SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

Bulletin No. 97. June, 1977.

Contents

Introduction

For our 'Beat the Budget' lecture at the recent A.S.E. (Scottish Branch) annual meeting we prepared a leaflet listing, with bulletin references, over 50 ways in which teachers could reduce apparatus costs. Copies of the leaflet will be sent free of charge to anyone enclosing a stamped self-addressed envelope (9" x 4") with their request.

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Our decision not to fill the junior technician post has put an additional burden on the rest of the staff, particularly as regards Saturday working. It may come as news to some teachers that the Centre is open on Saturday mornings, 9 a.m. - 1 p.m., but this has always been the case, except on week-ends of national holidays such as Christmas, New Year, and Easter. We have done this simply so that we should be open at some time when teachers are free, that they may more readily visit us. Only one member of staff is on duty then, and specialist teachers with a problem which requires their personal attendance at the Centre on a Saturday morning should telephone to discover when the chemist, biologist or physicist will be on duty so that they may have the benefit of the expert's advice. While the reason for Saturday opening disappears during school holidays, in the past we have kept the Centre open then, as a convenience to those who might remember if we were always open, but could forget the special occasions when we were closed. Now, however, that we have one fewer member of staff on the Saturday rota, we feel justified in closing down over the summer holiday period. Accordingly the Centre will not be open on Saturday 9th July, through Saturday 20th August, both dates inclusive. We are, of course, open during the week in the holiday period, our own annual holidays being staggered to allow for this.

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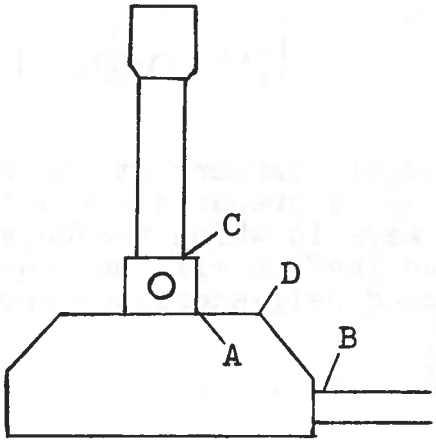
Our cost index of items of consumable apparatus (= 100 in May, 1974) now stands (10/5/77) at 169.4. This is an increase of 7.3% over the past six months, and 17.6% over the year.

Chemistry Notes

As a result of a fire in a laboratory we were asked to investigate the Rhodes Flamefast natural gas burner type C701. The fire safety officer for the university department concerned believed that the burner, or some parts of it ran excessively hot so that the connector tubing became loosened allowing gas to leak, which then ignited. We were therefore concerned to measure the temperatures of various parts of the burner under different operating conditions.



The temperatures in the table below were recorded using a copper/nichrome thermocouple calibrated against a mercury-in-glass thermometer.

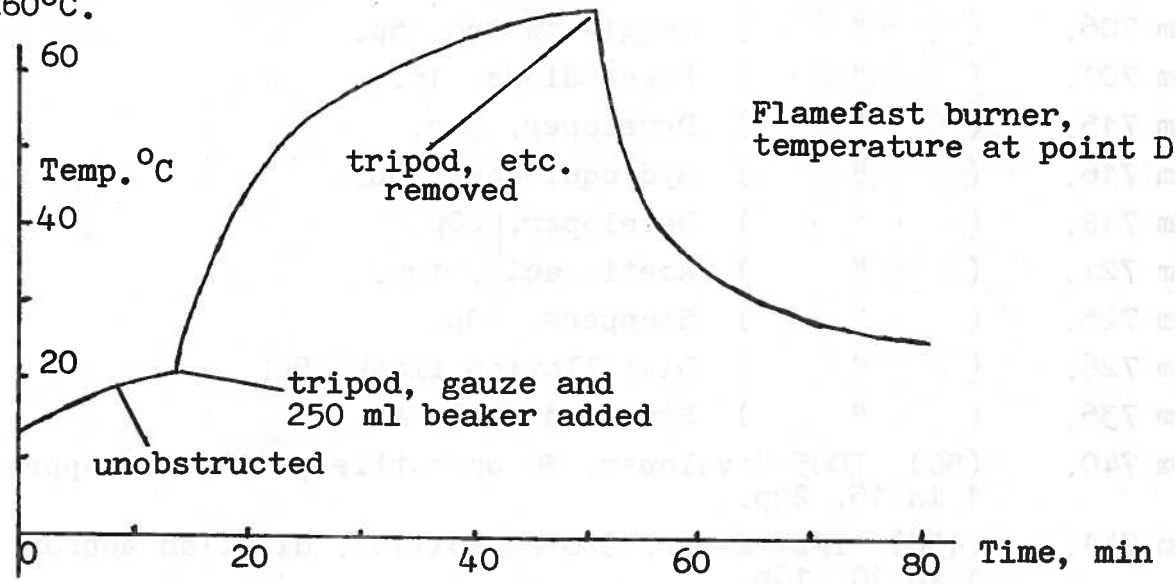
Operating Condition	Temperature (°C) at points in Fig. 1			
	A	B	C	D
Normal unobstructed	21	-	23	18
Normal, with gauze and 250 ml beaker on tripod	59	-	47	67
Strike back burning	210	140	380	-

