SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

Bulletin No. 43. December, 1970.

Contents

Introduction

The Centre will be closed on Christmas Day and on New Year's Day, 1971.

Opinion

The news given in our last Bulletin that Polaroid are no longer producing a camera with a shutter having a 'brief' setting making multiflash photography difficult if not impossible, may bring home an unpalatable fact to Scottish Nationalists in our profession. This is that, in the educational sphere at least, Scotland on its own is not a viable market. While the Polaroid camera is mentioned in Nuffield physics, more emphasis seems to be placed on the alternative using 35mm film and possibly as a result few Polaroid cameras have been sold to English schools. Link this with the fact that as a piece of capital equipment these cameras were being bought for Scottish schools in appreciable numbers five years ago, so that now the main market is in newly built schools, or in comprehensives which have been recently up-graded, and we can see the reason why the sales in the educational field have dwindled to a point where in the absence of a commercial outlet it was hopelessly uneconomic to continue selling the camera.

Meanwhile all is not lost. We are experimenting with one of the current 300 range of Polaroid cameras to see whether it can be adapted to suit the requirements of section J of the syllabus.

This is not the first time we have met the non-viability of the solely Scottish market. There have been apparatus designs which have been looked at by manufacturers and rejected, because they were specific to Scotland. Talking to book publishers will tell the same story. Unless a book can be expected to sell in England and abroad as well as here, it is unlikely to be taken up by a publisher. But prospective authors need not be dismayed. Books are easier to export than apparatus, and the Integrated Science Course has been adopted, or is being considered for adoption in Italy, Malta, Malaysia, the Phillippines, Sarawak, the West Indies and Nigeria.

Chemistry Notes

Our plea in Bulletin 40 for details of accidents which have occurred in science laboratories has brought a pitifully small response/

response, if one accepts the estimate of one H.M.I., that there may be upwards of 40 such accidents occurring in Scottish schools every year. We repeat our plea here, that any teacher with personal experience of such accident give us the details so that they may be made known to science teachers at large. It is only by making teachers aware of the possibility of accidents, particularly in the most unlikely situations that we can reduce the risk of hazard to pupil, technician and teacher alike.

The following are details of accidents which have been notified both to us directly and to district Inspectors.

1. Integrated Science Course, Section 12.2, action of metals on oxygen and sulphur. Zinc is one of the metals suggested and an experiment heating powdered zinc and sulphur mixture in a test-tube resulted in three separate instances in an explosion, in one of which the teacher concerned was injured. If zinc is to be used here, it is recommended that it be heated not in a test-tube but in the open. A small pinch of the mixture is placed on asbestos tape which projects over the edge of a wire gauze on tripod. Heat is applied underneath.

2. Integrated Science Course, Section 12.4. This involves finding the effect of heat on clay; if the clay has not been properly dried out there is a formation of steam which may result in an explosion. This hazard has occurred in the firing of clay models in art departments. It is recommended that the clay be in the form of discs 3mm thick x 10mm diameter or thereby, and that they be oven dried prior to use.

3. Oxidation of ethanol to acetic acid, as described in Chemistry Takes Shape, Book 4, p. 43. In three separate instances this experiment has resulted in an explosion, in one of which a pupil was seriously injured. As a result this experiment has been completely banned by one local authority. The temperature at which spontaneous combustion takes place, the auto-ignition temperature is 423°C for alcohol, and for acetaldehyde which is always formed is only 185°C.

4. An explosion occurred when heating water in a can which had a glass tube leading from it, due to the tube being blocked with a thin film of glass. This is surely the most unforseeable of accidents; how many teachers habitually check their glass or rubber tubing for blockages before using them?

5. The 'fountain' experiment with ammonia. A bung slightly too small for the size of flask neck was used. Due to the pressure reduction, the bung and glass jet entered the flask "like a bullet", piercing the base of the flask.

6. A carbon tetrachloride fire extinguisher was used on potassium which had accidentally ignited in an evaporating basin. The phosgene generated seriously injured two students. This accident occurred in a further education college, and should not occur/

occur in school where potassium is not used, but it is easy to imagine a similar situation occurring for example with burning sodium.

7. The experiment of reducing an oxide in a stream of hydrogen. The combustion tube cracked; the resulting explosion blew the top off the sulphuric acid drying bottle.

