SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

Bulletin No. 40. August, 1970.

Contents

Introduction

After protracted negotiations with the Ministry of Defence we have now obtained, albeit on a trial basis only, a similar concession to that granted to the Surplus Buying Agency run by Project Technology from Nottingham. The concession consists in our being allowed to examine surplus equipment in advance of its being catalogued for sale by auction and to select items which we would want to purchase for schools. These are then removed from the sale and we are told the price at which the Ministry is prepared to sell them. At the time of writing this procedure has operated once, and if this serves as any guide it will result in our being able to purchase at a lower price than that we might have expected to pay had the material been put up for auction.

Another benefit to schools will be that we can purchase in smaller quantities than the lots which are formed for auction purposes. It may be that a school wishes to obtain a particular instrument, and if we are notified of this need, we can keep an eye open for one in future inspections. An indication of the type of material on offer can only be got by sending to the auctioneers for a sale catalogue, which costs only 1s. The sales are advertised in The Scotsman and The Glasgow Herald and are held at Stirling and Carlisle. We must emphasise however that once an item has been catalogued we cannot purchase it through this privilege scheme, but must bid for the whole lot at auction. This seems to be the main disadvantage of the privilege scheme, that we have to inspect the material ten weeks before the sale is due in order that the necessary paperwork is processed and, again if our single experience is anything to judge by, a considerable amount of material which will be catalogued for sale comes into the depot after that inspection has to take place. However, once the system has had a longer period in which to operate, we shall be better able to judge its value. For the information of teachers who may wish to obtain catalogues, the next sales are in Carlisle on 16th September and in Stirling on 13th October; these are normally advertised about a fortnight before the sale date.

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From time to time we receive requests for permission to reprint a section of a Bulletin. These come mainly from overseas readers, and usually relate to practical designs for this or that piece of apparatus. To save unnecessary correspondence we would say now that we have no objection, either for past or future issues of a Bulletin, to such a procedure. Nor do we expect the extractor to adhere to the text as printed; his clientele may be very different from ours, and he should feel free to adapt the text to suit.

In return we make one small plea; simply that a good idea originating on their side of the fence be sent to us with a view to/

to publication. To some extent we consider this Bulletin to be a clearing house for ideas, and anything which helps to spread such knowledge will be welcome.

At the same time we would remind readers that the service we mentioned in Bulletin 26 of providing back numbers at a cost of 1s. each plus postage is still in operation, and all back numbers are still in print.

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Mr. R.H. Graham of Dalziel High School, Motherwell has resigned from the Development Committee, and his place has been taken by Mr. J. Williams, The Berwickshire High School, Duns.

Opinion

Elsewhere in this Bulletin we discuss the question of the disposal of hazardous chemicals. The effective answer to this difficulty of course is not to acquire the chemicals in the first place, or to acquire them in quantities sufficiently small to reduce the hazard involved. But is the teacher wholly to blame in this respect? What are the minimum quantities in which one can obtain a dangerous chemical? As a special order, it would no doubt be possible to purchase as little as 10g of sodium but, confining ourselves to the quantities listed in suppliers' catalogues, what do we find? The answers for three such chemicals are contained in the table below which has been extracted from the current catalogues of the firms concerned. We have avoided selecting ANALAR grade where the quantities are sometimes smaller but dearer, and given the smallest quantity quoted in the standard or technical grade of substance.

	Sodium Metal	Potassium Metal	Potassium Cyanide
May and Baker	500g	100g	100g
Hopkin and Williams	250g	25g	250g
Griffin and George	250g	25g	100g
B.D.H.	250g	100g	250g
Philip Harris	250g	25g	500g
T. Gerrard	100g	100g	100g

It should not be necessary to obtain potassium cyanide at all; it does not appear in our chemicals lists but it has been bought in the past, and in large quantities. Also, which school consumes more than 100g of sodium in a year? This, let it be pointed out, is enough for more than 400 of those experiments of dropping pea-sized/

sized lumps on water to observe the reaction. Even if this were not enough, is it not inherently safer to have two separate 100g bottles on the shelf than one of 250g? They will take up more valuable space, they will cost more, but in the changing opinion on questions of safety, schools would be willing to pay this price; if only manufacturers would list the hazardous chemicals, of which there are many more than those selected above, in smaller lots.