The temperatures given were the limiting or steady state temperatures reached for the given conditions. It is evident that when the flame is obstructed by gauze or other material being heated a considerable amount of heat is reflected down causing the lower parts of the burner to become hot. Pupils must be warned of this, and that they should always pull the burner out from under the tripod in order to adjust the air/gas mixture. Touching a hot regulator could cause a pupil to jerk a hand away involuntarily, knocking over the tripod and spilling the contents of any vessel being heated. As the temperature at point D can be taken to be that of the whole of the base of the burner, this will also be quite hot, and the safest way of withdrawing the burner will be to pull on the connecting tubing. This emphasises the need to ensure that bunsen tubing should be the correct size and should always be firmly attached to the burner and to the gas tap. A lightly attached tubing or one which is too large can swell when heated and come adrift, or be easily pulled off. This could result in a large and dangerous flare of gas. Tubing should be inspected regularly and replaced if damaged or perished.

Strike back behaviour means that the gas supply has been so

far reduced that the gas ignites and burns at the base of the tube. It is more difficult to cause a natural gas burner to strike back than a town gas burner. The normal gas pressure is approximately 20 cm water (if we may be excused these non-S.I. units!) and this has to be reduced to under 1.5 cm with the air hole fully open in order to make it strike back. Such a mode of use is clearly incorrect. However, the burner is fairly silent when burning in the strike back manner and there might be no audible warning that the chimney and air regulator are very hot. It should also be noted that the inlet tube (point B, Fig. 1) to which tubing is attached can reach 140°C which is perhaps hot enough to cause ill-fitting tubing to swell and become detached.

Even so, the Flamefast burner performs less badly than did its town gas counterpart. Where point A on the Flamefast burner reached a steady temperature of 210°C on strike back burning, this temperature was attained after 4 min with a town gas burner, and the steady temperature of the latter on strike back burning exceeded 260°C.



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Chemistry teachers may like to know that the low melting-point solids mentioned in Bulletin 94 for cooling curves will be suitable for illustrating relative lack of conductivity of molten covalent compounds.

Physics Notes

The following items of surplus equipment are offered for sale. Items from 740 onwards will be subject to the ballot procedure described in Bulletin 91 to which any prospective customer should refer before submitting an order. The number in brackets after each item gives the approximate number we have in stock. Items before no. 740 are unsold stock from previous lists and will not be subject to the ballot. Information on these can be obtained by referring to the appropriate bulletin.

Item 541. (Bulletin 77) Prodox developer, 20p.

Item 542. (Bulletin 77) Colour film chemical, 50p.
Item 544. (") Colour film chemical, 50p.
Item 545. (") Colour film chemical, 50p.
Item 575. (Bulletin 83) Promicrol fine grain developer, 20p.
Item 660. (Bulletin 89) Hour meter, £1.50.
Item 661. (") Hour meter, £2.
Item 663. (") 30 µA meter, £2.
Item 684. (Bulletin 91) McLeod gauge, £10.
Item 686. (") Vacuum pressure gauge, £2.
Item 701. (") Electrolytic capacitors, 2p.
Item 702. (") Potentiometer pack, 30p.
Item 704. (") Toggle switch, 5p.
Item 706. (") Toggle switch, 5p.
Item 707. (") Power diode, 1p.
Item 715. (") Developer, 50p.
Item 716. (") Hydroquinone, 50p.
Item 718. (") Developer, 20p.
Item 724. (") Acetic acid, 10p.
Item 725. (") Stoppers, 10p.
Item 726. (") Distillation flask, 5p.
Item 736. (") Standard cell, £2.

