SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

Bulletin No. 91. September, 1976.

Contents

Introduction

We are still trying to achieve an equitable distribution of surplus material, more of which is listed in this bulletin. The postal ballot, used for the material offered in Bulletin 89, is an improvement over the other systems we have tried; not only is it fairer, but it also gives us an idea of the demand for any item, so that we may gear better our future purchases. The fact that we received one or two requests several weeks after the bulletin had gone out indicates that either people are not reading it as soon as they get it, or that the system of sending two or three bulletins in the same envelope introduces a delay before the appropriate teacher gets his copy. We would like to be able to specify here the day on which the ballot will be taken, so that teachers might know if they were too late, but this is almost impossible to forecast. Any guess about the time for material to be returned from the printer can be out by a week either way.

Meanwhile, in an attempt to share out what material we have, we propose to introduce a further complication, viz. an order of priority. To cut down on the amount of scarce but unrelated items going to the school lucky enough to come first out of the hat, we are asking our customers to list their requirements in order of priority. We will then limit the allocation to the first two items on their list, and in the case of later draws, to the first two which are still available. This does not mean that a school will receive only two pieces of equipment; if someone thinks his first priority is for six telephone handsets, then we will try to fulfil that request. We have to exercise our discretion here; anyone who asks for 10 typewriters from page 5 of this bulletin need not expect to get them. To give some guidance on the question of quantity, we are now listing the approximate number in stock of the items detailed as surplus.

It should not be thought from all the foregoing that surplus equipment will be sold only through the postal ballot. There are still bargains to be picked up by teachers visiting the Centre. It is normally only after the bulletin has gone to the printer that we 'freeze' the sales until the ballot has taken place. Singles, i.e. items of which we have only one, are almost always held until we can offer them in the bulletin, as are items like typewriters where we expect the demand to greatly exceed the supply. This again is an area in which we exercise our discretion. We would give greater consideration to someone who has spent time and taken trouble to visit us from a distance, than to our next door neighbour.

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Those who received an allocation of chemicals from the list of Bulletin 88 and have not yet collected them are asked to confirm that they still require them and make arrangements to uplift them. Otherwise we will be obliged for lack of space to offer them to teachers visiting the Centre. We have already notified all who were unsuccessful; if therefore, you asked for chemicals and have not heard from us, you may assume there is material at the Centre which is being kept for you.

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Following the note in Bulletin 87 on F.E. help with CSYS projects we have received an offer from the Department of Science and General Education, Dumfries Technical College, which will give assistance in physics and chemistry. Enquiries should be made to the Head of Department.

Physics Notes

The following notes on the care of nickel cadmium cells have been compiled with the aid of material from Dunoon Grammar School, and may be of use to a number of teachers who over the years have purchased some of these from our surplus stocks. Readers might also like to note that a recipe for the electrolyte for such cells was given in Bulletin 58.

There is no simple test by which the state of charge of an alkaline cell may be determined, although when the e.m.f. drops to 1.2 V, it has lost over 90% of its charge. Fully charged cells in storage slowly discharge themselves; for example, when stored at 20°C a cell will retain the following %age of its original charge

Elapsed time	1	2	3	4	5	months
Charge retained	80	60	45	30	20	%

The lower the storage temperature, the slower is the self-discharging process. Alkaline cells are usually charged at currents varying between Ah/15 and Ah/20, where Ah is the ampere hour capacity of the cell. The lower value is safer, in terms of preventing damage to the cell, so that a one ampere hour capacity cell would be charged at 1/20 A or 50 mA. If the charging efficiency were 100% then this cell would be fully charged in 20 hours, but efficiencies are more likely to be between 50 - 67%, which means longer charging time. Electroplan, who sell the NCC400 cell which is the same physical size as the U2 type, recommend an assumption of 67% efficiency, so that the charging should be continued half as long again as the theoretical time to full charge, i.e. 30 hours instead of 20 in the above example. On the other hand, overcharging, i.e. leaving the cell on charge after it has been fully charged does not damage it, provided the process does not continue for too long. One manufacturer states that at the Ah/20 rates, the overcharge can continue without damage for 2½ times the theoretical full charge time, 50 hours in the example given above.