Chemistry Notes

We indicated in Bulletin 38 that as a result of growing concern over the use of hazardous chemicals in schools by unskilled or semi-skilled technicians in particular, the Standing Committee on Safety set up by the S.E.D. is to consider the publication of a manual giving guidance on the subject. If this happens, it is an exercise which is not likely to be repeated, and it is therefore important that we should sample the opinions of as many teachers as possible as to what should or should not be included in the manual. We therefore outline the proposals below and invite any teacher who has conflicting views on the subject to write to us; all the evidence submitted will be considered by the Committee before a final decision is taken.

The manual is not primarily intended as an emergency aid after an accident has occurred, although it must be capable of such use; rather the emphasis will be on the prevention of accidents. Thus any technician or teacher called upon to handle any unfamiliar chemical would be expected to consult the manual in advance; failure to do so, or to follow the procedures detailed in the manual might weigh heavily against anyone seeking legal redress as a result of an accident.

The format would probably be loose-leaf, to allow for later additions, and thumb-indexed alphabetically by name of chemical. This raises problems of nomenclature which have still to be resolved. Because of the possibility of emergency use, it is desirable that each entry should be self-contained so that there is no need to cross-refer to some other part of the book. This is why we dislike the colour coding of some versions of safety wallchart; reading the code may take too long in an emergency. The first sections of an entry would deal with the correct methods of storage and handling of the chemical, and of disposal of waste chemical. Later sections will carry advice on how to treat spillage on floors, benches, clothing and finally there would be advice on first aid treatment. An important part of each entry would be an empty space beneath the foregoing where the principal teacher would write details of storage etc. applicable to his own school. This increases the liklihood that the technician will consult the manual before use.

An introductory section should give general advice on storage of chemicals, details of how various neutralising solutions, emetics etc. should be made up and labelled. How many stores do we/

we require for the chemicals normally found in schools? Should a poison cupboard be locked? In this connection it is interesting to note that police in some parts of the country believe it shouldn't, on the grounds that a locked cupboard attracts vandals who might otherwise miss it, and without using something comparable to a safe it is impossible to make a cupboard vandal-proof. Do school building regulations lay down any safety standards for the storage of chemicals? If so, they are more honoured in the breach than in the observance. We know of one school where the chemicals store also houses the main electrical switchboard for the science department; we also know of an ether fire which was started by a spark in an electric switch. Does the British Standards Institution lay down a qualification for that oft-recurring but subjective phrase, a well-ventilated space? These and many other questions require to be considered before any publication on safety can be issued. Your co-operation is invited.

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On a different but related topic we invite teachers or others who have such knowledge, to send us for publication a purely factual account of any accident which they have witnessed recently in a school laboratory. We do this believing that only by giving publicity to such accidents can they be prevented in the future, since ignorance is a contributory cause in many accidents. The school will not be named, in fact we do not need to know it provided we have a name and address to which we can refer for further information if necessary.

In all fairness, we should start the ball rolling by recounting an accident which happened in our own laboratory. During an organic preparation a small amount of diethyl ether had to be evaporated. The technician heated water in a beaker over a tripod and bunsen to the required temperature, and turned off the gas before bringing the test-tube of ether into the room. Without removing the beaker from the tripod, the test-tube was immersed in the hot water and ether vapour ignited on coming into contact with the hot wire gauze or tripod. The moral of course is to remove and cool gauze, tripod and probably bunsen under water before introducing the ether. A safer alternative, and one which we think has many general advantages other than the specific safety aspect with which we are concerned here, is to heat any quantity of water with a mains operated immersion heater in an unbreakable container, e.g. plastic bucket.