Item 740. (50) ID85 developer, 30 oz bottles, dilution approx. 1 in 15, 20p.

Item 741. (150) IF24 fixer, 500 ml bottles, dilution approx. 1 in 10, 10p.

Item 742. Metol hydroquinone, in two plastic packs. Mix and dissolve to make 45 litres working solution, 25p.

Item 743. (20) Filter plates, 30 cm dia. Gallenkamp FD520, porosity No. 2, 2p.

Item 744. (200) Capillary tubes, glass 40 cm long internal dia. approx. 1 mm, per dozen, 5p.

Item 745. (300) As item 744, but 15 cm long, per dozen, 2p.

Item 746. (50) Glass tubes, 19 cm long 12 mm inside, 18 mm outside diameter, 1p each or 10p per dozen.

Item 747. Hotpoint refrigerator, 0.60 x 0.62 x 0.91 m, l x b x h, £10. This item will be sold against a requisition order only.

Item 748. Philips dictaphone, with microphone and pedal switch, plus a second identical machine not in working order, but may be useful for spare parts, £5.

Item 749. (5) Print-out adding machines, capacity £10M - 1p. £1. These could be useful in primary schools, please notify your colleagues.

Item 750. (2) Marchant Figurematic four function electro-mechanical calculators. One 16 and two 8 digit registers, £3.

Item 751. (5) Single beam oscilloscope type CD518 by Solartron. 75 mm dia. tube; time base 70 mm/µs max, sensitivity 0.4 V/cm max. The Y shift control is linked to a voltmeter to give continuous measurement of Y amplitude, £15.

Item 752. (25) This is described as a zener diode power supply, but is incomplete and offered for parts only. Contains all components of a low voltage power supply, one each of 5.6, 6.2 and 7.5 V zener diode, four glass envelope OC71 (so that by scraping off paint you have a phototransistor) one ten turn 1800 Ω pre-set potentiometer etc. etc., £2.

Item 753. (20) Rotary converter power supply. This has a d.c. motor rated at 28 V, 3800 rev/min which will work down to 8 V. H.T. output approx. 280 V, £1.

Item 754. L.F. spectrum analyser, by Fenlow Electronics. Frequency 0.3 - 1050 Hz in five ranges, £5.

Item 755. Automatic scaler type N503E by Ekco Electronics. Variable h.t. for Geiger tube. Two 6 decatron counting systems, one counting input pulses in a pre-set time, the other measuring (to 0.1s) time for a pre-set number of pulses, £5.

Item 756. Video oscillator type TF885A/1 by Marconi. Frequency 50 Hz - 12 MHz in 3 ranges. Output 1 mV to 31.6 V in 10 ranges, with output voltmeter, £10.

Item 757. Pulse generator type 1321B by Fleming Radio. Generates ½, 1, 2, 3, 4 or 5 µs pulses at p.r.f. 50 - 5000 Hz. Output continuously variable 0 - ± 10 V or 0 - 40 V. Switched attenuator for reduction by 10, 100, 1000 or 10,000, £5.

Item 758. Oscilloscope type 72C by Telequipment, for 110 V working. 90 mm dia. tube. Max. sensitivity 60 mV/cm, max. time base 2 µs/cm, £10.

Item 759. Value voltmeter type 378B/2 by Furzehill. F.S.D. 1 mV - 100 V in 5 ranges; scale calibrated 1 - 4 x 0.1; 4 - 7 x 0.2; 7 - 10 x 0.5, and 0 - 20 db, £5.

Item 760. (2) Addressograph typewriters. These machines are used to type the stencils for addressograph machine Item 625 (Bulletin 85) and cannot be adapted for ordinary typing, £1.

Item 761. (3) Time interval meters, type Chronotron 25 by Electronic Instruments. Complete but not working. Contains one large (12 x 10 cm) 1 mA meter and other components, £3.

Item 762. (20) Titling unit. Designed for placing titles on 8 mm movie film. Contains low voltage lamp, projection lens, gears etc., 50p.

Item 763. Pulse analyser type N102 by Dynatron Radio. Complete but not working. Contains large 100 µA meter and other components, £3.

Item 764. Reactivity meter chassis. Complete but not working. Contains large 200 - 0 - 800 µA meter with non-linear scale and other components, £3.

Item 765. Power supply chassis, incomplete. Contains output voltmeter, switches etc., £2.