When a nickel cadmium cell reaches full charge, the energy put in thereafter is dissipated partly as heat, and partly in the production of oxygen which oxidises the cadmium electrode. Elsewhere we have seen it claimed that a charge rate of Ah/9, continued for 28 days, will cause no damage. While this may be true, there is a danger that at a high charge rate, oxygen gas may evolve more rapidly than it can combine chemically with the cadmium, leading to a build up of pressure inside the cell which can be dangerous if the cell does not have a safety valve, or if these are not in good working order. A build up to 125 atmospheres can occur within minutes. This is one good reason for maintaining as low a charging rate as is practicable. If venting of gas does occur, the future life and capacity of the cell will be reduced.

While there is nothing one can do about the slow self-discharge of cells when stored, if it is thought desirable to have a cell or cells kept ready for use in the fully charged state, then they can be kept on a permanent trickle charge at Ah/100 rate.

Leakage of the electrolyte from faulty valves or stoppers is a hazard, as the potassium hydroxide solution is corrosive to the skin, and will cause damage to benches and apparatus with which it comes into contact. Such spillages should be mopped up with a weak solution of boric or acetic acid. Serious damage can be caused if the electrolyte enteres the eyes, and there is a particular risk of the liquid spurting out if a stopper is being removed from a cell which has developed a positive pressure. Anyone handling cells for charging should always wear safety spectacles and polythene gloves. If the liquid enters the eyes, they should be irrigated with plenty of water and medical attention sought.

Alkaline cells will deliver very large currents, of the order 50 - 150 A, without damage. We ourselves have evolved empirically a '5 second' test which consists of shorting a charged cell across an ammeter having f.s.d. 200 A for five seconds. During that time the current must not drop below a predetermined value. This value is a function of the internal resistance of the cell, which in turn is determined by the size and spacing of the electrodes, and in our case was arrived at by comparison of a large number of cells of the same type. Typically, it is the current which during the 5 s of the test will draw 0.5% of the cell's capacity. This gives a figure of 36 A for a 10 Ah cell, and other capacities in proportion, but we would emphasise that this is an average figure, and the small flat cells, advertised first under item 63 in Bulletin 41, are tested for a minimum current of 120 A which represents about 2.5% discharge of a 7 Ah cell.

A battery of alkaline cells should not be fully discharged as this runs the risk of the remaining cells in the battery driving a reverse current through the weakest one, something which will damage the cell. A reverse current is to be avoided as it will cause the cell to vent, with resultant loss of capacity and life, as explained above. On the other hand, every cell should be fully discharged once a year and then fully recharged, as otherwise the cells deteriorate chemically and the Ah capacity is permanently reduced. This can be done by disconnecting the cells from each other and discharging each through a low resistance - a 50 cm length of 26 s.w.g. eureka or constantan wire fitted to crocodile clips is suitable. Cells can be kept indefinitely without damage in the discharged state.

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The surplus equipment from Item 677 onwards will be balloted for under a priority system as explained in the introduction to this bulletin approximately 10 days after posting. From our point of view the ideal order would be a postcard giving the name and school address of the customer, and a list of item numbers only, with the quantity required of each item in brackets after it. But for those who prefer a sealed envelope, the same set of numbers repeated on the back of the envelope helps us a great deal by reducing the time spent in taking the ballot. Those who have been successful will be contacted by letter, giving details of the items they have been allocated.

The following items, up to No. 665 are still available from Bulletin 89. In all cases the number in brackets after the item number indicates our approximate stock. Where no quantity is given, it can be assumed that we have only one.

Item 653(a). (5) Moving coil meter, 20-0-20 mA, £1.

Item 655. (10) Headset, 50p.

Item 660. (15) Hour meter, £1.50.

Item 661. (10) Hour meter, £2.

Item 663. (80) Micro-ammeter, 30 µA, £2.

Item 665. (5) Micro-ammeter, edge scale, £3.

The following are new items, not previously listed.

Item 677. Output power meter, by Marconi. This measures the a.c. power into a pre-selected load. Load range available 2.5 - 20 Ω in 12 steps x 1, 10, 100 or 1000 i.e. 48 values between 2.5 Ω and 20 kΩ. Power scale marked 1 - 10 x 0.2 divisions; ranges 1 mV - 10 W, £5.

