produced by potential differences as low as 60 volts. For some especially sensitive individuals the threshold voltage is lower still. Wherever possible low voltage (55 or lower) should be used, and any supply through open terminals should be at not more than 12 or so volts.

Apparatus to be used by pupils should be supplied at an inherently safe voltage and about 12 to 14 volts is suitable for a considerable range of equipment and experiments. Much portable apparatus, however, works from the mains and its use is increasing. There can be no question that the safest course is to supply all science laboratories at 110 volts so that an earthed centre point would give a maximum of 55 volts to earth. So long, however, as apparatus continues to be supplied to operate at 240 volts it is advisable to afford some degree of protection by isolating each laboratory from the mains by a 1:1 transformer. Mains power-packs which supply high voltage should have internal resistances so that that they cannot deliver more than 5 milliamps D.C. on short-circuit, and be so smoothed as to reduce A.C. ripple to not more than 1 per cent.

It is comparatively unusual for an accident to happen through direct connection of the body between live conductors. Much more often the connection is between one live conductor and the floor, or against metal-work. Water and gas supplies, radiators, concrete floors, sinks and so on, which provide low resistance paths to earth, should be so positioned relative to electrical supplies as to minimise the risk of anyone's being able to touch an electric connection and an earth at the same time.

Switches should always break the live lead (red) and there should be some clear indication, preferably a pilot light, when a piece of

apparatus is switched on. The external metal parts of all apparatus connected to the mains should be earthed and if this is done properly no fault in the apparatus can lead to the outside becoming live and a source of danger. This does not, however, render the circuit inside innocuous and before making any adjustment to it the apparatus should be completely disconnected from the mains. Making a good earth connection calls for competent advice and all mains sockets in science laboratories should be for 3-pin plugs. Local lighting, such as for microscopes, should be at low voltage; adequate earthing is difficult and often, because it is lighting, is not provided for. In general, the wiring of an electrical installation calls for specialised knowledge and must be carried out in compliance with the *Regulations for the Electrical Equipment of Buildings* issued by the Institution of Electrical Engineers. There should be regular and systematic testing of all electrical appliances and their connections.

The connections between apparatus and 3-pin plugs should be made with 3-core flexible cable of suitable current rating. Braided flex should not be used for the flexible connections to portable equipment. There should be an outer covering of tough rubber or thick plastic. Moulded rubber plugs are less liable to damage than the moulded plastics type. It should be noted that the colour coding of the conductors in the mains connecting cable fitted to electrical equipment of foreign manufacture does not always conform to British convention (at present red, live; black, return; green, earth). The safest course with such apparatus is to change the whole connecting cable for one with conventional British colours. It is important that the earth connections should be regularly inspected and checked using an instrument designed for the purpose. A 'megger' insulation testing set, for example, is unsuitable for measuring the low resistance of properly made earthbound connections.

All portable equipment must be regularly inspected and tested by a competent person who should record the nature, date and result of the test in a log book or on an equipment record card. The interval between tests will vary in different schools, but it should never be less than once a year and more often when the apparatus is in frequent use.

Finally, the teacher should set a good example. There should be no long, trailing, leads even in demonstration experiments. Electrical apparatus should not be connected to the lighting circuit. Any loose or temporary connections should be made by using porcelain or plastics connectors. Old or threadbare wire should never be used

and insulation should be replaced when it shows signs of thinning or cracking. Avoid using open knife type switches for any voltage higher than 12-14 volts and always switch off any electrical apparatus before attempting to move, adjust or inspect it. See that pilot lights are operating and that fuses are of the correct rating.

**Electric shock**

The severity of an electric shock is determined mainly by the current and the path which it takes through the body. Thus the degree of moistness of the part of the body in contact with the appliance, the nature of the ground on which a person is standing and the area of contact with the appliance all effect the severity of a shock by causing variations in resistance to current flow. Defects in equipment used in dry rooms with well-insulated floors may cause no harm but they remain potentially dangerous, and might cause fatal accidents when the equipment is used elsewhere. Regular inspection and maintenance especially of portable equipment, is essential.

**Treatment of electric shock**

Switch off the current. If this is not possible use rubber gloves, a dry mackintosh coat or dry woollen material to protect the hands. Before touching a person stand on a dry mat and/or take off your coat and stand on that.

A doctor or ambulance should be called at once, and if no breathing can be detected apply immediate resuscitation (e.g. mouth-to-mouth resuscitation or other modern methods).

If the pulse cannot be felt, and there is no other evidence of heart action, external cardiac resuscitation should be applied in alternate conjunction with mouth-to-mouth resuscitation.

Efforts should be continued until medical supervision is obtained or natural response occurs.

If the victim becomes unconscious it is always advisable to call a doctor, whether or not first-aid measures are successful.

All science teachers should have some knowledge of modern methods of resuscitation. Placards of instruction should be hung in the laboratory.

## FIRE

**Fire-fighting equipment**

Fire-fighting appliances should be kept inside the laboratory as near as to the door as possible, but away from the part of the room

where the risk of fire is greatest. They should be kept in good order and in a constant state of readiness[6].

The following articles are needed:

(a) A fire blanket in a suitable container fixed to the wall.
(b) A bucket of sand with a scoop.
(c) A suitable number of fire extinguishers, usually of the carbon dioxide type.

As a precaution against fires involving active metals one extinguisher of the 'powder' type should be supplied to a chemistry department.

Note that fire blankets should not be used on glass apparatus where there is a danger that vessels may be tipped over or broken with consequent spreading of the fire. Carbon tetrachloride extinguishers should **not** be used in laboratories since the vapour is toxic and it may, when in contact with heated surfaces, produce toxic decomposition products.

At regular intervals all fire extinguishers should be weighed, or otherwise inspected by a qualified person, as a check that they are fully charged.

Where hose reels are installed in a school their coverage should include the laboratory area.

If a fire does occur the pupils should be directed to leave the laboratory at once. If it is possible to get at them, windows and doors should be closed, the fire attacked with appropriate extinguishers, the fire brigade called, and any other action taken in compliance with school instructions.

## FIRE PREVENTION

### Gases

Tubing to burners should be inspected periodically and replaced if it shows signs of deterioration. Open flames should only be used after a check on nearby material; bottles of inflammable liquids, for example, should be removed from the vicinity. There is a risk of injury in the fact that a bunsen flame is invisible in strong light. When a laboratory is to be left empty a check should be made that

[6] B.S.C.P. 402 Part 3: *1964. Fire-fighting installations and equipment—Portable fire extinguishers for buildings and plant.*

all burners are turned off and that there are no gas leaks. Then the main gas-tap should be turned off. Bunsens should not be allowed to burn beneath shelves and where there is any possibility of this happening it is a sensible precaution to fit a limiting wooden batten on the bench top as a reminder of this. Asbestos boards should be used beneath bunsen burners.

Explosions have occurred where petrol gas and propane-butane mixtures are used for bunsen burners, and such plant should not be installed without expert advice and spark-free or flame proof switch gear should be used for any electrical circuits where such systems are housed. Acetylene systems are not recommended because of the wide explosive range of acetylene-air mixtures.

Cylinders of compressed gases should be painted in the appropriate colours of the British Standards Specification. They should never be stored near a fire risk, such as a store of flammable solvents, nor near to any considerable source of heat. In use they should be fixed in stands or wall brackets in an upright position. Oxygen cylinders in particular should never be allowed to come into contact with oil or grease. Particular care is needed with hydrogen cylinders since the gas diffuses readily, but mechanical damage to any gas cylinder must be avoided. If a leak in a connection to a cylinder is suspected it can be tested with soapy water applied with a brush, but **not** with a naked flame.

**Flammable liquids**

Precautions to be taken when using flammable liquids are:

(a) Such liquids should not be poured from one vessel to another, or heated, near an open flame.

(b) The heating of low boiling-point liquids over a naked flame in the course of distillation must be done on a water-bath. High-boiling point liquids must be heated on a sand-tray or under reduced pressure on a water-bath. If an electric heater is used the elements must be enclosed and it is advisable that any switches should be away from the apparatus. Some liquids, for example, ether and carbon disulphide will ignite on contact with a hot surface.

(c) Condensers must be efficient. The rate of heating must be such that liquid does not accumulate in the condenser, otherwise it may be blown out and set alight by a distant flame.

(d) All glass-ware must be carefully examined for flaws and ill-fitting joints.

(e) It should be remembered that many of these liquids generate vapours which are explosive when mixed with air. Some of the vapours are also toxic.

**Flammable and dangerous solids**

Metallic sodium and potassium should be kept submerged in suitable petroleum oil, preferably in glass or stone-ware jars. White phosphorous should be stored under water in a glass container. Phosphorus pentoxide and sodium peroxide should be kept in tightly closed containers. These chemicals should not be kept in large quantities and any in excess of immediate requirements in the laboratory should be kept in store.

Strong oxidising agents such as chlorates, perchlorates and perchloric acid, nitric acid and nitrates, permanganates and peroxides need care in storage so that they are not accidentally mixed with readily oxidisable materials such as organic matter, charcoal or sulphur. They should never be placed on paper or the wooden bench.

Careless disposal of phosphorus residues and pieces of hot charcoal has occasionally led to fires. They should be placed in a non-flammable receptacle and removed to a safe place outside the building.

**Accidental explosions**

The wearing of eye shields should be insisted upon whenever there is risk to the eyes and such risks may arise from spills and splashes as well as from explosions.

In the event of acid or alkali splashes, the eyes should at once be flushed out with water from a laboratory tap. There should be no delay, and rather than waiting for an eye bath to be brought from the first-aid box the cupped hands should be used.

Teachers should take proper precautions when burning a jet of hydrogen or hydrogen sulphide, or when reducing a metallic oxide by heating in hydrogen. A sample of the hydrogen should always be collected and tested to see that it is free from air before either the jet is ignited or the reduction tube heated. Reduction experiments are more safely performed with coal gas, but here again the collecting and testing of a sample of the gas should be carried out as for hydrogen. Thorough precautions should be taken in experiments in which the following substances are used: sodium, potassium,

anhydrous aluminium chloride, concentrated acids, red and white phosphorus, potassium chlorate and other powerful oxidising agents, and carbon monoxide. The danger from using volatile liquids has already been mentioned.

The thermal decomposition of ammonium nitrate calls for special care and it should only be necessary to heat very small quantities indeed in a small test-tube. The method should not be used for preparing and collecting nitrous oxide. Nor should any but very small amounts of a mixture of potassium nitrite and an ammonium salt be heated, if indeed it is necessary to heat the mixture at all.

The use of old stock potassium has caused explosions, despite all the usual precautions being taken. The most probable reason is that old samples may become coated with the superoxide which is known to form under mineral oil. Old stocks, especially any which have a yellow appearance, should not be used but should be destroyed with extreme care.

There are many substances which although relatively harmless in themselves can become explosive if mixed with certain other substances.

*General rules are:*

(a) Do not mix combustibles with oxidising agents.
(b) Do not add concentrated strong acids to chlorates, or vice versa.
(c) When diluting acids add concentrated strong acids to water and not vice versa.

Teachers should warn pupils about specially dangerous mixtures, for example those containing chlorates. Because of their special dangers it is illegal to mix potassium chlorate with either sulphur or phosphorus.

Pupils should not be allowed to prepare mixtures for analysis or any other purpose without competent supervision.

'Thermit' reactions call for special care. Either they should be done out of doors or, if indoors, the quantities used should be small (a total weight of material of about 20 gm), the experiment being conducted in an open iron dish standing on two asbestos mats separated by an air space, and no one should be nearer the demonstration than 10 or 12 feet.

Chemicals which undergo change once the package has been opened should be purchased in small quantities. Examples are phosphorus pentachloride and aluminium chloride. Serious explosions have resulted from tightly stoppering bottles which contain substances which generate a gas by hydrolysis. After such bottles have been opened they should be kept loosely stoppered for a few days in a 'dry' box with, for example, silica gel, before tightening the stopper.

Care should be taken when washing out bottles, for example those which have contained sodium or potassium or sodium peroxide. An apparently empty bottle may contain a highly explosive residue or mixture of air and a flammable vapour.

In experiments which involve the heating of a compound which evolves a gas, care should be taken that there is no risk of a build-up of pressure through the blocking of a tube.

**Other fire risks**

Fires have been started by the focussing of the sun's rays by flasks of liquids and by solariscopes left near windows. Although most schools need to charge only a few accumulators at a time, it should be remembered that the mixture given off by a gassing accumulator is highly explosive. Stirrer motors running for some time near a flammable liquid have become hot enough to cause ignition.

**Burns**

All burns except the most trivial should be referred for medical advice after initial first-aid measures. Such measures should protect the damaged part and guard against the introduction of infection. The onset of shock should be anticipated by suitable precautions, particularly if it is necessary to move the injured person.

## CHEMICAL HAZARDS

Hazards may arise from chemicals used in all science laboratories and not only in the chemistry laboratory. Safety is mainly the result of a proper frame of mind, thorough preparation, methodical working and, not least, sensible planning. Since this last factor begins with planning the storage of chemicals and apparatus, this section is taken first.

Stocks of concentrated acids and alkalis should be kept in the storeroom, the larger containers being on or near floor level. Winchester bottles should always be carried in proper carriers and never by the neck alone. Heavy articles should be stored as near

trolley-top level as possible. There should be no protrusions of glass or other articles beyond the shelves.

Care should be taken to store well apart from one another chemicals which might react together to give off dangerous fumes or cause fire or explosion on accidental breakage.

Scheduled poisons and substances of high toxicity must be kept in a locked cupboard or store. There should, of course, be a careful check on such chemicals.

Asbestos wool should not be used in schools. It is very difficult if not impossible to avoid the creation of airborne dust if it is used, and the disease mesothelioma appears to be caused by the presence of even very small amounts of asbestos in the lung.

Pupils should not be allowed to remove chemicals from school save in exceptional circumstances when the goods should be properly packed and labelled.

Reagent bottles in the laboratory itself should be of small capacity and those for concentrated acids and alkalis should stand on an inert surface at bench level. There is much to be said for keeping bench tops clear of all reagents, etc., except for those in immediate use. A good way of achieving this and at the same time having reagents convenient to hand is to design chemistry laboratories in particular so that all bench reagents are kept on wall-mounted shelves with short fixed benches projecting from the walls towards the floor centre. Alternatively, drawers or trays may be specifically designed to take small reagent bottles.

Certain substances should only be ordered in such amounts that there is fairly rapid turnover so that old stock is never available. Ether is dangerous in this as in other respects. It readily forms explosive peroxides usually with a higher boiling point than the ether so that in distillation the peroxide accumulates until finally it causes a dangerous explosion. Before distillation a sample of the ether should be treated with acidified potassium iodide. If peroxides are present as indicated by the liberation of iodine, five per cent by weight of ground potassium hydroxide should be added to the ether and left to stand for four hours with occasional shaking. Alternatively the ether can be freed from peroxides by shaking with acidferrous sulphate solution. When retesting shows freedom from peroxides the ether should be redistilled and stored in a cool place in dark bottles containing a small coil of clean copper wire.

All reagent bottles and containers should be plainly labelled and whatever method is used the label should be clear and, if not permanent, firmly attached to the container. Bottles should be labelled on one side only and pupils taught to put the label side in the palm of the hand when pouring. This ensures that drips will not efface the label and that there is less chance of pupils' hands becoming contaminated. If a substance in an unlabelled bottle cannot be identified easily and certainly it should be disposed of safely.

Many schools are authorised to use radioactive substances for work in science. Guidance on the special requirements for storing these substances is given in the Department of Education and Science Administrative Memorandum 1/65 dated 8th January 1965 and in *the Ministry of Labour Code for Practice for the protection of persons exposed to Ionising Radiation in Research and Teaching*. (H.M.S.O.).

**Precautions when handling chemicals and apparatus**

Much of the advice in this section is largely a matter of common sense and its observance can do much to assist in the smooth running of laboratory work. Pupils should be taught from the beginning to check apparatus and to take all reasonable precautions.

(a) Some form of protective clothing, a laboratory coat or a simple apron, made from nonflammable material, is always advisable.

(b) In no circumstances should pupils put chemicals in their mouths. Eating or drinking in the laboratory should be forbidden.

(c) Mouth pipettes are convenient and easy to use. Nevertheless they are hazardous for beginners and unhygienic. Greater use should be made of the rubber bulbs now available and a measuring cylinder, burette or some other form of dispenser should be used when possible. Make sure that the tip of the pipette is kept well under the surface of the liquid. Never pipette poisonous substances, hot solutions, or corrosive liquids by mouth.

(d) Stopcocks should be kept lightly greased and the correct use of stopcocks on burettes, separating funnels etc., should be taught. The left hand should in general be used, with the hand surrounding the stopcock.

(e) Bottles containing liquids should be filled to the shoulder only and liquids which have a high vapour pressure at room temperature should be kept out of the sun and away from heat.

(f) Bottles should be opened with care, especially if they contain volatile or corrosive substances. It may often be desirable to

cover the bottle with a cloth or towel, or to hold the bottle behind a screen whilst the stopper is removed.

(g) Stoppers should be held in the hand whilst pouring from a bottle, thereby avoiding contamination. For the same reason, unused chemicals should not be returned to stock bottles.

(h) Stoppers should be replaced securely immediately after a bottle has been used (except where the contained chemical undergoes a change when the bottle has been opened—see above) and the bottle returned to its proper place. The outsides of bottles should be kept clean. Bottles should never be left standing near the edge of a bench.

(i) Plastics containers, whilst for some purposes having advantages over glass, become slippery in moist or wet hands and if dropped they usually bounce, with the risk that the contents are ejected upwards.

(j) Chemical spills should be cleaned up at once. Mopping-up cloths should always be available, as should a mop and bucket. Sand, sawdust and sodium bicarbonate should be available for putting on spills. If kept in small plastic bags the contents can be easily poured out, or the bag cut open and thrown on the spill from a short distance. Rolls of absorbent paper (for example toilet tissue) are useful for mopping up some spills but care must be taken with inflammable or corrosive liquids and, above all, with powerful oxidising agents.

(k) Reference has already been made to the danger of explosions. Ventilation should be forceful enough to ensure that concentrations of vapours are well below the lower explosive limit.
It is worth repeating here that apparently empty containers which have had in them volatile liquids can be a source of great hazard.

(l) Phosphorus is sometimes despatched in metal cans, and fires have occurred through the drying-out of the water after the can has been opened. On receipt, the contents of the can should be transferred to a wide-mouthed stoppered and labelled bottle containing water.

(m) For removal of items stored in a box cooled by dry ice long tongs must be used.

(n) Dissecting instruments should be cleaned after use, washed in hot water and detergent, and sterilized before putting away. The same treatment will frequently be necessary for glassware used in biological experiments.

(o) Accidents frequently occur because substances are mixed which have a highly exothermic heat of solution. In all such cases the solute should be added slowly, with stirring, to the

solvent, never the other way round. For example, add concentrated sulphuric acid slowly to water and not water to the acid.

(p) In an accident involving either acid or alkali splashed in the eye, flush the eye with water which would be immediately available from taps on the work bench.

**Toxic chemicals**

*A list of poisons with the appropriate antidotes and treatment should be available in every laboratory.*

Laboratory first-aid charts are available which give reference to the treatment for several toxic and commonly found chemicals. The National Chemical Laboratory publication *Safety Measures in Chemical Laboratories* (*H.M.S.O.*)[7] also gives a list of toxic chemicals and the relevant first aid treatment. In case of poisoning it is always necessary to call a doctor or to send the casualty to hospital but the cause of the poisoning will usually be known and first aid can be vitally important. Nevertheless, skilled medical attention must always be obtained for other than very minor injuries.

Scheduled poisons are usually labelled with the word 'POISON' in red capital letters but since most chemicals are to a greater or lesser extent poisonous it is wiser to keep the highly toxic substances in distinctive bottles and to insist on careful handling of all chemicals. It should be routine for hands to be washed in warm water after a lesson in which chemicals have been handled.

Great care should be exercised when substances labelled 'POISON' are used by pupils. Antidotes for cyanide in particular should be freshly made up periodically and well sited for emergency use.

