SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

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Contents

Introduction

As in former years we shall mount a display of equipment developed in the Centre at the annual meeting of the Scottish Region A.S.E. at Galashiels on Thursday, 10th April. Since manufacturers have their own exhibition stands at this meeting we make a point of showing only experiments or techniques which have no commercial origin, and any manufacturers' equipment on display is ancillary to an experiment. The situation is somewhat different, however, at other exhibitions which we hold at the invitation of a teacher or group of teachers throughout the year, and have on occasions been embarrassed at the conflict of interest between the manufacturers and ourselves.

For example, if teachers wish to have an exhibition of apparatus for the Certificate of Sixth Year Studies, there is no point in inviting both manufacturers and SSSERC to display, since 80% or more of the equipment which we could show would be duplicated by the manufacturers, and indeed, much of it might be removed from our display laboratory by them in preparation for the exhibition. Organisers must therefore decide in advance whether to invite SSSERC or the manufacturer to display equipment; in general it will not be possible to have both. We hope that one of the advantages of our exhibitions is the absence of self-interest, and certainly we can display items by the smaller and more specialised manufacturer who finds it hopelessly uneconomic to travel and set up exhibitions on his own.

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Also at the A.S.E. meeting we shall have for sale a selection of second-hand equipment which we have obtained from various sources. Some teachers may not be aware of this service, and it will do no harm if we reiterate what we said on the subject in Bulletin 23. Equipment which has been checked and found to be in working order is offered at prices varying from 5/- to £2, although occasionally the more directly usable items - e.g. oscilloscopes - will be charged at more than this. Components or panels which have a break-down value only are less than 5/-. While the majority of these items are electronic, we have in the past disposed of such items as a quantity of standard joint glassware, lens systems which convert commercial 35mm screen projectors from standard to wide screen projection, aneroid barometers and 16mm aircraft cine cameras. At the moment we have, in addition to most of the items listed in Bulletin 23, banks of 6 Kjeldahl heater units, mains operated, camera lenses, large scale moving coil milliammeters, valve amplifiers, air-operated vertical gyros, and a wire recorder which converts easily into a coil-winding machine. Equipment may be paid for in cash, or invoiced to the local authority or other governing body. Teachers who wish to avail themselves of these opportunities should bear in mind that there is a continual turn over of second-hand equipment and it will be worth their while to make periodic visits to the Centre or to telephone in to ascertain what is currently for sale.

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Our exhibition programme for the remainder of the session is nearly complete, although it would still be possible to organise one for the month of May. Teachers are asked to note the following future exhibitions, and remember that should they visit the Centre during an exhibition week, it may not be possible to see a full range of apparatus of the type being exhibited elsewhere.

Type of Exhibition	Place	Date
A.S.E. Annual Meeting	Galashiels	8-11th April
Integrated Science Course	Motherwell	26th April
Post Higher Chemistry	St. Andrews	20th June (provisional)

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The presentation to which we referred in Bulletin 28 will be made on the evening of Thursday, 10th April in Galashiels.

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The Centre will be open as usual over the Easter Holiday, being closed only on Good Friday, 4th April.

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Opinion

A recent conference at Moray House College of Education on the safe handling of chemicals in laboratories has high-lighted a problem which, already acute, will become more so as increased numbers of school-leavers make their appearance in science departments as trainee technicians. In present circumstances, the majority of these boys and girls are alone in the departments with none but a harassed and overworked head to turn to for guidance. During school holidays, particularly in the summer, the technician is often alone in the department. If an accident causes serious injury, whose is the responsibility? More significant than the placing of legal blame, whose conscience will be troubled if the accident results in permanent injury, disfigurement, or even death?

Technicians normally can expect three working weeks holiday in the year, which in most authorities places the technician in an empty school for four weeks of the summer vacation when anything can happen. An attempt two years ago to persuade the local further education college to run a four week course at this time for school technicians was countered with the argument that "Our staff have to have holidays as well, you know." I have always understood that a college, like a school, existed for the education of its students and not for the employment of staff (nor, one is tempted to add, the convenience of janitors!). If staff holidays can be staggered, as they are in England, there seems no reason why they should not be so here.

Even/

Even if this seemingly ideal solution to the problem of how to employ a trainee technician during the holidays were adopted, however, there would still remain the question of day to day supervision. As far back as Bulletin 1, I suggested that a laboratory manual be made up, alphabetically indexed, giving clear and precise details of any recurrent job, such as acid dilution, which the technician may have to carry out. Now I would go further and specify that there ought to be a second manual, also indexed, listing every toxic chemical which the technician is likely to meet. Under each heading, in this order, there ought to be specific instructions on handling, disposal, treatment of spillage and first aid. While the R.I.C. Handbook on Toxic Agents is alphabetically indexed, it does not give advice on disposal and its advice on handling is negative, rather than the positive, direct instructional approach needed for a young technician. "Avoid contact with skin and eyes" needs to be translated into "Always wear gloves and goggles."