Item 766. Avo valve tester, not known to be in working order, £.

Item 767. (2) Period meter chassis. Contains what looks like a low voltage stabilised power supply using two BLY10 transistors on heat sinks, 8 pre-set pots., switches, relays etc., £1.50.

Item 768. (2) Control circuit, series 60 by Leeds and Northrup. In working order but designed for use along with other panels. Contains output current (7 mA f.s.d.) meter, 2 x 12AX7 valves etc. Designed for use on 110 V, £2.

Item 769. (2) Control chassis. Contains 6 0C71, ten-turn 100 Ω pot with scale 0 - 1000 x 1, relay etc., £1.

Item 770. (20) Pair earphones with head band; impedance approx. 300 Ω, 40p.

Item 771. (20) Pair earphones as above, but with microphone attachment; earphone impedance approx. 40 Ω, 50p.

Item 772. (20) Single earpieces from item 771; these will work equally well as a miniature loudspeaker driven from a transistor, or as a microphone, 15p.

Item 773. Three phase, 400/440 V motor, 0.75 h.p., 1420 rev/min, £3.

Item 774. As above, 0.5 h.p. with reduction gearing and 106 mm dia., 85 mm wide pulley for belt drive, 1420/237 rev/min, £3.

Item 775. As Item 773, 0.5 h.p., 1420 rev/min, £2.

Item 776. As above, h.p. and speed unknown. Looks like 0.75 h.p.; 43 mm dia x 50 mm wide drive pulley, £2.

Item 777. As Item 773, 3 h.p., 1420 rev/min approx. 135 mm dia. triple V-belt pulley, £3.

Item 778. Motor generator set, consisting of 1.5 h.p. three phase 400/440 V motor, and 6 V, 100 A d.c. generator bolted on common sole plate. This item is very heavy (est. 200 kg), £10.

Item 779. (12) G.P.O. electric bell, 50 V: useful as an extension telephone bell in a noisy situation, 20p.

Item 780. Single phase 230/115 V transformer, 45 kVA, £3.

Item 781. Wet process photocopier by George Anson, bed area 45 x 33 cm. Appears to be in working order, £2.50.

Item 782. (10) Wire strippers, claw-nosed, £1.

Item 783. (10) Fine nosed pliers, £1.

Item 784. (12) Display panel. P.C.B. panel containing one ZM1080 common anode numerical indicator tube, and other components, 50p.

Item 785. (??) Digital integrated circuits, 14 and 16 pin d.i.l. similar to system 74, but they appear to be more tolerant of slow rise edges. These have been unsoldered from p.c.b. Types available include '00, '01, '02, '04, '05, '10, '42, '50, '74, '75, '76, '82, '83, '90, '93. All at 2p each.

Biology Notes

Seeds supplied to schools for germination and morphological investigations are usually dressed with fungicide/insecticide mixture, and it is becoming increasingly difficult for the supply houses to obtain untreated seed. The major suppliers affix warning labels to the packaging. Griffin Gerrard also coat the seeds with a dyestuff as a warning. The warning label states that seed is for examination/germination purposes only, that it is not for human or animal consumption, that it should not be handled unnecessarily and that hands and exposed skin should be washed after handling the seed.

We suggest that these warnings should always be communicated to pupils when treated seeds are used. We also suggest that seeds to be used for morphological examination should be washed in running water and soaked overnight prior to examination. The fungicides/insecticides used are usually those on commercial seed and are considered relatively harmless provided the advice on warning labels is followed. However, since much seed is imported, other dressings may have been used.

Trade News

We have to apologise to Philip Harris for describing in Bulletin 95 one of their soil profiles as clay instead of gley. In the same bulletin the s.w.g. of Harris stainless steel wire gauze was given as 24, and this, they have informed us is now 22 s.w.g.

Still on the subject of stainless steel gauze there has been more than a little confusion over whether a pack of the Griffin and George gauze, GMX-340-030A, contains 3 or 5. In the leaflets and letters we have from Griffin the score stands at 2-2, but we have been reliably informed that there should be five.

In the article on the mercury hazard in Bulletin 96 the catalogue number of the Griffin mercury collector was misprinted. It should read MGH-400-W.

Shandon Southern Products have moved to a new address, given on page 12 of this bulletin.

Reynolds and Branston have been taken over by L.I.P. All activities of the former firm are now housed within the L.I.P. building at the address given on page 12 of this bulletin.