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Following our comments in Bulletin 40 that school suppliers were to some extent to blame for the existence of large amounts of hazardous chemicals in schools because the minimum quantities listed in their catalogues were too big, Griffin and George have acted quickly by packaging some chemicals - see list below - in smaller quantities. Parts of their letter are worth quoting in full: "The small packs show very little, if any, price saving on the larger units already listed in our chemicals catalogue, but would be added to the range solely as a service to prevent schools buying quantities which are in excess of their normal school requirements.....Upon receipt of your confirmation that the attached list is acceptable, I will arrange for the items to be catalogued and stacked in order that they may be available in time for 1971 requisitions."

Acetyl chloride	pack of 5 x 5ml ampoules
Adipyl chloride	pack of 5 x 5ml ampoules
Aluminium chloride, anhyd.	100g
Barium metal	10g
Barium oxide	100g
Benzoyl chloride	50ml
Benzoyl peroxide	pack of 5 x 1g tubes
Calcium hydride	25g
Chloroacetic acid	50g
Lauroyl peroxide	pack of 5 x 1g tubes
Phenol	100g
Phosphoric oxide	100g
Phosphorus red	25g
" yellow	25g
" pentachloride	pack of 5 x 5g
" trichloride	pack of 5 x 5ml
Picric acid	25g
Potassium metal	10g
" cyanide	25g
" perchlorate	25g
Sebacoyl chloride	pack of 5 x 5ml ampoules
Sodium metal	25g
" cyanide	25g
" hydride	25g
" perchlorate	25g
" peroxide	100g
Stannic chloride	pack of 5 x 5ml ampoules
Strontium metal	1g
Sulphur chloride	pack of 5 x 5ml ampoules
Trichloroacetic acid	25g
Thionyl chloride	pack of 5 x 5ml ampoules

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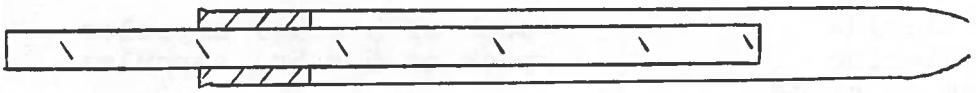
The construction of this electrode should be self-explanatory from the diagram. A 10cm length of glass tubing of 9mm internal diameter is fitted with a carbon electrode, using a piece of rubber tubing as a stopper. The other end of the tube is narrowed down to 6mm dia. by heating, the purpose here being that the end shall be narrow enough to retain water open end down. In electrolysis, a teat pipette is used to fill both units of a pair with the solution to be electrolysed. In some instances, stainless steel rod may be necessary for the anode. This can be obtained in 3/16in. dia. from K. Whiston. The electrodes are then inverted in a beaker of the same solution, and connected using crocodile clip to a D.C. supply. Sufficient gas for testing purposes will be formed in a short time in the electrode itself if a suitable concentration of solution is used.

For use as e.m.f. or Redox cells, two carbon electrode units are used. The oxidiser is placed in one, the reducer in the other. Both electrodes are then inverted in potassium chloride solution which acts as a bridge. E.m.f. can be measured by connecting a voltmeter across the electrodes and if visible effects in the solution are needed, the electrodes can be short circuited.



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A note from Jencons on mercury as a health hazard contains a useful tip for the treatment of non-recoverable mercury which is lodged in cracks between floorboards. This is to put down zinc dust in the cracks; mercury forms an amalgam with the zinc, thus making it non-volatile.

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It has been brought to our notice that the following chemicals are needed for teaching chemistry to O level, and also Integrated Science. We apologise for omitting these from our Chemicals List - Revised Circular 512, which was issued a year ago.

Diglycol stearate	250ml	-.10. -.
*Ferrous carbonate	250g	-. 8. -.
*Petroleum jelly (white)	500g	-. 8. -.
Phenyl salicylate (salol)	250g	-.15. -.
*Silver nitrate	25g	£1. 3. -.
Sodium hypochlorite (bleach)	2 l	-.10. -.
Zinc sulphide	250g	-. 7. -.

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The mobile fume cupboard described in the Workshop section of this Bulletin was originally designed by CLEAPSE for their own use, but has since been manufactured on a commercial scale by Scofield and Flexton at a cost of approximately £75. Although the original design was in wood, we thought that by using Dexion speed frame for the framework, the construction could be brought within the capability of the school technician, without adding very much to the cost. In fact the total cost of materials for the cupboard at April, 1970, was £48.50.

The advantages of a mobile fume cupboard are firstly all-round visibility, so that a class has a much better opportunity of seeing what is taking place in a demonstration. The second is that of cost, provided that architects can be persuaded to save the expense of the standard wall-fitting chamber. In general science, one such cupboard might serve the needs of two or three laboratories.

