SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

Bulletin No. 47. May, 1971.

Contents

Introduction

It is just possible that the Bulletin will reach schools before the first of our summer term exhibitions detailed below, i.e. on 29th May. This is being held in conjunction with a one-day meeting of the Scottish Branch of the A.S.E. which is replacing their normal Easter meeting cancelled because of difficulties caused by the postal strike. The apparatus shown will be that designed or built by the Centre during the past year. The exhibition will be open 10 a.m. - 4 p.m., and at 11 a.m. we shall give a lecture demonstration on new equipment for science teaching. Due to our commitments in Dundee the Centre will be closed on 29th May. Some ten days later we shall be back in Dundee with an exhibition which in one way constitutes a departure from our usual practice. The exhibition will be set up and then left unattended by us for a week, although visitors may ask advice from the resident technicians, and of course there will be catalogues explaining the purpose of the exhibits. The full summer programme of exhibitions is:

Exhibition	Place	Time
SSSERC Apparatus	Dundee University	29th May
I.S.C. Second Cycle	Teachers' Centre, Dundee	7 - 11th June
S.Y.S. Chemistry	St. Andrews University	16th June
Integrated Science Course	Nicolson Institute, Stornoway	24th June

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We continue to receive requests for back numbers of our Bulletins, some from newly established schools which want a complete set, some from teachers entering a promoted post who find that their predecessor has lost some of them, destroyed them, or taken them with him. We can usually fulfil such requests, as all back numbers are still in print, although they are charged for. With this Bulletin we include an order form for back numbers; since the last such form was issued the number of bulletin issues has doubled, and postage rates have increased. While readers in the U.K. may pay by any means, including a requisition drawn on their financing authority, overseas readers are asked to note that payment by cheque or postal order must be made with the order.

Opinion

There is so much activity in the education scene of today that many teachers may be unaware of what is going on. There may be many projects which are known only to those intimately involved in them and which are deserving of a far wider public. These remarks are high-lighted by the coincidence of two events in the field of in-service/

service training of teachers, to which much of SSSERC's activities could by a stretch of the imagination be said to be related.

The first was a phone call from a teacher enquiring the dates and location of courses on the safe handling of radioactive materials, which would qualify him to use open sources, and stronger sources up to the 4 mCi level. We passed the query on to the inspectorate who could not answer it directly since there is no central organisation collating such information. So the teacher was left to ring - this happened during the postal strike - round the various institutes which had run such courses in the past to see if any were repeating it.

The second is an article on in-service training for teachers in Scotland, published in a Science Teachers' Journal which is sent to us regularly by one of our foreign bulletin readers. The author is not stated, so that the views he expresses may be those of a native Scot, or of a teacher from the country concerned, himself on an in-service course studying these courses in Scotland. Whatever the origin of the views, they are notable for their forth-rightness.

"There is bad timing of courses. Some are held prematurely, others are held too late, some are held on topics of no immediate importance and thus absorb the energies of those who should provide courses on other topics that are not offered at all."

"There is an imbalance in the total national provision. Far too many courses are being offered to some teachers or on some topics, but much more reprehensible is the fact that there is not sufficient variety in type of the inservice training offered. There are probably too many short courses and one day conferences, and far too few working groups or work study groups, long courses, and staff tutors. Certain areas of the country are favoured for geographical reasons, and others, the distant and rural areas, are comparatively or completely neglected."

"Except in a limited although growing degree, it is difficult to obtain a policy for annual programme. a fixed calendar of events, a guarantee that a teacher will know where and when to look for a course or that the organisation or agency best suited to a particular activity will be the authority invited or left to do this work."

"None of the agencies, not even the Colleges of Education, that might be expected to do this work on a large scale, is as yet, fully equipped to do it well, and some of the agencies involved in this work are quite unsuited to do this work at all."

Finally the author concludes: "Nevertheless, a properly developed inservice system could also, in addition to offering courses, be able to maintain an individual information service for teachers and to provide consultation as required. Such a service presupposes a properly equipped inservice centre with library facilities, workshop and laboratory facilities, audio-visual and T.V. facilities, etc. It should be possible at least in a city of the size of Glasgow to provide one such centre which could be at the disposal of teachers from anywhere in the country."