Commonly used chemicals which present hazards not always fully realized are listed below:

*Aniline* is fat-soluble and easily absorbed through the skin. It is poisonous however absorbed, although severe poisoning is not likely to result from the small amounts used in laboratories.

*Benzene* is dangerous as a chronic poison if the vapour is inhaled in small quantities over a long period. Being fat-soluble it can also be absorbed through the skin. It should not be handled on an open bench and where possible it should be replaced by a less toxic alternative (for example toluene or xylene).

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[7] See Appendix C.

*Bromine* vapour is extremely dangerous to the nose, lungs and eyes. because of the high density of the liquid, bottles containing it fracture easily. Liquid bromine is dangerous in contact with the skin and the greatest care should be used in handling it.

*Carbon Disulphide* is not only highly flammable with a very low flash point but the vapour is very toxic and the liquid is absorbed by the skin.

*Carbon Tetrachloride and Chloroform* have toxic vapours and are also absorbed through the skin.

*Hydrogen Sulphide* is not a cumulative poison but it is almost as deadly as hydrogen cyanide. What is more, high concentrations have no smell. It should be used only in a fume cupboard.

*Mercury* vapour, even if inhaled over a long period in very low concentration, is very toxic and mercury used without great care can very easily give rise to dangerous concentrations of vapour especially in warm and poorly ventilated laboratories. Laboratories ought always to be well ventilated when using mercury. Any spills should be picked up at once. Trays should be used under apparatus containing mercury if there is any chance of breakage. Drops spilt on the floor should be collected by means of a glass capillary tube attached to a filter flask and water pump. Mercury surfaces should not be left exposed to the air—if necessary they can be covered by a layer of water. Transfer of mercury is best done in a fume cupboard and certainly any heating of mercury should be done, if it must be done at all, in a good fume cupboard and only then with great caution.

*Naphthylamine* and other known carcinogens "7A"* should not be kept in schools.

*Solid Carbon Dioxide* should always be handled with gloves or using suitable tongs, preferably with wooden handles. In a confined space it can generate sufficient gas to cause asphyxiation by oxygen deficiency. It should only be added to an organic solvent in small pieces at a time or it may cause splashing with possible damage to the skin or eyes.

*Sulphor Dioxide* is both corrosive and poisonous. Siphons are now supplied in a cardboard case which should on no account be removed. Siphons have exploded and it is wise to guard against softening of the cardboard by providing an extra

*7A. The Chester Beatty Research Institute Booklet *Precautions for Laboratory workers who Handle Carcinogenic Aromatic Amines* pages 2 and 3.

outer case of wood or metal. Siphons should not be carried by the neck.

*Sulphuric Acid* continues to be handled carelessly and to give rise to accidents.

*Sprays and Aerosols* are coming into use in schools in connection with, for example, chromatography. Many of the substances used are potentially dangerous if inhaled or allowed to come into contact with the skin and the work is better done in a fume cupboard. In many cases dipping, using tongs, is equally satisfactory and less hazardous.

*Pathogenic Organisms*. Great care should be taken in the culture of these organisms and wherever possible non-pathogenic material should be used instead.

**Toxic hazards from natural products and other materials used in biology**

Some of the plant material commonly used in biology is poisonous if ingested and some pupils may be hypersensitive towards various substances. The more dangerous ones such as aconite (monkshood), belladonna (deadly nightshade), digitalis (foxglove) and the poisonous fungi are well known but there are many British plants which contain poisonous principles, and pupils should be warned against eating plant parts unless they are absolutely sure that it is safe to do so. It is known, for example, that three or four castor oil seeds can kill an infant and that for an adult 12 seeds may be fatally poisonous.

Advice on handling animals likely to be found in school laboratories can be obtained from the Universities Federation for Animal Welfare, 7a, Lamb's Conduit Passage, London W.C.1., and if the method of handling advised is used there is little risk of bites. If bites do occur they should be treated with a suitable antiseptic wash or ointment.

The risk of infection should be clearly understood—it is particularly serious with wild rats, which dead or alive, should never be used by schools.

Animal cages should be cleaned regularly, at least once a week but depending on the materials used and the animals concerned. Ideally wooden cages should be steam sterilised at least once a fortnight, but in some cases regular scrubbing with disinfectant at the prescribed dilution is adequate. In case of doubt advice should sought.

Formaldehyde solution is irritating to the nose, throat, eyes and skin and should be used with caution. There is potential hazard in handling any preserved material. The skins of birds for example are likely

to have been preserved by the use of arsenical compounds and mercuric chloride.

Awareness of the possible hazards and thorough washing of the hands after lessons should be all that is required as a rule. Instruments which have been used for dissection should be thoroughly cleaned and disinfected immediately after use.

**Disposal of waste**

Dangerous waste chemicals should usually be destroyed under supervision by the science teacher. If he is in any doubt as to the safe way of doing so he should seek advice.

(a) Gases or smokes are usually carried off by way of effective hoods constructed of non-combustible and non-corrosive materials. Fans should be effectively protected and earthed.

(b) Liquid wastes may in most cases be washed into the drains with a copious flow of water. Those liquids, such as phosphoryl chloride and aluminium chloride, which hydrolyse to give toxic gases should not be poured into a sink until they have been diluted with a large volume of water. Caution should be exercised when adding water to such substances.
Flammable liquids should not be disposed of down a sink or otherwise allowed to enter the drainage system. They should be put into labelled bottles for recovery or for destruction (*outside the laboratory*) by burning.

(c) Solid waste, if insoluble and inactive, can be placed in waste boxes. Active metals, such as sodium or potassium, should be destroyed by converting them into soluble compounds. Thus industrial spirit can be added slowly to sodium or potassium. Goggles should be worn when doing so. Solid wastes (for example calcium carbide) which react with water to produce an active fuel require special treatment.
Calcium carbide should never be disposed of in the laboratory. it should be destroyed by adding it to water in small quantities at a time *in the open air*.
Disposal by burying may cause trouble later unless the substance has been made harmless first.

(d) Glass waste should be placed in special containers and never in the sink.

(e) Used plates of bacteriological or fungal cultures should be disposed of with care. They should be opened and washed under hot water containing disinfectant.

**Hazards which may arise from the use of ionising radiations**

The effects of radiation damage are not immediately apparent and there are no indications of danger to go by. Extra precautions must be taken with young people since they are particularly liable to genetic damage.

Because of this the use of apparatus capable of generating X-rays (and this covers a far wider range than equipment specifically designed as X-ray apparatus) and of radioactive substances *must* be in accordance with the advice given in Administrative Memorandum 1/65. Copies of this can be obtained from the Department of Education and Science, Curzon Street, London W.1.

It must be clearly understood that, apart from work with the usual laboratory compounds of potassium, uranium and thorium, or with some closed radioactive sources of very low activity about equal to that, for example, of a luminous watch, and with equipment in which electrons are accelerated by a potential difference of less than 5 K.V., all other radioactive substances and all other devices in which electrons are accelerated must only be used, and in the case of radioactive substances must only be obtained, in accordance with the conditions set out in the Administrative Memorandum.

## HAZARDS WHICH MAY ARISE IN PARTICULAR OPERATIONS

**Glass working**

Ground glass joints are frequently used but bungs still have to be bored and tubes inserted in them. Cork borers should be kept sharp and the cork lightly rolled before it is bored. The end of the cork away from the borer should not be held in the palm of the hand but between the thumb and forefinger and the cork pressed against a smooth surface to give support. With a rubber bung, soap or glycerine can be used as lubricant.

To break small-bore glass tubing into smaller lengths first make a file or knife cut and then cover the tube with a cloth before applying pressure. If a cloth is not used hold the tube at waist level with the file or knife-cut away from the body and apply the pressure outwards with the thumbs. Large-bore glass tubing should not be broken by hand. A cut should be made with a file or knife and then a hot wire or spot of hot glass used to effect the break. Before insertion in a bung the ends of a tube should be fire-smoothed and when cool moistened or alternatively, lubricated with glycerine or a trace of silicone grease. The glass tube should be grasped close to the end

which is to be fitted into the bung and a slight force applied longitudinally whilst the tube is gently oscillated. Avoid the temptation to make use of the extra leverage possible when inserting an angled tube by holding the tube at the angle. With a rubber bung it is safer to use a hollow borer as a guide. The borer is inserted in the hole and the glass tube run through the borer which is then removed, leaving the tube in place.

If silicone grease has been used as a lubricant there should be no trouble over getting the tube out of the bung. If a tube has become sealed into a bung it is dangerous to attempt to pull or push it out. In some cases the borer can be run outside the tube and then the tube can be removed. In others it is wiser to cut the bung away.

The fitting of rubber tubing to glass and its removal should be done with care. It is considered by many to be worthwhile using a cloth or duster in all manipulations with glass tubing.

For glass blowing the bench top should be covered by a sheet of fire-resistant material and it is prudent to wear an eye shield. Asbestos cement sheet should not be used because of the danger of explosion if a flame impinges on it.

The opening of a sealed glass ampoule requires special care and it is generally wise to use eye shields and gloves or to use gloves behind a screen.

Seized-in stoppers and stopcocks should be released with great care. Gloves should be worn, or the hand protected by a cloth and it is advisable to wear eye-shields. Hot water or hot cloths may be applied with care followed, if necessary, by light tapping. Mechanical devices can be purchased but it may be necessary on occasions to cut away the neck of the vessel. It should, however, be regarded as a failure to run a laboratory satisfactorily if such occurrences are more than a rare event.

**Optical instruments**

The sun, or for that matter any other intense source of light, should never be viewed directly through an optical instrument.

**Experiments at reduced pressure**

Vacuum desiccators are not often used in school but both they and Buchner flasks, even small ones, have been known to collapse under vacuum. Glass-ware used in this way must be free from scratches

or cracks, and thin-walled, flat-bottomed flasks should never be evacuated. The normal type of suction flask is thick-walled to resist pressure but if it does collapse it does so violently and, because it is thick, it is more liable to crack if hot liquids are poured into it. A properly constructed guard should be used to give protection. Vacuum distillations should always be carried out behind a safety screen.

**Dangerous experiments**

The making of explosive, and in particular the mixing of sulphur or phosphorus with chlorates, is forbidden by law, and for reasons of safety the making of other elaborate mixtures is strongly deprecated. Some schools have experimented with rockets and rocket fuels but because of the ease with which materials can frequently be obtained outside the school such experiments are also strongly deprecated. Such experiments are quite unnecessary in a school course and others would include the preparations of phosgene, hydrocyanic acid, cyanogen, nitrogen tri-iodide, the oxides of chlorine and the explosions of hydrogen and chlorine and of acetylene and oxygen. Nor are sealed-tube combustions necessary in organic chemistry in schools.

Among other chemistry experiments requiring special care are:
The action of water on sodium peroxide, where it is particularly important that there should be no organic impurities.
The action of sodium on water. The sodium should be cleansed of the surface film which may contain sodium peroxide.
The action of potassium on water. Only a very small piece of clean potassium should be used; the danger from potassium superoxide has already been mentioned.
The action of chlorine on ammonia solution.
The burning of hydrogen and explosions of hydrogen and oxygen.
Any involving hydrogen fluoride.
In organic chemistry care is needed in qualitative tests involving sodium fusions since some substances explode when heated with sodium.

Special care should be taken when using electrical equipment operating at high voltages.

Eyes should be protected by suitably tinted goggles from strong sources of ultra violet radiation since even short exposure may lead to painful inflammation of the eyes which may not develop until some time afterwards. Similar care is necessary in using electric

arcs. If it is necessary to raise or lower the air pressure in a glass or other vessel, previous tests should be carried out and a good safety margin allowed.

4

# Workshops and Workshop Activities

This chapter is mainly about the traditional workshop subjects, but it is not uncommon to find similar equipment in use in other specialist rooms, where the same principles should apply.

## GENERAL

### Responsibilities in the school workshop

Teachers of workshop crafts should give careful attention to safety training and to accident prevention. Their record in the past is a good one, but the increasing complexity of workshops places a heavy responsibility on them and on the local education authorities and head teachers. Specialised equipment should not be brought into use unless the teacher has acquired the necessary expert knowledge, by experience and by attending appropriate courses, and is fully conversant with its use. Professional competence as a teacher and as a craftsman are of equal importance from the safety point of view. The pupils must learn the correct use of tools, apparatus and machines and they must understand and act on the basic rules of the workshop. When workshops and equipment conform to the highest standards of efficiency and when teachers are fully competent, then safety measures need not be too limiting.

Where a safety hazard is known to exist, very careful thought should be given to the method of teaching and to subsequent work by the pupil. Potential sources of danger have been categorised as follows[8]:

*Sharp edges*, including all cutting tools and saws.

*Closing movements*, where flesh and clothing may be ripped.

*Rotating parts*, of all descriptions, particularly where they produce an ingathering nip or intake.

*Reciprocating parts*, such as rams running close to fixed objects and forming trapping points.

*Emissions*, including heat, sparks, fumes and dust.

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[8] '*Safety—Preventing Industrial Accidents*', L. Bruce Archer. Design No. 202. October 1965.

To these may be added other workshop hazards, such as :
*Electrical faults*, especially in circuits used for machinery and equipment.
*Flash and glare*, from welding and other equipment.
*Chemicals*, including acids, caustic solutions and poisons.

Special vigilance is necessary in any situations that give rise to potential danger under these headings. Teachers will feel a moral obligation to take all practicable precautions to safeguard their pupils and for this reason spoken instructions are often supplemented by the written word.

**Responsibilities beyond the school workshops**

A particularly disturbing feature of industrial accidents is the number which occur to young people under the age of eighteen. Of these, many involve the use of machines and take place during the early weeks of first employment on leaving school[9]. Conditions in industry are very different from those in school but there is a fundamental need to develop in pupils a positive attitude towards safety and accident prevention. Safety is not a subject which can be taught through a series of rules. An attempt should be made to help each pupil to understand his personal responsibility for safety. This can best be done by fostering an attitude of awareness to dangerous situations and by supporting general safety rules with reasoned arguments. Safety precautions should progress with, and be a relevant part of, the pupils' experience in workshop crafts. Under these conditions pupils are more likely to develop right attitudes to potentially dangerous situations and they will receive valuable preliminary training in precautions to be taken against accidents in the home and in industry where many of them will find employment.

Portable power tools are increasingly used in industry and in the home, and this places a further responsibility on the teacher of workshop crafts and on his colleagues generally. Occasions may arise for the teacher to discuss the potential dangers and the special safety requirements of these tools and he will have opportunities to stress the importance of proper electrical connections. If demonstrations are given, they should be of machines used for their main purpose in situations where the use of a portable machine is essential.

[9] *Industrial Training and Training in Safety*, Central Training Council, Memorandum No. 2.

Workshops in schools are not subject to the Factory Acts and are, therefore, not inspected under those acts. Nevertheless, pupils ought to have the protection afforded by the measures that have proved satisfactory in the prevention of accidents in industry. Moreover, local education authorities and schools may seek the advice of H.M. Inspectors of Factories, who welcome the chance of offering guidance either through specific advice on the arrangement of the workshop equipment, or through occasional talks to older pupils and to groups of school teachers. In implementing this advice the dissimilar purposes of school and factory, and the differing conditions in them, should be borne in mind[10].

### THE PLANNING OF WORKSHOP AREAS

It is at the planning stage that the basic safety considerations must be examined. Where an authority has an inspector, organiser or adviser with responsibility for workshop crafts, he should be consulted by the architects at the earliest opportunity. Other authorities equally need expert guidance; they should rely on the judgement of senior members of workshop staffs.

The principles governing the design of new workshops are dealt with in *Building Bulletin 31, Secondary School Design: Workshop Crafts*, but as the safe use of rooms is largely dependent on the lay-out of machines and benches, flooring, lighting, heating and colour schemes, teachers should look critically at their existing workshop arrangements in order to ensure that the working conditions are as safe as possible. The rearrangement of the benches may increase the width of the gangways, and the re-siting of a machine, with the approval of the head teacher and the local education authority, may well permit easier supervision of the room. The installation of strip fluorescent lighting for general illumination and of low voltage individual lights for machines is often possible[11]. (Modern fluorescent tubes are made so that there is a period of decay in the illumination produced and hence the risk of stroboscopic effects has been eliminated). The wiring regulations of the Institution of Electrical Engineers should be observed[11].

Workshops should be warm. If hands are cold they are less sensitive and if machines or hand tools are very cold they can only be handled with a much reduced degree of safety. Some floor surfaces may become burnished by saw-dust and shavings. Cleaning methods should

[10] RoSPA also offers a service to schools which is described in its pamphlet *Occupational Safety and the Education Service*.

[11] See Appendix C.

guard against this possibility and special precautions need to be taken especially near to woodworking machinery. Non-slip adhesive pads, set flush with the floor, give very good protection against slipping. A well organised-attractive workshop, where the British Standard colour coding is used to identify and to provide a warning against danger, is a lesson in itself.

Careful attention should always be given to the storage of materials and of partly finished work. Local education authorities should ensure that appropriate fittings (racks, shelves and cupboards) are installed. Racks should be constructed and supported to resist any tendency to collapse from uneven loading. Great care should be exercised in the storage of lengths of timber and heavy section metal, especially when these are vertically racked. Care should also be taken when lengths of metal and timber are stacked horizontally as projecting sawn ends could cause painful injury to both teachers and pupils.

Workshops should be considered as places with definite zones of work. If suitable arrangements are made for storing the relevant equipment and tools in each zone, unnecessary movement can be reduced considerably and the workshop will become more efficient—and thus a safer place for the pupils. Suites of workshops are often planned for new schools with machine bays, hot-working areas and constructional spaces leading to outside covered aprons. In these cases it is important for the teacher to be able to exercise supervision of the pupils from the main workshop.

## PRECAUTIONS

### First-aid and fire precautions

Every workshop must have its own first-aid box, suitably equipped, conveniently placed and immediately available; it is not sufficient to rely solely upon first-aid equipment in another part of the school. The first-aid box should be regularly checked and re-stocked. The teacher should have sufficient knowledge of first-aid to enable him to deal with any accident likely to arise in his workshop. Suitable courses in first-aid are arranged by a number of local organisations. The pupils should know which member of staff in the school has particular responsibility for the treatment of injuries. They should be thoroughly familiar with the fire-drill approved for the workshop and they should understand how to use fire extinguishers, fire blankets and sand pails. These appliances should be kept inside the workshop as near as to the door as possible but remote from that area of the room where the risk of fire is greatest. Rags, cotton waste and similar materials are a potential source of danger and should

not be allowed to accumulate or be stored near naked flames. It should be a rule that whenever the electricity power supply is cut off, for any reason, all switches controlling any portable appliances (for example, soldering irons) should be put in the off position. Instructions for dealing with burns and electric shock should be placed near the first-aid cabinet.

**Personal care and protective equipment**

It is especially important that pupils should regard the protection, in particular of eyes and clothing, as part of the normal procedure essential to the performance of any operation where danger is likely to arise. The teacher's example in this matter is of paramount importance. The protection of eyes must receive high priority in every school workshop. The cutting tools of certain machines need to be suitably guarded and these precautions are mentioned in a later section of this chapter which deals with metalworking machines. In any work where wood or metal chips, dust or particles may fly, general-purpose, one-piece P.V.C. goggles or similar spectacles should be worn. These are cheap and they give undisturbed vision over the whole lens area. Special visors, gloves and spats are essential when pupils assist in the pouring of molten metal into a mould. The special protection needed for pupils who are welding is dealt with separately in the paragraphs on gas and electric welding.

Most teachers encourage the use of aprons or overalls which protect the pupil and his clothes and also accustom him to the idea of wearing protective clothing in workshops generally. Where necessary these should be made of flameproof and chemically resistant material and need to be inspected periodically because loose belts and apron strings are a serious source of danger. The pupils should remove their jackets, roll up their shirt sleeves and secure their ties. It is very important that they should wear substantial footwear with laces properly secured. Leather or other thick aprons are necessary for boys working at the forge and foundry as a protection against hot scale, sparks and molten metal splashes. No pupil with long uncontrolled hair should be allowed to operate any machine.