Item 678. Snap-on ammeter, a.c. This links magnetically with the current carrying lead. Scale marked 1 - 10 x 0.2; ranges 10, 25, 50, 100, 250, 500 and 1000 A, £5.

Item 679. Scaling unit, type 1266B by Ericsson. This has a 5-digit display on decatrons, and will count positive pulses of 0.5 V or greater and down to 0.2 µs duration. Three position paralysis time switch giving 50, 500 and 5000 µs. This limits the maximum frequency of counting to 20 kHz. Contains a 15 kHz pulse oscillator for testing the decatrons, £5.

Item 680. Type 704 electronic counter, by Airmec. This counts on 6 rows of neon bulbs marked 0 - 9, and will count sine or square wave of 0.5 V amplitude or greater; an input amplitude control is fitted. Frequency range for counting 6 Hz - 100 kHz, £5.

Item 681. Interval timer type 103C by Ericsson. This has an internal oscillator at 100 kHz and counts on 6 decatrons. 100 Hz mains frequency is also provided for counting. Separate inputs and polarity switches for starting and stopping the count. Carry signals from each decatron are taken out to separate terminals so that pulses are available in decade steps from 100 kHz to 0.1 hz. External reference terminals allow an external frequency source of 50 mV or greater to be counted. There is also a d.c. gating supply on terminals to operate the start and stop channels, £10.

Item 682. Universal timer. The unit appears to be designed to measure the time delay for an externally connected relay between current switch on or off, and the contacts operating. It has a 4 decatron count, and 100 Hz (mains) and 1 kHz oscillators. Frequency input terminals accept 4.5 V sine or square wave, 7 Hz - 5.7 kHz for counting. There is an output terminals from the 1 kHz oscillator, and from each of the decatron stages, £5.

Item 683. Dual range d.c. kilovoltmeter, ± 15 or ± 30 kV, with high voltage probe and separate earthing clip lead.

Meter scaled 0 - 15 x 0.5 and 0 - 30 x 1. Requires calibration; as far as we can tell it reads about 20% low, £3.

Item 684. McLeod vacuum gauge by Stokes. Dual range 0.01 - 50 and 50 - 5000 microns. 13 mm dia. inlet has silica gel compartment. In working order, £10.

Item 685. Vacuum gauge as above, without mercury or silica gel, £2.

Item 686. (30) Combined vacuum and pressure gauge. Centre scale pointer reading on one side 0 - 30 x 0.5 in vacuum, and on the other 0 - 20 x 0.5 lb/in^2 pressure. Fitted with two riffled nozzles for 5 mm pressure tubing, and a spring loaded clamp for closing such tubing and isolating the gauge, £2.

Item 687. (10) Hand-operated piston pump, intended for use with the above, having two riffled nozzles one for pressure, one vacuum. The pump has a metal stand with holes for four fixing screws so that it could be screwed to a bench for 'stations' experiments. Supplied with a complete set of spare washers, £2.

Item 688. (10) Packs of pressure tubing, black rubber, for use with above, containing approx. 4.5 m, 50p.

Item 689. (10) Rototherm thermometer, scaled -30 - $+60^{\circ}$ x $1^{\circ}C$, mounted on a triangular bench stand which gives the meter a sloping front presentation. Scale dia. 50 mm, £1.

Item 690. (5) High vacuum grease, in tins containing approx. 500 g, £1.

Item 691. Gevafax 50 photocopier by Agfa-Gevaert. This will copy single documents, books etc. up to 37 x 21.5 cm. The copy paper is in the form of a continuous roll which the machine cuts to size. Can be set to copy any quantity up to 15 copies automatically; a 5-digit counter registers the number of copies. Supplied with 5 bottles developer, 2 bottles toner, and spare roll (135 m) paper. Dimensions 83 x 44 x 41 cm high; mass approx. 50 kg, £15.

Item 692. Stenorette dictaphone, by Grundig, complete with ear-phone, microphone and pedal switch. Three-position recording switch, £3.

Item 693. Stenorette dictaphone as above; no pedal switch, £2.

Item 694. Dictaphone by Philips. With microphone only, but this acts as a loudspeaker on playback, £2.

Item 695. Electro-mechanical calculator, Marchant Figurematic; one 16 and two 8 digit registers, £3.

Item 696. Electro-mechanical calculator, Madas; registers as above, £3.

