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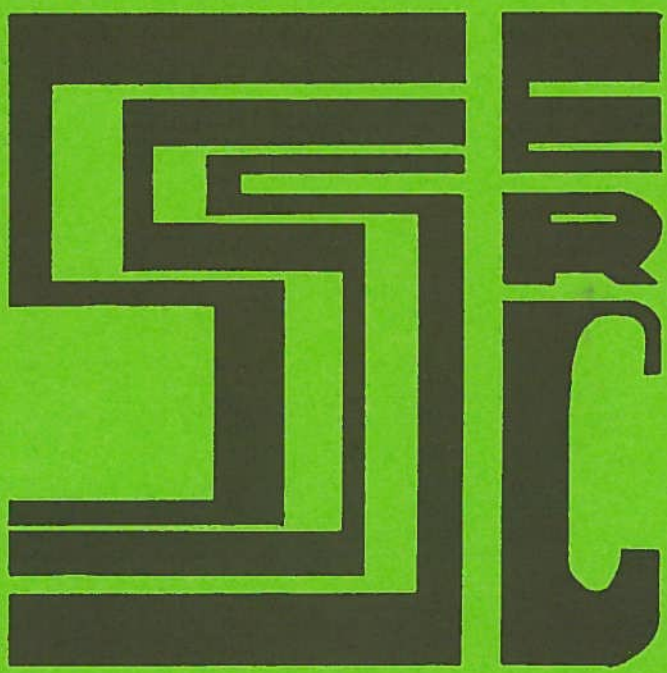
SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE



Bulletin No. 151 **May 1986**

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(**continued** on inside back cover)

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COMMENT

An allegory

Robert Henryson, the schoolmaster of Dunfermline, lived through the fifteenth century. Whilst exact dates are not known, it seems that he wrote his major narrative verse in the 1480s. We might therefore look on this year as being the five hundredth anniversary of his achievements. He began his best known work, 'The Testament of Cresseid', in the season of Lent, then as now blasted by cold, bleak, wintry weather:

"Ane doolie sessoun to ane cairfull dyte
Suld correspond, and be equivalent.
Richt sa it wes quhen I began to wryte
This tragedie, the wedder richt fervent
Quhen Aries in middis of the Lent;
Schouris of haill can fra the north discend,
That scantlie fra the cauld I micht defend."

We have had schouris of haill this Lent too. It has been a long, hard spell.

The mood being set for his story, Henryson, by a touch of magic, spies Venus in oppositioun to the Sun which had already set unseen. The evening star has broken through the storm and by her light he is able to watch the north wind disperse the clouds:

"Throwout the glas hir bemis brast sa fair,
That I micht se on everie syde me by,
The northin wind had purifyit the air,
And sched the mistie cloudis fra the sky;
The froist freisit, the blastis bitterly
Fra Pole Artick come quhisling loud and schill,
And causit me remufe aganis my will."

A man grown old that cold penetrates to the marrow. A gleam of light that, whilst not displacing winter, lets hope spring afresh. Spring 148-, spring 1986; equivalence and correspondence.

Opposition

Continuing with our literary theme, Henryson's use of the word 'oppositioun' deserves comment. The Shorter Oxford defines the word, in its astronomical context, as "the relative position of two heavenly bodies when exactly opposite to each other as seen from the earth's surface, their longitude then differing by 180°; **esp** the position of a heavenly body when opposite to the sun". The term cannot, nowadays, be applied to the position of Venus as seen from our earthly viewpoint; being an inner planet, she can never take up opposition. But in Henryson's time the theory of heliocentricity had not been proposed, therefore his concept of planetary orbits would not be ours.

Why did Henryson use the word in this fashion? As a schoolmaster and writer interested in language, he used words with care. We cannot jouk the question with the excuse of poetic licence. It would seem that his usage, its meaning being fairly obvious, is not included in the Oxford Dictionary.

Perhaps the word was his own invention and it was others who misused it? Henryson is credited with the original contrivance, or first recorded usage, or very early usage, of a number of items in our language, words like correspond (1529) (Oxford have slipped up there again), equivalent (1460) and invention (1480).

What about grade (1511) related (1530) criteria (1613)? Not according to Oxford, but their record for rummaging in the jewel box of Henryson does not, from this superficial analysis of three stanzas from the Testament, look too good. Over to you, SEB sleuths, to identify GRC with the scolmaister of Dumfermling.

INTRODUCTION

Editorial policy

As a rule bulletin articles are prepared for publication by SSSERC staff only. This is because of our policy always to first test out an idea or make at least one prototype. Through our exhibitions and in our display lab, items are then exposed to the informal, hopefully informed, criticism of teachers and technicians. In this way we hope to avoid major imperfections and unnecessary difficulties for anyone making or using a suggested design or technique. We are painfully aware of the warts on even this cautious face of development.

Despite occasional pressure for us so to do, authors are not named. Authorship is rarely clear cut. Many articles involve a number of staff, occasionally the whole staff team. Often the original idea or even a finished design may have come from third parties. To name individual staff or a restricted group would be to risk breaking faith with other contributors both within and outwith the Centre.

Rules can of course be broken. This issue takes the unusual step of publishing two submissions from outside contributors. The ideas contained in both articles have been bench tested. We have some spin-off from Primary Science work at Moray House College from Livingston Russell who heads the biology department there. We were also pleased to receive an article from Dr. Peter Williams, Director, MEDC. We hope that you, too, enjoy their humour and take in their message.

Finally, we are pleased to use an idea from a team at St. Ninian's High School, Kirkintilloch.

Data Protection Act

The final deadline for our registration under the "Data Protection Act, 1984" has been looming during the preparation of this issue. We are not, we think, required to directly and actively notify folk on our database that we so hold information about them. In the interests of good relations we thought it best to clarify the nature of that small amount of personal information which is held.

If you receive the Bulletin and other publications by direct mail, i.e. you are a subscriber or your EA does not use a bulk distribution scheme (often termed a "wallet" system) then we possibly hold the following information about you on our database: name, school, address and status (e.g. principal teacher and subject, senior technician, adviser, HMI etc.). In several cases we may have a post designation but no name. If you wish to see the type of data recorded look at the label on the bulletin envelope. Please let us know if you have any objections.

If your bulletin arrives via a distribution system from a bulk delivery then we hold nothing other than a global list of final delivery addresses. The only individual name and address we hold in that instance is the original recipient of our parcelled bulletins. Information on firms or organisations is restricted at present to name, address and a short summary of products or services.

Be reassured, this little brother isn't watching you. Would that we could find the time, but then, we would never have the inclination.