General laboratory rules also, while good for general guidance, may be worse than useless in specific instances. "Throw all solids to be discarded into the waste bin", is useful advice to a pupil, but to an unskilled technician this merely passes the disposal buck to a more ignorant cleaner, when the correct course would be to train the technician in proper disposal techniques through the manual referred to. "Never return unused chemicals to the stock bottle." Which teacher follows this advice when cutting off the requisite amount of phosphorus, or sodium? Yet the technician who took both bits of advice together would be perfectly justified in throwing sticks of potassium and sodium into the waste bin. If this seems far-fetched, it is as well to remind oneself that the unexpected can happen, and will happen given the right combination of inadequate supervision and incomplete or incompletely understood instructions. The existence of a manual, with instructions to the technician that he must consult it on every occasion when he has to handle or dispose of chemicals should make it unnecessary for him ever to have to read in an emergency the sections on spillage or first aid.

Low Voltage Transformers

This report details the procedures used to test transformers for providing low voltage AC for general purpose work, such as operating raybox lamps etc. In many experiments these transformers provide a cheaper alternative to the AC/DC power unit, reported on in Bulletins 21, 22 and 26. Also, in conjunction with the inexpensive rectifier system described in Bulletin 10 the transformer can be made to supply a variable DC output suitable for experiments where precise setting of the voltage is not required.

The transformers tested consist of Griffin and George N10-660; Philip Harris P7009; W.B. Nicolson 70/1556; Unilab 022.212 and Morris Laboratory Instruments 95-27. In addition we tested a similar transformer by Douglas Electronics available unshrouded from firms advertising in Wireless World. This transformer has tapped outputs of 12, 15, 20, 24 and 30V in a variety of current ranges, so that/

that by proper selection most integral values of voltage are obtainable from 3 - 30V. This transformer requires to be boxed up and fitted with an input fuse and possibly on/off switch, but when this has been done the teacher has a more powerful and versatile low voltage AC supply than that provided by the Nuffield Item 27 specification, to which most of the educational suppliers' transformers conform.

The Item 27 specification calls for outputs of 2,4,6,8 and 12V, all at 6A. No mention is made of the input circuit, and consequently we find that any, all or none of on/off switch, input fuse and neon indicator are supplied. Nor does the price appear to depend on the presence or absence of these accessories.

The more robustly constructed transformer has separate windings for the various voltage steps. The ends of each winding are brought outside the transformer to the output terminals, whereon the voltages are added to give the full final output. Less satisfactory is the single secondary winding, with soldered taps brought out to intermediate terminals. Soldered joints within the transformer are suspect and can give rise to trouble at high current levels, and the tapped wire being usually stranded may not have the same current handling capacity as the winding wire itself. These types have been distinguished as separate and single winding respectively in the report summary.

Regulation curves for the various output voltages were taken at 240V mains output, and a graph attached to the report gives the results of these tests. The transformers were then put on full load with a thermo-couple attached to the core to determine the extent to which they would heat up under continuous loading. All the transformers performed satisfactorily in this respect.

We next considered the effects of a short circuit on the output. None of the transformers have a fuse on the output side. An output fuse will not protect the external circuit, since a different fuse rating would be required for each load and such a system would have to be incorporated in the load input rather than in the transformer. An output fuse in the common OV lead would protect the transformer in the large majority of cases, excluding only those where the load is not attached to the common end of the secondary. Moreover, it would afford a greater degree of protection than the primary fuse which only some manufacturers have included. Where the only fuse must be fitted in the mains plug, the teacher is obliged to use as the minimum possible a fuse rated at 1A. This also appears to be the rating most favoured by manufacturers who fit a fuse link into their transformer, although only one specifically recommends this rating. In passing it is worth noting that the fuse link used is usually a 5/8in glass cartridge type, and that one would expect this to be changed to the 20mm size recommended by the A.S.E. Apparatus Committee when present stocks are exhausted.

Reference to the component applications data issued by Radiospares - from whom most teachers will buy their fuses - will show that a 1A fuse will operate at 1.5A for a period of an hour or longer before melting. We therefore arranged a short circuit across the 4V section of the transformer of a length to produce this initial current in the primary. After the/

the first 5 - 10s the primary current drops due to increased resistance of the heated winding, and the fuse is less likely than ever to melt. Also if a larger portion of the secondary were shorted the fault will frequently be self-fusing. Bare copper wire on the 4V section need not give any external indication that a short is occurring, nor should one exclude the possibility that a pupil may set out deliberately to short circuit the unit.