The Olympus HSC phase contrast microscope, Griffin and George cat. no. MJA-550-Q which was listed under item 72 in our biology equipment list has risen in price to £183. The other instrument under that item number on the list, the 464 from W.R. Prior is now £153.90. These price increases, respectively more than 38% and 20% over the past year put traditional phase contrast microscopes back into the unattainable luxury class.

C.E. Offord have changed their name to Offord Scientific Equipment, and their address to that given on page 12.

Vickers Instruments have appointed a microscope service engineer for Scotland, who will service a range of instruments as well as Vickers' own microscopes.

The trading activities of Nunc UK have been transferred to Gibco Bio-Cult and all orders for Nunc products should now be addressed to the latter firm.

Micro-Instruments (Oxford) are offering a range of microscope lamps, ranging from the 'Cherwell' model with metal base and wooden arm at £3.50 to the FO/55 55 W fibre optic lamp at £117.60. An illustrated leaflet and price list is available from the firm.

Philip Harris are now offering a MKII version of their long-arm stereo-microscope, cat. no. B28606/5 at £76. This has a number of modifications suggested by Cleapse and ourselves. The accessories of the MKI version, featured on page 313 of the 1977 Harris catalogue are also suitable for use on the MKII. These include a x2 objective B28640/7 at £9.10 and a transmitted light stage B28720/5 at £14.74.

C.F. Palmer and George Washington have recently merged and all enquiries and orders for their equipment should be sent to Searle Bioscience at the address given on page 12.

In The Workshop

The design for this animator came to us from Liberton High School, Edinburgh. It can be used to show by means of moving spots of light the direction of flow of a fluid in a diagrammatic sketch, either for unidirectional or circular flow. The animation is based on the convection principle employed in the artifical coal-fire effect produced in this type of electric fire.

A box is made (Fig.1) to outside dimensions 40 x 30 x 36.5 cm. The base and sides are of 12 mm blockboard, front and rear are 7 mm plywood. The base is raised 6 mm above bench level, and the rear plywood sheet does not come below base level, thus leaving a gap for free circulation of air through the model. Similarly the base in the region round the lamp has 10 - 12 airholes, 10 mm dia. drilled in it. The box top is a loose hardboard cover, with a 10 cm dia. hole taken out immediately above the lamp. A cover is not essential, but it may be considered that light coming from the top is a distraction, and at the front a cover helps to exclude extraneous light from the diagram. If a cover is made, then small wooden fillets nailed to the back and sides will make it easier to place in its correct position. The front of the box has a viewing area 30 cm square cut out, the lower edge of the hole being level with the base of the box.

The lamp is a 240 V, 100 W clear filament type, with its base mounted on a wooden block so that the filament is approximately 15 cm above the base of the box. A support for the convector is bent from 3 mm dia. mild steel rod so that it fits round the lamp base and rises to a sharpened point directly above the lamp and at a level 30 cm above the box base.

The convector is cut from a suitable can 10 cm or so in diameter, e.g. those containing motor oil. The can is cut 2 cm in from each end, and only the top and bottom are used. The top is cut with a cold chisel as shown in Fig.3, and the six vanes bent inwards slightly. A central hole is drilled to take the closed end of short length of 5 mm glass tube sealed off at one end; this forms the pivot. Araldite is used to cement the glass tube in place. The bottom of the can is cut out completely leaving only a 2 cm wide ring of metal.

The skirt of the convector is made from thin card (we used a file cover); slots 3 mm wide and 15 mm apart are cut in it, and it is then wrapped round the tin can at top and bottom, using Evostik to fix it in place. The bottom strip of metal is necessary to give the skirt rigidity which ensures that the slots stay vertical and do not balloon out. Fig.3 shows this part of the construction.

Six 10 mm wide strips of thin plywood are fixed on each side of the box; these form slots for locating hardboard sheets carrying the model diagram etc. Only two of these are used when the model is working, but the others are useful for storing the different diagrams used with the animator. A 'collimator' which sharpens up the moving spots of light is used in the first of these slots, that nearest the lamp. A hardboard sheet, 32 x 34 cm is cut as shown in Fig.4. The slots are again 3 mm wide and 15 mm between centres, and if a unidirectional flow is required in the model, the slots should extend the full length of the inside of the sheet. If, however, it is required that the direction of movement be reversed between upper and lower halves of the diagram to produce a circulatory flow, then all the bottom half of the hardboard sheet should be cut out leaving an open hole, as in Fig.4.