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There are several highly entertaining and probably apocryphal stories circulating in the teaching profession regarding attempts to dispose of unwanted chemicals, usually sodium or potassium. They are entertaining only because of the fortunate chance that no serious accident occurred, and disposal of such chemicals remains a problem. Hearing that the Chemical Engineering Division of A.E.R.E., Harwell, had offered such a service, we contacted them and give below the reply we received.

"We are mainly concerned with the collection and disposal of those/

those materials which do not have an accepted conventional means of disposal; e.g. alkali metals and cyanides can obviously be included in this category.

Economics play an important role in the minimum quantities we handle. To this end it would be to your advantage, should you require us to collect, to assemble as much material as possible at one central point. On the other hand, provided the materials for disposal were safely packaged, no doubt you could find one of the long distance carriers willing to deliver consignments to us at Harwell. Chemicals in an unsafe condition would necessarily need individual attention. Non hazardous non toxic chemicals can usually be disposed of by local authorities through their Public Health Inspector.

You will appreciate that we are unable to lay down fixed collection and disposal charges due to the many problems associated with toxic and hazardous wastes. We would however be pleased to quote for definite requirements on receipt of full details."

The larger local authorities may wish to make use of this service by arranging to collect any such chemical from individual schools. For the smaller authorities, or indeed for any authority, SSSERC is prepared to act as a collection centre for unwanted chemicals of this type, provided that they are identified and in a safe condition. We would not accept for disposal any unidentified chemical, and obviously any chemical thought to be in a dangerous condition should be treated <u>in situ</u>. It would be the responsibility of the individual school or local authority to deliver these chemicals to the Centre in Edinburgh.

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Along with the letter from Harwell we received the following note regarding an explosion hazard associated with ethers. Isopropyl ether does not appear in any of our chemicals lists, but it may well be lurking in some school chemistry cupboard having been used once and then had many years to build up a primely unstable condition. If, in addition, the label has dropped off....!

"In the presence of oxygen or air ethers form peroxides which may explode spontaneously or when heated, and isopropyl ether is known to be particularly dangerous in this respect.

Therefore where it is known that these substances have been subjected to such an environment or otherwise had a long shelf life they should on <u>no account be used, nor handled unless absolutely necessary</u>. A fatal accident was caused when a chemist attempted to remove the screwcap of a bottle of isopropyl ether which exploded, practically dis-embowelling him.

IPE <u>in common with other ethers</u> tends to form peroxides on long storage. These peroxides are unstable and under certain conditions may be explosive. The tendency to peroxide formation is accelerated by light and heat and samples, therefore, should be stored under cool, dark conditions and not retained for long periods. Peroxide formation may be inhibited by the addition of a number of substances, of which hydroquinone is one of the best, and <u>uninhibited IPE should never be stored</u>.

In/

In order to inhibit peroxide formation Shell IPE contains 0.01% by weight of hydroquinone. This may be removed when not required by extraction with dilute caustic alkali or water, or by steam distillation. It follows therefore, that it is inadvisable to store IPE that has been or may remain in contact with dilute caustic alkali or water, as this will tend to leach out the inhibitor.

Stocks and samples of IPE should be tested at least once every six months, and any peroxides found to be present should be decomposed by contacting with an excess of ferrous sulphate and sodium bisulphate in equimolecular proportions by distillation over dilute caustic soda, or by passing the IPE down a column of activated carbon or alumina. The presence of peroxides is indicated by the liberation of iodine as a brownish red colouration or precipitate when the ether is shaken with alcoholic potassium iodide solution. If the test is positive, the peroxides should be decomposed before distillation is attempted."

Integrated Science Course

Schools should have received a green-covered booklet entitled Memoranda for Teachers, Sections 1 - 8, on the course. It is unfortunate that one or two of the suggestions in the memoranda are at variance with our own recommendations for apparatus for teaching the course, and in case teachers may feel that the establishment talks with many voices we are setting out here the main differences, and suggesting ways in which the two views may be reconciled.