Item 697. (10) Typewriters, various makes; all in working order, £2.

Item 698. (35) Electro-mechanical £sd adding machines by Burroughs, with print-out; capacity £10M, £1.

Item 699. Panel-mounting electrostatic voltmeter scaled 3 - 15 x 0.5 kV; on plastic panel with 4 15 MΩ 2% resistors, £3.

Item 700. (25) Signal generator type J1a, by Advance. As far as we can tell, these are new and unused. Ranges 15 - 300 Hz;

0.3 - 4, and 4 - 50 kHz. Output control 0 - 25 V into 600 Ω, with 20 db attenuator; 5 Ω output for loudspeaker, vibrator etc., £30.

Item 701. (100s) Electrolytic capacitors. Types available are 32 µf, 500 V; 16+16 µf, 450 V; 500 µf, 25 V; 16 µf, 350 V; 32+32 µf, 450 V; 8 µf, 175 V; 8 µf, 500 V; 8 µf, 450 V; 8+8 µf, 500 V; 50 µf, 12 V; 5 µf, 50 V. The last only is wire-ended; the others are solder lugs. 2p each; specify type when ordering.

Item 702. (20) Our selection of 20 potentiometers, some wire-wound; values from 1 kΩ upwards, 30p. We also have 40 - 50 large track specialised wire-wound pots, double and triple ganged etc. Enquiries invited.

Item 703. Vibron electrometer model 33C by E.I.L. This has a large meter scaled 0 - 10 x 0.2, and 0 - 30 x 1, with switched ranges of 10, 30, 100, 300 and 1000 mV. Battery operated input converter unit (ionisation chamber?) with selector switch for input resistance in 4 ranges from 10^9 - 10^{12} Ω. In the absence of a battery this unit could not be fully tested but it gives meter deflections when a charged Bic pen is waved near it, £3.

Item 704. (100) Toggle switch, double pole double throw, 5p.

Item 705. (50) Toggle switch, d.p.d.t. with centre off position, 5p.

Item 706. (50) Toggle switch, d.p.d.t., biassed, 5p.

Item 707. (100s) Semi-conductor diode, 750 mA, 200 p.i.v., 1p.

Item 708. (10) Bi-metallic strip flasher unit. In series with 12 V and a 6 V m.e.s. bulb, this will cause the lamp to flash off and on, 10p.

Item 709. (20) Transistor panel; contains two BCY42 (=BC108 but with less gain), pre-set printed circuit pot, and various resistors, 3p.

Item 710. (2) Condenser lens, unmounted. 165 mm dia, approx. 200 mm focal length, £2.

Item 711. (2) Condenser lens, mounted in metal frame. 210 mm dia, approx. 100 mm focal length. This would appear to be a compound lens; mass 6.5 kg, £4.

Item 712. (5) Dallmeyer Pentac lens, f/2.9, f = 4", with iris diaphragm. Mounted on L-shaped metal bracket, £2.

Item 713. Film-winder, for 16 mm film, £1.

Item 714. Projection lens and lamp base. Focal length of lens approx. 6 mm. The base is sprung bayonet type fitting for zig-zag filament; we will supply a 30 V, 100 W lamp to fit, 50p.

Item 715. (8) D19 type high contrast hydroquinone developer, in tins, to make 4.5 l working strength, 50p.

Item 716. (20) 500 g bottles hydroquinone, photographic grade to B.S. 3103, by M. and B., 50p.

Item 717. (20) IF-18 fixer, in litre bottles; makes 1½ l working strength solution, 20p.

Item 718. (60) ID-57 developer, as item 717, 20p.

Item 719. (4) PQ developer, in tins, to make 4.5 l working strength solution, 30p.

Item 720. (15) M-Q developer, in tins. Each tin contains 12 packets, each packet making 0.45 l working strength solution, 30p.

Item 721. (10) Acufine film developer. In tins, to make 1 quart (10p) or 1 gallon (20p) working strength solution.

Item 722. (2) Kodak DX-80 developer, 2.7 litre bottle, for diluting 1 in 4 to working strength, 50p.

Item 723. (5) M. and B. fixer, for dilution 1 in 9 to working strength, in plastic bottles approx. 100 ml, 10p.

Item 724. (60) M. and B. glacial acetic acid, photographic grade to B.S. 576; 500 ml glass bottles, 10p.