Microelectronics monographs

At the time of writing, MeMo 4 the latest in the series is at SCDS Dundee awaiting the main distribution to schools. This MeMo is entitled "Making a Start in Teaching Microelectronics". Following on the fairly demanding content of MeMos 2 & 3 it was decided to again target a volume on a much wider audience. So, just as MeMo 1 dealt with a range of constructional techniques this latest issue looks at a number of learning strategies. No attempt is made at snapshot reviews of specific teaching equipment or kits. Provided instead are less ephemeral guidelines as to choice of tactics and educational weaponry. MeMo 5 is already in preparation and will deal with a range of control techniques and applications.

Additional copies of MeMos are available either from ourselves or SCDS, Dundee, at £1-50 per copy including postage (with bulk discounts to Scottish schools). Orders for less than £10 must be accompanied by payment in Sterling, drawn on a UK bank.

NO COMMENT

The Editor,

Dear Sir,

It is with great regret that I notice that, despite the hopes you expressed on page 3 of the 21st Birthday Edition, page 11 of the same issue has been invaded by the AIDS virus of written English, the wrongly placed apostrophe. My experience indicates that the chance of a cure is not high but I send you my best wishes for a complete recovery from what can be a most persistent bug.

Yours sincerely,

Julian Smith,

P.T. Chemistry, Broxburn Academy.

* *

Dear Sir,

One ought, I suppose, to be writing to congratulate SSSERC on its 21st anniversary as it only happens once unless the physicists have got it wrong!

However, when the celebration issue makes no mention of the **real** significance of the 1st March, one is tempted to ignore it! I suppose that it is perhaps asking a little for a Scottish organisation, directed by a Geordie, to realise that the 1st March is more properly regarded as Dewi Saint's Day or to the northern tribes, St. David's Day!!

As for the change in colour of the cover, I ask myself what next as the Bulletin's arrival came close on the heels of St. Patrick's Day. .....

Cheers,

Richard Turner,

Senior Assistant Secretary, ASE.

SURPLUS

Bent acid tubes - free

We have recently acquired a large number of boxes, each containing a gross of these tubes. The tubes are of soda glass, with internal diameter 3 mm and length 210 mm. They are slightly bent near one end, the end being flattened and polished to make a mouthpiece. Bent acid tubes belong to the era before the advent of pipette fillers and were used as a safety extension!

These are free on a first-come, first-served basis. Please state the number of boxes required.

Possible uses - well, that's up to you. Putting in two bends of the appropiate angle makes a nice sized delivery tube for gas preparation kits. The tubes can be used either for making short connections or as practice material for young glassblowers. In biology they could actually be used as a mouthpiece for blowing exhaled air into limewater.

* *

For Sale

We have been notified of a Warburg bath for sale by Waverley Secondary School in Glasgow. No, this is not a Russian car-wash but a device for measuring respiratory rates from enzyme cultures. The apparatus has 13 calibrated and 4 uncalibrated manometers in addition to 16 Warburg flasks. Each manometer can be independently oscillated about its vertical axis. Anyone interested should contact Mr. T. Sproull at the address shown on the inside cover.

* * * * *

SAFETY NOTES

Don't blow it!

Almost as an aside in Bulletin 148, we warned against the practice of fitting mains colour-coded cable to devices designed to operate at low voltage. The context then was an evaluation of the Ross & Lamont model house.

We have since received a report of a similar problem with sub-stage microscope illuminators. Routine use of a HVIE (high voltage insulation and earth) tester unearthed, as it were, the problem. The illuminator in question was possessed of a metallic body and had a mains plug attached to its cable. Not unnaturally it was earth tested. It failed.

Closer examination revealed that it was a Griffin & George item, Cat.No. MNE 280 E, designed to operate at low voltage. Therefore it did not require provision of a safety earth. Someone, not G & G we hasten to add, had fitted a mains plug. Aside from the initial annoyance of wondering why the bulb blew, this was a potentially hazardous error.

If you have such G & G lamps and are in any doubt as to their intended operating voltage, an examination of the bulb holder should decide the issue. As reported to us, the low voltage version MNE-280-E has an SBC lampholder and the mains type MNE-280-C a BC holder.

We can only repeat our Bulletin 148 advice. Never fit brown, blue (green/yellow) colour-coded cable to the input of any low voltage device. Suitable alternatives might be:

1. twin 'figure 8' cable
   (as used for driving loudspeakers)
   13/0.2 mm size rated 60 V r.m.s., 1 A
   e.g. RS stock number 357-592

2. twin lengths of standard grade, extra-flexible wire
   e.g. RS stock number 356-167

The cable ends should have obvious LT terminations such as 4 mm plugs. If there is any remaining possibility of confusion, affix a small but clear and permanent label stating "low voltage - X volts max.". In our experience this is something as neglected by some suppliers as it is by schools. The situation isn't helped when, ostensibly to prevent confusion, a few send out devices with mains cabling but without suitable termination(s). We are grateful to Mrs Jean Young, senior technician at the St.Paul's Street Teachers' Centre, Aberdeen, for bringing this incident to our attention.

Inflammatory literature?

Recently available is a useful little leaflet from the Health and Safety Executive. This is snappily entitled "Storage and Use of Highly Flammable Liquids in Educational Establishments". It is the first product of a Working Group set up by the HSE Education Service Advisory Committee (no doubt, you guessed - HSE ESAC).

We have to confess that our description of the leaflet as useful is coloured by the fact of our membership of the group. Copies of the leaflet should, we are assured, be available free from any local HSE office (see the selection in this bulletin address list or your local telephone directory).

The ESAC group wheel grinds exceedingly small and at the appropriate pace, just slightly quicker than an International Standards Committee. Eventually, more little publications may emerge.

No quicker are the folk deliberating the weighty matter of advice to education authorities on AIDS. That pace is perhaps even more appropriate. We would prefer sensible and considered advice based on a careful weighing of all the available evidence. Rushing to ill-considered judgements may leave us all up an educational cul-de-sac not daring to turn back because of unacceptable loss of face.

We are given to understand that Central Government advice is still under preparation with some issues requiring further investigation. In the circumstances further delay in the publication of an account herein is unavoidable. Watch this space!

BIOLOGY NOTES

Vital Capacity Apparatus

A simple spirometer/vital capacity apparatus, based on two plastic containers, was described in Bulletin 130 (March, 1982). We have recently received details of an even simpler design from Livingston Russell of Moray House College Biology Department. Ever the jester, Livi claims he only sent in the notes on his design to prove that "... I can do joined-up writing!".