With one exception, all the transformers tested under these conditions suffered damage. Smoke began to appear either from within the transformer or from the insulation of the output leads within 1 minute of the short being applied. On some of the transformers which have no ventilation holes, a short of this nature would ruin the transformer before the fault became evident, and on the others there is a strong possibility that much damage would have been done before smoke seeping through the ventilation holes became dense enough to be noticed. A further possibility is that the secondary circuit could become live due to carbonisation of transformer insulation, since some transformers have no earthed screen between primary and secondary.

Our recommendations are therefore that all low voltage transformers should include a primary fuse, of 20mm size, and that the unit should carry a recommendation that a 500mA anti-surge fuse be fitted. We do this with some reservation since our tests on this type of fuse are not yet complete, and this will be reported on in a future Bulletin.

Display Laboratory

The following items have been added to the display laboratory since this item was last included in Bulletin 26.

Item	Manufacturer
Binary Multiplier	SSSERC
Compressed Air Pucks	SSSERC
Gas Syringe Chart Recorder	SSSERC
Rutherford Scattering Model	SSSERC
Phase Contrast Model	SSSERC
Coulometric Titration Apparatus	SSSERC
Liquid Dispenser	SSSERC
Breathalyser Experiment	SSSERC
E.H.T. Power Unit	Morris
E.L.T. Power Unit	Morris
Low Voltage Transformer	Morris
Vuespec Spectrometer	Morris
Rotary Resistor	Morris
E.H.T. Power Unit	Linstead
L.T. Power Unit	Linstead
Model 05 Oven	Andrew H. Baird
Light Meter	Avo
Oscilloscope Camera	Shackman
Semi Micro Centrifuge	A. Gallenkamp
Velocity of Light Apparatus	Philip Harris
Franck Hertz Experiment	Griffin and George
Model 400 Microscope	Griffin and George
Microscope Model C	Parisian Opera
Microscope Model B	Parisian Opera

Physics Notes

In the article on the ether engine published in Bulletin 27, Fig. 5 omitted to show the positions of stops A and B referred to in the text. We apologise for this omission. Stop A, on the left side of the support, is 12cm from the top, and stop B on the right, 13cm.

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From a Teachers' Guide published by the New Zealand Department of Education comes this very simple method of demonstrating the identity of current and static electricity. Splay out the wire ends of a miniature neon bulb (Radiospares type "Wire Neons" is suitable) and, holding one wire in the fingers, bring the other wire up to touch a polythene rod which has been charged by friction. The neon will flash once or twice as the wire end is moved up and down the rod. The effect is of course enhanced if one uses an electrophorus. To show current electricity, the neon requires to be connected to a potential of 70V or over, and a series resistor of 100kΩ must be used. Alternatively, the neon can be connected across the output terminals of an E.H.T. power supply, provided that the control is initially at zero and is carefully turned by only a small amount to show the effect.

Biology Notes

We are currently revising the equipment list for the new biology syllabus which was published in Bulletin 23. The original preparation of this list was carried out under some pressure, as the draft proposals for the new syllabus were not made known to us until February, and we were required to have the apparatus list available in time for the publication of the final syllabus in June, 1968.

One or two individuals have since written us criticising the inclusion of some items on this list, and it was therefore decided by our Development Committee that the list should be reviewed. To ensure that the revised list shall be as comprehensive and up-to-date as possible, we would welcome any criticisms of the Bulletin 23 list, whether this involves alternative suggestions for existing items, additions or deletions from the list. Even wholly destructive criticisms will be valuable, if only because they will prompt us to a search for more suitable alternatives. To any who do send criticisms and then find that in the event these have not been heeded, we would point out that many criticisms are matters of opinion, and that our final choice must be that of the consensus of opinion of the biology members of our Development Committee.

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One of the items in the list referred to above which has been criticised is the light meter, No. 33. With some justification it was pointed out that these instruments are designed for use inside buildings and are unduly sensitive for ecology work in biology. To modify the meter for outside use it is necessary to reduce the sensitivity by a factor of about 10, by blanking off nine-tenths of the photosensitive cell area with black adhesive tape. The area left exposed to the light can be of any shape, so that the simplest method is to leave a narrow strip of exposed surface at one edge of the tape. An alternative is to punch out a hole of the appropriate diameter in the tape, using a cork-borer, and to cover the remainder of the cell area. The reduction factor can be obtained as the ratio of the readings with and without the masking tape in position, on exposure to the same intensity of light.