Physics Notes

The following items of surplus equipment are still available, and from Item 93 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. Fuller details of the service we give in respect of surplus equipment, and of methods of payment, will be found in Bulletin 43.

Item 1 (31) Large Scale Ammeters, 50p.

Item 3 (31) Mercury Barometers, £10.00.

Item 15 (31) Relays, 5p.

Item 16 (31) Switches, 2½p.

Item 17 (31) Potentiometers, 2½p.

Item 18 (31) Block Paper Capacitors, 2½p.

Item 23 (32) Fahrenheit Thermometers, type A only, 25p.

Item 24 (32) Transformers and Chokes, 10p.

Item 25 (32) Electronic Valves, 2½p.

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 56 (39) Height Capsule, 10p.

Item 62 (39) Silica Gel Desiccant, 2½p per lb.

Item 68 (41) Pocket Dosimeters, 5p.

Item 87 (43) Printed Circuit Panels, 5p.

Item 93. Power Amplifier, 16W. Input 24V, 5A. A rotary converter changes this to HT power supply and by removing this and rewiring the valve heaters the unit could be changed to conventional mains operation. £1.00.

Item 94. Frequency Bridge, 20Hz - 100kHz. This is a CR Wheatstone bridge with output terminals for connection to a null detector such as an oscilloscope or A.C. millivoltmeter. Contains five decade switched ranges, £2.00.

Item 95. Voltage Stabiliser by Westinghouse. Input 190 - 260V, output 230V, 300 VA. Weight 28.5 kgf, £1.00.

Item 96. Stabilised Power Supply, type 1931 by Furzehill. Fixed outputs of 500V, 250mA; 350V, 250mA; -150V, 50mA; -300V, 100mA, all stabilised and 500V, -150V, -300V, -400V unstabilised. Output volt/ammeter; £2.00.

Item 97. Low Voltage Power Supply. Two separate D.C. outputs of 45V, 7A. £2.00.

Item 98. Pulse Generator type 1174A by Southern Inst. 3ms pulse, 0 - 0.2V at 100Hz pulse recurring frequency; 45ms pulse, 0 - 0.2V at 10Hz p.r.f. Also 15 - 200µs variable pulse, 0 - 50V variable at both 10 and 100 p.r.f. 4mm output terminals, £2.00

Item 99. Pulse Generator type 1451A. 1, 5 or 25µs pulses, 0 - 20V x 1mV, 50Hz fixed p.r.f. £1.00.

Item 100. Scaling Unit type 1130A. Uses 12 small neons to indicate a total count of 999 in 1, 2, 2, 4 sequence. Without power supply, 25p.

Item 101. Dimmer Control Unit. A variable inductor (1 - 6 H) in series with a low voltage transformer. The inductor can be used along with a block paper capacitor - a suitable one is supplied in the unit - to show resonance at mains frequency. 50p.

Item 102. Variable Resistance, suitable for dimmer controls. 45Ω, 15A and 8Ω, 23A. Either type, 25p.

Item 103. Radiation Monitoring Film by Kodak, 28 x 31mm. This is out of date stock but we have verified that it will give a satisfactory negative on 1 hour exposure at 20mm distance from a 5µCi Radium source. Price ½p.

Item 104. Tracing Table. This has a ground glass top 23 x 38cm underneath which are four S.B.C. lamp sockets wired in parallel, illuminating a shallow white-painted box. 25p.

Item 105. Cable Lengths. Length of U.H.F. coaxial cable, terminated at each end with U.H.F. connector of the type approved by the A.S.E. Apparatus Committee, which will fit various types of school apparatus, e.g. D.C. amplifiers, 2½p.

Item 106. Polystyrene Cups, 60mm top dia x 60mm deep. Capacity approximately 150cm^3. Supplied with lids, 5p per 50.

Item 107. Electrolytic Capacitors, 250µF, 25V by T.C.C. in metal case 30 x 70 x 80mm overall, with fixing holes. 2½p.