Construction

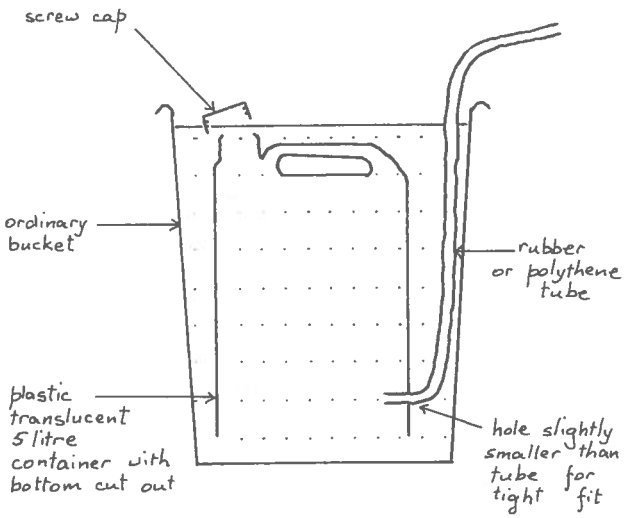

Fig.1.

The construction of this simple device should be clear from the diagram (Fig.1). The inner container should be calibrated in, say, 0.5 litre divisions. This is easily done by holding it upside down, i.e. cut-out base uppermost, with the screw cap on and pouring in measured volumes of water. After each 0.5 litre aliquot (every one a sop to the chemists) mark the level with a waterproof pen.

Use

Because of the simple nature of the device this is restricted to the estimation of vital capacity.

The device is set up as shown in Fig.1. The cap is screwed on tightly. The subject should breathe out into the tube whilst someone steadies the container as it rises. The container should then be held in a position where the water levels inside and outside are equal. The volume of air is noted. To reset the apparatus, the screw cap is removed and the container pushed downwards to displace the exhaled air. The cap is then replaced and the next measurement can be made.

Design advantages

The apparatus is cheap and need take no longer than 20 minutes to make. It is quick and easy in use, unlike the earlier bell jar in the sink, or inverted container in a giant aquarium, methods. The vital capacity of a pupil may be measured in 15 to 20 seconds, including the time required to reset the apparatus for the next student.

Disadvantages

Also as ever honest, Livi admits to two disadvantages of the apparatus. Firstly, because of the method of calibration and other factors, the degree of accuracy is not high. Secondly, with a 5 litre juice or other container the maximum measurable volume is ca. 4.5 litres. For older children and certainly for adult-size males, two devices may have to be placed in parallel and linked via a Y-tube mouthpiece.

Health and Safety

Clearly regular disinfection of the end of the breathing tube is necessary with the whole of the apparatus being cleaned and disinfected between classes. Some might consider necessary the use of a separate, plastic, mouthpiece tube attached at the end of the rubber breathing tube. (See also CLEAPSE/SSSERC Hazcards "Spirometers" and "Disinfectants").

* * * * *

Comments on 'A.C. current measurement'

In Physics Notes of Bulletin 149 we described a circuit which converts a.c. current into a d.c. voltage. The response has been this article by Dr Peter Williams, Director of MEDC.

The ideas outlined are by no means merely theoretical. The circuits described are working circuits, something we have confirmed at the bench.

Precision rectifiers come in different varieties: half-wave, full-wave and peak. Each variety has a multitude of flavours, but the differences are often small. Often each new version was produced to push the performance up - higher frequency, greater precision and so on. In the process the circuits often became more complex. It is worth retracing those steps to find the simplest solution. The performance may be less, but still more than adequate for laboratory use.

In Figure 1 of the article in Bulletin 149 (reproduced below), op amp 1 is used as a current to voltage converter. This makes it convenient to vary the sensitivity by varying the feedback resistor R.

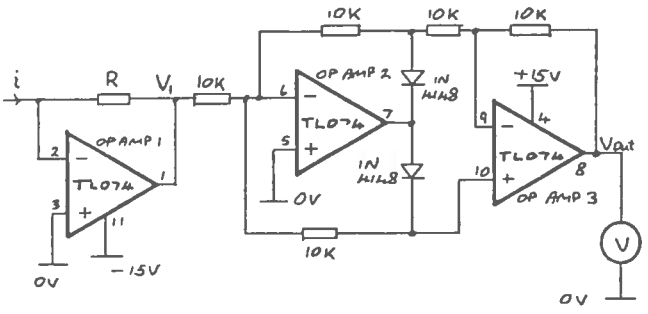

Fig.1 - Circuit diagram - a.c. current to d.c. voltage converter (from Bull.149)

The virtual earth at the input of op amp 2 could serve equally well, omitting op amp 1, if a pre-set sensitivity is acceptable. Savings: one op amp.

What are the other possible simplifications? Go back to the core of the circuit, the classic half-wave rectifier (Fig.2).

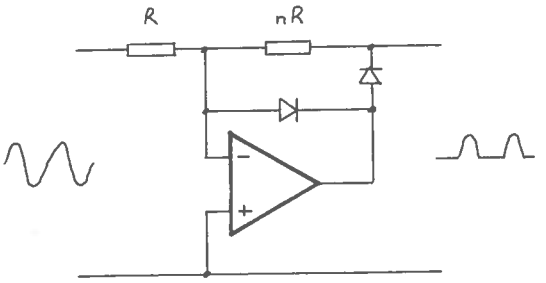

Fig.2 - Precision half-wave rectifier

The output goes positive for negative inputs and is zero for positive inputs. During a late-night design session to meet a publishing deadline in the early 70's, a colleague kept reporting breakthrough on the wrong half-cycle. We failed to find any leakage effects and were surprised that an open-circuit diode was the cause. The end result was that a half-wave rectifier needing two diodes was converted into a full-wave rectifier needing one (Fig.3).

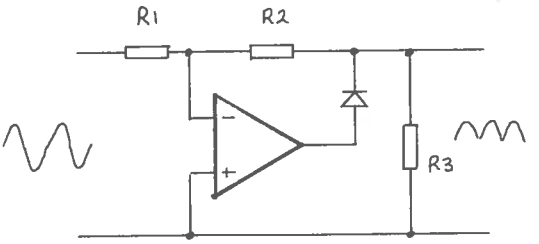

Fig.3 - Precision full-wave recifier

The output is attenuated and for precision rectification the magnitude of the 'gain' for negative inputs R2/R1 has to equal the attenuation of the potential divider for positive inputs

$$R3/(R1 + R2 + R3)$$

A suitable condition is R1 : R2 : R3 :: 2 : 1 : 3 giving an attenuation of half. (R3 can be a load resistor, a moving coil voltmeter, etc.)

The circuit does not meet the original specification in that it needs a voltage rather than a current input, but could be preceded by the same current to voltage converter if needed. Not only have we reduced the total number of components, but there are fewer to introduce errors.