Item 725. (100) Packs of 25 solid rubber stoppers 10 mm bottom diameter, 10p.

Item 726. (30) 250 ml distillation flask, Pyrex glass, 5p.

Item 727. (2) Box of 225 heavy wall, borosilicate glass rimless test-tubes 110 x 10 mm, £1.50.

Item 728. (2) Petri dish basket. Consists of plastic covered wire frame to hold 6 racks of similar construction, each of which will take up to 8 100 mm dia. petri dishes. Supplied with 3 racks only per frame, 20p.

Item 729. Model 49 titrator, by E.E.L. This consists of magnetic stirrer, lamp, photocell and one filter. The lamp requires a 6 V, and photocell a 3 V supply, and the output can be displayed on a mirror galvanometer. With these accessories, the instrument could be used as a colorimeter, £3.

Item 730. 'Chromoscan' reflectance densitometer by Joyce Loebl. For use on 110/250 V. In working order (as far as we can tell), this was fully described in Baird and Tatlock 1966 catalogue. Dimensions 76 x 57 x 28 cm high; mass 46 kg, £10.

Item 731. Dual dispenser. This is a mains operated device for drawing up and dispensing an accurate volume of solution and has two independent and identical systems in the same box. Dispensed volume is pre-set and adjustable in the range 3.5 to 5.5 ml, £2.

Item 732. Multi-range meter, Avo Multiminor 4. Direct current 100 μA - 1 A in 5 ranges; alternating voltage 10 V - 1 kV in 5 ranges; direct voltage 2.5 V - 1 kV in 6 ranges; ohms x1 and x100. In leather carrying case, £5.

Item 733. (3) Gamma scintillation ratemeter. This is a portable, self-contained ratemeter operating off two 1.5 V dry cells. Scale 0 - 30 μR/hr x1, x10 and x100. The instrument gives deflections on the x100 range when held against Ra and Sr school sources, and on the x10 range with Co, uranyl nitrate etc., £3.

Item 734. (2) Field ratemeter, similar to item 733, powered by 3 dry cells. Ranges 25, 5, 1, 0.5 and 0.05 mR/hr. Contains 4 Geiger tubes. This responds to Ra and Sr sources on x1 range and to Co on most sensitive range. Sockets for fitting external tube, and earphone, £5.

Item 735. (6) Betaprobe type BP5 by Nuclear Enterprises. This has coaxial p.e.t. type connection and contains a 9524H photo-multiplier. Untested, as they require a supply between 850 and 1650 V. We have one instruction book with circuit diagram for the probe, £1.

Item 736. (2) Weston standard cell, £2.

Item 737. A.C. - D.C. amplifier. Uses two integrated circuit amplifiers, powered by four PP4 or equivalent. 500 kHz bandwidth. Fixed gain of 1, 10, 100 or 1000, £3.

Item 738. 4-decade resistance box, 0 - 1111 x 0.1 Ω, £3.

Item 739. Combined pressure/vacuum pump, driven by 1/3 h.p. 240 V motor. Fitted with vacuum gauge reading 0 - 30 x 1 in mercury, £10.

Chemistry Notes

Since we published a note in Bulletin 88 on hazards due to asbestos in the science laboratory there has been considerable activity both within and without educational circles. Public reaction, or over-reaction, has been great enough to oblige the Asbestos Information Council to buy advertising space and time in newspapers and T.V. to convince us that we are over-reacting. In a search for asbestos alternatives, the Cleapse Development Group convened a meeting of manufacturers', suppliers' and L.E.A. representatives to discuss the position.

In broad terms the answers from that meeting are that it may cost from 2 - 10 times more to replace the asbestos at present in schools, and some of the alternatives still require development before being wholly satisfactory. Asbestos products will not disappear from the suppliers' catalogues; overseas customers have to be catered for and they may adopt a different policy from our own. Official policy on the use of asbestos in schools is at present confined to providing advice. Local authorities or the teacher himself may interpret this as imposing a ban on its use.