Item 108. Xenon Tubes, type FA10 by Mazda. These have a striking voltage between 1.8 and 3.0kV, and are an electrical but not a mechanical replacement in the Dawe Instruments type 1214A stroboscope, because the Dawe tube has a three pin socket. The flash intensity of the FA10 appears to be greater than the one used by Dawe. Price 20p.

Item 109. Various geared motors, for use on 240V mains. Final speeds between 1 and 100 r.p.m. £2.00.

Item 110. Test Set type 1323A by Philips Balham. This is basically a variable E.H.T. power unit giving 1.4 - 3kV at 10mA, with output voltmeter, £2.00.

Item 111. Hot Plate, consisting of 4 cylindrical depressions 75mm dia x 45mm deep for filling with sand and using to heat flasks etc., each supplied by 500W heater. £1.00.

Item 112. Geiger Tubes, type CV394, working voltage 1130V. These have been taken from hand monitoring equipment and so are presumably sensitive to alpha particles. Price 25p.

Item 113. Monitor Oscilloscope, type 1089C by Airmec 70mm dia. single beam tube, no Y plate amplifiers, three set-speed time base. £1.00.

Item 114. Low Frequency Generator, giving three fixed frequencies of 50, 250 and 100Hz. Outputs 14V R.M.S. sine, 8V square wave, -4V pulse. Price 25p.

Item 115. E.H.T. Power Unit, 0 - 3kV, 1mA, positive or negative, with output milliammeter, £1.00.

Item 116. Photocell Detector, consisting of L.E.S. bulb and photo-diode on integral stand with 50cm cable. Separation between source and detector 5mm. Price 25p.

Item 117. Resistor, 400MΩ, 48cm long x 5cm dia. Price 5p.

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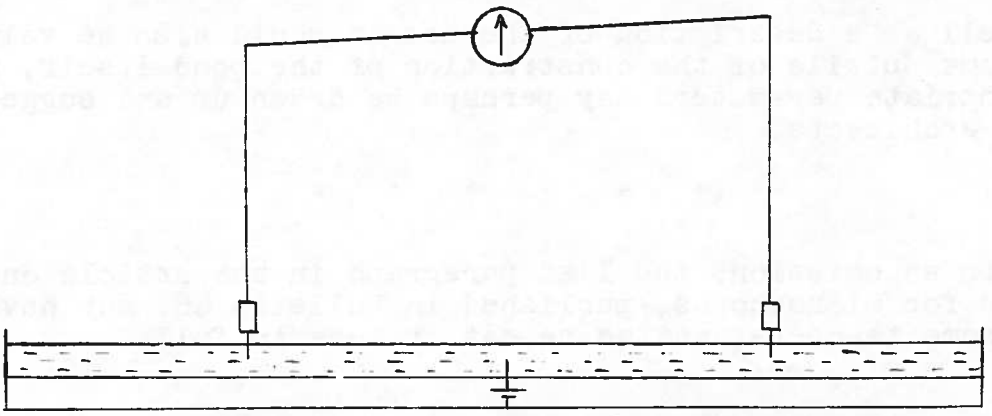
The experimental verification that the beat frequency between two oscillations is the difference between the individual frequencies is not easily carried out, because of the errors involved. The method described comes to us from Loretto School, where it originated as one more way of using a chart recorder. While the recorder is useful as a means of showing on a permanent record how the amplitude of the resulting sum of the two frequencies varies over the beat cycle, its place can be taken by a centre-zero milliammeter.

The schematic diagram below shows the principle. A long trough of electrolyte has current introduced at its mid-point, so that the potential drop towards the ends is symmetrical. Two pendulums are suspended equidistant from the mid-point, with contacts which dip into the solution, these contacts being connected to the milliammeter detector. The pendulums are displaced to the same amplitude and set swinging. When they are in phase, the meter deflections will be at maximum; when out of phase, deflections are a minimum. Stopwatch timing can be done on each pendulum separately - one pendulum should be longer than the other - and similarly the time over several cycles of the beat frequency can be measured.