A number of imported hardwood timbers, especially mansonia, dahoma, and opepe, are known to produce in some people skin irritation, and occasionally their fine dust may also irritate the nose and upper respiratory passages. When some synthetic adhesives are employed, skin contacts should be minimised, and any contamination removed as soon as possible. Pupils should wash their hands immediately the process is completed. Suitable proprietary skin

cleansers are available to remove resin set on the skin. Glass fibre is very irritating to the skin, and the best way to remove any on the hands or forearms is to place them in a stream of cold tap wate , which will flush off the fibres. Where a resin is being mixed with fi bre the volatile portion, which may be toxic or irritant, should not be allowed to escape into the workroom air.

## GENERAL WORKSHOP PROCESSES

The prevention of injury from hand tools depends, in the first instance, on the tools being well maintained. The pupils must be given careful training in the correct use of the tools and the teacher should maintain an appropriate standard of class discipline in the workshop. The dangers of blunt tools, of loose hammer heads, of files insecure in old handles and of dangerous burrs on tools and work are well known. The replacement of worn bench stops, sawing boards and vice cheeks, and the resurfacing of benches is also important. The well-displayed, clearly-labelled, special tool cupboard is one of the best ways of ensuring that the correct tools are used for particular jobs.

The provision of benches of varying heights will help to ensure that pupils use an appropriate one. Duckboards are a serious source of danger and should not be used. It is easier, and safer, to work at a bench which is a little too low than at one which is too high.

### Power-driven equipment

The independent motorisation and modern design of machine tools has made a welcome contribution to safety and local education authorities should install only those machines which conform to British Standard specifications[12]. The guarding of moving parts has become more effective recently and teachers should take every opportunity to ensure that the machinery in their workshop meets present-day requirements. A number of older machines have partly exposed vee belts which can easily sever a finger, and modifications to the guards should be considered. Geared drives should not be so concealed and inaccessible that they cease to be of value when pupils are learning to operate a machine; they must, however, be completely and effectively encased. For this reason guards and doors giving access to moving or electrical installations are being increasingly supplied with micro safety switches. A positive catch or lock is essential in all cases: H.M. Inspectors of Factories do not consider a spring catch sufficient. Boys should be taught to isolate a machine before any adjustment is made to it.

[12] See Appendix C.

Work on a particular machine which is carefully planned and phased throughout a course will help the pupils to appreciate the importance of the safety procedures. Only one pupil should be allowed to operate a machine at a time; if another pupil is allowed to observe he should stand clear of the controls, in a safe position.

Not less than three clearly identified safety buttons, which break the workshop power circuit, should be fixed at easily accessible points in the room for use by the teacher or by the pupils in any emergency. It is essential that individual machines should be supplied with push button starters with no-volt and overload releases to prevent their being restarted unwittingly when the main power supply is switched on. The safety switch system should be tested regularly to ensure that it works reliably.

It is not sufficient merely to switch off any piece of equipment installed solely for the teacher's use; there should be some means of locking the switch or isolator in the off position. When a workshop containing power-driven equipment is not directly under the supervision of the teacher, it is a wise precaution for him to lock the re-set switch controlling the workshop power in the off position. All machines should be equipped with isolator switches, preferably those which incorporate a pilot light.

The main causes of accidents inherent in the use of machine tools lie in the nature of the machine itself, in the apparent simplicity of certain operations and in the deceptive appearance of slowly moving parts. In some machines, or machine parts, however, the danger is obvious enough; sharp cutting edges of tools and fast running machinery are but two examples. But danger may not always be so apparent: an accident can be caused through over-confidence or lack of concentration on the part of the pupil. For this reason it is a sensible precaution for the teacher to check all work and tools before a machine is switched on. Notes outlining the procedure for a particular job prepared either by the teacher or by the pupil should invariably include reminders about the safe operation of machines or the carrying out of processes.

## METALWORKING PROCESSES AND MACHINES

### Forgework

Dust and fumes are a potential source of danger and considerable difficulty has been experienced with wrongly-designed chimneys. The installation of a power-driven extractor fan fitted in the forge flue is often necessary. A speed regulator should be available for the

fan. For efficient use and safety, the hot area, which may contain equipment for forging, heat treatment, brazing and casting, is often less strongly lit than the main workshop area, so that the colour of hot metal can be seen. However, additional lighting should be available in the hot area for occasions when it is necessary to use it. It may be helpful to fit a smoke barrier from ceiling level down to about seven feet across the opening to the hot area, with a roof or wall extractor fan to dispose of escaping smoke and fumes. The floor needs to be of concrete or granolithic compound extending around eight feet beyond the forge. It is a wise precaution to limit the number of pupils working at a hearth to two in number. The transfer of hot metal from the forge area should not be tolerated.

**Hard soldering and heat treatment**

The careful siting of the brazing hearth is essential and fire bricks or a metal screen should be provided. In no circumstances should the hearth be below or in front of a window where the flame may become invisible in strong sunlight. Only the hose recommended by the local Gas Board should be used for gas and air pipes, and appropriate non-return valves need to be incorporated. The siting of the compressor in the store-room or in a closed cupboard provided with some natural ventilation is recommended in order to reduce noise and so help to ensure that instructions can be heard while the equipment is in use. Extra care needs to be taken if bottled gas is used. The siting of the bottles should be carefully considered and good ventilation of the workshop is essential. Precautions should be taken against the danger of overheating special heat treatment equipment, for instance a muffle furnace.

**Acids for pickles and macro-etching**

The troughs of acid pickle should be placed in a lead-lined cupboard near the sink. If the pickle is used at sink level great care should be taken to prevent eye injuries through the accidental splashing of acid. A vent to the outside of the workshop to disperse acid fumes is recommended. Troughs of bright dip, strong pickle for cleaning and weak pickle for removing oxide should always be made up by the teacher or by the workshop technician. A lockable cupboard, preferably having a stone base, must be available for storing all poisonous substances. The cupboard should be sited well below eye level and only a limited supply of concentrated acids should be kept in stock.

Care should be taken in the preparation of all etching agents and expert guidance should be obtained especially if picric or hydro-

flueric acid is used. Provision for the speedy washing out of any accidental contaminent in the eyes should be at hand. Generally, a stream of ordinary cold tap water, especially if this can be delivered as an upward jet, is the best method. In other circumstances eye wash bottles containing either cold boiled water or 0·5 per cent sodium chloride solution will be necessary.

**Finishes**

The regulations made under the Petroleum Acts apply to schools and a separate lockable cupboard or store, made of fire-resistant material, and adequately vented to open air with the vent openings protected on the inside with a copper gauze (mesh not less than 28 to the linear inch), is necessary for containing flammable finishes. If possible this should be located in a safe place outside the workshop. Although there may be occasions when the use of spray equipment is an advantage, its use with certain finishes inside a building gives rise to serious fire-risk and to pollution problems which can only be solved satisfactorily by the construction of a special booth. This provision can only rarely be contemplated in schools and expert advice should always be sought beforehand. B.S. 4163/68 gives detailed guidance.

If electro-plating or anodising is attempted an area of the workshop should be planned for the purpose. Expert advice should always be taken before any but the simplest processes are attempted because of the dangers arising from the use of caustic and toxic solutions. This applies to the installation of the equipment, to the storage of chemicals and electrolytes and to their use in schools.

**Soft soldering**

A separate bench, covered with stainless steel sheet and provided with fixed gas connections, is required. A bunsen burner is occasionally used for soft soldering. The flame may be almost invisible in bright daylight and screening from windows is desirable. Care should be exercised if corrosive fluxes are used because of the dangers to hands and eyes.

**Moulding and casting**

The planning of the workshop area for moulding and casting should be carefully considered in order to provide conditions of maximum safety. Good general lighting is essential and a non-slip, refractory floor of suitable size is required. For work with low melting-point materials a protected bench with a normal gas supply will suffice.

When a crucible furnace is provided, a three-quarter inch gas supply is required and the gas should be piped through an armoured hose fitted with a non-return valve. Careful consideration should be given to the position of the crucible furnace especially if it is to be sited near the forge. A common canopy, incorporating local exhaust ventilation, to carry away fumes from both sources, may be possible. The extraction of the dangerous fumes is particularly important where metal alloys with a zinc content are used. Toxic fumes may also be given off when lead is overheated. Where this metal is used extensively a thermostatically controlled heating unit, set at a temperature just above the melting point of lead, is essential. A serious accident can be caused by the explosive vaporisation of water by molten metal and under no circumstances should the furnace and casting area be within easy reach of water taps or boshes.

Clear instructions should be given to the whole class about the procedure to be followed when molten metal is poured and the pouring should only take place under the personal supervision of the teacher. He should also supervise the making and drying of the moulds and the melting of the metal. Special care is needed to ensure that equipment for handling crucibles is efficient. Refractory crucibles need to be inspected frequently and they should be replaced when they become worn. Pupils involved in the pouring operation need protective goggles for their eyes and appropriate covering for their hands, arms and legs. Any pupils who may be watching should stand sufficiently far away to avoid the risk of being splashed with molten metal. When the two halves of the moulding box are closed they should be carefully weighted or suitably clamped together, to prevent them opening when the metal is poured. A sand tray set flush with the floor provides a suitable refractory surface on which to stand the crucible and moulding box during the pouring operation. Magnesium alloys are potentially dangerous because they are often highly inflammable and must not be used in school workshops. For this reason the source and composition of any material must be tested before use.

**Gas welding and brazing**

The introduction of welding techniques will normally be reserved for senior pupils who have satisfactorily completed a course of instruction in general metalworking processes, including hard soldering. The head teacher must understand that there are a number of dangers to be avoided and where a course is planned he must satisfy himself that the teacher is thoroughly competent to use the equipment. Nothing less than the successful completion of a formal course of training in welding should be accepted as evidence of competence.

It is not sufficient, for example, that a teacher has 'picked up' some handiness in the use of welding apparatus: this can be quite inadequate and highly dangerous if he is unaware of the precautions that are to be taken. Furthermore, knowledge of what to weld is just as important as knowing how to weld. It follows that when a teacher leaves a school where gas welding equipment has been installed, the competence of his successor should be ascertained before he is allowed to use the apparatus.

The chief fire prevention officer of the County or County Borough fire brigade will offer help concerning the storage of the gas cylinders. He often advises that the cylinders should be housed in a brick-built chamber. The gases are then piped through the wall and hose protectors are fitted between the hose and the torch to reduce risk from back-fire. The provision of a well-designed metal bench, complete with side guards, is recommended for welding operations. A simple device to light the torch should be fitted to the bench. If cylinders are mounted on a trolley they should be wheeled out of the workshop when not in use. In either case the supplying company's regulations must be followed, strictly, especially with regard to storage of the cylinders, gas pressures, cleanliness and maintenance. The equipment needs to be kept separate from the general metalworking equipment in order that these requirements can be met. The use of welding equipment in schools is usually intermittent and the consumption of gases small. Cylinders may, therefore, be on the premises for longer than is normal in industry. As a precaution, cylinders should be exchanged and the equipment thoroughly checked and overhauled at least once a year.[13]

The eyes of the operator and of any observers must be protected from glare and from sparks. The teacher should exercise very careful supervision of the operator and he should check the results of all work. There should be adequate ventilation of the room especially when galvanised materials are being welded.

**Electric arc welding**

The most serious problem associated with electric arc welding is the risk of a painful form of 'flash blindness'. The danger lies more with pupils using tools and equipment in the workshop than with the operator who is welding. A booth, shielded by metal screens extending at least from three feet six inches to five feet six inches

[13] See Appendix C.

above the ground, will effectively protect other pupils from direct flash. It is also important to screen any windows through which direct flash may be harmful to pupils, or to others passing by. Ventilation must be adequate and the installation of an extractor fan may be necessary. When the welding apparatus is being used, nearby workshop windows should be opened to obtain a through draught. The equipment must have a properly earthed transformer[14] and the teacher should ensure that the return path of the electric current is adequate before switching on. An additional earth lead from the bench to the earth on the electric arc set should be fitted as an additional safety measure. The output voltage on open circuit should not rise above thirty, or at the most fifty volts.

The pupil operating the equipment should wear a leather apron and gloves and must use a welding mask at all times. The helmet type of mask is preferable as it removes any temptation the pupil may have to lower it from his eyes. The live electrode should have a guard to protect the hand from the arc and from the live portion of the electrode.

Much of the advice included in the previous section on gas welding is applicable to electric arc welding also. In particular the use of the equipment must be properly understood by the teacher before instruction is given to boys.

**Shearing machines**

When a manually operated sheet metal shearing machine is out of use it should be made safe by securing the handle to a suitable fixture or by a fitting a stout pin into the hole in the blades.

**Centre lathes**

The machines should be so arranged that no-one is liable to be hit by swarf or by tools or work which may become detached from a lathe. Where lathes are placed back to back or with their ends against a wall, positioning is especially important and a screen between the lathes may be needed to protect the pupils. Care must be taken when a lathe is positioned, to avoid the possibility of the operator being affected by glare or by reflection from the sun.

Most pupils will use the lathe early in the metalwork course. The complexities of the machine can, therefore, be introduced gradually and this will help to ensure that the pupils understand the importance

[14] See Page (12) and Appendix A.

of safe methods of operating. At all times when they are using a lathe, pupils should be protected from eye injury, either by a suitable transparent screen attached to the machine or by wearing safety spectacles. The majority of school lathes are not equipped with a coolant pump and in these instances care should be taken when the coolant is applied with a brush. Accidents do occur when swarf is being removed from turned work and it is advisable to have a simple hook available for this purpose. Special care should be taken when very heavy attachments are changed on certain lathes and in many instances the teacher will wish to change them himself. He should check that all attachments are properly secured before a pupil switches the machine on. Hand-held tools need special care. If spinning is undertaken, the set-up of the lathe must be inspected by the teacher and the job made safe by 'locking' the disc of metal over the forming chuck. Material which is fed through the hollow mandrel of the headstock should be adequately guarded at the free end and an excessive length of metal overhanging the lathe should be avoided. If a lathe has a hollow mandrel in which a pupil's finger might be damaged, it is a wise precaution to plug the open end of the mandrel with a rubber bung when it is otherwise exposed.

**Double-ended tool grinders and other grinding machines**

The power-driven grinder should be of the enclosed type, with robust guards to the wheels and with adequate transparent screens to protect pupils from eye injury. Pupils should wear safety spectacles when they use any type of grinding machine. Teachers should check the position of the tool rests and their relation to the grinding wheels at regular intervals. Dual-purpose machines for grinding and polishing are not recommended.

**Double-ended polishing machines**

Spindles of buffing machines must be guarded by sleeving. A cloth or an apron should on no account be used to hold work whilst it is being buffed.

**Drilling machines**

Powered drilling machines are in frequent use and foot-operated stop switches are an advantage, especially for the beginner. The floor-mounted machine is preferable, but it should be provided with a safety device to prevent the table of the machine from dropping on to the operator's feet when the clamping screw is released. Work should be securely held, either with a machine vice or clamp, or less frequently with a hand-vice or wrench. The machine table should be slotted and the accessories should include a range of equipment for

clamping the work-pieces, the vice and other apparatus to it. A chuck guard must always be used. Spindles, whether splined or plain, thrust races and belt and pulley spindle drives should be guarded. Most modern machines are well protected in this respect but some older machines may require some modification.

**Shaping machines**

At least eighteen inches must be allowed between the extreme rear position of the ram of the machine and any other fixture, including the wall. Unless this precaution is taken when siting a shaping machine which is not equipped with a ram guard, a pupil could be seriously injured.

**Milling machines**

Vertical and horizontal milling machines require very careful siting. Great care should be exercised in teaching milling operations. The dangers which are known to arise in the course of ordinary working and from dangerous practices should be discussed. Above all, milling machine cutters must always be guarded as completely as possible. For safety it is usually necessary to extend the guard supplied for a horizontal machine. A perspex guard is recommended for the vertical machine.

## WOODWORKING PROCESSES AND EQUIPMENT

**Hand tools**

Both the chisel and the saw can be highly dangerous tools if wrongly or carelessly used. Careful teaching of stance, position of hands and the securing of the wood has long been recognised as absolutely necessary for the safety of the pupils.

**Guillotine or mitre trimmer**

Although hand-operated, this machine is highly dangerous and is generally not recommended for school use. For the unwary, it can easily result in the amputation of a finger end. If a mitre trimmer is installed in a workshop only senior pupils should be allowed to use it after careful instruction by the teacher. It should be locked or put away when not in use.

**Wood-turning lathes**

Wood-turning lathes are best placed where there is good natural lighting and away from parts of the workshop that are in frequent use by the pupils. The end of a long wall away from the workshop entrance and from the storeroom is a suitable position and for a

number of reasons the lathe is often sited so that a pupil using it faces inwards. A suitable screen should then be provided in front of the lathe, sometimes the lathe is placed so that the pupil faces the wall of the workshop, or so that the headstock of the lathe is in the corner of the room and the bed at an angle to the wall. Provided that there is room to work round the headstock, this latter position may be the safest.

Provided that careful instruction is given by a teacher who is himself an experienced wood turner, wood-turning lathes can be used with safety in schools. Slow speeds and scraping tools are advisable for beginners. although speeds may be increased and the use of the gouge can be introduced as the pupil's confidence develops. Timber should always be carefully inspected for defects. The use of jointed or laminated blocks of wood can be highly dangerous and is to be discouraged except when it is unavoidable, for instance for pattern making. The dual use of one lathe—one pupil turning between centres or on the main face plate while another is working on the outside face plate—should be strictly forbidden. The outside face plate carrying a heavy job may become unscrewed if pressure between the cutting tool and the work is not maintained as the lathe is stopped or slowed down. This is particularly important on machines fitted with a brake or with a reversing switch. The utmost care should be taken to ensure that work fixed to a face plate by screws is secure.

The turning tools should always be maintained in a sharp condition, and should be stored in a small trolley or rack conveniently placed under or alongside the lathe. The rack should not be fixed behind the lathe, nor should tools be placed on the bed of the lathe. A draughtsman's smock is an excellent protective garment for a pupil using the lathe, but if an apron is worn the strings should be tied behind the back. Spectacles or panoramic goggles should always be worn. During the introductory lessons, the teacher must check the work to be turned for security and clearance, the lathe for correct speed and the tee rest for height and clearance. Where a considerable amount of turning is done the dust produced may present a problem. Normally, however, extraction equipment above the lathe, is not required. Timbers that produce irritant dust should not be turned.

### WOODWORKING MACHINERY

Some woodworking machinery, such as power saws and planing machines, is notoriously dangerous and if it is installed in a school it should be for the teacher's and technician's use only. Where, in

special circumstances, a wide range of woodworking machinery is installed, a portion of a large workshop may be enclosed by a suitable partition. In these instances there must be ample space round the machines and in the general area of the workshop itself and equipment may need to be installed to extract the dust. In large schools a central wood store with a planned area for the woodworking machine has many advantages. Properly designed, separate machines should be installed; improvised, dual purpose or multi-purpose machines, including portable saws and circular saw attachments to woodturning lathes, have no place in a school workshop.

It must be possible for the teacher to lock the isolator switch of the machines in the off position. It cannot be assumed that every teacher of workshop crafts is experienced in the use and maintenance of wood-working machinery and there should, therefore, be a rule that the competence of the teacher to use the machines should be confirmed before he is allowed to use them. Classes which provide expert instruction in these matters are available at most technical colleges. The teacher should try to avoid using the woodworking machinery when a class is present and when his attention is easily distracted. Lack of concentration through divided attention might result in an accident either to the teacher himself or to the boys working in the workshop[15].

**Circular saws**

The position of a circular saw in the workshop should be carefully considered. Ample space is needed for the manipulation of timber. The saw should not be close to a bench and space should not be made for it at the expense of a satisfactory arrangement of the benches. Provided there is room for its safe operation the best position for a circular saw is probably in a large store room.