A similar hardboard sheet with all the inside 25 x 24 cm cut out is used as a mount for the model diagram in the slot next the 'collimator'. This is cut from thin card (corn flakes packet) with the narrowest channels 2 mm wide and others in proportion. As the light movement is horizontal, vertical or nearly vertical channels will show no movement and they should be avoided. In a circulation model, lines joining top and bottom halves of the diagram should curve so that the diagram has its maximum breadth at the same level as that where the slots of Fig.4 end, as this is where the apparent flow will reverse its horizontal direction. When a channel has been cut, the pieces on either side are held in place by sellotape, and if desired this can be coloured with different felt pens for different parts of a diagram, e.g. veinous and arterial blood. An alternative is to use different Cinemoid filters held down by sellotape. Translucent paper, e.g. kitchen grease-proof paper stuck round the edges to the card acts as a diffusing screen to show the effect more clearly. A rotation speed of 6 rev/min, which is what our model achieved with the top on, produces satisfactory animation. Diagrams we have made for the animator include blood circulation, transpiration stream, kidney tubule and refrigerator circulation.

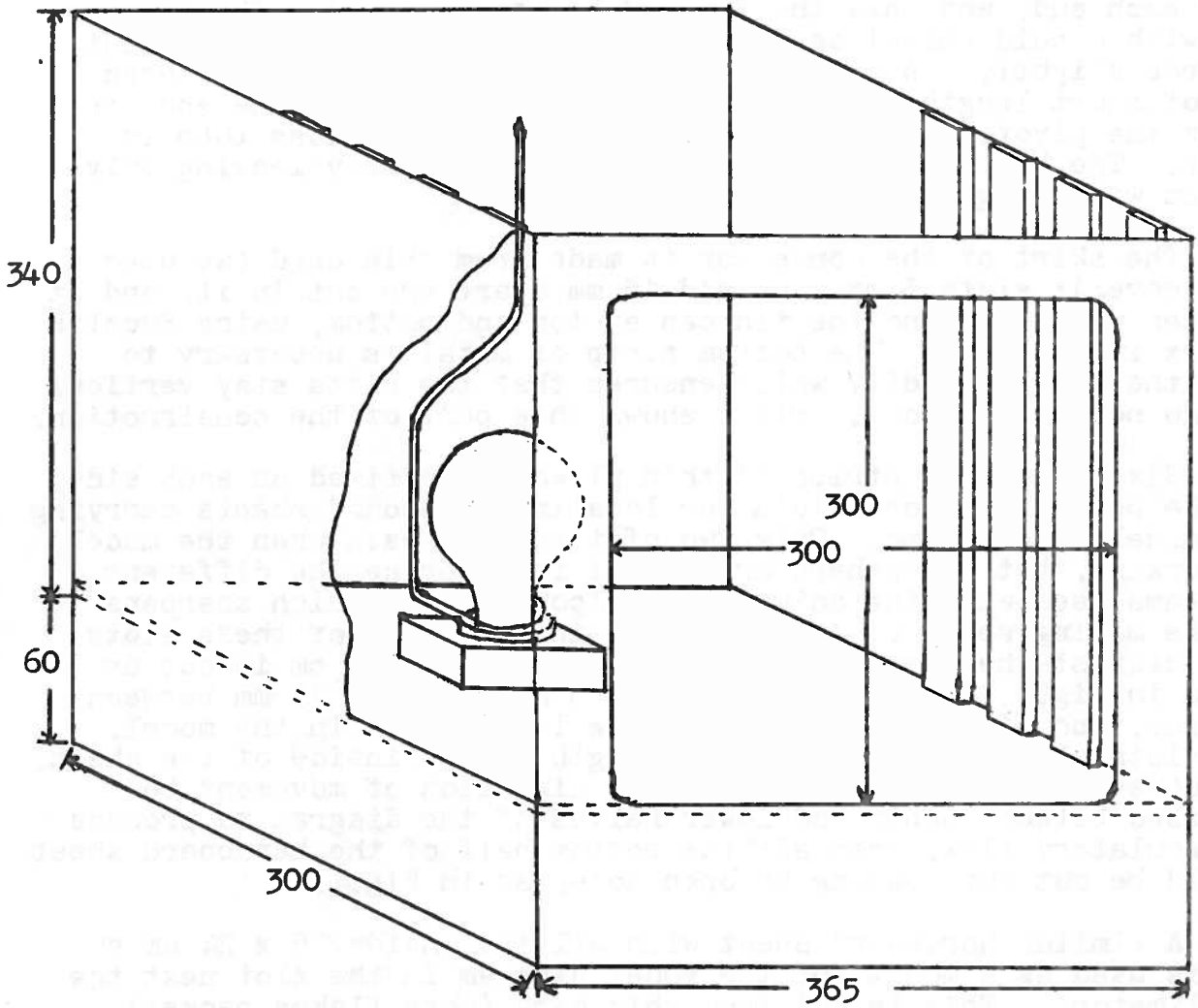


Fig. 1. Layout.

