SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

Bulletin No. 15. July, 1967.

Contents

Introduction

So far we have avoided the temptation to open the columns of this Bulletin to manufacturers or agents of science apparatus, believing that teachers prefer to judge them on their own ground of the glossy pamphlet whipped up by the advertising agency. Nor would we want teachers to think that we were in sympathy with this or that firm to the exclusion of others, so that by denying access through the Bulletin to all firms, we are at least being fair.

When we make the exception below it is as a special case and because we feel that otherwise a one-sided view of the situation may prevail. The letter which we print is a reply to an Item on page 5 of Bulletin No. 13.

"In Bulletins Nos. 12 and 13, reference is made to the prices in the Griffin and George 1966 catalogue. We cannot but agree that prices have risen overall, but when comment is made, the question must be looked at as a whole and one must ensure that like is compared with like.

Griffin and George set out to cater for the total requirements of science teaching, from primary to University, and thus list over 20,000 different items. A very large number of these are not of Griffin and George's own manufacture, nor are they price-controlled by this company.

As an earnest of our endeavour to offer a complete service, it can be seen that we list and stock all but five of the Nuffield Physics items, and furthermore, that all the items listed are approved. It will also be appreciated that where possible the cost reduction benefits of large scale demand can result in lower selling prices for the benefit of our customers. An example of this can be seen when comparing present-day prices for our power Packs with the prices originally quoted."

The letter is signed Douglas Savage, General Manager, Science Teaching Equipment Division, Griffin and George Limited.

Opinion

We have probably all at one time amused ourselves with these multiple choice Test-Your-Own-Personality questions which appear in the Reader's Digest and Women's Weeklies. They are amusing rather than instructive since anyone who isn't a complete ass can decide which of the choices can be labelled Good, Bad and Indifferent for furthering the image which he has of himself. A more revealing and therefore less frequently applied test is to get a near friend or relative to complete the questions on your behalf to show the image which he has of you.

I give an example of this kind of thing, addressed to Directors of Education. An honours physics graduate writes to you stating that he is a student finishing training and wishes to teach in your authority;/

authority; have you any vacancies? Do you:

a) grab him with both hands
b) consult your Adviser in Science before replying;
c) advise him to make application for specific posts as and when they are advertised in the national press?

Directors will probably choose a) or b); but how many of their teachers would unhesitatingly underline c) on their Director's behalf? This might be amusing had it not actually happened that a student got the c) reply. He visited the Centre recently and expressed his bewilderment at a situation which was apparently aimed at discouraging honours graduates from taking up teaching. The fact that he came from England may have had some bearing on the case; English degrees here are regarded with the same mixture of distaste, distrust and necessary evil toleration as are Scottish bank notes there.

In all fairness to the Director concerned he probably never got to hear of the case; but he must bear responsibility for so organising and directing his Department that this kind of thing could happen. From the circumstances it will be evident that this occurred with one of the larger local authorities, which makes all the more disturbing the view of the Scottish Education Department in their written submission to the Royal Commission on Local Government in Scotland that the educational service should be administered by not more than 12 or 15 authorities, compared with the present 35. Teachers in the main have always been suspicious of bureaucratic control, maintaining that the maximum authority appeared to be invested in those furthest removed in time and space from the blackboard. If put into effect, the proposals of the Scottish Education Department would be taking not one, but several steps in the same direction. and while I would agree with them when they say "the balance of advantage seems to lie in a substantially reduced number of multi-purpose popularly elected local authorities to deal with primary, secondary and further education", they should remember that only monumental authorities can make monumental mistakes.

E.L.T. Power Supplies

This term is used to denote the Extra Low Tension power supply which has been specially designed for use with the Westminster electro-magnetic kit of the Nuffield Physics Project. The Guide to Physics Apparatus lists the requirements of the unit as follows: "These special low voltage units have an output of 1 volt D.C., and 1 and 2 volts A.C. at up to 6 or 8 amps." It is not immediately clear from this that the current requirement also applies to the D.C. side, but here the Teachers Guide III, p. 303 says that "A suitable power supply providing, say, 8 or 9 amps at about 1 volt, is ideal for this work." There has also been a wide-spread understanding that a feature of these power units was their ability to withstand a short-circuit - whatever this term may mean - without damage to the components.