The practical details of setting up the apparatus are not critical, and it is only for guidance that we give those of our own apparatus. The trough was made by cutting off one of the longer sides of a length of Marley plastic drainpipe and cementing a wooden block at each end. The end electrodes are sheets of copper foil tacked to the wood above the water line. The centre electrode is a 1cm wide strip of the same foil bent over one edge and along the bottom of the trough. The electrolyte is weak copper sulphate solution, 10g solid per litre of solute. The pendulum bobs are 200g weights; the stem of each pendulum is a length of thin plastic covered connecting wire. At the bob, each wire was soldered to a thick piece of copper wire which was bent round the bob to dip vertically into the solution. Our pendulums were 74 and 80cm from the liquid level to the points of suspension, which were two retort clamps. The pendulums cannot be made much shorter than this because of the inertia of the meter; if it were thought desirable to use a large-scale demonstration meter they would require to be made longer. The e.m.f. to be applied to the trough must be tailored to fit the meter, or vice versa; 5cm is a reasonable amplitude for each pendulum, so that the maximum P.D. applied to the meter is that due to 10cm length of solution, and this should equal the half scale deflection. Because of the shunting effect of the meter. the deflections may be less than the calculated value, and either the applied e.m.f. or the concentration of the solution can be increased to compensate for this.

Biology Notes

In the I.S.C. second cycle fresh water biology course it is recommended that much more use be made of the school pond ".....a hitherto much neglected feature." In most cases it is probably used as a reservoir - at best of living organisms, at worst of potato crisp packets.

There must be some teachers who have found their pond valuable in other ways; it would be helpful if they could tell us of these uses so that we may pass their ideas on in future Bulletins.

As well as a description of the use it would also be valuable to have some details of the construction of the pond itself, so that appropriate parameters may perhaps be drawn up and suggested to school architects.

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Due to an omission, the last paragraph in the article on test procedures for microscopes, published in Bulletin 46, may have confused some teachers, and we repeat it here in full.

General Comments If different arrangements are available on the same basic stand - including phase contrast - the more suitable of these are discussed. The cost of each arrangement is given and they are separately assessed. Assessments are in three grades: A - most suitable for school use; B - satisfactory; C - unsatisfactory. Price is a major factor in determining whether an instrument is given an A or B grade; where a microscope is given a C grade it is usually because of unsatisfactory optical performance, but in each case the full reasons are given. Any accessories supplied with the instrument - including a wooden case - are described and servicing arrangements are also indicated.

Display Laboratory

The following items have been added to the display laboratory since this item was last included in Bulletin 44.

Item	Manufacturer or Agent
Bicarbonate Indicator Modules	SSSERC
Gas Analysis Experiments	SSSERC
Simple Respirometer	SSSERC
Microscope Storage Trolley	SSSERC
Microscope Slide Storage Drawers	SSSERC
Test-Tube and Bottle Racks	SSSERC
Polythene Dip-Coating	SSSERC
Oxidation of Ethanol Experiment	SSSERC
Polarimeter	SSSERC
Crystal and Molecular Models	SSSERC
Gas Collection Apparatus	SSSERC
Wind Direction Recorder	SSSERC
Aneroid Barometer	SSSERC
Hair Hygrometer	SSSERC
Beat Frequency Experiment	SSSERC
Feedback Classroom Apparatus	SSSERC
Mechanical Resonance Apparatus	CLEAPSE
Thermopile Demonstration	CLEAPSE
Strain Gauge Demonstration	CLEAPSE
Cut Price Physics Apparatus	George Watson's College
Janetski T5 Centrifuge	Copley
pH Meter	Griffin and George
pH Meter Model C5	Walden Precision Apparatus
pH Meter Model C10	Walden Precision Apparatus
pH Meter Model A47	Chandos
Colorimeter	Griffin and George
Colorimeter	Foxall
Scale Atoms Molecular Models	Heinemann
Mettler P161 Balance	Gallenkamp
Mettler H7 Balance	Gallenkamp
Torbal 400 Balance	Griffin and George
Natural Gas Burner	Flamefast
Natural Gas Burner	Amal
Semi-Micro Natural Gas Burner	Flamefast
Colour Slides, Chemistry.	Philip Harris