The Scottish Education Department have a memorandum in preparation which is not likely to differ materially from that issued by D.E.S. for England and Wales (AM. 7/76: The Use of Asbestos in Educational Establishments). The gist of the advice contained in that memorandum lies in the following paragraph. "Dust may also be formed by abrasion of asbestos products in the course of normal usage. In some cases such abrasion is unavoidable and in such cases asbestos products should not be used. Thus asbestos wool should not be used in science; soft asbestos mats should not be used in science, in home economics (on for example ironing boards or iron stands), or elsewhere in the establishment; nor should asbestos cord, asbestos gloves, or wire gauzes with asbestos centres be used. A number of "fillers" are on the market which contain asbestos; unless rigorous precaution can be taken to ensure that dust is not formed they should not be used. "Hard" asbestos products whether as mats or as board are much less likely to give rise to dust. Nevertheless hard asbestos mats should be replaced wherever possible. Asbestos tape and paper as it is commonly used in chemistry laboratories should create little,

if any, dust but even so establishments are advised to discontinue their use." This leads us to the question of alternatives.

Asbestos centred wire gauzes have been so common in science rooms in the past that myths have grown up around their use. It may be the case that the asbestos is needed to protect the gauze metal more than the flask placed above it. Pupils must sometimes wonder at the energy conservation sense involved in pushing a heat insulator between the source of heat and the material to be heated. To teachers seeking an alternative we would suggest stainless steel wire gauze. The 5 in x 5 in size, 20 mesh, 28 s.w.g. is obtainable from Begg, Cousland and Co. for 20p, which is slightly cheaper than asbestos centred gauzes. These gauzes will need a period of testing in schools where alternate heating and cooling coupled with spillages will occur before we can be certain that they are satisfactory. At the moment they should allay the fears of pupils or parent about the most common of asbestos products in the laboratory.

Asbestos paper and tape are used for supporting solids to be heated. Samples of Kaowool ceramic fibre, produced by Morganite Ceramic Fibres have been tested by us, and give promising results. This material is still under development by the firm and is now available only in the form of large rolls 250 mm x 80 m long at £21.80, which is much more than any school could want. A variety of oxides and sulphides have been heated on the paper; molten lead falls through it, but then this used to happen sometimes with asbestos.

Asbestos is also present in heat resistant mats used as bench protection. Several firms are developing substitutes which usually employ glass fibre embedded in cement. Unfortunately most of these alternatives will be more expensive than their asbestos equivalent. Cheaper are squares of hardboard which can be thrown out when they have become too charred, or household ceramic tiles mounted either 2 x 2 or 3 x 3 in a tray.