On page 3 one finds a recommendation to use 75mm dia. test-tubes and 50ml dropper bottles. Neither of these items features in our equipment list. Regarding the test-tubes, the Development Committee which considered and produced the list of glassware published in Bulletin 37, were at pains to reduce the number of items required to a minimum, and it was believed that two sizes of test-tube were adequate. Dropping bottles, of which only a small number are called for, we thought could easily be made up by the teacher or technician as required. There is also perhaps some advantage to be gained by the pupil using his own teat pipette and learning to rinse it between operations.

Page 4 shows how a carbon microphone may be connected to an oscilloscope through a transformer. We find that a crystal microphone may be connected directly to the oscilloscope and gives adequate response to show on the trace provided the oscilloscope gain is turned to maximum. The problem of mains pick up referred to in the memorandum can be cured by using screened cable for the connection. We would like to point out that the microphone specified in our I.S.C. list, Item 17, is no longer obtainable, and that a suitable equivalent, Type CM10 is obtainable at 5s.8d. from the Alpha Radio Supply Co.

The/

The Coddington type hand lens mentioned on page 7 was a strange term to us. A search through over a dozen suppliers and manufacturers' catalogues brought up only one mention of the word Coddington, by Bausch and Lomb. At 8 dollars, however, this may be considered rather expensive. Moreover, their definition of a Coddington lens as "a single thick lens with a groove diaphragm around the circumference," is at variance with one which we extracted eventually from a local optician. They define it as two plano-convex lenses cemented together, the effect being to produce a flat field. We have written to the major suppliers of hand magnifiers to ascertain whether their models are Coddington type lenses.

The difficulty mentioned on page 16 of the memorandum of inflating a balloon with coal gas or hydrogen is not as great as the writer imagines. In Bulletin 1 we published an adaptation of a commercial party balloon inflator which can be used for this, and the same instrument can be purchased from E.J. Arnold.

Page 23 recommends that spot tests for glucose should be made with Fehling's or Benedict's reagent, which need not even be named. If this is so, there seems no reason why the more convenient Clinistix test-paper, obtainable from local pharmacists, should not be used instead. It and the companion Albustix as a test for protein appear as Items 164 and 165 of our I.S.C. list. Clinistix contains the carcinogen orthotoluidine, but provided the active end of the stick is not handled there is no danger. The alternative to Albustix which is Millon's reagent, contains mercuric nitrate which is poisonous.

Display Laboratory

The following items have been added to the display laboratory since this item was last included in Bulletin 34.

Item	Manufacturer
Cooled Stream	SSSERC
Water Powered Aerator	SSSERC
Solenoid Operated Aerator	SSSERC
Joulemeter	SSSERC
Magnetostriction Experiment	SSSERC
Gas Syringe Oven	SSSERC
Gas Chromatography Apparatus	SSSERC
Longitudinal Wave Model	SSSERC
Coulomb Law Experiment	SSSERC
Test-Tube Holders	Philip Harris
Aluminium Test-Tube Racks	Philip Harris
pH Meter	Philip Harris
Air Table	Philip Harris
D.C. Amplifier	W.P.A.
Potentiometer/Wheatstone Bridge	W.P.A.
A.C. Adaptors for Demonstration Meter	Weir

