SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

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Introduction

Congratulations, thanks and farewells

To Ian Young, until recently Science Adviser for Argyll, Bute and Renfrew divisions of Strathclyde, and by now in his new post at the Scottish Health Education Group. Ian has been Science Adviser member and chairman of SSSERC's Planning Committee since 1979. This was a particularly busy time for that committee, with the introduction of a new Bulletin format and revised arrangements for drawing up the Centre's work programme. Ian made an invaluable contribution, chairing the meetings through very full agenda with great efficiency allied to informality and quiet humour.

A new science adviser member will now be nominated at the next meeting of the Scottish science advisers group and a new chairman elected at the next SSSERC Planning Committee meeting. Meanwhile we wish Ian as happy and fruitful an association with his new colleagues as we have enjoyed with him in his contributions to the work of this Centre.

At about the same time, we have had to say goodbyes to Eric Edington, senior technician at SSSERC. Eric was our longest serving member of staff, having been at the Centre almost since it opened in the sixties. Eric's work included making prototypes to our so-called designs. A technician and mechanical engineer of great depth and breadth of experience, he often made things bearing no resemblance to our original sketches - but infinitely superior in operation.

A technician of the old school, having come up the hard way as a time-served instrument maker, brass finisher, tool setter and scientific model maker; he had none of the benefits of modern formal technician training. Our experience of working with Eric has taught us to judge folk by what they know and can do, rather than by the height of any pile of certificates.

One of his great talents in making d-i-y apparatus for publication was to put himself in the shoes of any less skilled technician or teacher in the schools. Perfectly capable of producing highly finished articles, of complicated construction, he would instead look for the lowest acceptable denominator. He would then construct the apparatus using the simplest possible techniques, consistent with the article doing its job and being sufficiently robust for school use. A job was rarely done without thought for those others with only basic skills and access to simple hand tools.

Eric is at his best though, when untrammeled by such restrictions. Allowed to use all his skill at bench, lathe or milling machine and his own ideas, he made some marvellous things. A standing joke at SSSERC has been that if you wished to automate some dull clerical task, you waited for a staff shortage and got Eric to help out for an hour or two. He wouldn't stand it for long before disappearing into the workshop to make a suitable machine. As a result, we have our own unique document folder, powered stapeller, power driven duplicator and film cassetter, to name but a few. These were all beautifully and quickly put together, largely from surplus or scrap materials.

We shall miss him. We wish him and his wife a marked and rapid improvement in their health so that they may enjoy the happy retirement they both have earned and deserve.

Saturday morning opening

Saturday morning opening will restart on the first two Saturdays of each month from 9 am to 1 pm as from, and including, the 3rd September.

Safety Notes

The attention of readers is drawn to the recent announcements from the **ASE** Laboratory Safeguards Sub-committee published in "Education in Science", June 1983. These covered the following subjects:

- "12V immersions heaters: an explosion" (see also SSSERC Bulletin 114)
- "Evacuated bell jars: implosion risk" (see SSSERC Bulletin 132)
- "Cleaning combustion tubes" (deals with problem of potentially hazardous contamination e.g. with magnesium silicide).
- "Laboratory centrifuges" (deals with new British Standard).

Lack of copy space in this issue allows our further amplification of only this last item.

Laboratory centrifuges

The recently published British Standard specification "Safety Requirements for Laboratory Centrifuges" (BS4402:1982), does cover small bench top centrifuges of the type used in schools. However, we are anxious to ensure that schools and education authorities avoid overkill in reacting to its provisions. We would stress the following important points:

(i) a British Standard is not a regulatory document in the strict legal sense. It represents a consensus of informed technical opinion, so giving a guide to accepted good practice.

(ii) manufacturers are not obliged to design and make centrifuges to the new standard. However in the event of any accident involving a centrifuge made after the publication of that standard, its provisions would have relevance in any action against a manufacturer or supplier under Section 6 of the Health and Safety at Work etc.