The saw itself should be so guarded, equipped and maintained as to conform to the standards of safety prescribed by the Woodworking Machinery Regulations made under the Factories Act. The guard should always be in the correct position and the underside of the saw table needs to be adequately guarded. It is not always realised that the correct design of the riving knife and its positioning are of equal importance to the correct adjustment and the use of the guard. Under no circumstances should the riving knife be removed, because the wood may trap the back of the saw and rise from the table at a

[15] See Appendix C.

startling speed. The riving knife should be slightly thicker than the plate of the saw but thinner than the saw kerf. In order that it may act as a guard and splitter, the knife should be aligned with the blade, and should also be within half an inch of the saw teeth.

The saw fence should not be too long or the wood may pinch on to the saw, thus causing danger. It should guide the wood up to the teeth of the saw but not more than an inch or two beyond.

The saw blade must be properly sharpened and set; inaccuracy or neglect in either respect can cause an accident. Saw blades should be regularly checked for cracks, particularly near the gullett. A cracked saw must not be used. Properly shaped push sticks and guide blocks should always be to hand and should be used without exception[16]. Unless a saw blade is correctly tensioned, it will not run true and will not cut accurately. If by any means a saw blade becomes overheated, it should be returned to the maker for retensioning.

**Planers**

When, exceptionally, a planing machine is installed, the correct setting of the knives in the cutter block is very important; 1/32 inch is the maximum overhang and after grinding the correct balance of the blades should be checked. Timber should not be forced through the machine or planed against the grain: poor results will be achieved and an accident may arise. Nor should short pieces of timber be planed. A 'bridge' guard complying with the requirements of the Woodworking Machinery Regulations should be provided on every planing machine and should be used in the correct manner. The part of the cutter block exposed behind the fence should be guarded.

**Band saws and jig-sawing machines**

If a band saw is included in the woodworking equipment the blade should be completely guarded except between the table and the top guide. The bottom mouth of the band saw table should be replaced when it becomes worn. If a jig-sawing machine is installed the belt and pulley should be enclosed.

**Mortisers**

Only hollow-chisels mortisers are appropriate for school work: other kinds are dangerous. The purpose designed mortiser is always preferable to an attachment to a drilling machine.

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[16] See Appendix C.

PORTABLE ELECTRICAL EQUIPMENT

Electric soldering irons, portable drills, tool-post grinders and hacksaws are sometimes used to supplement the original equipment installed in a school workshop. Whether such equipment is supplied on requisition or from other funds, it must be approved by the local education authority and any necessary wiring should be carried out by an expert[17]. The equipment should be robust, preferably of industrial weight and capable of performing a sound job in its own right: it should be without attachments. It is emphasised that the use of lightly insulated flexible leads is highly dangerous in a workshop and should never be tolerated, even as a temporary measure.

Fifty per cent of all fatal electrical accidents which occur in industry involve the use of portable equipment and H.M. Factory Inspectorate strongly recommend that an electricity supply of 110 volts from a fixed transformer should be used for machines of this type. The mid-point of the secondary winding of the transformer must be properly earthed. Portable transformers are not recommended. Electrical outlet sockets wired to the 110 volts circuit should be of a different design from any sockets installed at the mains voltage.

In order adequately to protect users of portable electrical equipment, designed to run from the normal domestic supply, the apparatus should be connected to the supply mains by means of a three-core tough rubber sheathed conductor, and a two-pole and earthing-pin plug and socket outlet. The wires should be of ample cross-sectional area. The earth-continuity conductor in the flexible cord should be connected at one end very securely to the metal frame of the tool and at the other to the earthing pin of the plug. The use of extension cables in school workshops is not recommended as this increases the risk of inadequate earthing of equipment.

Electrically operated tools and their cables should be regularly checked by the teacher and periodically examined by an expert. Teachers must be under no illusions about the inherent dangers of portable tools and adequate precautions must be taken.

**Portable electric drills**

An electric drill can be lethal if its internal insulation breaks down or becomes defective and if the metal frame is not properly earthed. Great care must be taken when an electric drill is used near radiators, water pipes and earth-connected machines or when the operator is

[17] See Chapter 3.

standing on a concrete floor. These are all points at which a dangerous current, released by a possible breakdown of the insulation in the drill, can readily flow to earth through the body of the operator. Some manufacturers are now producing double-insulated portable drills which meet the stringent standards set by H.M. Inspectors of Factories and B.S.I.[18].

## CONSTRUCTIONAL AND OTHER COURSES— SOME SPECIAL CONSIDERATIONS

The general principles already discussed apply to the construction of large projects. Indeed, much of the work will take place in workshops or in utility areas. When pupils are working outside the workshop teachers should ensure that they are ready for this added responsibility and that they have received adequate instructions in the use of the necessary tools.

A most important consideration in a course of boat building is the selection of a soundly designed and proved boat. The soundness of its construction must be thoroughly tested in the water when the boat is complete[19].

In rural crafts, large cutting tools such as axes are often used in the coppice by pupils working either singly or in pairs. Careful instruction in their use is essential under these circumstances.

Where larger constructions of a permanent or semi-permanent nature are considered, detailed plans must be agreed with the appropriate departments of the local authority. Care should be exercised by the teacher to ensure that no pupil is subjected to additional dangers, for instance, through working at a height, without adequate instruction and protection, or through lifting heavy weights. Helmets and protective boots may be necessary for pupils working on large constructions.

When an internal combusion engine or motor test bench is used during a course the exhaust fumes must be properly discharged to open air. Petroleum spirit or mixture must be contained in metal cans which should be kept in an approved store-room. If a supply of petroleum spirit is stored in a school a licence may be required and the petroleum department of the County Borough or County District council should be consulted. Inspection pits are occasionally

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[18] *Design Analysis; Electric Drill*, Richard Carr, Design No. 203, November 1965.

[19] See Chapter 7.

provided in schools and these often present serious hazards. They should be of adequate length to allow the pupils and the teacher safe access and exit whilst a car is in position. Inspection lamps are especially dangerous: they should be wired by a qualified electrician and they should be of an approved pattern in which the live conductors cannot come into contact with the handle or frame. Special care should be taken when any type of lifting equipment is used.

The discussion of safety precautions and accident prevention should be an important part of any course in the workshop. In the type of courses for senior pupils which have been mentioned briefly in this section, these aspects will need very careful consideration. Situations may arise which will enable teachers to relate the work to industrial problems. When these occur a valuable element of the course may be a discussion between pupils and H.M. Factory Inspector or with the safety officer of a local works.

**Conclusion**

Inevitably, this survey includes a formidable list of potential dangers, but experience fortunately suggests that by good teaching and organisation, and by maintaining the right degree of vigilance and control, teachers are able to safeguard their pupils and themselves and at the same time to undertake enterprising and varied work.

5

# Home Economics and Needlework

**The teaching rooms**

The first steps to safety are the provision of well-designed teaching rooms and the sensible lay-out of the home economics and needlework rooms and their fixed equipment. Clear passage-space is essential to allow free movement. Natural lighting should be adequate and artificial light should be placed at strategic points in the rooms. It should be possible for a girl to see well and reach easily every part of the appliance she is using.

**Flooring**

Material chosen for the flooring of home economics rooms should be resilient, non-slip and resistant to grease; it should be easy to keep clean; regular maintenance and repairs are essential.

**Open fires**

Serious and even fatal results can follow accidents when clothing catches fire. For this reason all open fires, whether coal, electric or gas, should have firmly fixed, well-fitting fire guards of suitable mesh.

This is the safety precaution most be be emphasised in the training of girls. In view of the extreme danger from the flammability of clothing a separate section is devoted at the end of this chapter to safety factors in choosing fabrics and designs for clothing.

**Electrical equipment**

Chapter 3, gives general advice about the installation and use of electrical as well as portable equipment. The principle points regarding electrical equipment in home economics and needlework are that electrical power points should be within easy reach and so placed as to avoid trailing flexes and any contact with water supply at sinks or washbasins; water heaters and irons should be thermostatically controlled; irons, like other electrical appliances, should have individual switches.

Care should be taken to select only electrical equipment which bears the certification mark of the British Electric Approvals Board for Domestic Appliances. Any equipment on loan to the school should also conform with this standard[20]. The use of this equipment, which includes washing machines, drying cabinets, spin and tumbler dryers, refrigerators, food-mixers, sewing machines and hair dryers, should be carefully taught there should be provision for it to be regularly inspected and serviced, including switches and electric cables.

**Gas equipment**

Careful training is also necessary in connection with the use of equipment worked by gas supplied from the mains or from containers.

The positioning of gas equipment is important. Where cookers are placed under windows, strong sunlight makes the flame invisible and the pilot light can be blown out by draughts.

Care should be taken to see that the pilot light has been extinguished before the gas is turned off at the main.

**Other equipment**

(a) Only one girl at a time should work a sewing machine or be in control of a piece of mechanical equipment.
(b) The use of pressure cookers should be carefully taught and supervised.
(c) The ropes of clothes pulleys as well as the structure of step ladders should be examined periodically.
(d) Great care should be exercised when frying with deep fat. Pupils should be warned of the possible danger when using this method at home.

**Furniture**

Working surfaces, chairs and stools of various heights should be provided, so that each girl can work conveniently and in comfort.

**Utensils**

Utensils should be graded within a range of size and weight that can be easily managed. It has to be remembered that girls of eleven and

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[20] See British Standard 3456 FIREGUARDS. *Heating appliances Regulations*, 1953. S.I. 1953 No. 526—

B.S. 1945: *1953, Fireguards for heating appliances.*
B.S. 1945: *1953—Supplement No. 1.—1956. Fireguards for heating appliances.*
B.S. 2788: 1956 Fireguards for solid fuel fires.

twelve years of age are often small and slightly built. For example, irons should not as a rule weigh more than 4 to 5 lbs.; saucepans and kettles should not be too large for one girl to lift when they are full.

**Poisons**

Some cleaning agents and disinfectants often to be found in the home economics room are internal poisons, though not scheduled poisons, for example, commercial stain removers and bleaches; adequate precautions must be taken concerning their custody and use and pupils should be clearly instructed accordingly. If scheduled poisons are obtained for a specific purpose, they must be properly labelled and kept in appropriate containers in a locked cupboard or store. Further reference is made to this matter in Chapter 3, under Chemical Hazards.

**The influence of the teacher**

Safety will depend on the teacher, her powers of organisation and the kind of training that she gives, and her own awareness of the possibility of accident. She must, therefore, make a point of using every kind of safety precaution as an example. Some of her pupils will already have acquaintance in their homes with the same sort of equipment and utensils that they will have to use in the home economics room. In school they can learn to handle cooking and needlework equipment and utensils, which may often be sharp-edged or power driven, in a sensible fashion, They must also be made aware of danger and be taught how to safeguard themselves and others against accidents. In doing so they will learn how to prevent accidents in their own home and will become conscious of the dangers facing younger children.

**Safety training**

The teacher should explain to her pupils the reasons for the precautions on which she insists. A few examples of safety practice are given here:

(a) Work should be planned so that there is no more movement about the room than is absolutely necessary.

(b) Pupils must be suitably dressed and shod: long hair constitutes a danger and should be tied back.

(c) Safe methods should be taught from the beginning: for example, ways of lighting the gas, carrying trays or bowls of water, holding hot irons or other hot objects, using the wringer and lifting and moving heavy pieces of equipment such as sewing machines. It is particularly important that girls should

be taught, when using a cooker, the danger of stretching across a lighted gas burner or hot electric plate to use a pan on a back burner. It is also important to impress upon them the necessity of keeping handles of saucepans away from lighted burners or hot electric plates and also of preventing young children reaching up to them.

**First-aid**

To supplement their training pupils should be taught first aid. The teacher should keep herself familiar with methods of treatment and have an up-to-date first-aid box in the home economics room.[21]

**Fire precautions**

Easily handled fire extinguishers, tested at regular intervals, and a fire-blanket, should be placed in every home economics room and teachers and girls should know how to use them. Fire drill for the home economics class should be part of the normal school fire drill. Where the home economics room is not part of the main building, the teacher should make a plan for regular drill and see that everyone understands it.

**Domestic burning accidents**

A copy of the *Children's Nightdresses Regulation 1964* (Consumer Protection, 1964 No. 1153) should be in the possession of every needlework teacher, who should ensure that no garment is made in school that would contravene these regulations. Danger from fire in the home is a most important matter to which teachers of home economics and needlework should give their attention. Much useful information about the fire risks inherent in certain clothing designs and flammable materials can reach parents through their daughters.

**Flammability of fabrics and clothing**

The teacher of needlework should emphasise the fire risk of clothing made from the very many flammable materials on the market nowadays; she should play an important part in encouraging the choice and use of flame-resistant or flame-proof materials. The study of fabrics, interlinings and trimmings is an integral part of every satisfactory needlework course, and teachers should be knowledgeable about the relative flammability of fabrics, and aware of developments in this field. Experimental work to test flame resistance should be carried out before fabrics are made up. The fact that material has

[21] See Appendix B 'First-Aid'.

received treatment to make it flame-resistant should not lead to complacency; careful teaching of proper laundering methods is essential.

**Design of clothing**

Here again the teacher of needlwork can exercise great influence in advising on the design of clothing, especially for young children and elderly people, to prevent accidents by burning. There is a special fire risk in long, loose-fitting, flowing and flimsy garments for day and night wear. The teacher should include this with other considerations concerning the design of garments. It is a strong argument, for example, for recommending well-designed sleeping suits rather than night-dresses for young children.[22]

[22] Schools may find the RoSPA Booklet *Stop Accidents in the Home* useful. It contains a wide range of general safety information, of value to children.

6

# Physical Education

## PREMISES AND EQUIPMENT

### The design of schools

The area and shape of a hall or gymnasium, the situation of windows and doors, and the design and placing of equipment, are some of the important factors to be considered in preventing accidents. In schools already built, particularly in older buildings, some restriction may have to be imposed on physical education if unsatisfactory features cannot easily be altered.

### Indoor accommodation

Whether lessons are taken in a hall or in a gymnasium, the condition of the floor is most important. It must be possible for the pupils to move quickly, to dodge about and stop suddenly, with absolute security of foothold and without risk of collision. The surface of the floor must be free from splinters and dust and should clean easily; ideally it should be suitable for work in bare feet. Special treatment of old floors will often eliminate loose splinters and irregularities.
Whether a floor is new or old, it is dangerous for physical activities if it is slippery, and waxing or polishing may result in this. In vaulting and other work on apparatus there should be no fear of slipping at take-off or landing, nor should there be any movement of the apparatus on the floor unless it is designed to move when in use; beating-boards, spring-boards, trampettes and similar devices should, in particular, remain firm and still. A gymnasium is used for a wide range of activities including fast movement, games and practices, and work at considerable heights. Resilience in the floor is therefore important both for the pupil's safety and for the protection and satisfactory development of the arches of the feet. The harder the floor, the more risk there is of fatigue and injury.

It should be possible to clear the gymnasium floor, and a store, adequate for all the movable equipment may be regarded as a necessary safety precaution; storage racks and hooks on the gymnasium wall introduce an element of danger, as do all such projections as heating elements, door knobs and handles. Where the

school hall is used for physical activities, as most halls are, special care is needed if there is furniture which cannot be removed to a store; chairs, pianos and any free-standing hot cupboards present special problems.

Care and forethought are needed in the location of windows, lights and fittings and in the use of glass or other brittle substances for door panels and lamp shades; there will always remain the possibility of breakage by personal contact, balls or other flying objects, and special precautions such as the use of wired or toughened glass may be required to prevent splintering. Care should also be taken in the siting of windows and in the choice of artificial lighting so that dazzle in the use of apparatus may be avoided. With certain types of strip lighting it may be necessary to fit anti-stroboscopic devices.

Attention should also be paid to the acoustic design of the gymnasium.

In the changing room and shower compartment the nature and condition of the floor surfaces are again important and they should be such as to reduce the danger of slipping with bare feet when wet and the spread of foot infection. A high degree of cleanliness is essential. There is also a need for well-designed fittings in kit stores, changing rooms and shower baths, where there are many hooks, racks and projecting objects in spaces which are frequently congested.

**The playground**

The proportion of accidents in school playgrounds has been commented upon earlier in this pamphlet. Many of these accidents arise from collisions and falls when too many children are 'letting off steam' in too small a space or on a playground with an unsuitable surface. A smooth, well-drained and quick-drying surface is required, clear of obstructions and without steep slope or irregularity. If grids are a necessary part of the drainage system, they should be carefully sited and constructed to avoid a break in the levels; sockets for posts should not be left uncovered and should be flush with the ground. In older premises, the resurfacing of rough, uneven, loose or gritty playgrounds will prevent some accidents and render others less harmful, but there will be places where limited space and numerous obstructions demand unusual precautions during organised games and in the supervision of free play. The side lines of marked pitches, for example, should not be placed close to walls.

Where a playground is bordered by a road used for motor traffic, it is desirable to erect a fence or netting of suitable height to prevent balls going on to the road.

**Playing fields**

Playing fields should be efficiently maintained, with particular attention to the playing surface. There is always risk of injury if games, especially the national team games, are played on bumpy and uneven pitches; for cricket and hockey, a particularly good surface is required. The latter will require more cutting and preparation than is usual for football. The more the ground slopes, the more important is it to preserve a good surface. Play may sometimes be inadvisable on pitches affected by severe weather; frost, rain or drought may cause a dangerous surface. Sockets for goal posts should not project above ground level, and holes for posts and water-points should be covered. Posts and flags should be of the right height and appropriately placed.

Protective nets or netting of suitable height may be necessary around special practice areas and pitches and these should be sited so that they can be used without danger to other users of the field. For athletics, suitable surfaces will be required to give a firm foothold for jumping and throwing events; properly constructed take-off areas and landing-pits, regularly maintained, are essential, and sand pits should be kept loose when they are in use. Competent organisation and ample space are needed for the practice of field events, and no javelin, shot, discus, or hammer should be thrown unless adequate precautions, as recommended by the Amateur Athletics Association, have been taken to avoid accidents.

There is a risk of tetanus infection in wounds inflicted in fields that have been grazed, and it may be wise in certain conditions to seek advice from the Principal School Medical Officer of the area on the risks involved bearing in mind that active immunisation is the only measure which affords reliable protection against tetanus.

Remote playing fields should be equipped with a telephone.

**Equipment**

Fixed and portable apparatus, for use indoors or out, should be of suitable design and construction; strength, stability, and good finish are particularly important. Portable or movable apparatus should be safely stowed when not required for use. Arrangements must be made for regular inspection and adequate maintenance by responsible persons, particularly of ropes used out-of-doors and

of any points subject to constant wear or friction. Damaged apparatus should not be used.

Great care is needed in the choice and use of improvised apparatus and in the use of the more traditional apparatus in unorthodox ways; chairs should not be used as obstacles or supports for jumps or vaults.

The equipment used for games and athletics, such as bats, sticks, balls and rackets, should be suited in size, weight and design to the age, strength and ability of the players and should be of good quality and in good repair. Especial care will be needed in the selection, use and storage of weight training equipment.

**Clothing**

For most games and sports there is a recognised dress which allows the greatest freedom of movement, consistent with protection from the hazards of the game and the weather. Most schools try to ensure that pupils are suitably dressed for physical activities, and may regard this as a safety precaution. Appropriate footwear is especially important, whether for running in a playground or gymnasium, for clambering on apparatus, for practising athletics, or for playing games. Plimsolls are suitable on hard surfaces and will often be safe on dry turf, but appropriate studs or spikes will be necessary for many activities on grass, which becomes quite a dangerous surface when wet and may, when only slightly damp, be unfit for activities for which plimsolls are worn. The risk of injury to other performers from spikes and studs should not be overlooked in assessing the suitability of shoes. On no account should pupils work indoors in stockinged feet, which do not grip the floor, nor should they be allowed to work barefoot unless conditions are suitable. Coloured braids, which are sometimes worn to distinguish teams, might in some circumstances be dangerous; watches and jewellery should not be worn.