In testing the power units we accordingly determined the regulation/

regulation curves, i.e. the variation in output voltage with output current for a resistive load, and with a 240V mains input, or 12V A.C. input where appropriate. These curves were taken up to 8 or 9 amperes A.C., and similarly on D.C. unless our measuring equipment could not load down the system sufficiently, when the curve was taken to the maximum current we could register. Using a Model 8 Avo, the P.D. across the meter at full scale deflection on D.C. is 0.5V, and when leads to the instrument are taken into account we frequently found that the maximum current which could be drawn by the meter was of the order of 5 amperes.

None of the power units examined met the Nuffield requirement of 8 or 9 amps at about 1 volt, and it is our belief that had they been designed to this specification they could then not have met the short-circuit condition.

A more significant test of performance of the power units is whether they will successfully carry out the more stringent of the experiments with the Westminster kit for which they have been designed. Of these we selected the demonstration of lines of magnetic force using iron filings around a straight wire, the field of a 5 turn solenoid with similar technique, the test of adhesion of iron filings to a current-carrying wire, and the catapult force of a current-carrying wire in a magnetic field. In all cases we were satisfied that all the power units would demonstrate the effects, although in the adhesion experiment it was usually necessary to carry out a control experiment without current to decide whether the effect was significant.

On the A.C. side, all units gave substantially more than 1 and 2 volts on open circuit, but not all provided these voltages at 6 or 8 amperes. Since the A.C. is used in conjunction with coils and C-type cores in transformer and inductor experiments, the loading is comparatively light, and we did not consider it necessary to use the units with experimental apparatus, accepting that they would in fact drive the transformers or inductors as required.

The effect of an accidental or deliberate short-circuit on the unit is to dissipate all the output energy within the components. All the units examined use either semi-conductor diodes or transistors in a full-wave circuit to generate the D.C. and shorting the output can raise the temperature to a point where permanent damage can be done to the rectifiers. On A.C., a short may heat the transformer to a point where the inter-layer or inter-winding insulation is chemically oxidised to conducting carbon.

To assess the behaviour of the units on short circuit, a copper constantan thermo-couple was previously calibrated with a water bath, the balancing end of the couple being immersed in an ice-water mixture. The main purpose of this was not to achieve accuracy, which we believe to be about $\pm$ 2 degrees C, but to get a thermometer probe which could be fixed into position inside the power unit which could then be run operationally with top panels etc. bolted down. This was normally achieved by inserting the probe through the ventilation louvres and in the few cases where there were none, by screwing any removeable panel lightly down on the probe leads.

For D.C. s short consisting of a double thickness of 20 SWG bare copper wire was connected in a direct line between the terminals. This rather drastic short would not occur in practice unless a pupil deliberately set out to test the powers of resistance of the equipment. The probe was taped on to the heat sink which mounted the rectifiers, and temperature was recorded initially every minute and thereafter at less frequent intervals until a steady temperature/

temperature was reached, or until the noise and smell of boiling wax and/or paint indicated that the unit had better be switched off. Apart from the loss of some wax or paint, however, none of the units showed signs of permanent deterioration. In some cases the steady temperatures achieved, when taken along with the manufacturer's specifications for the rectifiers used, did suggest that in a continued short-circuit the rectifiers might be over-rated.

On the A.C. side the thermo-couple probe was strapped to the transformer core and the test repeated at the maximum current specified by the manufacturer, the equipment of course being allowed to cool after performing the D.C. test. In one case where the manufacturer did not specify a maximum current we used the same short-circuit test as for D.C., and only in this instance was it necessary to stop the test before a steady temperature had been reached.

To test the short-circuit behaviour of the A.C. side, which it is assumed would only arise accidentally, the double thickness of 20 SWG copper wire was connected across the A.C. 2V terminals for such time as it took to measure the transformer primary current. Where this was comparatively high, or where the initial current dropped rapidly after switching on, indicating that the transformer was heating up and affecting the primary resistance, the test was repeated using a 25 cm. length of the 26 SWG PVC covered wire supplied with the Westminster kit to simulate conditions which might occur in the classroom. In all these cases smoke and smell from the burning PVC would have drawn attention to the short within 30s, so that no permanent damage would have occurred.

To summarise, all the units tested will perform the experiments of the Nuffield Text, and the teacher's choice must be one of personal preference, taking into account such features as price, ability to stack together for storage, etc. In particular, teachers should be careful not to judge the performance of a unit as the result of a multi-range meter connected across the D.C. terminals. The meter impedance is frequently too high at the low level of voltage to give a realistic short-circuit current.