The main problem of a mobile chamber, that of fume extraction, is overcome by using flexible polythene tubing passed through an open window. The pressure created by the fan is usually sufficient to keep the tubing inflated, even at the point where the tube meets the sharp edge of the window. In some instances, e.g. where the tubing has to rise to the window, constriction can occur, and the ideal situation would be where the architect has designed a suitable vent somewhere on the laboratory wall, closed when not in use, and to which the tubing could be attached when required. With the open window vent, the possibility of fumes entering adjacent classrooms has to be considered. On the other hand, the reduction in recent years in the scale at which experiments are carried out has reduced the intensity of the hazard.

Physics Notes

The cameras which we obtained for the photography topic of the second cycle of the Integrated Science Course, as mentioned in Bulletin 41, have all been sold. We do not intend to repeat the order, as we have learned that Griffin and George are bringing out a kit for photographic science which will have as one of its components a camera very similar to the one we are offering.

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The other item in which we trade because there is no normal school supplier prepared to handle the small quantities involved, viz. bi-metallic strip, is still available at 2½p per piece. Details of sizes etc. were given in Bulletin 35.

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The following items of surplus equipment are still available, and from Item 80 onwards we give details of new lines not previously listed. The number in brackets after each item indicates the bulletin in which the item was first advertised, and in which a full description will be found. We would remind teachers that as many of the new items are sold out almost as soon as the bulletin appears, it is in their interest to phone us immediately they see an item which they would like to obtain, and we will hold it in reserve for them indefinitely, which means even if the item has to be paid for through the annual requisition. All bulletins are collected for posting from the Centre by the Post Office, and we cannot therefore arrange a preferential posting for one part of Scotland at the expense of the remainder. We do keep a file of orders which we have been unable to fulfil, and when a similar item recurs we get in touch with the customer so that he may have the opportunity of buying it before it appears in print. Finally, once the list below has been made out for printing in a bulletin, in cases where there are only one or two of the item, the stock is frozen until the bulletin has been posted so that teachers who can readily visit the Centre do not have an advantage over those in more distant areas.

Item 1 (31) Large Scale Ammeters, 50p.
Item 2 (31) Aneroid Barometers, 50p.
Item 3 (31) Mercury Barometers, £10.00.
Item 7 (31) Scaler, slightly defective, (see Bulletin 41), 50p.
Item 15 (31) Relays, 5p.
Item 16 (31) Switches, 2½p.
Item 17 (31) Potentiometers, 2½p.
Item 18 (31) Block Paper Capacitors, 2½p.
Item 22 (32) Wire-wound resistors, 25p.
Item 23 (32) Fahrenheit thermometers (both types) 25p.
Item 24 (32) Transformers and chokes, 10p.
Item 25 (32) Electronic Valves, 2½p.
Item 26 (35) Heavy Duty Rectifier, 50p.
Item 48 (36) Sine/cosine potentiometer, 50p.
Item 49 (36) D.C. Voltmeter Relay, 25p.
Item 50 (39) Ratemeter, £1.50.
Item 51 (39) Rotary Transformer, 35p.
Item 52 (39) Rotary Transformer, 25p.
Item 53 (39) Double Reduction Gear Train, 50p.
Item 56 (39) Height Capsule, 10p.
Item 61 (39) S.B.C. Bulbs type (b) only, 1p.
Item 62 (39) Silica Gel Desiccant, 2½p per lb.
Item 67 (41) A.C. Dynamometer, £5.00.
Item 68 (41) Pocket Dosimeters, 5p.

Item 80. Three Channel Recording Milliammeter by Everett Edgcumbe, each channel 0 - 5mA at 660Ω input impedance. As each output is shunted the current sensitivity could be increased by removing the shunt at the expense of the input impedance. Chart speeds 3 and 12 inches per minute. £5.00

Item 81. Recording Anemometer by Short and Mason. This consists of a very sensitive fan connected to a revolution counter with 4 dials, graduated in ft, capacity 100,000ft. Fitted with start/stop and reset controls. In conjunction with a watch, wind speeds could be measured in ft/min. £1.00.

Item 82. Dust Sampler by Barcross. Essentially a vacuum/air blower, fitted with a set of dust filters. It will operate all the linear air tracks, air beds etc. we have in the Centre. £1.00.

Item 83. Bubble Sextant. In working order, but too complicated to describe here. £1.00.