## THE PRACTICE OF PHYSICAL EDUCATION

**Playing for safety**

Even before a child is old enough to go to school, nature has set him a number of problems in movement. He has to master certain basic activities; he must learn to walk and to run. As he grows and his proportions change, the balance of his body has to be readjusted; the problems of control become more complicated, and in trying to solve them he often misjudges the situation, and stumbles or falls. But, as has been said before, trial and error are an essential part of

the learning process, and misadventures are likely to happen whenever an effort is made to acquire new skills or improve old ones, no matter what the age or experience of the performer. The aim of safety precautions should not be to make such mishaps impossible but to eliminate unnecessary risks.

If physical education is to contribute to full development of the individual, it must provide varied opportunities for the acquisition of skill and for the exercise of such qualities as initiative, determination and courage. Physical education includes many activities which offer a challenge to the child. Some are of a kind not essentially safe, while others, though safe in themselves, are given a spice of adventure by being carried out under compelling or hazardous conditions. The personal risk involved in competitive games and in many outdoor pursuits is no doubt one reason for their wide appeal. This is the very spirit which physical education should preserve and foster.

Yet every reasonable precaution must be taken to prevent accidents. To this end it is essential that arrangements should be orderly, and that pupils should be trained to move under all sorts of conditions, difficult as well as easy, with skill, confidence and self-control. They should also learn to take care of themselves, both indoors and out of doors, in circumstances which vary widely. If, in spite of everything, an accident should happen, the teacher must know exactly what to do and be able to recognise a situation in which medical help is necessary. A first-aid box and whenever possible a supply of clean water should be available. Any accident, however slight, should be reported to the headmaster or headmistress without delay.

Precautions of a different kind should be taken to ensure that the body is thoroughly warmed up before severe muscular effort is demanded. Additional clothing immediately before and after exercise is often necessary to retain body heat. A change of clothing and the use of shower baths are wise precautions against colds and chills.

The programme of physical education may include gymnastics, games, athletics, swimming, dancing, boxing, wrestling, judo, fencing and such outdoor pursuits as camping, climbing, caving, rowing, canoeing and sailing. It is with safety measures in relation to these activities that this chapter is concerned; before any specific recommendations are made, it is necessary to stress the fact that the prevention of accidents largely depends on the skill, knowledge and example of the teacher.

## PRIMARY SCHOOLS

The kind of physical education provided in many schools today probably fits the nature of children more closely than ever before. Often there is apparatus on which to climb, swing, slide, wriggle and twist, and on which the children invent their own activities. The natural enjoyment that most children show in running, leaping, rolling and in playing games of all sorts is also taken into account; and every effort is made to exploit and preserve the flexibility with which every child is born, which enables him to perform extraordinary antics, and which acts as a safety device when he falls as, in all sorts of circumstances, children often do.

Of course, the teacher must do everything possible to ensure the safety of the conditions under which the children work; but there should be complete confidence in the natural competence of the children to do successfully what they choose to do in the environment in which they are placed—otherwise they may become timid and inhibited and fail to make progress.

In primary schools the class teacher is usually responsible for all subjects including physical education, and the working relationship established between teacher and class is perhaps the most important factor in creating opportunities without inviting accidents. The teacher knows each child well—whether he is likely to need stimulating or steadying; whether he is bold, vigorous, nervous or delicate, fit or 'under the weather'—and will act accordingly. He is also aware of the mood of his class, and knows when to give rein to exuberance and when to induce concentration. But certain types of equipment (e.g. trampettes and trampolines) should not be supplied or used unless teachers with adequate and specific training are in charge.

There are, of course, certain precautions to be taken. Children should be trained to share the apparatus, which they learn to do very readily; but, if necessary, the teacher must regulate the number using any one piece. Apparatus should be fixed or placed so that it is stable, and spaced so that collisions are unlikely to happen. Where, as is usual, the children are taught to handle, arrange and adjust the apparatus themselves, they are the more likely to notice if anything is amiss, and to put it right or ask for help. But the teacher is responsible for seeing that the apparatus is properly set up, and, where necessary, for arranging the sequence of activities. It is also important to see that the children wear suitable shoes and clothing.

Advice about swimming follows in the section devoted to work in secondary schools.

## SECONDARY SCHOOLS

In secondary schools physical education is generally in the hands of teachers who specialise in the subject, though they may not have been trained as specialists. These teachers may meet each class on a few occasions only each week; in these circumstances it is not possible to build up the same kind of working relationship which the class teacher in the primary school is able to do, nor is it easy to know each pupil really well. It is all the more important for specialists to be observant, alive to the needs of different classes, and aware of the potentialities and difficulties of individuals so that mishaps do not occur through undetected fear, fatigue or recklessness.

### Gymnastics

As there are several different trends of thought about gymnastics, the impact of a new teacher on a class may be disruptive and bewildering, unless he is aware of the need for a carefully-planned period of transition from one kind of work, or one method of teaching, to another. This is especially important in relation to the precautions to be observed. In some classes the pupils are accustomed to being told, in detail, exactly what to do, and each child is expected to perform the same feats as his fellows. Where work is of this kind errors can often be foreseen and provided for because the pattern of action is prescribed, and it is, therefore, possible to prevent a fall or reduce the effects of a stumble by arranging for members of the class to 'stand by' for certain activities. Sometimes 'standing by' is merely an emergency measure, but at other times pupils may be given a considerable degree of support, and in some schools may even come to rely on 'catchers' to control their efforts. Where 'standing by' or 'catching' is practised it is, of course, necessary to train the helpers efficiently, and in some situations the teacher may think it necessary to give support himself. In the use of the trampoline there are special precautions for 'standing by' appropriate to this apparatus (see also page 61, paragraph 3).

There are many schools where the outlook on the work is different. In these the pupils are seldom asked to follow, in detail, prescribed patterns of movement, but are expected to respond individually to situations which are outlined for them in general terms. Each is expected to do as much as he can manage confidently, whether the use of apparatus is involved or not. With this method of teaching it is possible for the pupils to learn to manage themselves in many and varied situations, though whether they do so or not depends on the

scope of the terms of reference within which they work. Where each individual develops his own response to a situation, neither 'standing by' or 'catching' is practicable, because the movements are not predictable. In these circumstances the ability to recover, without injury, from a fall or a stumble is very important, and landing is practised in all sorts of ways as an important safety measure. Mats are often provided as a precaution against injury, and are certainly needed in some situations; but if they are too generally used they may serve to mask clumsy, inflexible habits of movement, and so act as deterrents to the development of the pupils' ability to manage themselves skilfully. In everyday life, falls cause many injuries and the ability to recover from a stumble, or to fall without injuring oneself, is important.

It is probable that where boys and girls are expected to judge for themselves what may be attempted, fear of work on apparatus, especially fear of vaulting, which remains as a paralysing memory for many adults, largely disappears, and with it the excessive tension which, in itself, is likely to be a source of accident or injury. Yet tension of a kind there must be in any act requiring resolution, and it is important that in ridding pupils of fear we should not also deprive them of opportunities for endeavour.

As in the primary school, the secondary school teacher is responsible for teaching the pupils how to handle, adjust and fix the apparatus, and for training them to see to these matters themselves. Care and skill in the handling of heavy objects may be of value in other situations in everyday life. Children may have to be taught not to crowd on to a piece of apparatus, and not to get into each other's way, especially when activity is very varied and the numbers large for the space available. Today, when many teachers are trained to consider their pupils as individuals and to plan their work accordingly, there is an added risk if the pupils are grouped together in larger classes than are normal for other subjects.

Above all it is essential that the teacher should be alive to the needs of his pupils, and that he should understand the implications of the methods of teaching he uses and of the kind of work he puts before his classes. This is especially important in deciding the kind of precautions to be observed

**Games**

Competitive games offer a healthy and exciting challenge and any measures taken to prevent accidents should not have the effect of

curbing enthusiasm, dash and determination, Games and practices should be graded to fit the stage reached by the players, and the full eleven (or fifteen) a side games on a large pitch should not be introduced until they are ready to manage, understand and enjoy the co-operative efforts required. In most games some of the rules are designed to prevent accidents and players should be familiar with such rules. Dangerous situations exist when beginners or young people take part in matches where the circumstances involve fierce competition. In matches a good referee will add considerably, not only to the enjoyment of the game, but also to the avoidance of accidents which may be due to excitement or over-zealousness.

**Athletics**

The growing interest in athletics has tended to outrun the facilities provided and, in a sport where some may be running, others jumping and yet others throwing the javelin or discus, the need for space and for careful organisation is essential. In an activity where maximum effort is aimed at, often in circumstances of acute competition, a carefully graduated scheme of training is required to develop the necessary skill and stamina. Any scheme of training should be adapted to meet the capacities of individuals, and the number and choice of events for which they prepare should be carefully regulated.

**Swimming**

An increasing number of schools are now being built with swimming pools and many more are being provided as a result of voluntary effort, Care should be taken that the proper hygienic precautions are observed.

Swimming is an activity where safety precautions must be specific, must be understood by the pupils and must be rigorously observed. There is a limit to the number for whom one teacher can be expected to be responsible, especially in a bath where the public are admitted at the same time as school swimmers and where the water is deep.

In many areas there are local bye-laws which require a second adult to be present during school swimming, and there are many circumstances in which this is a necessary precaution. The following points should be borne in mind:

(a) In class instruction the teacher must be in a position to see the whole class and should, therefore, teach from the side of the bath.
(b) A long, light pole and life-saving apparatus should be readily available to assist any pupil who gets into difficulties.

(c) The teacher should be competent in the principles and practice of life saving and resuscitation and should realise the need for urgency in applying them.
(d) The bath surround should be of a non-slip type of surface but pupils should learn that it is dangerous to run along the edge of the bath.
(e) It is advisable that swimming should not take place within an hour after a meal.
(f) Diving may be dangerous unless the water is sufficiently deep. Guidance on the necessary depth of water under diving boards may be obtained from the Amateur Swimming Association. The use of improvised diving boards can only be dangerous. The depth of water in different areas of a bath should be clearly indicated.
(g) For sea and river bathing special precautions are always required to suit the varying conditions of depth and current. Particular care is needed in swimming and diving where it is not possible to see the bottom or judge the depth of the water. Patrol boats are frequently used in sea-bathing together with ropes or floats of varying kinds.
(h) The teacher is well advised to count the pupils before they enter and after they leave the water.
(j) There should always be a telephone available for use in public or other baths separate from the school site in case of accident.

**Boxing**

It is vitally important that school boxing should be placed in the hands of knowledgeable and experienced teachers who are fully aware of its possible effects on boys. Strict and specific precautions will be necessary. Only boys who wish to do so should take part in actual bouts and competitions and they should first be medically examined; scrupulous care must be taken to match them according to age, size, skill and experience, and the duration and number of rounds must be appropriate. Good refereeing and good discipline in the ring are essential for the safe conduct of contests. Advice on clothing, equipment and procedure can be obtained from the handbook of the Schools' Amateur Boxing Association.

**Fencing**

Competent organisation and instruction are necessary for the introduction of fencing, and all who participate must appreciate the need and importance of suitable protective clothing (including masks), which should be compulsory for all types of play. Ample space is required for bouts or practice.

Technical rules and more detailed guidance are issued by the Amateur Fencing Association.

**Wrestling and judo**

Competent instruction and supervision, appropriate clothing and suitable and sufficient mats are necessary for most forms of wrestling and judo.

**Boating and canoeing**

Common sense demands that all who participate in these activities should be able to swim sufficiently well to make death from drowning an unlikely hazard. On most occasions life jackets will be an essential extra precaution and these should conform to current B.S.I. standards. Boats and equipment should be in good condition. Instructions about safety and capsize drills should be clearly understood by all who go afloat. In water affected by current, tide or weather, there is need for special knowledge and experience in all who have responsibility for pupils and craft. More specific advice is contained in Chapter 7 'Safety Afloat'.

**Miscellaneous outdoor activities**

For camping, climbing, caving and miscellaneous expeditions in open country, safety depends on sound training and experienced leadership and in certain expeditions in mountainous country the qualifications required by the Mountain Leadership Certificate of the Mountain Leadership Training Board are advisable.[23] Suitable clothing, footwear and equipment are important. All concerned should be trained how to act in the event of accident or misadventure. No-one should be allowed to travel alone in remote areas, and independent groups will normally have at least three members. Precautions should be taken to ensure that injured or ill-clad persons do not find themselves cut off from assistance or exposed to severe weather conditions. Meteorological reports should be consulted before departure into rough or mountainous country and when appropriate the local mountain rescue teams or headquarters should be notified; their location should certainly be known. On all occasions, suitable clothing, footwear and equipment are essential. Parties following ridge routes will need to be particularly careful not to knock down stones, since there may be climbers on the cliffs below.

[23] Mountain Leadership Training Board, Central Council of Physical Recreation, 26/29 Park Crescent, London, W.1.

More detailed guidance may be found in the handbook of the Mountaineering Association and the British Mountaineering Council and in the many regional guide books of mountaineering clubs. Education Pamphlet No. 41, *Camping and Education*[24], gives the necessary information about camping.

[24] Education Pamphlet No. 41 *Camping and Education.*

7

# Safety Afloat

## SAFETY IN GENERAL

Building boats and canoes and then sailing them are becoming increasingly popular activities in schools, either during school hours or as out of school activities. Whatever facilities are available, whatever the purpose of building the boat, and whatever the uses to which the finished boat is to be put, a sound design is the first essential. Many designs made by professional designers are available from which boats have already been built, and they have been fully tested. Deviation from a tested design may lead to tragic consequences. A well-built well-found boat should have a long and useful life and, since depreciation in value is small, the initial cost should not be cut by the acceptance of inferior or unsuitable materials.

The type of water on which the boat is to sail affects the design; ample freeboard is desirable in open water where waves are likely to be encountered, but too much freeboard increases wind resistance considerably. Lightweight decking may be considered desirable, but decking adds extra weight, and if the boat is to be manhandled each time she has to go into the water, weight is an important consideration. Whether the boat is to lie at mooring or to be housed in a boat-shed, a light, strong hull is desirable. Boats should be carefully maintained and a log-book recording the condition of boats at regular intervals, and repairs done, should be kept.

Having built or bought a satisfactory boat, the school will want to use her on whatever stretch of water is available and it is at this stage that the question of suitable precautions inevitably arises. It is essential that activities of this kind should be properly organised. While some element of risk must be accepted, all reasonable precautions should be taken to reduce the possibility of accidents and to minimise any consequential danger to life when mishaps do occur.

Various bodies with expert knowledge and wide experience in the use of small craft have helped to draw up the recommendations that are set out below; they apply both to inland waters and to off-shore

sailing; they are based upon long established practices of good seamanship and may help to avoid the mishaps which can arise from inexperience, faulty gear or wrong appreciation of conditions. They are put forward for guidance and the language used will indicate the degree of rigidity with which it is thought they should be applied. No code of rules could cover every possible set of circumstances; the exercise of common sense and consideration for others is necessary at all times; sailing and canoeing, if carried out in the right spirit, should develop just those qualities in all who take part[25].

RECOMMENDATIONS

**General**

A responsible and thoroughly experienced person (referred to below as the 'Director') should be in charge of the party and their activities; he may be a teacher or some other qualified person. It is recommended that the Director of Sailing should hold the Instructor's Certificate issued by the National School Sailing Association. The appropriate qualifications for a Director of Canoeing at a school is the Senior Instructor's Certificate issued by the British Canoe Union. In either case refresher courses every two years are recommended for instructors in this demanding sport. The responsibilities of a Director might include:

The conduct and safety of all concerned; for example, checking the condition and suitability of boats and other equipment and deciding whether crews have sufficient experience to go out in the prevailing weather conditions.

Administrative arrangements; for example, insurance, where necessary, of persons and property.

Arranging instruction and ensuring that he has enough competent assistance.

The Director and his assistants should be fully conversant with local conditions; for example, tide, weather and dangerous features such as weirs. He should provide for the possible dangers of large craft operating in the stretch of water his craft will be in. He should satisfy himself that every person taking part can swim, in light clothing, a distance of at least 50 metres in the conditions likely to be encountered. Every member of the party should be proficient in applying artificial respiration. All loose equipment, including oars, (but not canoe paddles), should be secured by lines so that it will not be lost in the event of a capsize. This applies as much to rowing as to sailing

[25] The RoSPA pamphlet *Safety Afloat* contains much useful and concise information.

boats and canoes. The Director should lay down operating limits within which boats are required to work. These should ensure that every boat remains within signalling or hailing distance.

**Sailing**

*Life-jackets.* Everyone, instructors and crew alike, when afloat should wear life-jackets. In suitable conditions, for example, in a large rowing boat, it might be reasonable to relax this rule at the Director's discretion, but the decision should be a positive one made for a specific purpose and life-jackets should never be taken off unless definite instructions have been given to do so.

Life-jackets should conform to British Standards Institute specification No. 3595. If their buoyancy depends entirely on air, they should be kept at least partially inflated. It is important that they should be properly fastened so that the wearers would float upright. Practice in wearing a life-jacket in the water is desirable. Further information about life-jackets suitable for school sailing can be obtained from the National School Sailing Association.

*Captaincy.* Whenever a boat goes out one person should be appointed captain, and his orders must be obeyed.

*Capsize.* In the event of a capsize **Stay With the Boat.** The routine, when a capsize occurs must be thoroughly understood by all taking part in sailing. The procedure should be drilled thoroughly under controlled conditions so that young people know what to expect and fear of the unknown is eliminated. Crews should be familiar with the hazards and know what to do, e.g. if they are unable to put matters to rights, cut away the mast and rigging in extreme cases, and sit in the boat as though in a bath until rescued.

*Recall signals.* These signals should be clear and must be understood by all concerned. They should be obeyed at once.

*Arrangements for rescue.* These are particularly important when boats are used in tidal or exposed waters. The Director should make arrangements to meet all foreseeable contingencies, and he should make certain that everyone understands them. Local conditions govern such arrangements but they may include:

(a) informing the coastguard or harbourmaster;
(b) posting a look-out to keep all boats under observation;
(c) keeping a power boat or pulling boat ready to start immediately.

*Boat buoyancy.* Boats should be so designed and equipped that they will float and support their crew after a capsize and so that the water can be baled out. To this end it is essential that buoyancy bags or tanks be sufficient and be properly secured and that aids such as caulking for the centre-board casing be conveniently stowed. Swamp tests should be carried out periodically to ensure the effectiveness of these measures and to instil confidence in the crews.

*Ballast.* In heavier craft, moveable ballast should be so secured that it cannot move at all, or should be so arranged that it will fall clear in the event of a capsize.

*Clothing.* It is invariably colder afloat than conditions ashore would lead one to expect. Warm and waterproof clothing, at least on the trunk, should be worn and a dry change of clothes should be available ashore. Light deck shoes or plimsolls should be worn and *never* on any account should gum boots be worn afloat in small craft.

*Equipment.* In addition to a full sailing outfit, each boat should carry equipment to meet emergencies. All craft, including light dinghies sailing in sheltered waters should carry a list of things to do and to check before setting sail. This list should be waterproofed and fitted to the boat or supplied to the cox'n. All craft should also have at least two oars or paddles and the necessary crutches or thole-pins as well as a baler and a knife. Larger craft or those undertaking more extended passages ought, in addition, to carry the following: a length of light marline or boatlacing; an anchor and warp; a sea anchor when working in exposed waters or where surf may be expected on beaching; a torch; some means of making a distress signal; a boat hook; a lead line; a lifebuoy or buoyant object on a length of line for throwing to a person in the water (this is of particular importance in heavy craft and power safety boats); a compass.

**Canoeing**

*Life-jackets.* These should always be worn and should conform to B.S.I. specification No. 3595.

*Preliminary Instruction.* It is essential that novices be introduced to canoeing by working at first in shallow water (preferably a swimming bath) where his instructor can stand in the water beside him. Capsize drill should be thoroughly mastered before a novice goes out on his own.

*Stay with the boat.* Unless there is danger from drifting down to some hazard such as a weir or sluice, a canoeist should stay with his canoe in the event of a capsize and either await rescue or swim towards the bank pushing his canoe before him.