Chemistry Notes

One or two school teachers have written suggesting an alternative method for measuring alternating currents when carrying out conductimetric titrations. As we indicated in the article in Bulletin 10, A.C. milliammeters are not cheap, and we felt that on balance the advantage lay in the use of D.C. Since then in addition to the written correspondence, several teachers we have talked to have expressed a preference for A.C. and we therefore give below a cheap although not accurate method of measuring the conductivity of the cell.

Basically the principle is to use a D.C. meter and rectifier to/

to measure the alternating voltage across a small resistance in series with the cell. The circuit which we used consisted of a ten ohm resistor shunted by a 0-1 mA Japanese meter, diode, and series resistor to reduce the meter current to 1 mA, see Diagram 1. The meter is obtainable from G. W. Smith and Co., resistors from Radiospares, and the diode can be any small signal version. As the graph shows, the relation between alternating current and meter reading is not linear, although it is reasonably so between 30 and 80 mA. Below 30 mA, i.e. when a solution is nearing neutrality which is of course the most critical part of the experiment, the system becomes less sensitive, as changes in cell current produce smaller changes in meter reading.

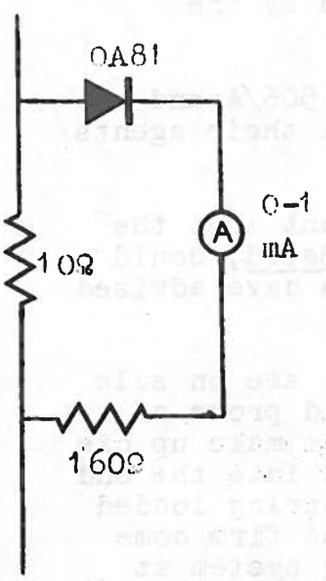

Fig. 1.

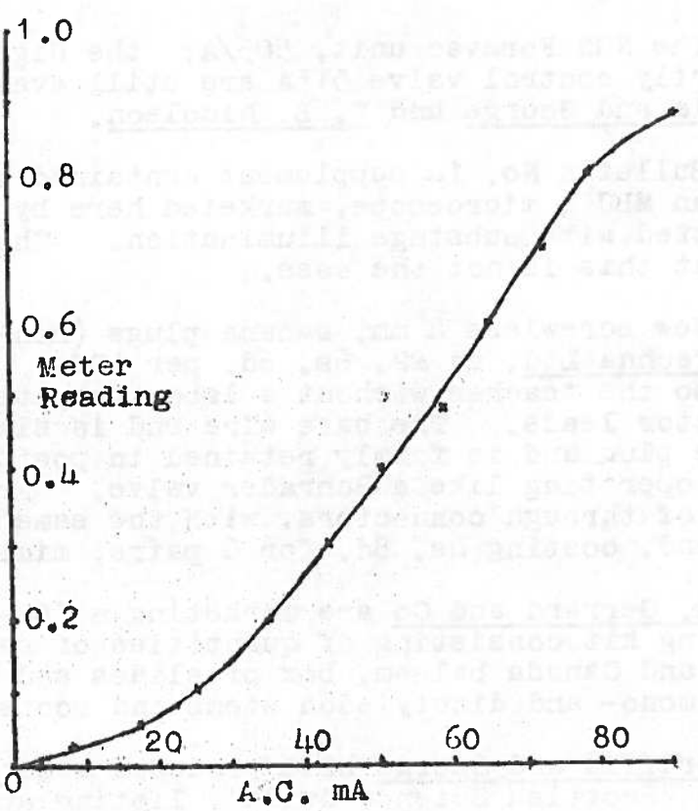

Fig. 2.

Two refinements which we found convenient and which add little to the cost of the equipment are (i) to substitute for the 10Ω fixed resistor a 25Ω variable rheostat, also from Radiospares. This can then be used to adjust the initial meter reading to a suitable value nearly or at full scale deflection. The second was to connect a 1,000μF 6V electrolytic capacitor across the meter. This removes the tendency on the part of the pointer to vibrate at 50 Hz.

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An exothermic reaction which is safe for use by pupils themselves occurs when Tide detergent is mixed with water. If added to approximately five times its own volume of cold water, a rise of 5-10 deg. C is produced.

Trade News

In Bulletin No. 14 we wrongly stated that the firm of NGN Limited had ceased production of their vacuum pump, and we apologise to the firm for this error and for any inconvenience caused to them or their agents. The firm have submitted the following explanation to us.