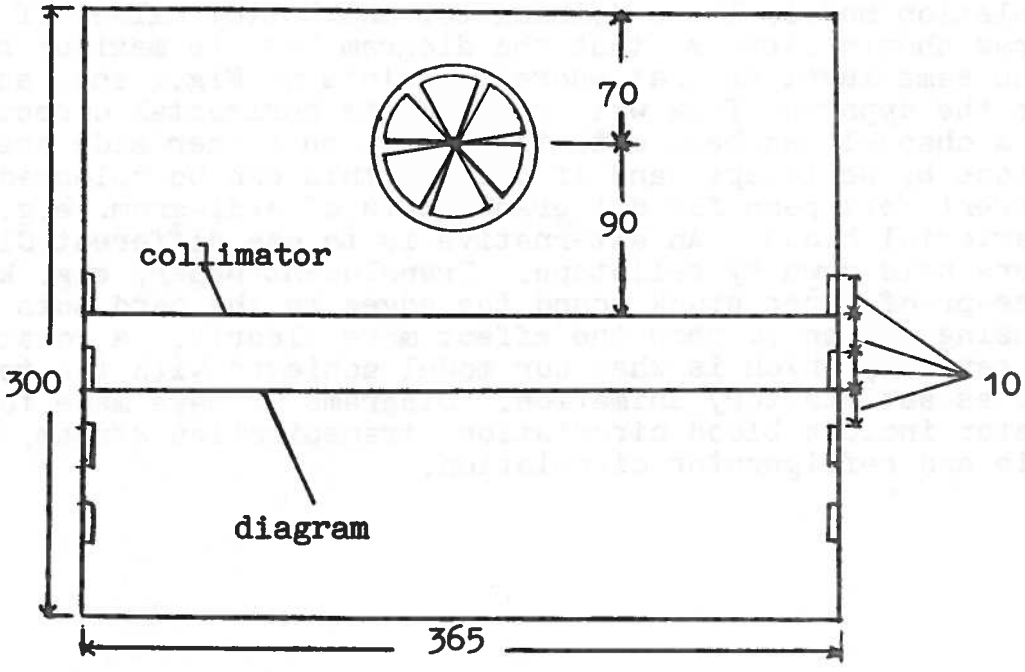
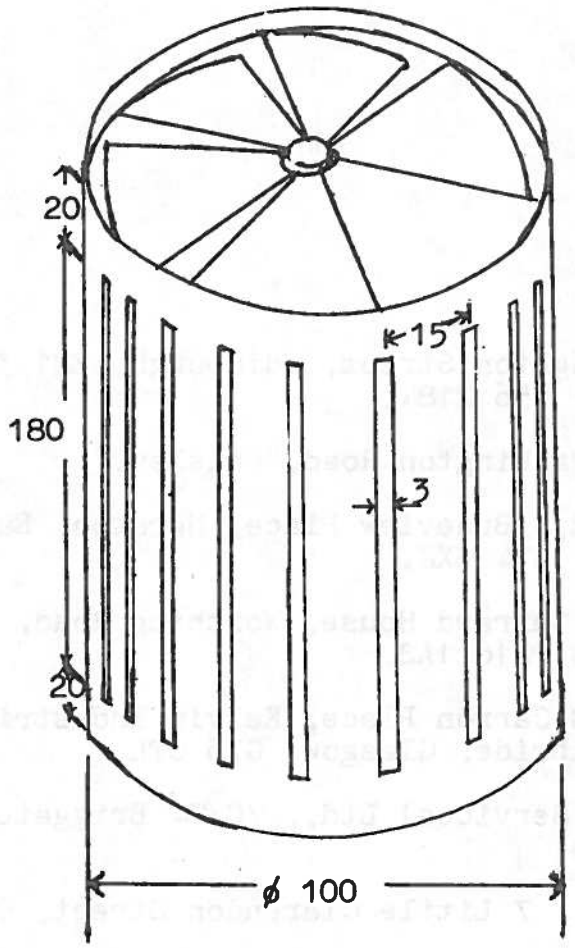
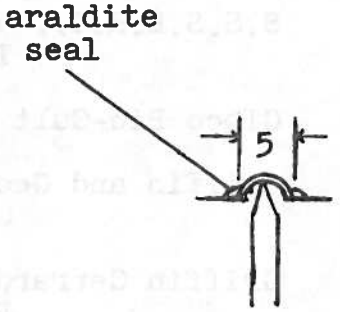