*Buoyancy*. Every canoe should be fitted with internal buoyancy firmly secured at bow and stern. (38 kg. or 60 lbs. of positive buoyancy in a submerged canoe is recommended.).

*Recall signals*. These should be simple, clearly understood and obeyed at once. A whistle is recommended for this purpose.

*Rescue arrangements*. In all but the most confined and sheltered waters, at least two canoes in a fleet should be manned by people experienced in rescue and rafting techniques. In very cold water it is advisable to have a larger boat standing by.

*Equipment*. In addition to paddles, the following should be carried: a spray cover for the cockpit (this should not be of the type fitted with press buttons; those fitted with elastic bands and release straps are to be preferred); it is important that spray covers should fit snugly over the after-end of the cockpits; a buoyant painter, fore and aft, with the ends properly secured; a sponge for baling; a repair kit should be available—1 inch industrial P.V.C. tape will be found to effect most temporary repairs.

## EXPEDITIONS

In recent years small craft have been increasingly used in the mounting of expeditions. These expeditions may be little more than a picnic afloat but may include landing and camping overnight. They may range from a week-end spent on a quiet canal to the passage of a river, rapids and all, in canoes, or a coastal voyage from port to port in craft as small as light dinghies. If these adventures away from familiar waters are to be both profitable and safe, some additional precautions are called for.

It is impossible to lay down rules which will be applicable in every case and each venture should be considered on its own merits and in its own circumstances. The following ideas may however be of value to authorities planning to develop this activity.

### General

A considerable body of knowledge and experience in this field has been built up and is available from the following sources:

The National Schools Sailing Association, Education Department, County Hall, Chichester, Sussex.

The British Canoe Union (26 Park Crescent, London W.1.).

The Royal Yachting Association (171 Victoria Street, London S.W.1.).

A greater degree of skill and physical stamina is required for extended expeditions than for an afternoon's racing. It is wise to

start passage work in a small way with very short trips and build up as experience and strength grow.

An expedition should be meticulously prepared in advance.
*Special instruction.* In beaching, portaging, shooting rapids and keeping close order, special instructions should be given well in advance and the necessary skills practised.

*Seaworthiness.* The craft themselves should be brought to a high state of perfection and tested well in advance.

*Stowage.* The stowage of camping gear and equipment needs care and planning. It is important that craft are not over-loaded; care should be taken that trim is maintained and that stability is not disturbed. It will be found useful to stow kit in strong plastic sacks whose mouths can be made airtight by tying securely with light line. If some air be trapped in the parcel, it will not only keep dry but will float if dropped overboard and, if properly secured, it will provide some additional buoyancy to compensate the boat for the extra weight.

*Insurance policies.* All policies should be checked to ensure that they cover the planned activity.

*Voyage plan.* A plan, with estimated times of arrival and departure, should be prepared in advance. This should be based upon the personal experience of the Director who should be familiar with the water to be covered. It is wise to prepare a list of 'contacts' with their telephone numbers. These should be, for example, police stations, coastguards, water-bailiffs, lock-keepers, who can if necessary, help to maintain communications and, should conditions warrant, keep a look out for the expedition. It is good practice for some one person, not on the expedition, to maintain a 'headquarters' to follow progress. He should always be informed of the times of arrival and departure and of any change of plans. Each craft should possess this information.

When under way, sound seamanship enjoins the rule 'keep together'. Several craft in close company are not only much safer, since they can support each other, but engender confidence in their crews. The fleet when under sail should be led by the most experienced sailor; the Director should remain in the rear. When under sail, the Director normally remains to windward and the most experienced sailor to leeward of the fleet.

While it may not always be easy, there is much to be said for keeping a full and accurate record of events. If this is done on short passages, an abstract or errors and omissions will be of great value in preparing and training for a more ambitious project.

## COASTAL OR EXTENDED INLAND WATER PASSAGES

### General

(a) Life-jackets should be fitted with a whistle, and conform to B.S.I. specifiction No. 3595. They should always be worn when afloat.
(b) A water bottle and iron rations should be carried however short the proposed time afloat.
(c) Wind, weather and tide must be carefully considered. Weather forecasts should be obtained and local advice should be taken. An offshore wind or outgoing tide should be treated with great respect.
(d) On coastal passages, sea sickness must be guarded against; tablets should be taken if needed. Previous experience in rough water but close to refuge should be a prerequisite for anyone joining in a venture of this kind.
(e) Coastguards, yacht clubs, harbour masters and similar authorities along the route should always be asked to keep watch on a cruising fleet of small craft.
(f) Additional equipment should include up-to-date charts or maps and when off-shore, a compass and distress signals are essential. Plastic covers will keep these dry. Experience has shown that care must be taken in the choice of pyrotechnics and preparatory training in their use is essential.
(g) Most important of all, crew must be trained in advance to deal with the hazards they may meet and the Director should ensure by personal experience that he knows what these are.
(h) In all but the finest weather on the kindest of coasts, a fleet should always be accompanied by a powered safety boat, whose duties may well be more extensive than those of a boat standing by a racing circuit. It may be necessary to take crews aboard and to tow disabled craft.

### Sailing passages

It is important that the boats are suitable for the work, that they are rigged with a 'cruising' suit of sails, that sail can be reduced or furled when under way and that crew are trained to do this.

Crews should be practised in 'man overboard' drill and in the art of sailing in close order, heaving to and going alongside to transfer personnel, and in beaching through shoal water and surf.

All boats should carry spare oars and crutches, extra balers, torches, a length of line and a distress signal.

**Canoeing passages**

Before attempting a sea passage or one of the more difficult inland water voyages, a canoeist should pass the Inland Waters or Sea Proficiency Test of the British Canoe Union.

Canoes should be of a type designed for work in rough water, whether on rivers or off-shore.

Canoeists must be trained in advance in 'rafting' techniques, not only to help a capsized comrade, but also to deal with a cramped, exhausted or seasick person who may need to be helped ashore. Beaching techniques are equally important and need prior practice.

It is important to remember the effects of cold water. Even a very fit canoeist can rapidly become chilled when exposed to bad weather and may thus be at risk through loss of strength.

All canoes should carry spare single bladed paddles, balers, a length of light rope and when on a sea passage, chart or map, compass, and distress flare or pistol.

## OFF-SHORE CRUISING

When it is intended to undertake cruises in larger craft in which longer passages may be attempted, it is less easy to recommend general rules for their safe conduct. The following ideas may however be of value in outlining the additional hazards to be guarded against and in suggesting the sort of precautions which will prevent mishaps from developing into accidents. These suggestions are as important in considering a vessel to be chartered as when purchasing one.

A considerable body of knowledge and experience in this field has been built up and is available from the following sources:

The National Schools Sailing Association (Education Department, County Hall, Chichester, Sussex).

The Central Council of Physical Recreation (26 Park Crescent, London, W.1.).

The Royal Yachting Association (171 Victoria Street, London S.W.1.).

The Little Ship Club (Bell Wharf Lane, London, E.C.4.).

The Sail Training Association (Col. R. G. F. Schofield, Sec. Gen., Ferndown, Mill Brow, Liss, Hants.).

The Royal Society for the Prevention of Accidents (52 Grosvenor Gardens, London, S.W.1.).

**Advice on craft**

When considering the use of a vessel for cruising in open water, it is necessary to consult the Survey Department of the Board of Trade to get the advice of its officers on the following points:

(a) The suitability of the proposed vessel and what alterations or repairs may be needed to make her seaworthy.

(b) The limits of time and area within which she may reasonably be used.

(c) The equipment she should carry, for example, auxiliary means of propulsion, life saving appliances, including special life-jackets and inflatable rafts, signalling and navigation equipment, navigation lights, fire fighting equipment, anchors and cable.

(d) The numbers the vessel may safely carry under the various conditions proposed for her use.

(e) Any special qualifications which are desirable or required in the commanding officer or professional crew which may be made necessary by the size of the vessel or the nature of the voyages to be undertaken.

(f) The arrangements to be made for periodical survey and overhaul of hull and equipment.

(g) A radio receiving set for weather forecasts should always be carried but the Postmaster General's Department should be consulted before making arrangements for radio transmitting equipment.

**Fittings**

In recent years, more accidents to cruising craft have occurred through ill designed or badly maintained fittings, than from almost any other cause. The following are points which it is particularly important to watch:

*Cooking arrangements.* Unless these are of good design, expertly fitted, surrounded by flame-proof materials and hold utensils securely under sea-going conditions, fire, burns and scalds are serious risks. Equipment should be of the type specifically designed and labelled 'For Marine Use'. Petroleum spirit should never be used, nor should any burner system which depends upon atmospheric or wick feed. Stoves which operate from alcohol, fuel oil or paraffin with either pressure or gravity feed are suitable, as are those using butane gas. In the latter case, care must be taken to ensure that all connections are in good order and are tight. Ventilation of the bilges to avoid the accumulation of explosive gas mixtures is imperative. Danger alarms to warn of the presence

of gas in the bilges can be obtained quite cheaply. Main fuel cocks should be turned off on all stoves when not in use. The Royal Society for the Prevention of Accidents[26] publishes leaflets giving advice on this subject.

*Fuel tanks and pipes*. Expert advice and the best of materials and workmanship are needed if leakage under sea-going conditions is to be avoided. Good ventilation is needed in spaces containing fuel tanks and pipes to avoid the accumulation of vapour.

*Electrical Equipment*. Electric wires, batteries and charging motors need regular attention. A chafed wire can easily spark and lead to fire hazards.

*Ropes and rigging*. Wires, ropes, fairleads and rigging generally, need to be stronger and heavier for work in the open sea, possibly for days at a time, than would be required for shorter passages. In sailing craft, chafe is a great destroyer of gear and precautions must be taken to minimise this. It is important that equipment be designed for the job and that spares be carried.

*Openings in the hull*, Water intakes or soil pipes should be kept in perfect condition, and if below or near the water line, should be fitted with sea cocks.

**Manning**

The commanding officer of a vessel cruising with young people should have considerable experience in the sort of voyage projected and in the type of craft to be used. At least a proportion of the crew should have made a number of short passages with him before an extended cruise is attempted. An able assistant should be available if the size of the vessel or the duration of the voyage justifies this. At least one member of the crew should be able to prepare hot meals at sea. The total ship's company should not exceed the number which can be carried comfortably having regard to the length of time to be spent at sea. Fatigue is the great enemy of safety. One member of the crew should be qualified in first-aid and suitable equipment should be provided for this purpose.

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[26] Royal Society for the Prevention of Accidents, 52 Grosvenor Gardens, London, S.W.1.

**Preparation**

A cruise should be meticulously prepared beforehand.The following points are important:

(a) During the months preceding a cruise, the commanding officer and as many of the crew as possible should take every opportunity to increase their skills in navigation and seamanship. Many local authorities and other bodies run courses in these subjects.

(b) During this period, everything possible should be done to put the vessel to be used in the best possible condition. If the crew is involved in this work their knowledge of their ship will be improved.

(c) Before sailing, a voyage plan with estimated times of arrival and departure should be communicated to coast-guards, harbour authorities and others who will keep a watch and act in the event of serious delay. This should be revised as necessary during the voyage and the various authorities informed. It is important that at each stage of the voyage an alternative plan should be arranged in advance to cover such eventualities as taking shelter in a convenient harbour of refuge. It is wise to have some one person, probably at the home port, who can maintain these contacts and follow the progress of the voyage. He should always be informed of departure and arrival times.

(d) Food, water, fuel and stores should be stocked for considerably more than the expected time at sea.

(e) Even though plans may be made for daylight passages, navigation lights, compass and chart should always be carried.

(f) All gear and equipment should be carefully checked before sailing. As in small boat work, a 'checklist' prepared in advance is necessary.

(g) Insurance policies should be checked to ensure that they cover the planned activity.

**Safety measures**

The following ideas will be found to be generally useful and indicate the need to maintain an active discipline:

(a) Apart from personal buoyancy (see *Sailing*, page 70) the use of which will depend upon the vessel and the weather conditions, each member of the crew should be provided with a safety harness to be worn at all times and to be attached when under way and on deck.

(b) Rules governing movement about the vessel at night or when under way, should be established at the outset and strictly adhered to; for example, no one should ever be on deck alone.

(c) Rules for the prevention of fire are of great importance.

(d) Equipment such as bilge-pumps, auxiliary power, anchors, drogues and signalling apparatus should be used regularly to give practice and to ensure efficiency when the need arises.

(e) Emergency drills such as 'Man overboard', 'Fire' and 'Abandon ship', should be practised frequently and under as realistic conditions as possible. The crew's confidence in the equipment and in each other is a prime factor in preventing accidents from developing into disasters. If the crew is a large one, it is wise to draw up a 'Quarter Bill', assigning duties to each person.

(f) A well organised and active routine should be developed. Boredom can lead to mischief and thence to accidents.

(g) The advantages of two or more vessels cruising in company cannot be overstressed.

**Health**

Sea voyages in comparatively small craft are often accompanied by cramped conditions, damp, discomfort and fatigue; only the physically fit should take part and care should be taken not to overtax their strength by too long a period at sea. Whenever possible, each leg of the voyage should be completed within a single day and should begin and end with a quiet night in harbour. Voyages should be short to start with and should only be lengthened as experience is gained and bodies become enured to the hardships.

**Navigation**

In addition to the general preparation for the cruise, all available sources should be studied for information about each leg of the voyage. It is good practice to prepare in advance a resumé of courses, distances, sea marks and turning points, since chart work may be difficult when under way, though plastic covers on charts and a china-graph pencil are of value. The following sources of information should not be neglected.

The Meteorological Office and B.B.C. for weather forecasts.

Admiralty Sailing Directions for the area.

The latest Light List.

Current Notices to Mariners.

The largest possible scale charts, which should be corrected up to date.

Tide tables and tidal charts.
Local sources of knowledge e.g. fisherman, pilots, harbour masters and yacht clubs, though caution should be used as there may be a lack of understanding of the limitations of the crew.

It is always good practice to establish and record errors inherent in navigating instruments and to test them periodically for accuracy. This particularly applies to steering and bearing compasses, logs, depth recorders, sextants, chronometers and radio aids.

**Records**

It is wise to maintain a fairly full account of a cruise in the form of a log book. If this is done during short passages an abstract of the 'sins of omission and commission' can be made which will be of great value when preparing a more ambitious project.

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# Safety in the Air

## EDUCATION IN THE AIR

For some years now school parties taking holidays abroad have travelled on scheduled and chartered flights and the use of this form of transport will increase. The advice given in this chapter is not related to safety precautions which are to be taken for this type of flying. This is more appropriately the concern of the Civil Aviation Department of the Board of Trade, the airline company, the local education authority, the school and parent. The information which follows is for those occasions on which an aircraft is used, in effect, as an extension of the school classroom or as a break from the traditional team game and sport offered in class-time and out-of-school activity.

It is not uncommon for groups of senior pupils to view from the air the terrain which they are covering for field studies. Parties of junior school children have followed the course of their local river and others have made flights to see the changing pattern of the landscape. Several schools already timetable gliding as an alternative to the physical education and games period and a few local education authorities have organised residential courses at gliding clubs. Education has, in this way, relevance to the air and space age of the mid-twentieth century.

Obviously, in all these activities some element of risk must be accepted but the adoption of certain reasonable safety precautions will help to minimise the risk of accidents.

### General precautionary measures

The following precautions should be taken before a school party takes up flying or gliding:

Insurance: Flying and gliding clubs are covered for third party risk only and personal insurance, if desired, should be taken out by the parent of the individual boy or girl or by the party collectively. The local education authority's own insurance cover for

school parties on educational visits or school journeys may possibly give individual cover for flying and gliding but the organiser of the party or the person in charge should know precisely what insurance coverage there is from this source.

Before any person under the age of 21 can fly, the written consent of the parent or guardian should be obtained.

No one should fly or glide when suffering from a cold or catarrh.

## POWERED FLIGHT

**General safety precautions**

The following precautions should be taken when organising flights by parties of school pupils:

(a) All operators of aircraft of over 5,000 lbs. maximum weight which are used for the purpose of public transport (that is in general, where fares are charged) must hold an Air Operator's Certificate which is issued by the Director of Aviation Safety at the Ministry of Aviation. If an aircraft carries seven or more passengers it will usually be over 5,000 lbs. maximum weight.

Anyone proposing to take parties of young people on an educational flight should therefore make certain that the operator of the aircraft holds this Certificate.

In cases where a small aircraft (that is, one of maximum weight of 5,000 lbs. or less) is used, the school organiser of the flight has no specific protection of this kind.

(b) The organiser, or a teacher fully briefed by the organiser, should fly with the group.

(c) The organiser of the party should give to the operator of the aircraft the fullest information about the purpose of the flight so that the pilot may be briefed on the educational nature of the exercise and of the requirements of the party.

(d) The Captain of aircraft, with this background of information, will then be able to brief the party on what to expect during the flight, on what flying conditions are likely and on some of the limitations of the aircraft when used for this special educational purpose. At the same time he will be able to issue instructions on matters such as movement about the aircraft, access to the flight deck and general conduct and discipline during the flight.

(e) Where such a briefing by the captain, member of the crew or cabin staff is not possible, the organiser should obtain the necessary information and give the briefing. He will, in any case, have touched on several of these matters at the time of classroom preparation.

**Ground safety measures**

(a) The strictest discipline is demanded of the party when walking between the terminal building and the aircraft.
(b) Generally, and certainly with large parties, this movement should be under the direct supervision of a member of the staff of the aircraft company. If there are twenty or more passengers in the aircraft there will be at least one steward or stewardess who may be available to escort the party.
(c) At all times the organiser of the party will make himself familiar with local safety regulations and see that they are carried out.
(d) All clothing, exercise books, maps, papers, etc. must be firmly secured in case engine slipstream is encountered. The retrieving of any object blown away must be done with the utmost care. There is a good deal of ground traffic at a busy airport.

**Construction of powered flying machines**

Any school proposing to build a powered flying machine should consult with the Air Registration Board before starting construction, so that advice may be obtained on the requirements which will have to be met. It must never be flown until either a Permit to Fly or a Certificate of Airworthiness has been issued, and then only by a properly licensed pilot.

## GLIDING

**Gliding as a curriculum subject or extra-curricular activity**

An increasing number of older pupils participate in gliding activities and an organiser of school gliding should satisfy himself that:

(a) The glider has a Certificate of Airworthiness. This is issued annually for each aircraft, generally by the British Gliding Association.
(b) The person instructing in the air has an Instructor's Category.
(c) The aircraft to be used has had its daily inspection.
(d) The launching equipment is of a satisfactory standard.
(e) The club field has a good, hazard-free landing area. This is essential for solo flight landings if it be intended that pupils will reach this stage.
(f) Although no special dress is necessary, the gliding pupil must be properly equipped for the weather. In winter it can be extremely cold out on the field, and warm windproof clothing and appropriate footwear are essential. In hot summer weather a head covering is advisable.

(g) It has to be remembered that flying is different from other sports in that there can be intial, and in some cases continuing, nervous tension. The person in charge must be sensitive to these feelings in learner pilots and no pupil should be forced to fly against his wishes.
(h) Small pupils will need cushions.

The above general safety measures and the matter of membership of the British Gliding Association, to which the vast majority of gliding clubs in this country are affiliated, should be explored when the organiser makes a first approach to the club at the preliminary arrangements stage.

**Safety precautions especially applicable to gliding**

*On the field*

(a) Pupils must not stand or walk in front of a glider about to be launched or coming in to land.
(b) The launching cable must not be handled except under express order by the instructor and a finger should never be put through the ring at the end of the cable.
(c) Gliders on the ground can easily be damaged, for example, if something heavy is dropped on to the machine, or if it is held or pushed at an incorrect place. Should a pupil see any damage or feel that some damage may have been done it must be reported at once so that an appropriate inspection can be made.
(d) Pupils must learn to park a glider correctly and must not unpark it without permission from the flying instructor or the owner of the aircraft.
(e) At all times pupils must do exactly what the instructor orders. This applies to instruction by the winchdriver, cable retriever and any person in charge of a ground activity concerned with gliding.
(f) The landing approach of a glider is soundless. At all times on the field a pupil must keep a look-out for approaching gliders.
(g) Ground discipline and good team-work mean more flying and therefore all the more reason to pay attention to safety precautions.
(h) In winds in excess of 20 knots it is not practicable to continue flying for pupils under instruction.
(j) Where there is aero-towing of gliders, pupils must not pass in front of a powered aircraft when the engine is running and must keep well clear of the propellor even when it is stopped. They should know also that pilot visibility from a single engine aircraft which is stationary or taxying is never very good.