A further simplification follows from the unipolar input. A number of op amps are now available which work with inputs and outputs able to swing down virtually to the most negative supply rail. They can be used with a single positive supply as low as 5 V or less in these circuits while still giving full-wave rectification (Fig.4).

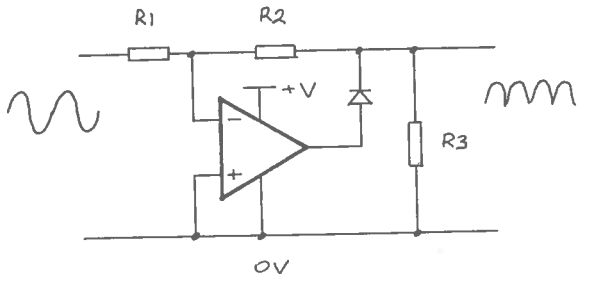

Fig.4 - Single-supply full-wave rectification

So precision measurements are possible with one amplifier, one diode, one supply voltage and three resistors. Keep going.

Further reductions need a fresh approach. If you can't solve a problem, change the problem. Re-define a precision rectifier as a circuit which has different voltage gains for the two polarities of input. A half-wave rectifier could then be provided with, say, a gain of unity for positive inputs and zero for negative inputs. This is a voltage follower running off a single supply (Fig.5)! The output can never go negative and can be equal to the input for all positive voltages above a few millivolts.

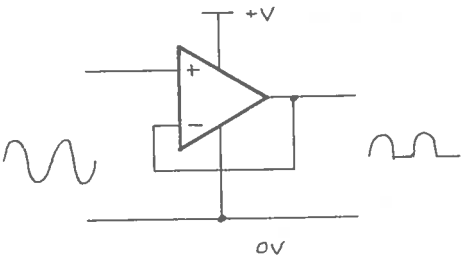

Fig.5 - Precision half-wave rectifier

It does work no matter how ridiculous it might look. It needs a suitable op amp and the input voltage should be restricted to, say, < 1 V p.p., but with just one amplifier, a single power supply of uncritical value and no passive components at all, it could hardly be simpler.

Wonder if we could do without the op amp .....?

* *

Quartz crystal oscillator

Abstract

Oscillators based on the quartz crystal are commonly used to provide a stable frequency standard. Their ubiquity, however, beguiles the fact that they are not the easiest of components to work with. In this article, a dependable circuit is given which uses such a crystal.

The crystal

Quartz crystal oscillators are used as the common, modern basis for the measurement of time and frequency. Even the simplest of crystal oscillators put together in a gung-ho, artless fashion (and we are not going to pretend that this circuit is finer than that) can be reckoned to achieve an overall accuracy of 0.01% for all conditions. By comparison, the best performance one can get from an RC or LC oscillator is 0.1% or 0.01% respectively and to obtain values as good as these the designer must work to "the rule of 10" whereby all components are overspecified to a factor of 10 or 100.

The apparently simple, two terminal, quartz crystal functions in a complex way. The material is piezoelectric and both the generator and motor effects occur: under strain, the material generates a voltage; under an applied voltage, the material is subjected to stress.

In manufacture, the crystal is cut as a slab with parallel faces. A pair of electrodes is deposited on opposite planes and the electrical symbol (Fig.1) is a graphical representation of this structure.

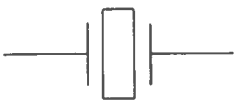

Fig.1 - Crystal symbol

The electrical behaviour can be described as the series combination of an inductor, capacitor and resistor with a second capacitor shunted across the lot (Fig.2). It acts as a series resonant L-C circuit with a very high Q-value (that is, it accepts only a very narrow range of frequencies).

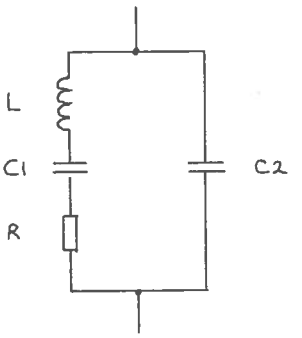

Fig.2 - Quartz crystal - equivalent circuit

Low price quartz crystals are available, off the shelf, in a range of standard values: 1.0, 2.0, 3.0, 4.0 MHz, etc. for clocking microprocessors, frequency measurement, etc.; 32.768 kHz for clocks and watches (divide by 2^{15} to get 1 Hz); and other industry standard values for performing specific tasks such as TV line driving.

A 2 MHz oscillator circuit

A CMOS inverter gate (1) is connected across the crystal (Fig.3) so that at switch-on a transient surge across the crystal sets it oscillating. The gate provides the electrical energy for maintaining these oscillations, its output driving one contact of the crystal to the opposite polarity of that on the other face.

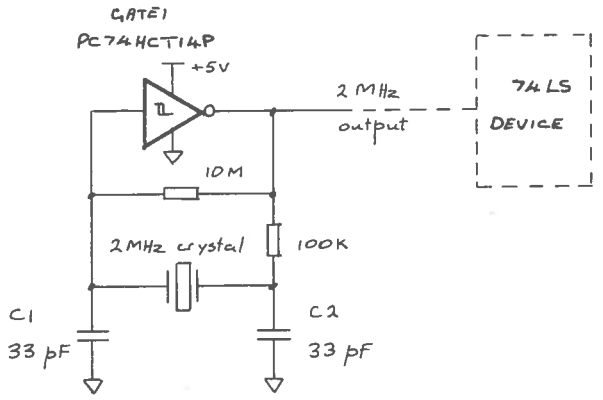

Fig.3 - Circuit - 2 MHz oscillator

The type of CMOS inverter is critical. Several were tried (Table 2), but only three out of the ten worked, including the PC74HCT14P as specified in our circuit. We have heard tales of how specific this particular component has to be, that a chip from one manufacturer does work, from another does not. Such tales are part of the mythology of crystals; those of us who only dabble, look on their working as a black art. The circuit as shown has worked reliably over a period of time and could therefore be used as a dependable basis for laboratory instrumentation.

	i.c. package	test result
	HEF4049BP	fail
RS	4049UB	fail
	HCF4069UBE	fail
	MM74HCU04N	pass
	PC74HC04P	fail
	PC74HCT04P	pass
	MM74C14N	fail
RS	74HC14	fail
	SN74HC14N	fail
	PC74HCT14P	pass

Table 1

Of the three inverters which maintain oscillations, the one with a Schmitt trigger input (PC74HCT14P) is reckoned to give the best performance. The two straight inverters which worked had a higher level of noise sitting on the 2 MHz waveform than had the one with Schmitt input.