Low/

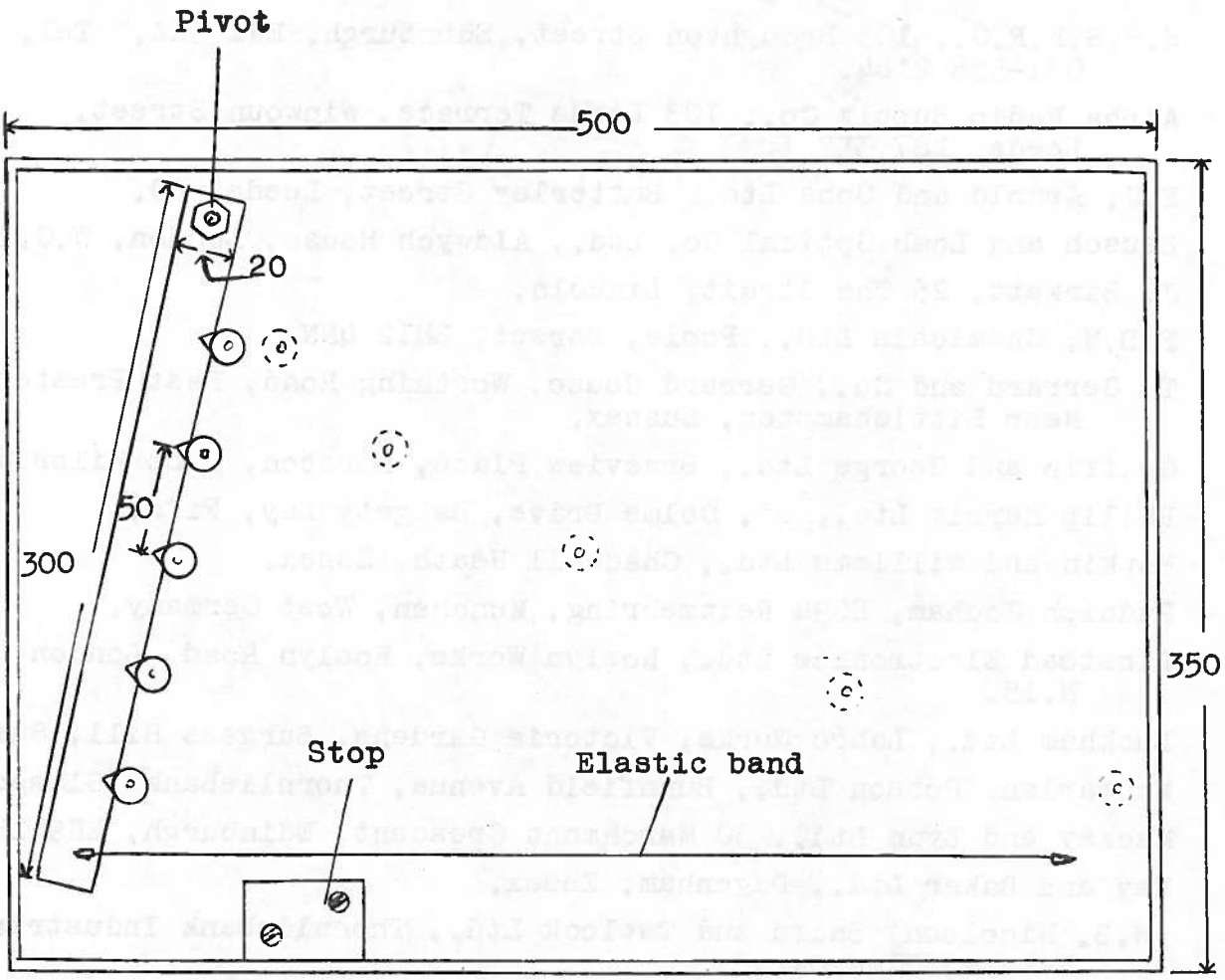
Low Voltage Power Unit	Weir
Low Voltage Power Supply	Unilab
'Chemistry' Power Supply	Unilab
Loughborough Crystal	Unilab
Aluminium Test-Tube Racks	Luckham
Gemstones Polisher	Scotrocks
Minerals Collection	Scotrocks
Sartorius 1104 Top-Pan Balance	S.S.I.C.
Overhead Projector	Griffin and George
Malvern Environmental Chamber	Griffin and George
Potometer	Griffin and George
Porometer	Griffin and George
Compensated Respirometer	Griffin and George
Thermopile and Motor	Griffin and George
Logic Gates	Birkett
Ripple Tank	W.B. Nicolson
Vibrator	Linstead Electronics
Myacope 1000A Microscope	McFarlane Robson
Model NES Microscope	Opax
Embryology Slides	Mackay and Lynn
Storage Boxes	Pharmaceutical Plastics
Optics Kit	Jocham