Item 84. Teleprinter Tape Reader, Model 11/1/W by Creed and Co. This consists of a mains A.C. motor with a friction, variable speed drive to the reading head, which by means of two contacts converts the holes in teleprinter tape into electrical signals. £2.00.

Item 85. Plutonium Monitor type PNi 1080 by Plessey Nucleonics. This is a Geiger counter, complete with tube, although it appears to require a supply additional to A.C. mains. It is completely transistorised, with 6kV E.H.T. generator, test oscillator, meter reading to 100 counts per second and electro-mechanical register. £2.00.

Item 86. Photographic Timer by Junghans. A large, wall mounting stopclock, scale 180mm diameter, calibrated in seconds and in hundredths of a minute, 50p.

Item 87. Printed Circuit Panels. These are offered for their components, since although all will be in working order they have been extracted from larger units. Most have a minimum of four transistors, and some have many more; 10p. Also diode panels containing only semi-conductor diodes and passive components, 2½p.

Item 88. Personal Gamma Dosemeters. Clips into a breast pocket, and supplied less batteries. This contains an edge scale 50μA F.S.D. meter, calibrated 0 - 20 röntgens, 25p.

Item 89. Gamma Survey Meter, type 1452A, by Ekco Electronics. Supplied without batteries, and without the calibrating radioactive source. The box contains a moving coil meter of unknown sensitivity, switches and other components, 25p.

Item 90. Moving Coil Meters. Sizes and ranges are too varied for detailing here. All have had the F.S.D. checked. Let us know the F.S.D. you require and we will supply the best we have at the time your order is received. 25p.

Item 91. Thermal Housing. This is made in clear perspex and measures 70 x 36 x 20cm. It contains two heaters giving a total of 80W and a rod thermostat, for which the range appears to be 40 _ 50°C. With little modification this could be made into a locust/

Locust or egg incubator cage. £2.00.

Item 92. Surgical Scissors, in stainless steel, 7in. long, blunt ends. 20p.

In The Workshop

The dimensions of the mobile fume cupboard to be described are not critical, and as ours were determined by the over-riding need to get the product inside our van for transporting to exhibitions, teachers may well want to depart from them. As described, the interior of the chamber measures approximately 87cm wide, 80cm high, and 65cm deep from front to rear. This we consider to be adequate for most experiments, but if for example it were thought necessary to reflux organic preparations inside one, using standard instead of semi-micro apparatus, then the chamber could with advantage be 10cm higher.

The main materials required are:

6" Acid resistant, panel mounting fan		Vent-Axia
6" Flexible ducting	1m	"
6" Control switch type SD		"
1" Speedframe	14m	Dexion
No. 52 Speedframe joints, 1" range	4	"
No. 41 Speedframe joints, 1" range	8	"
1" Two-way glazing section	1.6m	"
1" One-way glazing section	5.3m	"
1" Single shelf supports	4	"
2½" dia. Castors with brakes	4	Arthur Hems
5mm Perspex sheet	2 pieces 76 x 51cm	Peter Plastics
" " "	87 x 51cm	" "
3mm " "	2 pieces 76 x 43cm	" "
18mm Chipboard	2 pieces 91 x 56cm	Local
½" Sindanyo, standard grade.	86 x 51cm	T.A.C.
12" Layflat polythene tubing	1 length as required	Transatlantic Plastics
13A Panel mounting mains socket with switch		Local

Sundry small items required to complete the cupboard will be detailed in the next bulletin. The various sheet materials have been given approximate sizes only, since they will be cut to size once the Dexion framework has been assembled. In particular, a slightly larger sheet of Sindanyo, which is a machinable/

machinable form of asbestos will be needed, since narrow fillets are cut from the same sheet to finish the edges of the base of the chamber. One disadvantage of Sindanyo from the commercial aspect is that there is a surcharge of £2 on orders below £5, and transport charges on top of this, which makes it an expensive material unless a science centre decides to construct a number of fume chambers for its schools and buys in bulk. The cost of a single 4ft x 3ft board of ½" Sindanyo is £3.67½.

For a school making only one chamber, Sindanyo may be considered unnecessarily expensive, and the chamber floor could be made from formica on top of 12mm chipboard. Apart from discolouration formica is resistant to acids, alkalis and a large range of organic materials. Almost as good is vinyl floor covering material provided asbestos mats are used under bunsens when heating.