"NGN and Teltron originally combined to produce the educational vacuum pump unit which was subsequently approved by the Nuffield Foundation and currently appears in their list of recommended physics apparatus for schools. Some nine months ago Teltron decided to part company from NGN with regard to this particular project and tied up with Leybold a German manufacturer on high vacuum equipment. The unit Teltron is now offering is based on a Leybold pump and, as far as we are aware, has not yet been officially approved by the Nuffield Foundation."

The NGN Forevac unit, 505/A; the Highvac unit, 506/A and butterfly control valve 515A are still available from their agents Griffin and George and W. B. Nicolson.

Bulletin No. 14 supplement contained the statement that the Russian MBU 4 microscope, marketed here by Andrew H.Baird, could be fitted with substage illumination. The importers have advised us that this is not the case.

New screwless 4 mm. banana plugs (non-stackable) are on sale from Techna Ltd. at £2. 6s. 6d. per 100. They should prove a boon to the teacher without a laboratory technician to make up his connector leads. The bare wire end is simply pushed into the end of the plug and is firmly retained in position by a spring loaded ball, operating like a Schrader valve. From the same firm come pairs of through connectors, with the same connecting system at each end, costing 4s. 8d. for 6 pairs, minimum quantity.

T. Gerrard and Co are marketing a "Do-It-Yourself" botanical staining kit consisting of quantities of safranin, light green, ether, xylol and Canada balsam, box of slides and cover slips, and 12 each of TS mono- and dicotyledon stems and roots. Total cost £2. 12s. 6d.

Griffin and George have produced a catalogue and price list, called "Scottish Science Guide", listing apparatus which they have selected as being suitable for the Scottish alternative syllabuses in physics and chemistry, and for the biology syllabus.

The price of the Stanton SN1 balance, reported on in Bulletin No. 11 has been raised to £110. If desired the balance can be supplied without the clamps which are used only to secure weights and beam in transporting the balance at a reduced price of £106.

In Bulletin No. 14 we gave the price of the miniature Weston standard cell from Parametron with solder lug terminals as £2. 12s. 6d. The correct price should be £3. 3s. This cell and the other 4 mm. socket terminal type mentioned in Bulletin No. 14 are available from Griffin and George at the same prices, catalogue Nos. L82-350 and L82-355 respectively.

The firm of Flatters and Garnett have gone into voluntary liquidation.

Biology Notes

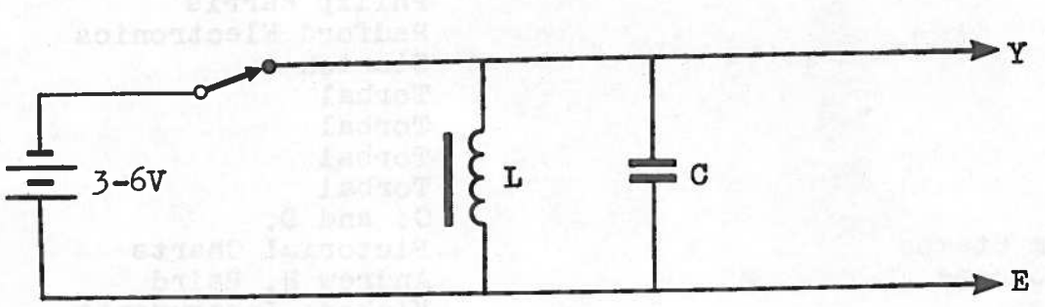
Keeping a successful culture of amoeba in the school laboratory has always been a hit or miss affair. One method which we have found successful and which will provide a plentiful supply for months is outlined below. As is well known however, one amoeba's water may be another's poison and we cannot issue any guarantee that the method will be successful in your area.

Some pond water and mud is put into an aquarium tank (36 x 22 x 22 cm. is the size we used) half filled with water and aerated. After a few days add some boiled wheat (a small handful or dessert spoonful) and inoculate with amoebae or old amoeba culture. Quite a succession of microorganisms will result and terminate with a great number of amoebae 4 - 8 weeks later. Colpoda may become so numerous as to appear like a mist near the bottom of the tank and the amoebae will later form a crust like snow covering the entire debris at the foot of the tank. Eventually the amoebae will disappear, but the whole cycle may be repeated simply by adding more boiled wheat and waiting. Aeration of the tank is necessary for a period of 24 hours every week or whenever the surface becomes covered with a film.