In The Workshop

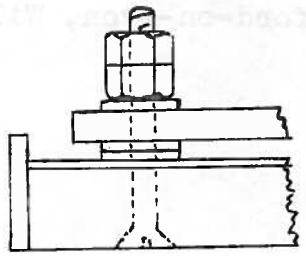
The piece of apparatus to be described is the simplest we have seen for demonstrating that the kinetic energy of a body is proproportional to v^2. A piece of formica measuring about 35 x 50cm is cemented to a plywood base and wooden strips fixed round the edges to form a shallow tray. A wooden lathe, 30 x 2cm is pivoted near one end on a 2 BA bolt countersunk into the plywood base. Small notches are cut every 5cm from the pivot on one side of the lathe.

Two small curtain hooks are fixed, one on the free end of the lathe, and one at the far end of the tray. An elastic band made from two or more rubber bands tied together is stretched between the hooks. A small wooden stop is screwed to the formica so that it will arrest the movement of the lathe in a position parallel to the shorter side of the tray.

To operate the system the lathe is pulled back into the position shown in the diagram, and five 100g brass weights (or other similar and necessarily equal masses) are fitted one into each notch. The lathe is then released. Because of their spacing from the pivot, the velocities with which the masses are projected along the surface are in the ratio of the natural numbers. If the surfaces are uniform so that friction is constant, the masses will come to rest on a parabola which passes through the pivot. To help achieve constant friction, we polished up the under surfaces of the brass weights and rubbed graphite on the formica. It is also necessary to experiment with different elastic bands, starting position of the lathe etc., to get a projection which is big enough to show up the parabola, yet not so large that the fastest weight bangs into the far side of the tray.



General layout



Pivot detail

S.S.S.E.R.C., 103 Broughton Street, Edunburgh. EH1 3RZ. Tel. 031-556 2184.

Alpha Radio Supply Co., 103 Leeds Terrace, Winwoun Street, Leeds. LS7 3YY

E.J. Arnold and Sons Ltd., Butterley Street, Leeds, 10.

Bausch and Lomb Optical Co. Ltd., Aldwych House, London, W.C.2.

J. Birkett, 25 The Strait, Lincoln.

B.D.H. Chemicals Ltd., Poole, Dorset, BH12 4NN.

T. Gerrard and Co., Gerrard House, Worthing Road, East Preston, Near Littlehampton, Sussex.

Griffin and George Ltd., Braeview Place, Nerston, East Kilbride.

Philip Harris Ltd., St. Colme Drive, Dalgety Bay, Fife.

Hopkin and Williams Ltd., Chadwell Heath, Essex.

Rudolph Jocham, 8094 Reitmehring, Munchen, West Germany.

Linstead Electronics Ltd., Roslyn Works, Roslyn Road, London, N.15.

Luckham Ltd., Labro Works, Victoria Gardens, Burgess Hill, Sussex.

Macfarlane Robson Ltd., Burnfield Avenue, Thornliebank, Glasgow, S.3.

Mackay and Lynn Ltd., 30 Marchmont Crescent, Edinburgh, EH9 1HG.

May and Baker Ltd., Dagenham, Essex.

(W.B. Nicolson) Baird and Tatlock Ltd., Thornliebank Industrial Estate, Glasgow.

Opax Ltd., 6 Frant Road, Tunbridge Wells, Kent.

Pharmaceutical Plastics Ltd., Outer Circle Road, Lincoln.

(SSIC) Scottish Scientific Instrument Centre, 42 George Street, Edinburgh.

Scotrocks Ltd., 48 Park Road, Glasgow, C.4.

Unilab Science Teaching Equipment Ltd., Clarendon Road, Blackburn, Lancs, BB1 9TA.

Walden Precision Apparatus Ltd., Shire Hill, Saffron Walden, Essex.

Weir Electrical Instrument Co. Ltd., Bradford-on-Avon, Wilts.

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