Item	Manufacturer or Agent
Colour Slides, Physics.	Philip Harris
D.C. Amplifier EN50	Walden Precision Apparatus
Potentiometer KN15	Walden Precision Apparatus
Environmental Comparator	Griffin and George
Locust Cage	Dutt
Disposable Specimen Tubes	Luckham
Disposable Glass Vials	Labco
Universal Projector	Edinburgh Camera Centre
Microprojector Base	Philip Harris
University Lynx Microscope	Gillett and Sibert
Model L201 Microscope	Frank
Didactic Microscope	Universal Optics
London Microscope	Beck
Diamax Microscope	Beck
Binomax Stereomicroscope	Beck
Conference Projection Microscope	Gillett and Sibert

In The Workshop

We have used the polarimeter described below to show how the polarising angle depends on concentration of solution with sucrose, and further to show that the hydrolysis of sucrose by hydrochloric acid is a first order reaction by measuring the polarising angle at different times from the start of the reaction.

Basically the polarimeter is made in a wooden box of overall dimensions 15 x 16 x 26cm. Three sides and base are made from 12mm thick plywood; one of the 26 x 15cm sides is open, and the top is a piece of perspex, 150 x 160 x 7mm. The inside of the three plywood sides is painted matt black. A hardboard shelf forms the base of the polarimeter proper, and is recessed into the sides at a height of 7cm from the base. The shelf has a 20mm dia. hole cut in it; beneath it is a plane mirror tilted at 45° to reflect light up into the solution under test.

On the underside of the shelf a piece of Polaroid, cut and joined as in Fig.2 , is stuck on with Evostik, and under the Polaroid we cemented a green filter, Kodak No. 58 green, applying the Evostik cement round the edge only. Cutting the Polaroid at an angle of 5°, and turning one of the pieces gives a split field effect which makes it easier to determine the point of extinction. A plane mirror, 10 x 7cm was cemented to a triangular wooden block which in turn was cemented to the base. The top surface of the hardboard shelf was varnished, and then an 8cm square sheet of ordinary glass was cemented over the hole. This will reduce the effects of any spillage on the Polaroid sheet.

A wooden block 40 x 45 x 20mm is screwed on to the back of the box; to it is fixed a No. 80/3A Terry clip which will hold a 50ml Nessler tube. The clip and block are both painted matt black.

The arrangement for the analyser is shown in Fig. 4. A 30mm dia. disc is trepanned out of 7mm perspex sheet. A Polaroid disc of the same diameter, and then a 360° protractor are bolted together to the perspex with a 6 BA bolt. The perspex sheet which forms the top of the box is drilled out to accommodate the nut which secures these/

these three parts, and a locking nut is used over the end of the bolt to keep the assembly in place on the top. A scratch mark on the perspex top serves as a reference point for reading the angles involved. The analyser should be easily rotated by finger pressure on the protractor.

Other filters which give a narrow bandwidth could be used in place of the one we have suggested, or the polarimeter could be assembled without a filter and used with monochromatic light such as sodium or mercury lamps. To keep the apparatus simple we thought it not worth while to make a filter holder which would allow filters to be added or removed at will, but at a pinch one could stand the Nessler tube on a piece of coloured glass or gelatine film.

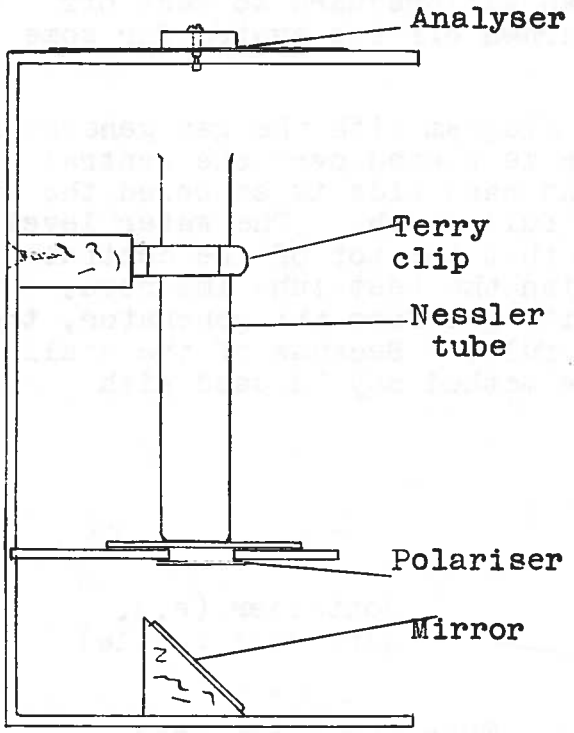

Fig. 1. Side view.