The output from gate 1 is capable of driving 74LS packages. No intermediate buffer or driver is required. The direct drive link-up is shown in Figure 3.

The optimum value of the pair of capacitors between the crystal terminals and ground should lie between 22 and 68 pF. The fixed value, C2, can be replaced by a trimmer in order to make fine adjustments to the oscillation frequency.

Components

item	supplier	cat.no.	price
quartz crystal 2 MHz	Farnell	103-873	2.63
	RS	302-176	2.80
inverter with Schmitt trigger PC74HCT14P	Farnell	PCF74HCT14P	0.72
capacitor 33 pF	Farnell	104-884	0.04
(10)	RS	113-235	0.88
trimmer 5.5 to 65 pF	Farnell	808 32659	0.21
(3)	RS	125-660	0.65

* * * * *

The block and tackle - a demo. of the underlying physics

I have, from time at sea, long marvelled at the effectiveness of a single turn round a spar or capstan. This demonstration results from that experience. Whilst the demonstration could be done on a miniature scale with twine and laboratoryware, a larger scale is more dramatic. By way of equipment you will require a length of rope. Old climbing rope which is no longer used for its original purpose is ideal. You also require a securely anchored bollard. Indoors, a permanently fixed laboratory bench might do, but the demonstration is more safely done outdoors, round a stout oak.

Part one is a straight tug of war between yourself at one end and four pupils, eager to demonstrate their prowess, at the other. The obvious point is made that one cannot hold four.

Part two is the same arrangement, but with the rope taken a half turn round the bollard (Fig.1). By this means it should be possible for one person to hold four. The point can then be made that tension B is greater than tension A, the disparity being due to friction which acts as to prevent the rope slipping relative to the bollard's surface.

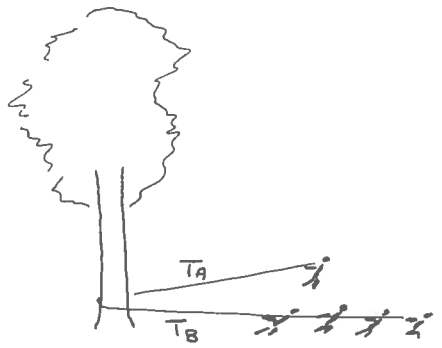

Fig.1 - One against four with half turn round bollard

There is not a one-to-one correspondence between this demonstration and the block and tackle. Some care is required in teasing out similarities and differences. There is sliding as well as static friction in the pulley block. However the same general principle applies and both can be described by the equation:

$$T_B = T_A + \text{friction}$$

Haul away

The 'Junior' or 'Miniature' hoist, as its name suggests, is normally used for lifting. There is also a splendid demonstration of its use at haulage which you might like to try. An upturned laboratory bench can be imagined to be a boat lying on a beach. When loaded up with three or four volunteers it becomes a difficult object to push around. The demonstration involves securing the 'hoist' to one table leg down at floor level and to a secure anchorage also at this level. By hauling away, the boat is dragged up the beach.

The safe working load of one such hoist on the market is specified by the supplier to be 275 kg. Such a demonstration should lie within this limit.

* *

Measurement of g

An ever so simple arrangement for measuring the acceleration due to gravity has been sent in by a team from St. Ninian's High School, Kirkintilloch (namely Pat Cleary, PT Physics, and technicians, Alex Alexander and Andrew Donnelly). Their system is based on a couple of reed switches and a ticonal magnet. This description is our own development from their original scheme.

The set up should be clear from the diagram (Fig.1). Wiring arrangements will depend on the type of timer. The arrangement shown uses the Unilab digital stopclock, 513.051. With these connections, a momentary short between terminals 2 and 3 will either START or STOP the clock. Because of its design, this clock cannot be used to measure intervals which are less than 12 centiseconds. To keep outwith this limit the minimum drop should be 20 cm.

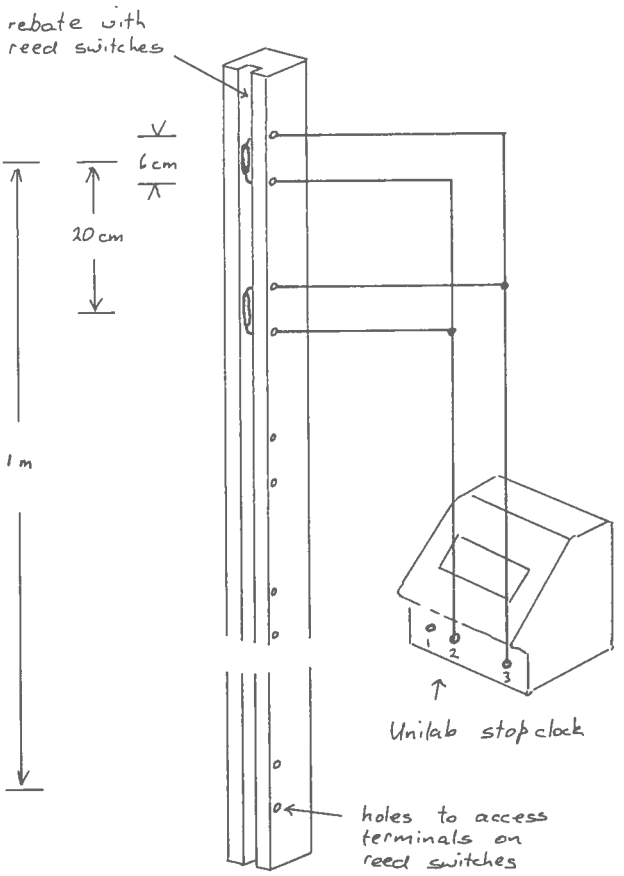

Fig.1 - Apparatus to measure g

Miniature reed switches should be used, e.g. either RS stock number 338-147 (42p) or SSSERC surplus item no. 354 (10p). These are mounted in the rebate of a length of channelled wood., which might be either the type sold for use with small sliding doors, decorative pine cladding, or some similar artifact from a hardware shop. The rebate width should be 4 mm so that it will just accommodate the 3.2 mm glass case diameter of the reed switch. Pairs of 3 mm holes, drilled at 6 cm spacings, should be made into one side of the channelling. There should be six pairs, one pair every 20 cm as shown (Fig.1) allowing for a variation in dropping distance of up to one metre in 20 cm steps.

Wires to connect the reed switches to the timer are threaded through the holes in the channelling. One can either use six reed switches permanently mounted or two reed switches, one fixed at the top and one floating between the other five positions.