The main assembly details are shown in Fig. 1. The horizontal front and rear members of the framework are 6 pieces of speedframe 85cm long. 6 pieces 51cm long form the side members. The lower uprights (4 off) are 69cm and the upper ones 76cm. The method of fitting these together to form the framework should be obvious once the materials are to hand; a plastic insert is placed into the open end of the speedframe tube and the joint hammered into it. This practice differs only at the joints at the chamber floor level, where the shelf supports are placed in position after the plastic insert has been placed in the lower upright, and before the joint is hammered in (see Fig. 2).

The framework rests on an 18mm chipboard base, cut to the outside dimensions of the frame. 4 lengths of 25mm square hardwood fillet are screwed to the chipboard so that they fit the inside edges of the frame. We fitted four swivelling castors, each individually braked, to the chipboard. This amount of anchorage may not be necessary, although one has to consider that pupils may lean against the chamber while it is in use. It may suffice to have two such castors, and to use two non-swivelling ones on the other corners.

A second piece of chipboard of the same dimensions forms the roof of the chamber. A piece of formica is stuck with Evostik or similar adhesive to its underside. The hole to fit the fan is cut out from its centre, and locating fillets are fitted in the same manner as for the bottom. Neither of these chipboard pieces was secured in any way to the Dexion framework; this makes them readily removable for cleaning. The floor of the fume chamber, either in Sindanyo or chipboard with a formica top, is cut to the inside dimensions of the framework and secured by wood screws passing up through the shelf supports at each corner. Sindanyo or hardwood fillets, of a size to fit under the glazing section (see Fig. 3) are fixed with countersunk screws round three of the inside edges of the floor. At the front where there is no glazing section, the fillet can be flush with the top of the speedframe. When these fillets and the base have been varnished there will be no risk of spillages leaking round the edges to come into contact with the speedframe.

The/

The glazing section needs no adhesive either to the frame or the perspex sheet. It is supplied in two sections, a major portion which fits the speedframe and is held in position by the perspex, and a minor portion which snaps into position to hold the perspex in place. The major portion is cut to size, the ends are mitred and it is fitted in position on the side and rear members of the speedframe forming the chamber. Two way section is used on the two rear uprights, single section on the rest. The perspex sheet should be cut 10 - 12mm smaller than the inside dimensions of the Dexion framework. The sheet is placed in position in the glazing section and the minor part of the strip snapped into position, using a mallet if necessary, along its length.

Details of the doors, fittings inside the chamber and electrical wiring will be given in our next bulletin.