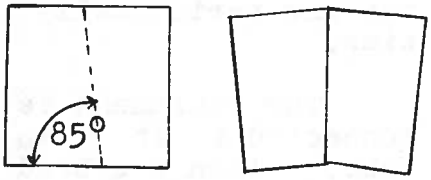

Fig. 2. Polaroid sheet is cut at 5° to the normal, one half reversed, and the pieces cemented to the hardboard shelf as shown to form the polariser.

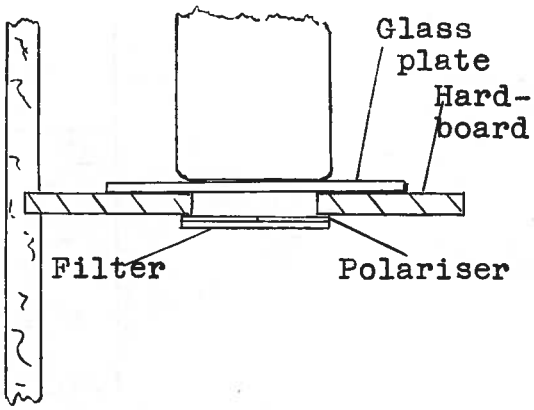

Fig. 3. Detail of base.

Figures not to scale.

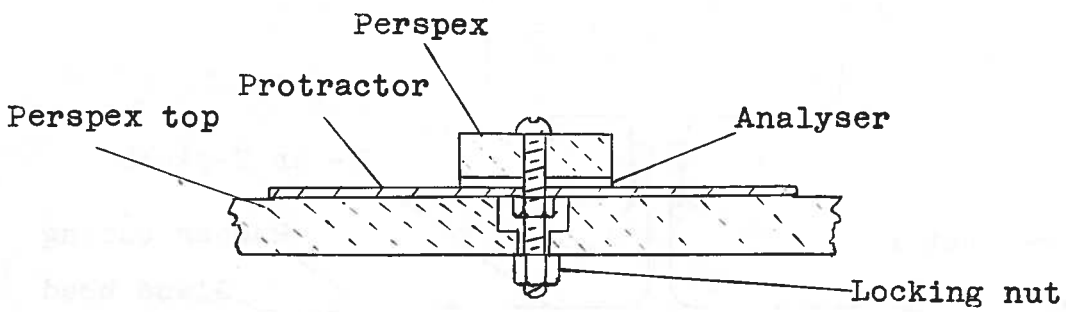

Fig. 4. Detail of top.