**In the air**

The flying instructor is in charge of glider and pupil. He is responsible for the teaching of safety precautions but the following general points should be known:

(a) When getting into or out of the glider care must be taken to step on those parts of the aircraft specifically reinforced for this purpose.
(b) Safety harness must be correctly worn and must never be undone during flight.
(c) Small pilots will need cushions.
(d) The correct method of attachment of the cable to the glider must be learned by all pupils.
(e) The correct method of signalling for glider take-off must be known.

**Construction of gliders by schools**

Schools attracted towards gliding and interested in glider construction may wish to know that:

Continuous skilled inspection by an inspector approved by the British Gliding Association or the Air Registration Board is obligatory and will have to be paid for.

The project calls for many months of highly skilled effort, appropriate tools, an adequately heated workshop and considerable technical knowledge on the part of the person in charge.

Technical information and advice may be obtained from the British Gliding Association, Artillery Mansions, 75 Victoria Street, London, S.W.1.

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# Road Safety

## THE BACKGROUND TO THE PROBLEM

The graphs on pages 88–91 show the trend of fatal and serious casualties to children and young people aged from 5 to 19 years during the period of 1961 to 1965. In these five years traffic grew by just under 25 per cent. Although the total number of fatal and serious casualties increased by 15 per cent, the 5–19 age group suffered the severest casualty rise amounting to 29 per cent. On the basis of casualties per hundred thousand of the population, the total increase between 1961 and 1965 was 10 per cent, but for the 5–9 age group the increase was 11 per cent, for the 10–14 age group 16 per cent, and for the 15–19 age group 21 per cent. After allowing for an increasing population in the 15–19 age group due to the post war bulge, and a decreasing population in the 10–14 age group, the casualties in the two groups showed approximately the same rate of growth.

There has been little change in the type of accident among children aged 5–14. From 5–9 years most of the fatally or seriously injured were pedestrians, while those in the 10–14 age group were almost equally divided between pedestrians and pedal cyclists. A different pattern emerges for casualties in the 15–19 age group in which, at the end of the period 1961 to 1965, 56 per cent were riders of two-wheeled vehicles and 30 per cent were occupants of cars or other four wheeled vehicles. Taken over the five years, these figures represent increases of 13 per cent and 68 per cent respectively per head of the population in this age group.

The greater volume of traffic which can be expected in the future will expose all age groups to greater risks. It is likely that more and more young people will be driving vehicles while they are still at school or soon after they have left. Road accidents are responsible for half the total of accidental deaths in childhood and the continuing upward trend of accidental deaths contracts with the reduction in the number

of deaths from illness and other causes. Every child killed, or seriously injured, in a road accident represents a human waste and a family tragedy.

**Circumstances of accidents**

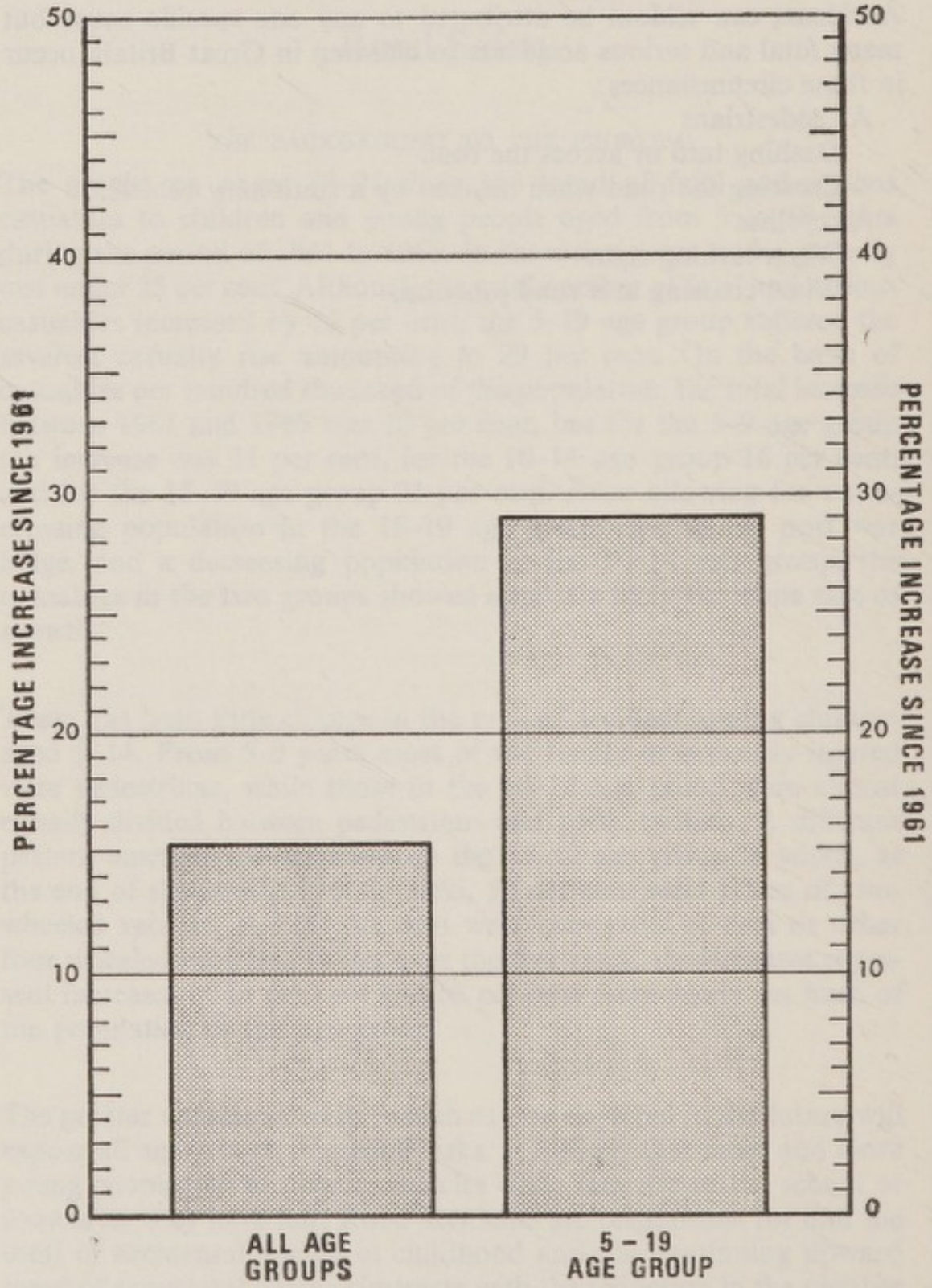
Accidents can seldom be attributed to any one specific cause but many fatal and serious accidents to children in Great Britain occur in these circumstances:

As pedestrians
- Dashing into or across the road
- Crossing the road when masked by a stationary vehicle.

As cyclists
- When turning right
- When crossing at a road junction.

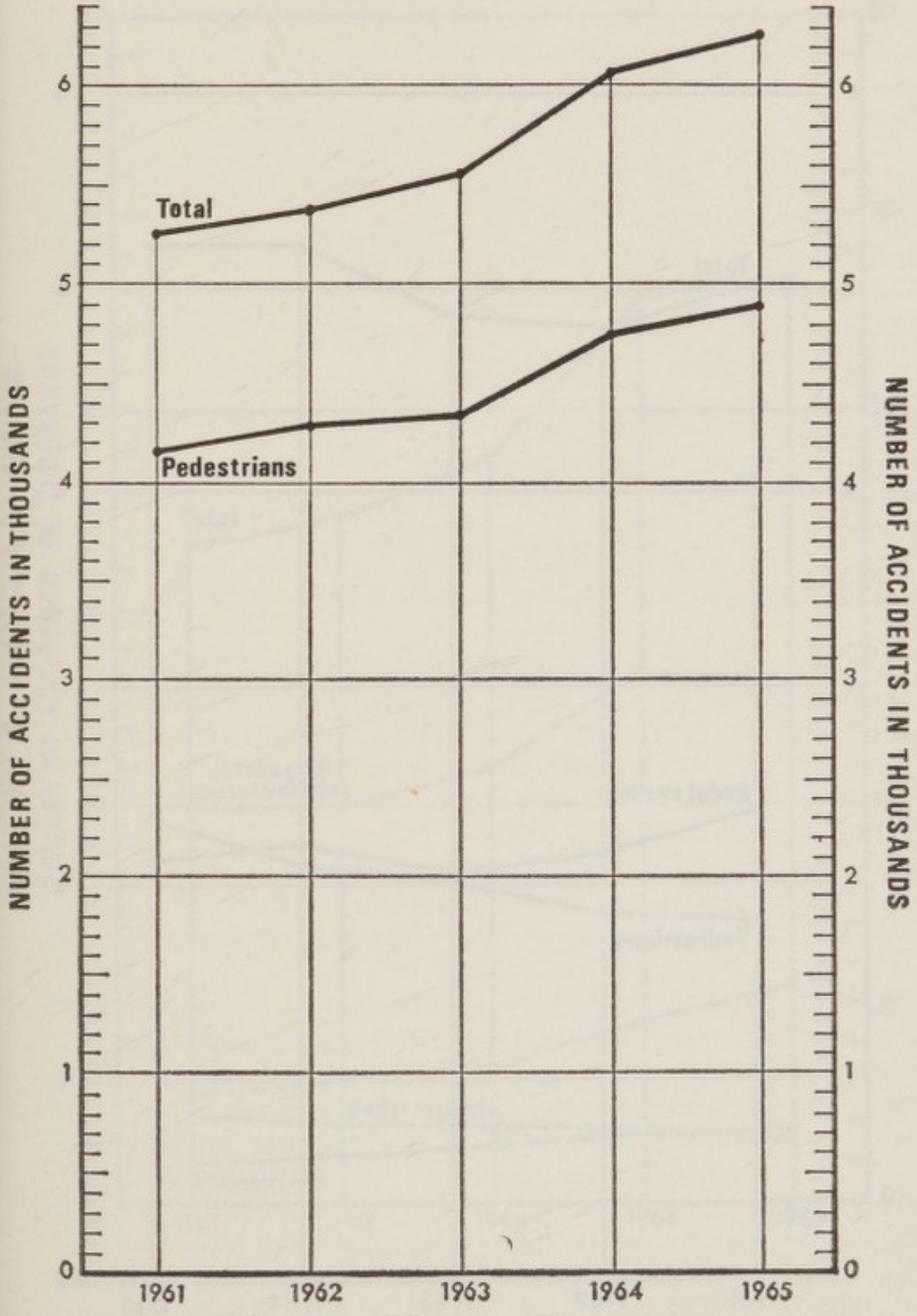
# ROAD ACCIDENTS

## FATAL AND SERIOUS INJURIES IN 1965 COMPARED WITH 1961



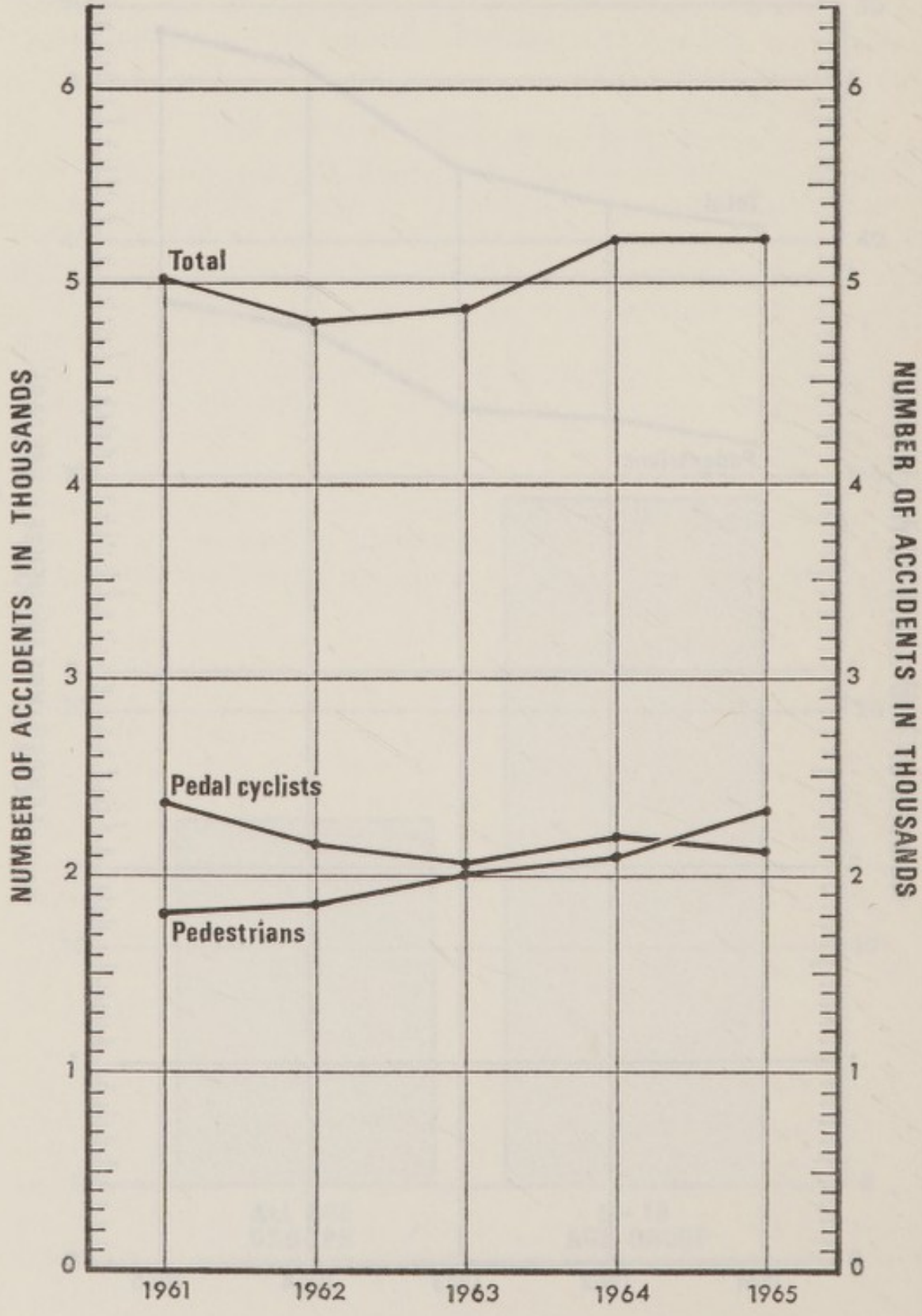
# ROAD ACCIDENTS

## FATAL AND SERIOUS ACCIDENTS TO CHILDREN AGED 5 – 9 YEARS



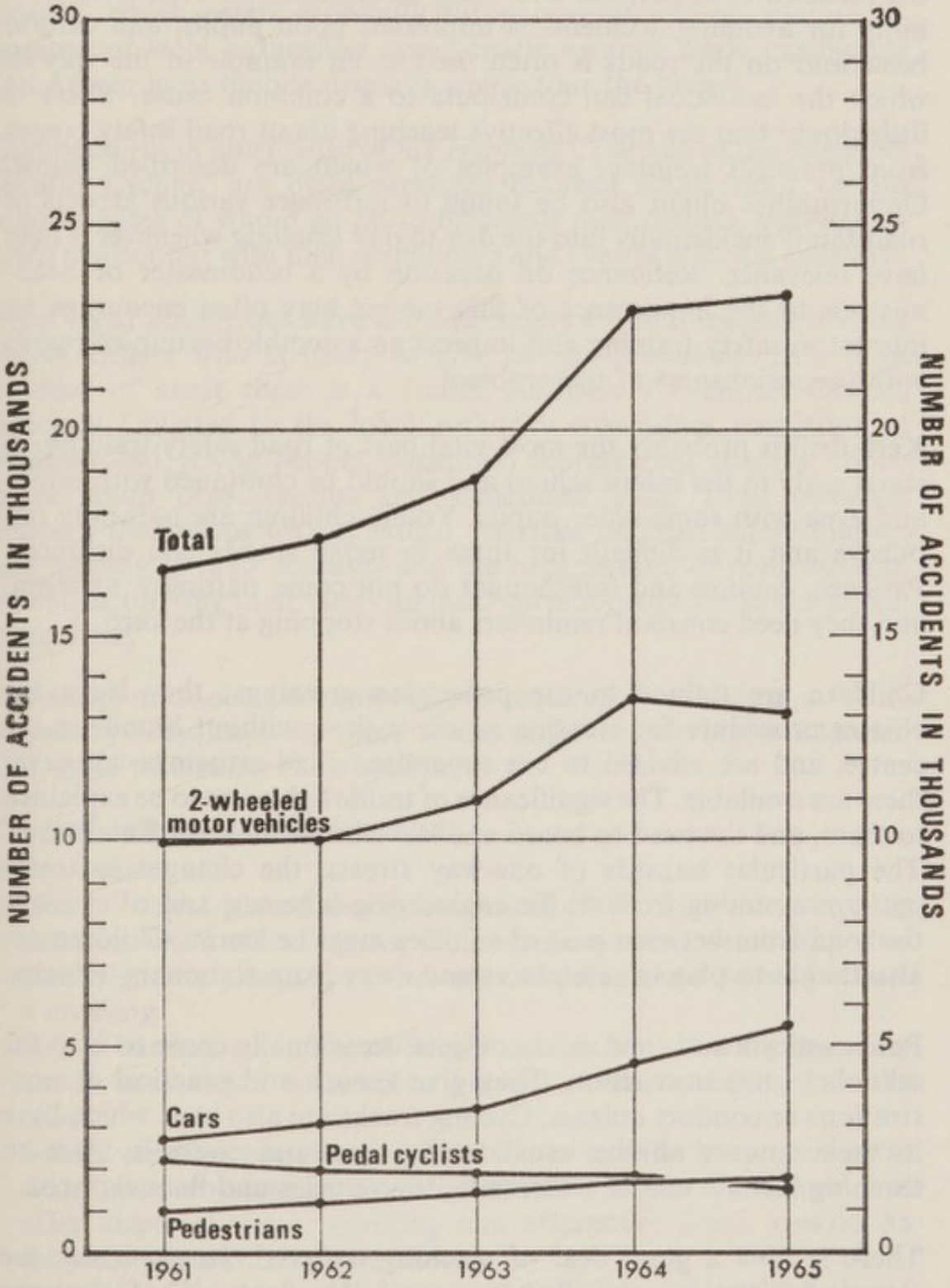
# ROAD ACCIDENTS

## FATAL AND SERIOUS ACCIDENTS TO CHILDREN AGED 10 –14 YEARS



# ROAD ACCIDENTS

## FATAL AND SERIOUS ACCIDENTS TO YOUNG PEOPLE AGED 15–19 YEARS



WHAT IS BEING DONE

**Road safety training in schools**

The place of training in road safety is firmly established in schools, though the attention it receives in a school naturally depends upon the location of the school and other circumstances. Their responsibility for avoiding accidents is impressed upon pupils, and careful behaviour on the roads is often used as an example of the way in which the individual can contribute to a common cause. There is little doubt that the most effective teaching about road safety comes from practical training, examples of which are described below. Opportunities might also be found to introduce various aspects of road safety incidentally into the day to day teaching whenever it may have relevance. Reference on occasion by a headmaster or headmistress to the importance of this subject may often encourage an interest in safety training and impress an assembled group of pupils with the seriousness of the problem.

Kerb drill is probably the most vital part of road safety training. It starts early in the infant school and should be continued with junior and even with some older pupils. Young children are naturally impulsive and it is difficult for them to judge speeds and distances. Patience, caution and forethought do not come naturally to them, and they need constant reminders about stopping at the kerb.