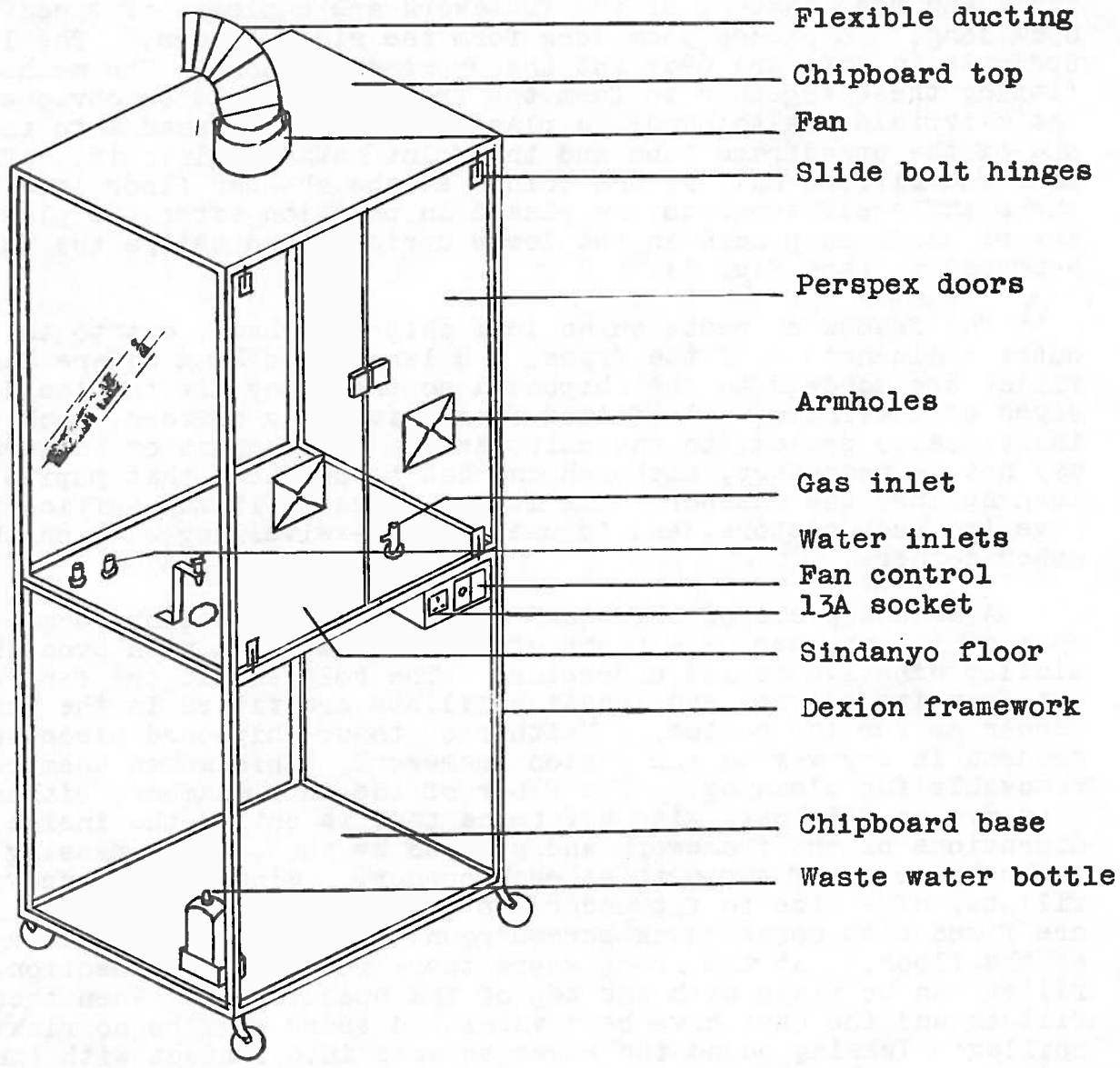

Fig. 1. Not to scale

The remaining diagrams will be given in Bulletin 44.

Bulletin Supplement

Below is a summary of tests carried out on microscopes. Individual reports on these can be borrowed for up to one month by writing to the Director. The classifications used are: A - most suitable for school use; B - satisfactory for school use; C - unsatisfactory. Both microscopes were tested to 'H' grade specification; in addition, the ABF was considered for 'O' grade work.

Model	ABF	Swift M956R(N)
Supplier	Opax	Andrew H. Baird
Price	£29.18s.	£52.16s.
Eyepiece	x10	x10
Objectives	x5; x10; x40	x4; x10; x40
Condenser	N.A. 0.65	N.A. 1.20
Iris Diaphragm	Rotating Disc	True
Substage Illumination	Available. Mains or 12 Volt	Available. Mains or 12 Volt
Assessment	C* for 'H' grade B for 'O' grade	B

*Inadequate resolution, due to inadequate substage assembly.

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

Andrew H. Baird Ltd., 33-39 Lothian Street, Edinburgh, EH1 1HE.

Barcross Ltd., West Drayton, Middlesex.

CLEAPSE Development Group, Brunel University, Kingston Lane, Uxbridge, Middlesex.

Creed and Co. Ltd., Telegraph House, Croydon, Surrey.

Dexion Ltd., Dexion House, Empire Way, Wembley, Middlesex.

Ekco Electronics Ltd., Ekco Works, Southend-on-Sea, Essex.

Everett Edgcumbe and Co. Ltd., Colindale Works, Colindeep Lane, London, N.W.9.

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

B. Arthur Hems Ltd., 9 Rutherglen Road. Rutherglen. Lanarkshire.

Jencons Scientific Ltd., Mark Road, Hemel Hempstead, Herts.

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

Peter Plastics Ltd., 234 Paisley Road West, Glasgow, S.W.1.

Plessey Nucleonics Ltd., Weedon Road, Northampton.

Polaroid Ltd., Rosanne House, Welwyn Garden City, Herts.

Scofield and Flexton Ltd., 11 Vyner Street, London, E.2.

Short and Mason Ltd., Aneroid Works, 280 Wood Street, London, E.17.

T.A.C. Construction Materials Ltd., Leigh Road, Hendley Green, Wigan.

Transatlantic Plastics Ltd., Garden Estate (267W), Ventnor, Isle of Wight.

Vent-Axia Ltd., 45 Finnieston Street, Glasgow, C.3.

K.R. Whiston, New Mills, Stockport, SK12 4HL.