Experimental technique

The major problem with the method is ensuring that the magnet is dropped from a point just above the position that triggers the first reed switch. It is critical that the starting point lies within one centimetre of the initial triggering position. Errors within sample sets of readings have been traced to this requirement and the experimental analysis is not easy should this condition be ignored.

In the set of readings (Table 1), values in the time column are the averages of ten measurements with the specified stopclock.

s (m)	t (s)	t^2 (s^2)	g (ms^{-2})
0.2	0.187	0.0350	11.43
0.4	0.281	0.0790	10.13
0.6	0.342	0.1170	10.26
0.8	0.393	0.1544	10.36
1.0	0.432	0.1866	10.72

Table 1

Taking the gradient of the best fit straight line through a plot of s against t^2, the value of acceleration is found to be 10.5 ms^{-2}. The method therefore gives quite a good determination.

* * * * *

Cold light source

Microscopic creatures can often be disturbed, to put it mildly, by the heat given off by the illuminating lamp. A modern way of overcoming the problem is by siting the lamp remote from the microscope and piping the light to the object via a fibre optic bundle. Such a system is called a 'cold light source'. The construction is described below.

The material used to make the light pipe is unclad plastic fibre of 1 mm diameter. A 10 m length is required in total and should be cut with a sharp knife into twenty lengths of 50 cm each. These lengths should be fed through a 49 cm length of heat shrink sleeving of bore size 6.4 mm to make up the bundle. The ends of the bundle should be very gently heated in a cool blue bunsen flame, with the air vent one quarter open, to seal and polish. The whole bundle is then gently taken through the flame to reduce the heat shrink sleeving down to the diameter of the bundle.

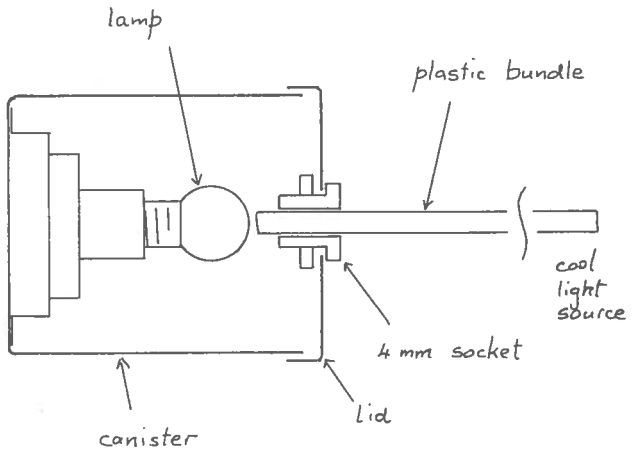

Fig.1 - Lamp housing and light pipe

Caution Plastic fibres are easily set alight, the fire rapidly travelling down the fibre. Be canny with the heating. Do not work with other flammables nearby.

The light pipe is now complete. The lamp should be mounted in a sealed housing (Fig.1) so that the viewer is not dazzled by its light and can adjust his/her eyes to the much reduced intensity coming out of the cool light source.

The lamp housing can be made from an empty metal or plastic canister such as a pill box. A 4 mm socket is modified to act as a gland for ducting the fibre bundle into the canister. The socket end is sawn off and the 4 mm diameter conducting collar removed. About two turns of p.v.c. insulating tape is wrapped round the bundle end to pad it out such that it makes a tight fit inside the barrel of the socket.

It is imperative that as much light as possible enters the plastic fibres. To achieve this the lampholder should be mounted so that the lamp is very close to the end of the bundle. The dimensions of the mounting jig will depend on the size of the canister. A 12 V, 2.2 W lamp is suitable.

The bundle will be flexible, but users are warned against bending it repeatedly as this can cause some displacement of the fibres relative to one another and may eventually require both ends being repaired.

Materials

item	supplier	cat.no.	price
unclad plastic fibre 1 mm dia. 10 m len.	Quantum Jump		3.03
heat shrink sleeving 6.4 mm dia.	RS	399-524	5.13
4 mm socket (10)	RS	444-618	1.94
MES lampholder (5)	RS	564-891	3.26
MES bulb 12 V 2.2 W (10)	RS	586-217	1.50

* *

Jig for sharpening screwdrivers

The trick is to run the edge being sharpened along a flat stone in such a way that the shaft of the implement is held at a constant angle with the surface of the stone (Fig.1). This is the principle behind commercially available,

adjustable, honing guides for sharpening chisels and blades from other woodworking tools. Such guides may not easily accommodate smaller tools such as electrical or instrument (watchmakers') screwdrivers. Described here is a cheap and cheerful jig for use with small tools.

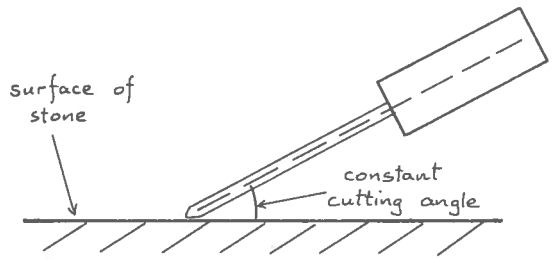

Fig.1 - Constant cutting angle

The dimensions given are suitable for sharpening small electrical screwdrivers. The materials required are a pair of ball bearings and a short length of rod, either metal or perspex, whose diameter is that of the internal dimensions of the bearings. A shaft size of about 12.5 mm is suitable.

The rod is cut to a length of 5 cm and a hole (AB) (Fig.2) is drilled transversely through the centre of the rod. The diameter of this hole should be large enough to allow the passage of the screwdriver blade. A second hole (CD) of diameter 3 mm is drilled at right angles to AB to meet the first hole in the centre of the rod. Hole CD is threaded with a 4 BA tap.

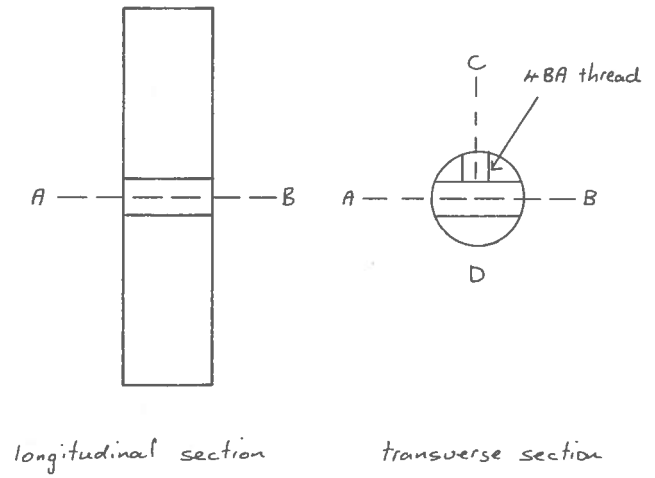

Fig.2 - Preparation of rod

With the bearings fitted to the rod the jig is ready for use (Fig.3). A 4 BA screw in hole CD clamps the screwdriver in place.