Children are trained to use pedestrian crossings; they learn the correct procedure for crossing roads, with or without islands in the centre, and are advised to use supervised road crossings whenever these are available. The significance of traffic lights has to be explained to them, and the need to board and leave buses only at official stops. The particular hazards of one-way streets, the changes in traffic patterns resulting from traffic engineering schemes, and of crossing the road from between parked vehicles must be learnt. Children are also taught to play in safe places and away from stationary vehicles.

Police officers and road safety officers occasionally come to help the schools in this instruction. They give lessons and practical demonstrations or conduct quizzes. Cycling tracks are also used which have in their courses all the usual traffic signs and controls. Aids to teaching include model crossroads, toy vehicles and flannelgraphs.

There is now a good deal of teaching material. In particular the Royal Society for the Prevention of Accidents (52 Grosvenor Gardens, London, S.W.1.) has an 'Education Safety Service' which is available for local education authorities and schools and which

issues posters and a magazine entitled 'Safety Education' each term, in addition to other road safety literature, films and film strips. It also organises poster and essay competitions for schools. The Society has a permanent road safety training centre and exhibition at RoSPA House, 17 Knightsbridge, London, S.W.1. close to Hyde Park Corner, which caters especially for parties of school children. A number of local authorities occasionally arrange static exhibitions and others have mobile displays which tour the area.

Competitions in knowledge of the *Highway Code* and of the pamphlet 'Skilful Cycling' are often arranged between teams from various schools some of whom go on to represent their district, borough or town in a contest with their neighbours and even in regional contests.

Most local authorities have a Road Safety Committee and a Road Safety Officer who is ready to give advice to schools. In a large number of areas there is a Junior Accident Prevention Council which is affiliated to the local authority committee, consisting of children and young people sometimes representing schools, sometimes youth organisations and sometimes both. Their members concern themselves with practical activities on road safety matters and helping in road censuses and the organisation of competitions, as well as offering their views on local current problems to the parent committee.

Special precautions and training are required for children who are physically handicapped, those whose sight or hearing is impaired and those who suffer from epilepsy.

**Physical safeguards outside school**

These consist of:

'School' signs placed facing oncoming traffic at a safe stopping distance from school gates. Children may need reminding that these signs are intended as a warning to drivers and do not indicate a crossing.

Safety barriers of sufficient length outside the school gates; they are in most cases essential to prevent children rushing into the street.

School crossing patrols posted outside schools in busy areas or at dangerous crossings in the neighbourhood before assembly and after dispersal times, morning and afternoon. Some remain on duty throughout the dinner hour.

Painting on the road of the words 'School Entrance' to discourage parking, and in certain districts the imposing of statutory waiting restrictions.

**Training and testing of child cyclists**

In some parts of England and Wales juniors and even infants may cycle to school, but in towns it is mainly older boys and girls who do so. The accident rate for child cyclists between 1949 and 1958 showed an almost continuous upward trend, especially for the older children, but during 1962, 1963 and again in 1965, this trend has been reversed. Many local education authorities and schools insist on cyclists being trained and tested before they are allowed to cycle to school regularly. Many children, of course, ride bicycles but do not use them to come to school. It has been found that points which need special emphasis are training in the difficult manoeuvre of turning right and the need to give clear hand-signals well in advance.

The Ministry of Transport in conjunction with RoSPA started in 1958 a national scheme called the National Safe Cycling Proficiency Scheme designed to introduce and expand arrangements for training child cyclists until eventually all children who cycle will be given an opportunity of first receiving proper training and subsequently taking a proficiency test. Training is given on school premises or on other sites away from other forms of traffic. In 1964 the number of children trained and tested in Great Britain was 197,000 and in 1965, 193,000. During the summer of 1966 the number of children successful in the test since its inception passed the one million mark. Regional cycling organisers have available numerous films, filmstrips and other aids for this training, and schools may obtain them from RoSPA. The cycling proficiency test can be carried out in playgrounds of reasonable size: a few local authorities have built model training grounds where the children are trained and tested before cycling on the road.

The police, road safety committees and their organisers, cycling organisations, teachers, senior pupils and members of youth organisations help greatly in the training and testing of child cyclists, including the maintenance of the machines.

The provision on school premises of adequate covered cycle racks is encouraging children to take a proper pride in their cycles, and checks on the conditions of the machines are made occasionally at school by Police Officers, Road Safety Officers, staff or senior pupils.

**Children in the country**

Country districts normally have much less density of traffic than urban areas but they have their own special dangers for children. The quiet lanes and main highways may be conducive to driving with

less care and more speed than in towns, and they usually have neither footpaths nor lighting. Children should be urged to wear something white at night. Special armbands, of a material which reflects headlights, can be obtained from RoSPA.

Regulations have been made with the object of preventing accidents to children arising from the use of tractors for agricultural purposes, both on and off the highway. It is now illegal for children to drive, or ride on, tractors until they are thirteen years of age. Under that age they also may not ride on agricultural implements moved by tractors or upon rollers even when they are drawn by animals. The circumstances in which children may and may not ride in trailers are also laid down[27]. A leaflet explaining the regulation is obtainable from the Ministry of Agriculture, Fisheries and Food, Soho Square, London, W.1. RoSPA's Agricultural Safety Division also issues appropriate literature.

**Road safety campaigns**

In recent years annual road safety campaigns have been launched under the titles of: 'Road Training Year', 1962; 'Get Fit for the Road', 1963; 'Think Ahead', 1964; 'Road Safety Depends on You', 1965.

It is essential that the present educational contribution to road safety shall be maintained and, where possible, strengthened by making full use of these regular nation-wide campaigns.

**Children under five years of age**

Only a small proportion of children under five years of age attend nursery schools or classes, and the responsibility for giving boys and girls their earliest training in road safety clearly falls on parents. At this age children readily imitate the behaviour of their elders and accept the risks which they see them take. This is especially true with regard to the standard set by those who help children to cross the road. Children often pay particular heed to the example set by older brothers and sisters, and in this way road safety training given in school can benefit children below school age. Head teachers have opportunities of reminding parents of children in the school of the need to train their younger brothers and sisters in road safety and not to let them go out alone.

[27] The Agriculture (Avoidance of Accidents to Children) Regulations, 1958—S.I. 1958, No. 366.

Of recent years a steep rise in the numbers of young children killed led to the organising by RoSPA of the Tufty Club at the end of 1961. This exists not only to teach young children kerb drill and basic road safety but also to remind parents of their responsibility for training their children to behave safely and sensibly at home and at play. Many infant schools are included in the 1,500 clubs in existence and these, together with individual members, have accounted for half a million enrolments in the first four years of the scheme.

**Motor-cycling**

Many boys still receiving full-time education ride a motor-cycle. For some years the death rate among young motor-cyclists has been very high. In many cases motor cycling accidents have been due to the inexperience of the rider involved. Training schemes organised by the R.A.C. and the Auto Cycle Union exist in many parts of the country, and schools can encourage their pupils to take advantage of this training. Some secondary schools have motor-cycle clubs in which boys learn about the maintenance of their machines and receive road safety training, but schools would be wise to consult the Authority before initiating such schemes.

A number of schools with older pupils have now introduced driver-training schemes, not only with the object of teaching basic skills but also to take advantage of the pupil's interest in learning to drive in order to inculcate the right attitudes towards the use of the roads. The quality of instruction is most important and wherever possible schools intending to introduce this kind of training would be well advised to use the services of the Ministry of Transport approved driving instructors.

## CONCLUSIONS

In the life of today the roads present one of the most serious and ubiquitous sources of danger to children as well as to adults. Road safety is the concern, as has been seen, of a wide range of people and organisations. A substantial reduction in the number of accidents to children is likely to be achieved only if all parties make their full contribution and work in close co-operation.

The schools clearly have a vital part to play, not merely through direct instruction in road safety but through their general efforts to develop in children good sense and consideration for others. The schools are also in an excellent position to enlist, through parent-teacher associations or in other ways, the interest and help of parents, who in the last resort bear the prime responsibility for their children's safety,

APPENDIX A

# Precautions in the Use of Electricity

We live in a world in which electrical appliances have come to form an essential part of life. This is true in school as elsewhere and the study of electricity properly forms an important part of school science courses. In this section we are concerned with those precautions which all teachers should exercise in the use of electrical equipment of any kind.

Fatal accidents are fortunately rare but the conditions from which they may arise are not[28]. School authorities and teachers must reduce these conditions to a minimum and take every opportunity to educate children into an awareness of the dangers involved and of the need for continual vigilance and care. The major concern is the danger of electric shock which at all times is unpleasant but which can be fatal even with apparently innocuous voltages.

The severity of an electric shock is mainly determined by the strength of the current passing through the body and the path which it takes. Accidents do happen in which the body provides a direct connection between live conductors as when the hand or a tool is introduced into equipment connected to the supply. Much more often the connection is between one live conductor and the earth through the floor. or adjacent metalwork. Metal water and gas supply pipes, radiators, concrete floor and sinks provide ready conducting paths of this kind and the disposition of power points and equipment should be such as to prevent the possibility of the body forming a link between 'live' equipment and such conductors.

A dangerous current may well be produced by a voltage as low as 60 or even lower in certain especially sensitive individuals. Much depends on the nature of the contact with the live and earth conductors. Wetness or moisture at the surfaces, perspiration, for instance, and an increase in the area of contact will lower the resistance and thus increase the current with its attendant dangers[29].

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[28] About 200 people die each year as a result of electrical accidents; many more suffer severe injuries of which burns are a particularly dreadful example.

[29] See Treatment of Electric Shock chapter 3. Page 14.

**Installations and equipment**

Electrical equipment in schools ranges from the fixed permanent installations for lighting, cooking and craft, to the temporary experimental circuits used for teaching purposes, which are referred to in Chapter III. Within the range are included a wide variety of audio-visual aids and the semi-permanent installations of which illuminated aquaria and lighting equipment set up for a limited period are common examples.

The fixed installations should be designed and approved by a qualified electrical engineer and they must not be extended or modified without reference to the appropriate authority. Compliance with the *Electricity Supply Regulations* (which are statutory) and also with the *Regulations for the Electrical Equipment of Buildings* issued by the Institution of Electrical Engineers should be a condition of contract. Within this category must be included such items as stage lighting and the heavier power driven equipment in craft rooms, workshops and home economics departments. If the appliances are in regular use, they should preferably be fixed. Metal parts should be permanently connected to earth and this connection should be regularly and frequently inspected by someone of appropriate technical competence.

A rapidly increasing amount of portable equipment working from the mains will be met with in schools—small power driven tools, domestic appliances and audio-visual aids for example. Some of these can be the cause of serious accidents. Thus, the firm grip on the metal part of an electric drill will produce the low resistance contact referred to earlier and a breakdown of insulation in the equipment would set up the conditions for a serious or even fatal shock if the earth connection were not properly made.

This underlines the need for constant concern for the safety of the connection between the appliance and the power point. Switches should *always* break the live lead which should be coloured red, and in some instances a double pole switch should be used to ensure complete isolation from the supply. There should be some clear indication, preferably a pilot light, when a piece of apparatus is switched on. The external metal parts of any equipment should be earthed. This, if done properly, would ensure that no fault in the apparatus could lead to the outside becoming live and a source of danger. This does not, however, make the inside innocuous and before making any adjustment, even replacing a faulty lamp, the apparatus should be completely disconnected from the mains.

Making a good earth connection is a part of the general installation and calls for specialised knowledge and full compliance with the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers. All mains sockets should be for three pin plugs. Connection between the equipment and the plugs should be made with three core flexible cable of suitable current ratings. Braided cable should not be used for connections to portable equipment; there should be an outer cover of thick plastic or tough rubber. Moulded rubber plugs are preferable to the brittle plastic type since they are less liable to mechanical damage. It should be noted that the colour coding of the conductors in the mains connecting cable fitted to electrical equipment of foreign manufacture does not always conform to British convention (red: live (L); black: neutral (N); green: earth (E)). The safest course is to change the whole connecting cable for one with conventional British colours.

Fuses are important safety devices and in replacing them care should be taken to use the correct type and rating. It is desirable to keep a stock of suitable spares for this purpose, but the cause of the fuse failure must always be known before replacement is made.

Regular and systematic inspection and testing is necessary both of equipment and connections. This calls for technical skill and training and school authorities should ensure that a competent person is assigned to the task. Records of all tests should be kept either in a log book or on an equipment record card. The interval between tests will vary in different schools but it should never be more than a year and when the equipment is in frequent use, it should be shorter.

Both because safety demands it and also because he should always bear in mind the need to inculcate sound habits in his pupils, the teacher should at all times take the prescribed precautions and in all he does he should demonstrate the need for the greatest care in dealing with electrical equipment. Electrical appliances should not be connected to the lighting circuit. On each occasion they are used cable and plug connections should be examined for wear or displacement, particularly at the point where the cable is clamped to the plug. Old and threadbare cable should never be used. Pilot lights must be working. In the wiring of semi-permanent installations such as aquaria, particular care must be exercised to make them safe so that the mains voltage is never brought to an exposed contact by an extension lead. These are examples of possible sources of danger.

The very rapid extension in the use of electricity multiplies these possibilities enormously and increases the responsibility which teachers have in preparing their pupils for its use.

APPENDIX B

# First-Aid

## First-aiders

All teachers should have a simple working knowledge of first-aid, and it is important for them to be able to recognise a situation where medical advice is necessary. It is very desirable that teachers on the staff of every school should have attended a course of training and taken a certificate in first aid issued by The British Red Cross and The St. John Ambulance Association. The names of those so qualified should be made known both to teachers and to pupils in order that in the event of an accident first-aid may be applied without delay.

## Equipment

Fully equipped first-aid boxes should be provided in every school. The contents should be carefully considered and should include at least the following:

- scissors
- bandages of varying sizes
- triangular bandages
- adhesive strapping
- absorbent sterilised cotton wool (various sizes, individually wrapped)
- sterilised dressings (lint or gauze), (various sizes, individually wrapped)
- simple splints for immobilising fractures
- eye bath
- safety pins
- telephone number of the doctor to be called.

It should be the duty of one of the teachers, preferably one trained in first-aid, to overhaul the equipment periodically and make sure that the necessary stock of dressings and medicaments is maintained. The first-aid boxes should be easily accessible; teachers and pupils should be aware of their location. In secondary schools it is essential that one should be kept in a laboratory, in a workshop and in a housecraft room. In addition pupils should also be made aware of where the telephone is kept in school, and if there is one on the playing field, should know how to use it.

**Teaching first-aid**

Much is done through the uniformed organisations[31] to which boys and girls belong and sometimes in lessons in school hours to equip them with a knowledge of first aid which will enable them to deal as effectively as possible with such emergencies as they are likely to meet when more expert assistance is not immediately available. The chief principles behind such instruction should be:

to recognise whether a particular injury calls for expert attention;
to render such immediate help as will prevent further injury.

Boys and girls can be taught how to apply simple dressings, to bandage and to deal with scalds, burns, fainting, sprains and simple grazes and cuts. It is clearly dangerous, however, for children to be given more advanced training than their age, experience and sense of responsibility warrant. They should not attempt to deal with fractures, or treat serious injuries unless they have been selected for their aptitude in first aid work to have more advanced training. They should clearly understand the dangers of their trying to move persons who have met with serious accidents or to do anything (except to treat for shock and to send immediately for skilled help) in cases of obviously serious injury.

All teachers and senior children should have some knowledge of modern methods of resuscitation so that they can help somebody suffering from electric shock or rescued from drowning, and placards of instruction should be hung in appropriate places. H.M. Inspector of Factories, the Royal Society for the Prevention of Accidents, the Royal Life Saving Society, the British Red Cross Society and the St. John Ambulance Association supply suitable information[32].

[31] The British Red Cross Society and The St. John Ambulance Association have schemes of training for young people over the age of 11, and are prepared to give instruction in schools if requested to do so.

[32] The First Aid Manual of the St. John Ambulance Association, St. Andrew's Ambulance Association and British Red Cross Society, Second edition (1965) gives a description of mouth-to-mouth resuscitation on pages 61–66.

APPENDIX C

# Literature and Information

The following booklets and film strips offer valuable advice on aspects of safety.

*Available from Her Majesty's Stationery Office:*

Department of Education and Science,

*Health Education* (Education Pamphlet No. 31), 1958, Chapter 12.
*Metalwork in Secondary Schools* (Education Pamphlet No. 22).
Report of the Chief Medical Officer for the years 1956 and 1957 chapter 20
1958 and 1959 chapter 15
1960 and 1961 chapter 20.
Building Bulletin No. 7: *Fire and the Design of Schools, Third Edition*, 1961.
Building Bulletin No. 31: *Secondary School Design: Workshop Crafts.*
Administrative Memorandum No. 9/63: *Training and Testing of Child Cyclists.*
Administrative Memorandum No. 1/65: *The Use of Ionising Radiations in Schools*, Establishments of Further Education and Teacher Training Colleges.

Home Office,

*Accidents in the Home* 1953: (Report of The Standing Interdepartmental Committee on Accidents in the Home).
S.I. 1964 No. 1153: *Children's Night Dresses Regulations.*
Film strip No. 1. *Fire Precautions in the Home.*
Film strips No. 2 and 3 (available as one unit) *Safety at Night: in the Event of Fire.*
Film strip No. 4. *Fire Safety for Children and for the Elderly.*
Film strip No. 5. *Fire in the Home—What to Do While Awaiting the Arrival of the Fire Brigade.*
Lecture notes are available with each of the above film strips.

Ministry of Transport and Civil Aviation,

*Report of the Road Safety Sub-Committees on Child Cyclists* 1956.

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| Ministry of Labour and National Service, | *Industrial Accident Prevention* 1956: Report of the Industrial Safety Sub-Committee of the National Joint Advisory Council. This pamphlet has a section in Chapter 7 containing suggestions how schools and technical colleges can contribute to the avoidance of accidents in industry. |
| Ministry of Labour, | Factories Acts 1937–1959: *The Prevention of Accidents to Young Workers.* |
| H.M. Factory Inspectorate | *Accidents* (a quarterly journal). |
| SHW. No. 279 | *Safety Hints on the use of Wood-Working Machinery.* |
| Form No. 281 | *The Prevention of Accidents to Young Workers.* |
| SHW. No. 329 | *Memorandum on Electric Arc Welding.* |
| Form No. 330 | *The Prevention of Industrial Dermatitis.* |
| New Series Booklet SHW No. 18 | *Industrial Dermatitis: Precautionary Measures.* |
| Form No. 1704 | *Dangers connected with Acetylene Gas and Oxy-Acetylene Welding.* |
| Film Strip No. 1 | *Fire Precautions in the Home.* |
| Ministry of Technology | Leaflet No. 23, *Circular Saws* |

Available from British Standards Institution, 2 Park Street, London, W.1.

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| B.S. 1710 | *Specifications for Identification of Pipelines.* |
| B.S. 2771 | *Electrical Equipment of Machine Tools.* |
| B.S. 2929 | *Safety Colours for use in Industry.* |
| C.P. 3004 | *Guarding of Machinery.* |

A committee of the British Standards Institution is considering the publication of a Code of Practice for Safety Requirements in School Workshops.

Available from the addresses shown

*Regulations for the Electrical Equipment of Building*
(Institution of Electrical Engineers, Savoy Place, London, W.C.2.)

*Anodising for Schools.*
(Aluminium Federation, Portland House, Stag Place, London, S.W.1.)

*Handbook on Electro-plating.*
(W. Canning & Co. Ltd., Great Hampton Street, Birmingham 18).

*Safety in the Use of Compressed Gas Cylinders.*
(The British Oxygen Co. Ltd.,
Industrial Department, London,
or from local offices).

Information on posters and films suitable for school use can be obtained from the Industrial Division of RoSPA, Terminal House, 52 Grosvenor Gardens, London, S.W.1.

Teachers may also find a visit to the Industrial Health and Safety Centre at Horseferry Road, London, S.W.1. of interest as it demonstrates good practice in factory safety over a wide range of industries.



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