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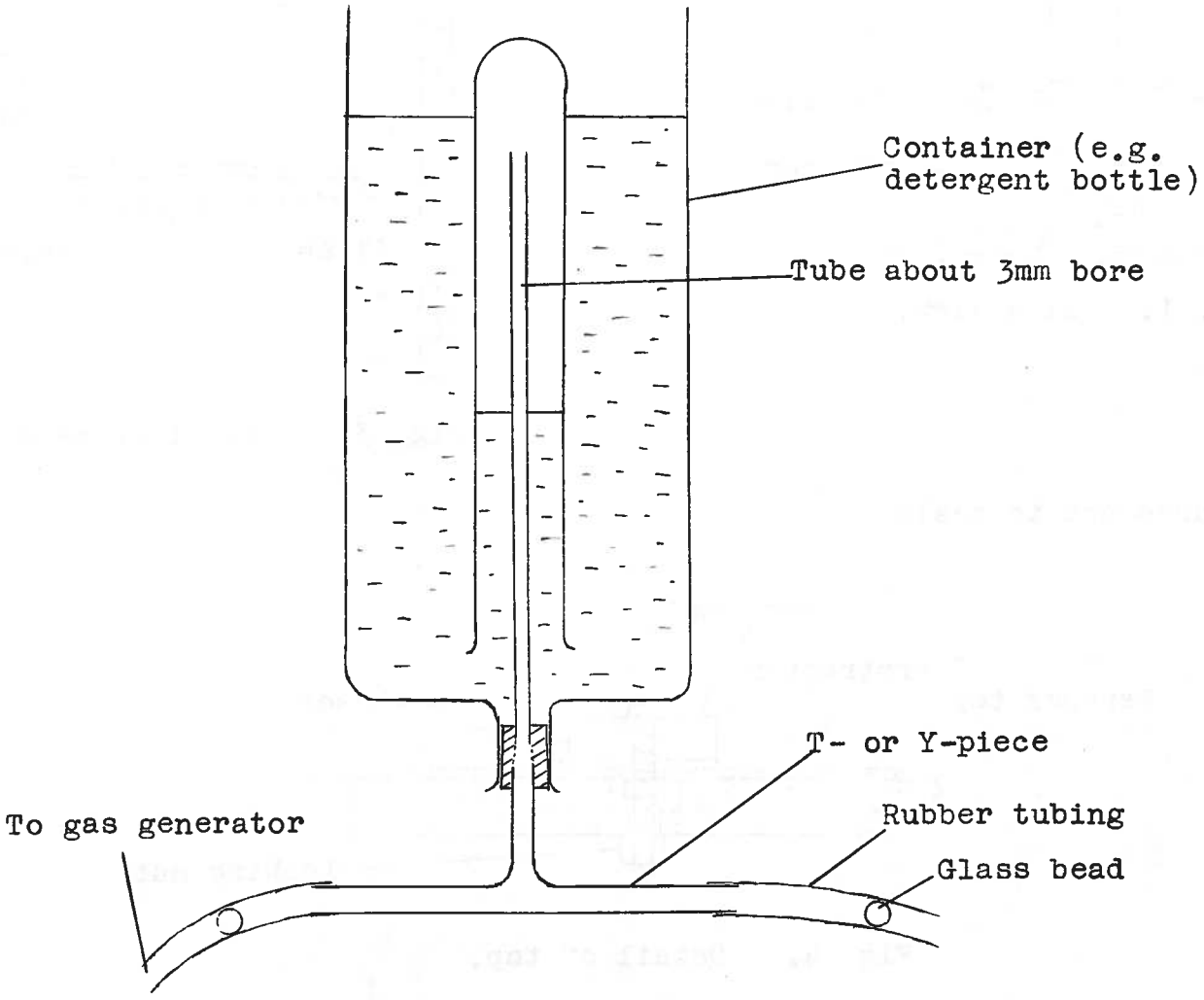
The design of the gas collector given below originated in Belmont Academy, Ayr, and arose out of a need to provide a quick method of providing from gas generators of various types an individual pupil sample, usually in a test-tube. Some have solved this problem by having the laboratory technician fill test-tubes or gas jars in advance of the lesson; the method given is simple enough to be used by pupils themselves to obtain the sample as required. It will operate off any low pressure gas generator, i.e. cylinders require to have the pressure adequately controlled by a reducer valve. It can be used without supervision on any generator of the Kipp type (including that given in Bulletin 20) where the reaction eventually ceases if no gas is drawn off; with a simpler apparatus using a thistle funnel the teacher or technician will require to vent off the gas periodically if none has been drawn off the system for some time.

The equipment is set up as in the diagram with the gas generator connected to it. An 'empty' test-tube is placed over the central tube. When the bead valve at the right hand side is squeezed the air escapes and the test-tube sinks to its full depth. The water level in the container should be adjusted so that the top of the central tube is level with the water surface with the test-tube immersed. Squeezing the left hand valve then admits gas from the generator, the test-tube rises and is lifted off when full. Because of the small water surface presented to the gas, the method may be used with moderately soluble gases.



Bulletin Supplement

Below is a summary of tests carried out on a selection of stereo-microscopes. Individual reports on these microscopes 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.