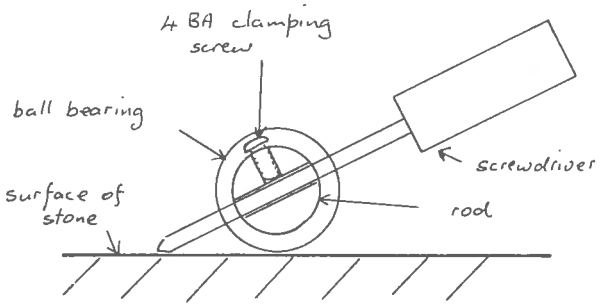

Fig.3 - Jig in use

A change in dimensions obviously will accommodate other sizes of blade. For those with sets of same-size screwdrivers to sharpen, the idea can be extended. A longer rod and as many holes as the width of the stone will allow is the obvious route to further time-saving. We used this trick to make up sets of insulated, plastic-bladed tools for use as 'trimmers' for adjusting potentiometers in servicing and repair work.

* *

Mixing of aquadag

Commercially prepared aquadag is available at low cost, but for those who are interested in preparing their own, and from enquiries we know some are, here is a pointer to the recipe.

The major ingredients are an extremely fine powdered form of graphite or unflocculated graphite and water. The problem when the powder is mixed with water is that it tends to settle. To prevent this one should add a little tannic acid either in chemical powder form or, if you fancy an old fashioned practice, using a strong brew of tea. We have tried the chemical powdered form and have achieved the desired result in that the graphite remains in suspension. However the grain size of the graphite we experimented with was too large to give a suitably smooth coating on a slide.

TRADE NEWS

New Scottish company

We are pleased to note the appearance of a new Scottish company, djb microtech limited. This firm specialises in packages for use with the Unilab Interface Unit and BBC microcomputer. The firm is starting with two products:

capacitors and d.c.
inductors and d.c.

Both contain teacher's notes, students' worksheets and disk based software to support experimental investigations with the Interface and to relate to specific objectives in the Higher Physics course.

The price per package is £17.50 with post and packing £1 extra.

Something new, something old

J.R.Moore specialises in the invention and manufacture of mechanical models to demonstrate the properties of waves. This year's model has yet to be given a proper name (far less a catalogue number) so we will call it 'sine wave'. We can reveal that it is priced at £37. The model demonstrates the effects on amplitude of superposition. An ingenious contrivance.

VELA

Some of the Mark 2 Velas which were supplied under the DOI scheme appeared to give limited resolution on the y-axis when recording voltage. If any school has one of these instruments which suffers from this problem they should write to the manufacturer, Educational Electronics, who have offered to supply, free of charge, a small piggyback board which plugs into the A-to-D converter socket within the instrument.

Whilst on this subject, the Vela Users' Group Newsletter contains a range of ideas on experiments to interest teachers of Biology, Chemistry and Physics. It is well worth the annual membership fee of £1.50.

Electronics kits

Omega Electronics produce a range of single function, modular boards for use in teaching electronics. Bottom of the range is a set of boards each carrying a single component, e.g. motor, pushbutton switch, reed switch, LDR, etc., which might be of use in S1/S2 electricity and in O Grade Physics. For ages 14 upwards, there are boards aimed at teaching digital concepts and for undertaking projects. Units comprise logic gates, timing and counting devices, latches, a shift register, RAM, drivers, etc. There is an emphasis on 4-bit processing and the system is complemented with a 4-bit output interface and 4-bit input to link with either BBC or RML computers. The system will therefore support both hardware-only and hardware-software solutions to problems. There is a set of booklets which could form the basis of a series of short courses with these boards.

Directly comparable to the Omega range are the Philip Harris Electronics Modules. Their 11-13 modules consist of boards with single components and offer three alternative types of connector: Worcester circuit board mounts or units with either 2 or 4 mm plug connections. Meanwhile their 13-16 modules, available with 2 mm plug connectors only, feature NAND gates, counters, displays, a latch, a decoder and a memory unit. Again the emphasis is on 4-bit processing. A teaching manual is also available.

One question we have been asked a number of times this session is to indicate the next step beyond that which can be achieved with the kits just described. There are a number of kits which, whilst primarily aimed at the FE market, could be that next step and should not necessarily be regarded as being beyond school level.

A young Glenrothes firm, Delcomm Microcomputer Systems Ltd., market a range of interesting, advanced, teaching packages chief of which is the R.C.S. Microsystems 'Eleven-Q' FORTH education package costing £325. This is a self teaching course with microcomputer hardware (based on the enhanced 6502 processor, the R6511Q) and concentrates on control applications. The programming language is FORTH. Also very relevant,

the 'Eleven-Q' Interfacing Control Learning Pack (£270) has a series of single function boards including a 6522 I/O board, an A-to-D board and a D-to-A board. A version of this interfacing pack is to be developed for the BBC computer.

Changes of name

A number of subsidiaries of BDH have undergone internal reorganisation. In some cases this has simply resulted in a change of name only, but in others also in function and range of products.

Macfarlane Robson simply becomes BDH Ltd., but provides the same product range as before from the same addresses in Glasgow, Aberdeen and Blaydon-on Tyne. BDH Chemicals Ltd. also change theirs to the same, BDH Ltd., with Hopkins and Williams becoming the Industrial Group of BDH Ltd. The only subsidiary to retain its name is Baird & Tatlock, who will now be concentrating on sophisticated laboratory instruments of the sort more relevant to research and tertiary education laboratories than to schools. Their present interest in consumables passes to other apparatus divisions of BDH.

So future orders for chemicals and general apparatus should go to BDH Ltd. at the old Macfarlane Robson addresses.

McQuilkin and Company, based in Glasgow, have been supplying apparatus and chemicals to the education sector and to health authorities for many years. Their consumables catalogue for 1986/7 will be published later in the year. Equipment and instrumentation are supplied by McQuilkin Instruments Ltd. and backed up by their technical service.

Changes of address

At the beginning of the year Griffin and George moved house from Alperton to Loughborough. Their new address is given on the inside cover.

We still receive enquiries from schools finding difficulty in contacting Radford. The present address for Radford Laboratory Instruments Ltd. can also be found on the inside cover.

Payne Scientific, a general laboratory supplier, is another firm who have recently moved.

Just after publishing details in Bulletin 146 about Mendascope Ltd., the firm which specialises in the repair and recalibration of all makes of oscilloscopes, the company shifted premises to Llangollen in Clwyd. Details of their services are as described before.