Teachers wishing to establish an amoeba culture can obtain a free sample on calling at the Centre on those occasions when our supply is plentiful. For those making a special errand, an advance phone call or letter is advisable just to check that the amoebae are available. We also have limited quantities of adult locusts offered under the same conditions for teachers wishing to establish their own colony. Again the supply is sporadic.

Physics Notes

From Northfield Secondary School comes this suggestion for displaying a damped oscillation on the oscilloscope.



L is the 250 turn section of Unilab LB-3 coil, with a single C core inserted; C is a 4μF paper capacitor and the switch is made up by inserting a piece of copper foil in place of the normal tape in a ticker timer. This gives a recurrent switching action at 50 Hz,/

50 Hz, if one uses a mains operated timer. One side of the switch is the copper foil, the other is the vibrating reed of the timer. The oscillation can be displayed on any oscilloscope.

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We have a note from a teacher complaining that if Aerocups are used with turpentine as indicated on p.148, Book III, Physics is Fun, J. Jardine, Heinemann, they dissolve, a fact which we can confirm in the light of our own experience using the cups supplied by Dobbies Paper Supplies (See Bulletin No. 6).

Display Laboratory

The following items have been added to the display laboratory since the previous Bulletin:

Item	Manufacturer
Steam Turbine Model	SSSERC
Lever Kit	SSSERC
Respiration Model	SSSERC
Senser Mechanism	SSSERC
Ryke's Tubes	SSSERC
Electrode Potentials	SSSERC
Electrostatic field display	SSSERC
Capacitor Smoothing display	SSSERC
Mechanical oscillations	SSSERC
Transpiration Model	SSSERC
Electric circuit analogue	SSSERC
Sunshine Recorder	SSSERC
Gas Generator	SSSERC
Clockwork Clinostat	SSSERC
Ripple Tank	Griffin and George
Power Supplies	Griffin and George
Junior Microscope	Griffin and George
Combined Mechanical Equivalent of Heat Apparatus	Griffin and George
Clinostat	Griffin and George
2 stroke Fuji Motor	Griffin and George
Power Supplies	Unilab
Power Supplies	W. B. Nicolson
Power Supplies	Philip Harris
Clinostat	Philip Harris
Power Supplies	Radford Electronics
SNI Balance	Stanton
STI Balance	Torbal
DH2 Balance	Torbal
PLI Balance	Torbal
PL800 Balance	Torbal
Microprojector	C. and D.
Zoology Diagram Stamps	Pictorial Charts
Swift 956 Microscope	Andrew H. Baird
M14A Microscope	Vickers Instruments

The following items have been removed from the display laboratory since the last Bulletin:

Microscope Microsystem 70	Watson
Model 71 Balance	Oertling
R10 Analytical Balance	Oertling
V10 Analytical Balance	Oertling

S.S.S.E.R.C., 103 Broughton Street, Edinburgh, 1. Tel. WAV 2184.

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

C and D Scientific Instruments Ltd., 459a London Road, Boxmoor, Herts.

Flatters and Garnett Ltd., Mikrops House, Bradnor Road, Manchester,22.

T. Gerrard and Co. Ltd., Gerrard House, Worthing Road, E. Preston, Nr. Littlehampton, Sussex.

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

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

N.G.N. Ltd., Kirk Road, Church, Accrington, Lancs.

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

L. Oertling Ltd., Cray Valley Works, St. Mary Cray, Orpington, Kent.

Parametron Ltd., 70 Westward Road. Stroud, Glos.

Pictorial Charts Educational Trust, 2nd. Floor, 132-8 Uxbridge Road, West Ealing, London. W.1.3

Radford Electronics Ltd., Ashton Vale Estate, Bristol, 3.

Radiospares Ltd., P.O. Box 268, 4/8 Maple Street, London. W.1.

G. W. Smith and Co. Ltd., 3/34 Lisle Street, London, W.C.2.

Stanton Instruments Ltd., Reliance House, Copper Mill Lane, London, S.W.17.

Techna Ltd., 47 Whitehall, London, S.W.1.

(Torbal) The Torsion Balance Co. Ltd., 694 Stirling Road, Trading Estate, Slough, Bucks.

Unilab Div^{n}. Rainbow Radio Ltd., Mincing Lane, Blackburn, Lancs.

Vickers Instruments Ltd., Haxby Road, York.

W. Watson and Sons Ltd., Barnet, Herts.