Model	Sterimag I	Sterimag II	Stereo-master	Grey 5/40
Manufacturer	Vickers	Vickers	Prior	Eastern Scientific
Price	£70.90	£84.20	£51.00	£76.25*
Magnifications	10x; 20x	10x; 20x	10x; 20x	10x; 20x
Magnification change mechanism	Change of eyepieces	Swing objectives	Slide out objective	Swing objectives
Objectives protected?	No	Yes	No	Yes
Diameter of field of view 10x	14.5mm	20mm	24.5mm	21mm
Diameter of field of view 20x	10mm	10.5mm	10.5mm	10.5mm
Working distance 10x	125mm	90mm	160mm	90mm
Working distance 20x	125mm	90mm	95mm	90mm
Maximum vertical clearance	260mm	245mm	31mm at 10x 250mm at 20x	210mm
Maximum horizontal clearance	210mm	230mm	205mm	200mm
Eyepiece separation	44 - 84mm	38 - 97mm	49 - 86mm	54 - 82mm
Stability (a) pull	2.2kgf	1kgf	1.6kgf	2.5kgf
Stability (b) angle	35°	18°	35°	20°
Distortion	A	A	B	A
Blurring	B	B	B	A
Lamp	6V, 6W	6V, 6W	6V, 6W	6V, 18W
Lamp position	Fixed, overhead	Fixed, overhead	Fixed, overhead	Moveable, side
Head adjustment	95° up; 100° down	20° up; 75° down	92° up; 90° down	3° up; 40° down**
Weight	11.4kg	12.1kg	7.3kg	5.1kg
Storage dimensions	265 x 185 x 325mm high	370 x 185 x 260mm high	240 x 200 x 325mm high	230 x 380 x 310mm high
Assessment	B	B	A	B

*With duty remission £68.75.

** The transformer is on the arm, which may therefore be removed from the pillar with illumination intact.

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

Airmec Electronic Instruments Ltd., High Wycombe, Bucks.

Amal Ltd., Holdford Road, Witton, Birmingham, 6.

Beck Ltd., Greycaine Road, Watford, WD2 4PW.

Chandos Intercontinental Ltd., Chandos Works, High Street, New Mills, Stockport, Cheshire.

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

F. Copley and Co. Ltd., Private Road Seven, Colwick Industrial Estate, Nottingham, NG4 2ER.

Dawe Instruments Ltd., Western Avenue, Acton, London, W.3.

P.K. Dutt and Co. Ltd., 115 Lavender Hill, Tonbridge, Kent.

Eastern Scientific Instruments Ltd., Carrow Hill, Norwich, NOR 61B.

Edinburgh Camera Centre, 55 Lothian Road, Edinburgh.

Flamefast Engineering Ltd., Pendlebury Industrial Estate, Manchester.

T. Foxall and Sons Ltd., Maylands Avenue, Hemel Hempstead, Herts.

Charles Frank Ltd., 145 Queen Street, Glasgow, C.1.

Furzehill Laboratories Ltd., 47 Theobold Street, Borehamwood, Herts.

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

Gillett and Sibert Ltd., Lynx House, 50 Vicarage Crescent, Battersea, London, S.W.11.

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

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

Heinemann Educational Books Ltd., 48 Charles Street, London, W.1.

Kodak Ltd., Kodak House, Kingsway, London, W.C.2.

Labco Ltd., 54 Marlow Bottom Road, Marlow, SL7 3NF.

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

The Marley Tile Co. Ltd., London Road, Riverhead, Sevenoaks, Kent.

(Mazda) Thorn Lighting Ltd., Photographic Department, Thorn House, Upper St. Martin's Lane, London, W.C.2.

W.R. Prior and Co. Ltd., London Road, Bishop's Stortford, Herts.

Southern Instruments Ltd., Frimley Road, Camberley, Surrey.

Universal Optics Ltd., Dominions House, St. Augustine's Parade, Bristol, BS1 4UF.

Vickers Instruments Ltd., Haxby Road, York.

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

Westinghouse Brake and Signal Co. Ltd., 82 York Way, King's Cross, London, N.1.