Fig. 2. Plan.

Diagrams not to scale.
All dimensions in mm.





Pivot detail.

Fig. 3. Convector.

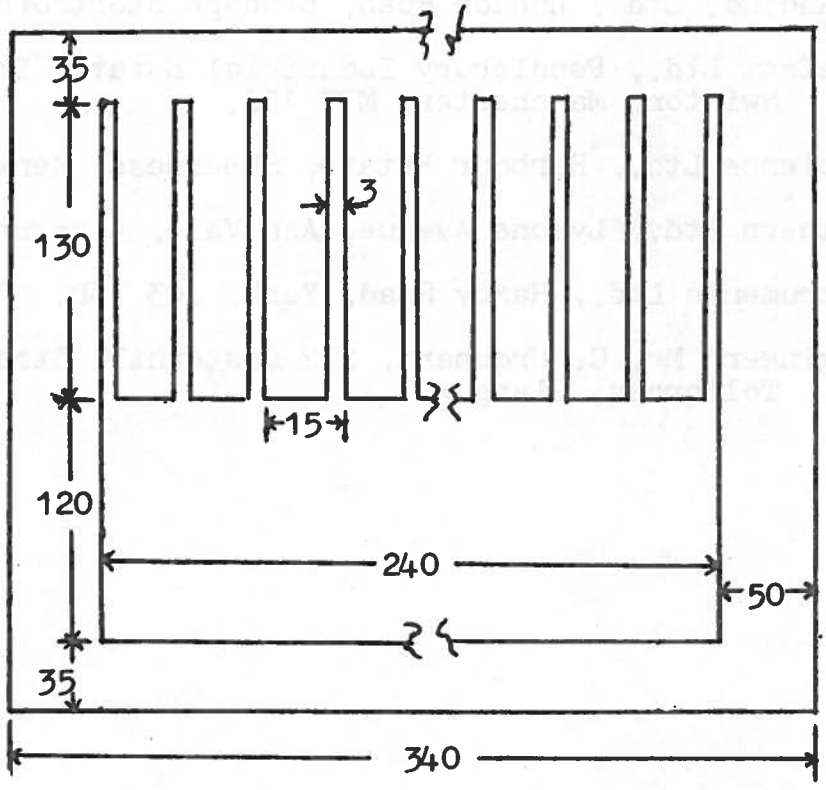


Fig. 4. Collimator sheet.

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

Gibco Bio-Cult Ltd., Washington Road, Paisley.

Griffin and George Ltd., Braeview Place, Nerston, East Kilbride, Glasgow, G74 3XJ.

Griffin Gerrard Ltd., Gerrard House, Worthing Road, East Preston, PN16 1AS.

Philip Harris Ltd., 30 Carron Place, Kelvin Industrial Estate, East Kilbride, Glasgow, G75 0TL.

L.I.P. (Equipment and Services) Ltd., 70/74 Briggate, Shipley, W. Yorks.

Micro-Instruments Ltd., 7 Little Clarendon Street, Oxford, OX1 2HP.

Offord Scientific Equipment Ltd., 113 Lavender Hill, Tonbridge, Kent, TN9 2AY.

W.R. Prior and Co. Ltd., London Road, Bishops Stortford, Herts.

Rhodes Flamefast Ltd., Pendlebury Industrial Estate, Bridge Street, Swinton, Manchester, M27 1FJ.

Searle Bioscience Ltd., Harbour Estate, Sheerness, Kent.

Shandon Southern Ltd., Lysons Avenue, Ash Vale, Aldershot, GU12 5QF.

Vickers Instruments Ltd., Haxby Road, York, YO3 7SD.

(Service Engineer) Mr. C. Urquhart, 202 Easterhill Street, Tollcross, Glasgow.