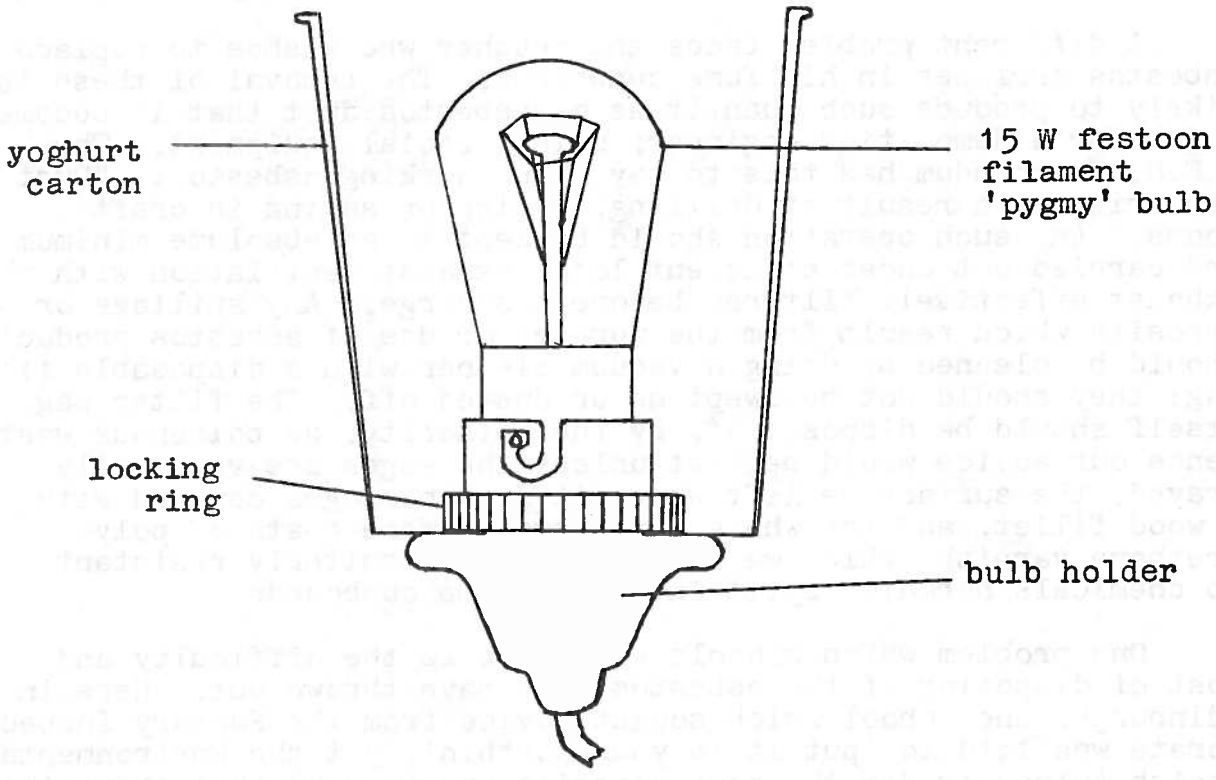
A different problem faces the teacher who wishes to replace asbestos surfaces in his fume cupboards. The removal of these is likely to produce such quantities of asbestos dust that it becomes a job for a demolition engineer, using special equipment. The D.E.S. Memorandum has this to say about working asbestos: "Dust may arise as a result of drilling, filing or sawing in craft rooms. Any such operation should be kept to an absolute minimum and carried out under efficient local exhaust ventilation with the exhaust effectively filtered before discharge. Any spillage or deposits which result from the working or use of asbestos products should be cleaned by using a vacuum cleaner with a disposable filter bag; they should not be swept up or dusted off. The filter bag itself should be disposed of, by the authority, as poisonous waste." Hence our advice would be that unless the edges are very badly frayed, the surface be left where it is, the edges covered with a wood fillet, and the whole given two or more coats of polyurethane varnish, which we have found to be suitably resistant to chemicals normally spilt in school fume cupboards.

One problem which schools will face is the difficulty and cost of disposing of the asbestos they have thrown out. Here in Edinburgh, one school which sought advice from the Factory Inspectorate was told to 'put it in your dustbin', yet the Environmental Health Authority for the same district has told us that they will not accept asbestos as if it were household rubbish, and that it

must be treated as poisonous waste. The D.E.S. Memorandum takes the same view. This means that it comes under the Disposal of Poisonous Waste Act; notice must be given to the appropriate local and river authorities of the intention to dispose of waste, for the areas from which the waste is removed and into which it is to be deposited. Re-Chem International, a firm which accepts hazardous chemicals for re-cycling, will not handle asbestos. Hence it must be properly buried. For the small amount of asbestos we have in the Centre - much less than even an average school might possess - the only legal way we can get rid of it is through Lothian Industrial Cleaners, syn. Beatwaste. They will provide an 8 yd^3 hole in which to bury it, for £40. We still have to notify the authorities, and fill in all the forms. If this situation is general throughout Scotland, then we are concerned that the difficulties and disproportionately high cost may influence teachers and others into illegal disposal by simply dropping the asbestos in the waste bin. Before regionalisation, many of the old local education authorities organised the collection and disposal of large quantities of hazardous chemicals; it looks as if the regions will require to do the same for asbestos.

In The Workshop

The sketch of the microscope illuminator below should be largely self-explanatory. The hole in the case of the yoghurt carton is started with a cork borer, resting the carton on a wooden block, and enlarged with scissors. We would not recommend any higher powered lamp bulb because of the risk of overheating. In use, the illuminator is held by a retort clamp round the bulb holder at a downward angle. This avoids glare in the eyes of the user and at the same time gives some degree of ventilation to the lamp.