Trade News

With the increasing amount of Sixth Year projects in physics, not to mention developments in mathematics and the proposed syllabus for the Certificate of Sixth Year Studies in Engineering, logic circuits are gradually finding their way into school laboratories and classrooms. One factor inhibiting their use has been expense, coupled with the fact that a large number of these are normally required to perform any useful function. When the cost is only 3s.6d. each however, the outlook is somewhat different. Industrial logic microcircuits are offered at this price in a catalogue from J. Birkett. Types include dual 3-input AND, OR and NOR gates. On the same catalogue is a stud mounting silicon rectifier, 800 P.I.V., 10A, offered at 4s.

If fires start up at all in a science laboratory they are usually noticed when still small, and the teacher may be torn between the desire for immediate action to prevent the fire spreading, and the delay involved in searching for the fire extinguisher, lugging it round the room, and reading its instructions before ever starting to put out the fire. This is where the Sargom Baby Fireman can help. In the form of a press button aerosol spray, it can be held in one hand, requires only seconds to be picked up and directed at the fire, and as we have proved is effective against such diverse substances as alcohol, benzene and phosphorus. It is intended only for small fires, as the canister will empty in approximately 1 minute. The vapour is non-toxic and non-corrosive and being volatile it can be sprayed with beneficial results directly on to skin. The Baby Fireman costs £1.7s.6d., and other larger sizes are available.

The firm of Ofrex Fordigraph have introduced an overhead projector, the 3AW, which uses a fluorescent tube as a light source. This dispenses with the need for fan cooling which is a feature of projectors with tungsten halide lamps, and greater light intensity is also claimed for the lamp. Another feature which should be welcomed by large-scale users of the projector is a manually operated shutter which absorbs 90% of the light when one is actually writing on the surface, the remaining 10% being just sufficient to show up the writing on the surface itself. The cost of the 3AW to educational users is £99.

Small, direct-vision spectroscopes, consisting simply of a cardboard tube with slit at one end and plastic grating at the other, both on removable caps, are being offered by Morris Laboratory Instruments. Pointed directly at a source of light, they will show a band spectrum with incandescent lamps or the sky etc., and line spectra on fluorescent tubes. The spectroscopes are sold at 6 for £1.10s.

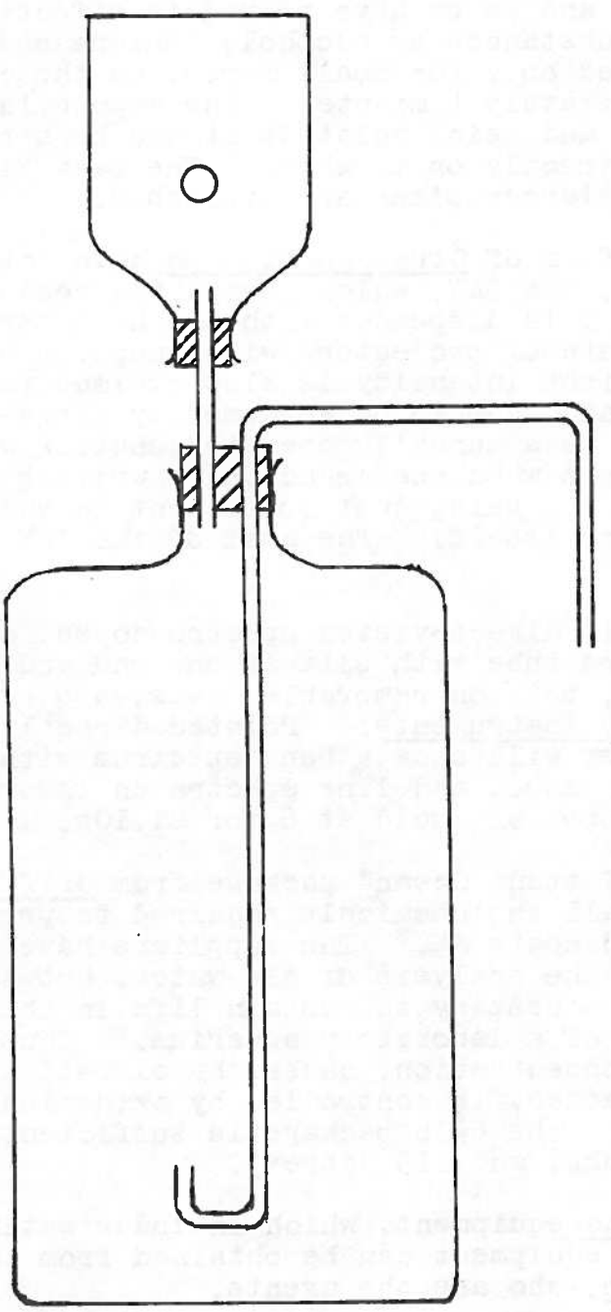
An "Instant Ocean" package from Griffin and George provides all the chemicals required to prepare synthetic sea-water, and costs £4. The suppliers have not attempted to duplicate the analysis of sea-water, but to provide the chemicals necessary to sustain life in the artificial situation of a laboratory aquarium. Thus the increase in ammonia concentration, caused by excretion and decomposition of dead matter, is controlled by oxidation to less toxic nitrates. The 8½lb package is sufficient to make 25 gallon. (Why not 4kg, and 115 litre?).