Another takeover

Behind the ballyhoo over the Argyle Group, J. Arthur Bell, Distillers, Guinness, Westland, etc., we have another takeover to report. This concerns **Panax** who some years ago were taken over by Rotheroe and Mitchell who themselves have recently succumbed to the clutches of Negretti Automation. Anyone with a technical enquiry about Panax products, or wanting items serviced or replaced, should contact Rotheroe and Mitchell at their new Aylesbury address.

Expanded range

Galbraith Laboratory Supplies, long renowned for supplying marine specimens, have greatly widened their range of products to include chemicals, glassware and much laboratory instrumentation. Their 1986 equipment price list is available.

Spillages

Spillage absorption granules available from BDH mop up their own weight of liquid spills and are stated to be satisfactory for virtually all chemicals, thus removing the need for the keeping of different adsorbents for each type of chemical. The few exceptions are mercury vapour which is not adsorbed at all and, one not likely to be found in schools, hydrofluoric acid. The latter reacts with the otherwise inert silicates. Prices of 1kg, 3kg and 15kg packs (Cat. Nos 33237 5A, 33237 6B and 33237 8D) are respectively £6.90, £15.20 and £60.

Second-hand equipment

A Bristol firm Severn Sales publishes, at regular intervals, a catalogue listing all manner of second hand laboratory apparatus. Their prices are much dearer than SSSERC tends to charge for surplus, some examples from the most recent list being:

Edwards Speedivac belt dr. pump	£120;
Gallenkamp magnetic Stirrer/hotplate	£50;
WPA colorimeter + 6 filters	£70.

If you are hunting for Hach Field kits, a UV/visible spectrophotometer, mechanical balances weighing to 0.1 mg for £200 or gas chromatographs it may be worth looking in this catalogue.

Parts for Torbal balances

Torbal sold many balances before going out of business several years ago and spares are not easy to obtain. Anyone seeking spares or rather a repairer who stocks spares should consult Northern Balance Consultancy. The firm services all makes of balance, including Torbal, and do visit Scotland at weekly intervals.

Two-way valves

They keep telling us that inflation is low. One example of this are those minature two-way valves from Gordon Keeble which for many years sold at £2.75 each. They will now put you back £3.00 per valve, but are sold in packs of 6 (cat. no. GK14). Syringes with luer fittings attach directly to them, thereby making a small force pump or a repeating liquid dispenser for measured volumes. We have found countless uses of it, two examples being illustrated in Bulletins 78 and 89.

Glassblowing again - repair of condensers

In Bulletin 143 we mentioned one example where it was possible to obtain custom made glassware which was no longer available 'off the shelf.' Among items often broken are the water inlet or outlet connection arms on liebig condensers.

Careless pupils sometimes break off these arms in endeavouring to detach the tubing. We would recommend that the rubber tubing is not removed after use, but is stored by wrapping it round the condenser.

Repairs to these and other glassware can save money. One example of a quote given to us by Thomas P. Young for repairing and/or converting a liebig condenser to take the Bibby plastic hose connector was £6. This conversion replaces the existing outlet and inlet arms with threaded outlets to which the hose connectors can be easily screwed or unscrewed. Small condensers cost about £6 and are probably best replaced with new, but the larger, more expensive ones are worth repairing. Other items which T.P.Young will repair include Dreschel heads for gas wash-bottles, chromatography columns, or dropping funnels. Burettes with broken jets can be fitted with PTFE stopcocks for £4. The cheapest Class B burette with a PTFE tap costs about £6.

Special items such as multi-entry flasks for biotechnologists or brewers are made to order.

Another glassblower prepared to carry out similar work is Multi-Lab of Newcastle-on-Tyne.

* *

Microtechnology Inset Team

Whilst not in the proper sense being Trade News, we thought that readers might be interested in obtaining resources developed by the Microelectronics Education Programme (MEP) of England, Wales and Northern Ireland, now sadly no longer in existence. The Electronics and Control Technology Domain of MEP brought out a range of publications which could be very relevant to Scottish teachers interested in this field. These publications are all still available. Enquiries should be directed to the Microtechnology Inset Team, which is a short-term programme staffed by a number of former, key, MEP employees.

* * * * *

Mendascope Ltd., Camhelyg Isaf, Glyn Ceiriog, Llangollen, Clwyd LL20 7PB; Tel. 0691 72597.

djb microtech ltd., 22 Broomberry Drive, Gourock, Renfrewshire PA19 1JY.

Microtechnology Inset Team, Ronsella, Lordswood, Highbridge, Eastleigh, Hants. SO5 7HR;
Tel. 0703 617627.

J.R. Moore, 95 Swann Lane, Cheadle Hulme, Cheadle, SK8 7HU; Tel. 061 485 5654.

Multi-Lab, Unit 3, Riversdale Court, Newburn Haugh Industrial Estate, Newcastle-upon-Tyne, NE15 8SG;
Tel. 091 264 6801.

Northern Balance Consultancy, Greens Farm, Consett Road, Lobley Hill, Gateshead NE11 0AN;
Tel. 091 488 2881.

Omega Electronics, 12 Oxhill Road, Middle Tysoe, Warwicks.; Tel. 029588 455.

Payne Scientific, Hillside, Slough, Berks. SL1 2RW; Tel. 0753 72353.

Quantum Jump Ltd., 98 Queens Drive, Mossley Hill, Liverpool L18 1JN.

RS Components, PO Box 99, Corby, Northants. NN17 9RS; Tel. 0536 201201.

Radford Laboratory Instruments Ltd., 47a Clifton Road, Weston-Super-Mare, Avon BS23 1BW;
Tel. 0934 416033.

Rotheroe & Mitchell, Stocklake, Aylesbury, Bucks. HP20 1DR; Tel. 0296 5931.

SCDS, Dundee Centre, College of Education, Gardyne Road, Broughty Ferry, Dundee DD5 1NY;
Tel. 0382 201201.

Severn Sales, 36 Moon Street, Stokes Croft, Bristol BS2 8QE; Tel. 0272 425770.

Unilab Ltd., Clarendon Road, Blackburn, Lancs. BB1 9TA; Tel. 0254 57643 or 57644.

VELA Users' Group, care of J.K. Jones, Physics Department, University of Leeds, Leeds LS2 9JT.

Waverley Secondary School, 120 Summerhill Road, Glasgow G15 7LD; Tel. 041 944 1171.

Thomas P. Young (Scientific Glassware), Queens Lane, Bridge of Allan, Stirlingshire; Tel. 0786 832137.

S.S.S.E.R.C.

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