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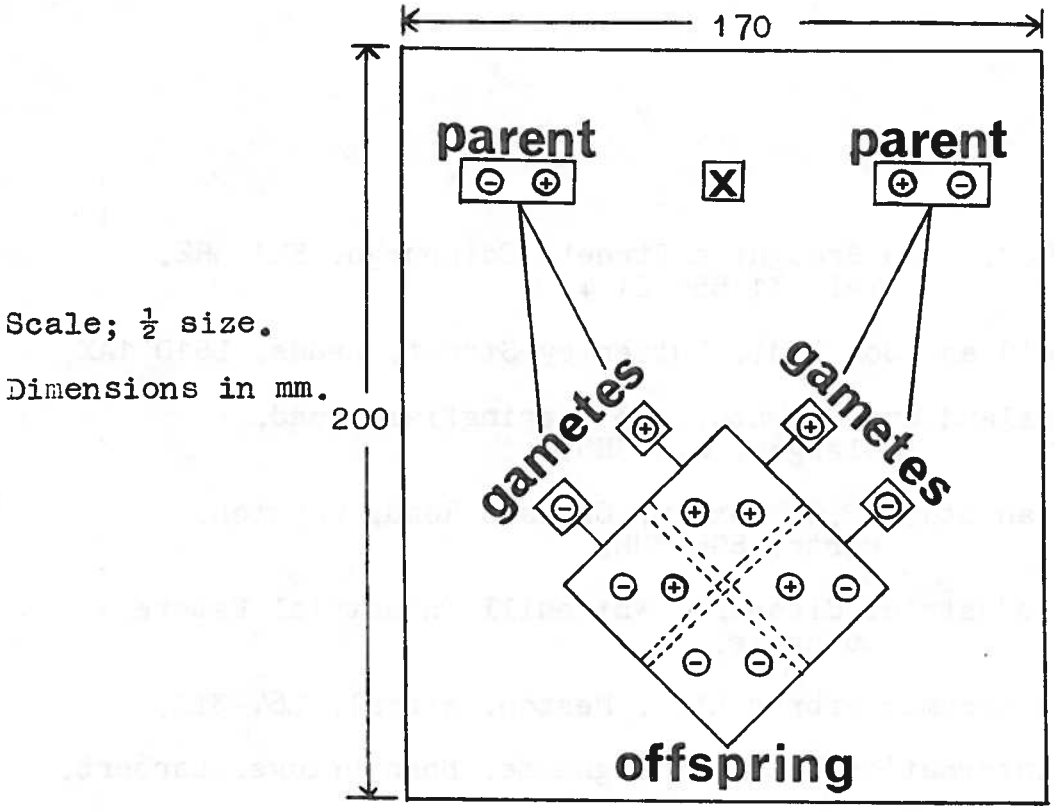
Courses in genetics often start by considering variation and then progress to Mendel's laws. Study of Mendel's first law requires the consideration of a simple monohybrid cross. Because the conventions and format are novel, pupils sometimes experience initial difficulty in drawing out such crosses on paper. In Clydebank High School a model designed for pupil use has been used successfully to overcome some of these difficulties. The model, described below, should allow pupils to follow the sequence of a cross involving one pair of alleles with the minimum possibility of error. It can also be used to show the nature of a backcross.



Scale; $\frac{1}{2}$ size.

Dimensions in mm.

The model is made in 5 mm plywood. On a piece measuring 20 x 17 cm, various blocks of the same plywood are stuck in the positions shown in the diagram, using any suitable wood glue. There are five small 10 mm squares, two pieces 10 x 30 mm, and a large square 60 x 60 mm. The circles on these blocks denote holes to take two different colours of plastic peg, type KN071, from E.J. Arnold. These represent the genes involved; the diagram illustrates a cross between two heterozygous parents and to show how the gene pegs are arranged we have labelled the circles + and -. Thick lines are drawn with felt pen to connect the parent blocks to the gametes and thence to the offspring. The large block is partially divided in 4 by two sawcuts 3 mm wide, shown as dotted lines on the diagram, which go to half the depth of the block. The labels we have put on the diagram with Letraset are done in embossed tape on the model.

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

E.J. Arnold and Son Ltd., Butterley Street, Leeds, LS10 1AX.

Begg, Cousland and Co. Ltd., 636 Springfield Road,
Glasgow, G40 3HS.

Electroplan Ltd., P.O. Box 19, Orchard Road, Royston,
Herts, SG8 5HH.

Lothian Industrial Cleaners, Whitehill Industrial Estate,
Bathgate.

Morganite Ceramic Fibres Ltd., Neston, Wirral, L64 3TR.

Re-Chem International Ltd., Roughmute, Bonnybridge, Larbert.