Techne equipment, which includes water baths, ovens and ancillary equipment can be obtained from the firm of A. Christison, who are the agents.

In The Workshop

In the majority of cases when a liquid is to be dispensed from a bottle an exact measure of the quantity is not needed, and this makes the commercial fixed-volume dispensers expensive. Also from the safety viewpoint it may be an advantage to dispense the most commonly used reagents, e.g. dilute acids and alkalis from two or three Winchesters placed on side benches in preference to 500ml reagent bottles. There is less risk of spillage, and no risk of contamination through careless handling of stoppers.

The dispenser uses the ubiquitous plastic bottle. Detergent bottles are suitable, but probably too large and unwieldy, and bottles of hair lotion, bubble bath etc. are more convenient. A hole which can be covered with the thumb, is made in the side of the bottle, which is then fitted up as in the diagram. The dispensing tube passes almost to the bottom of the liquid container, and the upturned end prevents any sediment, e.g. from lime water, from being delivered. To dispense the liquid the user requires to squeeze the plastic bottle while keeping the hole covered by the thumb.



Bulletin Supplement

Below is a summary of tests carried out on low voltage transformers. For reasons of space only some models are included; the remainder will be summarised in a future Bulletin. Reports on these models can be borrowed by writing to the Director. The classifications used are: A - most suitable for school use; B - satisfactory for school use; C - unsatisfactory.

Model No.	N10-660	P7009	022.212
Supplier	Griffin and George	Philip Harris	Unilab
Price	£4.17s.6d.	£7. -s. -d.	£6.10s. -d.
Output Terminals	2, 4, 6, 8 and 12V	2, 4, 6, 8 and 12V	1, 3, 5, 7, 9, 19 and 20V
Maximum Current	6A	8A	6A
Output on open circuit	13.0V	12.5V	21.2V
Output on full load	12.0V	11.5V	19.8V
Primary Current at full load, mA	325	420	450
Primary fuse	No*	No	Yes
Transformer screen	Yes	No	No
Secondary winding	Separate	Separate	Single
Behaviour on 4V short	Unsatis-factory	Unsatis-factory	Unsatis-factory
Assessment	B	B	B

* An input fuse is being fitted to new stock

S.S.S.E.R.C., 103 Broughton Street, Edinburgh, 1. Tel 031-556 2184

Avo Ltd., Avocet House, Dover, Kent.

Andrew H. Baird Ltd., 33-39 Lothian Street, Edinburgh, 1.

J. Birkett, 25 The Strait, Lincoln.

A. Christison Ltd., Albany Road, Gateshead East Industrial Estate, Gateshead, 8.

Douglas Electronic Industries Ltd., Eastfield Road, Louth, Lincolnshire.

A. Gallenkamp and Co. Ltd., Portrack Lane, Stockton-on-Tees.

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

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

Linstead Electronics Ltd., 35c Newington Green, London, N.16.

Morris Laboratory Instruments Ltd., 96-98 High Street, Putney, London, S.W.15.

W.B. Nicolson Ltd., Thornliebank Industrial Estate, Glasgow.

Ofrex Fordigraph Ltd., Ofrex House, Stephen Street, London, W.1.

Parisian Opera and Field Glass Co. Ltd., 24/5 Princes Street, Hanover Square, London, W.1.

Radiospares Ltd., P.O. Box 427, 13-17 Epworth Street, London, E.C.2.

Sargom (Northern) Ltd., 20 Alva Street, Edinburgh.

David Shackman and Sons, Mineral Lane, Chesham, Bucks.

Techne (Cambridge) Ltd., Duxford, Cambridge.

Unilab Science Teaching Equipment, Clarendon Road, Blackburn, Lancs.