Act. In practice therefore, nearly all manufacturers have already complied with, at least the draft version of, BS4402. Changes have been made in the standard since it was first circulated as a draft and some models may be being slightly remodified to meet the provisions of the final standard.

iii) most centrifuges already in schools will not comply with the standard in every respect. There is no statutory requirement, as far as we are aware, that they should so conform.

iv) notwithstanding (iii) these older models may well be judged by HSE Inspectors or safety officers in the light of the new standard. It is thus important that the limits of the application of BS4402 to typical schools centrifuges be understood. This is in order that "reasonably practicable" measures are taken and undue expense be avoided.

(v) the more onerous and thus expensive requirements of BS4402 apply, sensibly, to centrifuges with rotors of relatively high mass and velocity and thus high rotational energies. Breakages and/or loss of control etc. in such machines could clearly have very serious consequences. Fairly massive cases, positive braking and interlocks and strong fixings to bench/floor clearly make sense in such a context.

(vi) bench centrifuges in Scottish schools however may have maximum rotor speeds of say 3000 revolutions min^{-1} and all will have maximum rotational energies of much less than 1kJ. (The EiS article quotes 2400 rpm maximum and less than 0.1kJ as "typical" figures). The require-requirements for this type of equipment are less onerous.

vii) As we understand it, positive interlocks (preventing opening of the lid until the rotor speed is less than 6 revolutions min^{-1}) are not absolute requirements at these relatively low energies (less than 1kJ). Some new models may have such a device of a simple type and may also have a simple braking system. They are not however required to have such devices if the maximum rotational energy is less than 1kJ. (The actual words used in BS4402 are "shall" for energies greater than, and "preferable" for energies less than, 1kJ). A new model without interlock and brake can be purchased and they should not have to be added to older models already in use. Those who advise otherwise should, we think, be challenged for the basis of that advice.

ii) likely problems in practice should be more prosaic:

- very old models may have naked swing-out rotors or angled heads. These should be suitably enclosed in a stout casing capable of containing any fragments resulting from rotor failure. At the low rotor speeds usually involved, a plywood or blockboard case may be all that is needed. If this is not practicable the centrifuge may have to be withdrawn from use.

- it may be necessary tc improve catches and fit cut-out microswitches to lids.

- some simple means of clamping the centrifuge case to the bench may be needed. Mounting it on a board that can in turn be G-clamped to the worksurface should suffice.

Sodium lamp holder

We have received the following item of information from **Griffin and George** on the Gallenkamp Sodium Lamp, Griffin catalogue number LCH-600-Q:

> "I am writing to tell you of an incident which occurred at a school where a pupil using the above Sodium Lamp in an experiment with a spectrometer, received an electric shock when the shade came into contact with the pins of the lampholder.
>
> The shade was being twisted to align the aperture with the spectrometer when the two halves of the lampholder separated and the metal shade made contact with the live pins. The position of the shade should have been adjusted using the bosshead on the lamp support rod.
>
> Constant twisting of the shade in use had caused the clamping ring holding the two halves of the lampholder to become unscrewed and eventually to fall apart (see enclosed diagram). This exposed the live pins which came into contact with the shade being held by the pupil. Fortunately he was not badly hurt.
>
> The lamp had been in use in the school for about 2½ years.
>
> No similar incident has been reported to us on any of the hundreds of units sold.
>
> It is unlikely that a similar incident will occur but to make teachers aware of the possible danger we are affixing a warning label to the shades of all the sodium lamps in stock. (sample enclosed):
>
> WARNING
>
> DO NOT TWIST SHADE
>
> ADJUST LAMP POSITION USING
>
> BOSSHEAD ON SUPPORT ROD

Further copies are available to teachers who wish to fit them to lamps they may already possess. Perhaps you could include this in your next safety bulletin.

A design modification is being put in hand so that the shade will be held in position by the lamp support arm and not by the shade ring on the lampholder."

One additional d-i-y modification seems sensible to us. A simple safeguard would be to add a separate earthing point and a yellow/green earth wire preferably on a crimp terminal to the shade itself. Earth continuity would then be safeguarded even if the shade became detached from its holder.

* * * *

Foundation Science Notes

Wave power

Three alternative model devices for producing electricity from the energy of waves are illustrated below (Figs. 1-3). Two of these models (Figs. 1 and 2) are developments of, and we hope improvements on, designs first put forward in the Lothian and Dunbarton examplars for the core topic "Energy". Constructional details are given in the "Workshop" section of this issue.

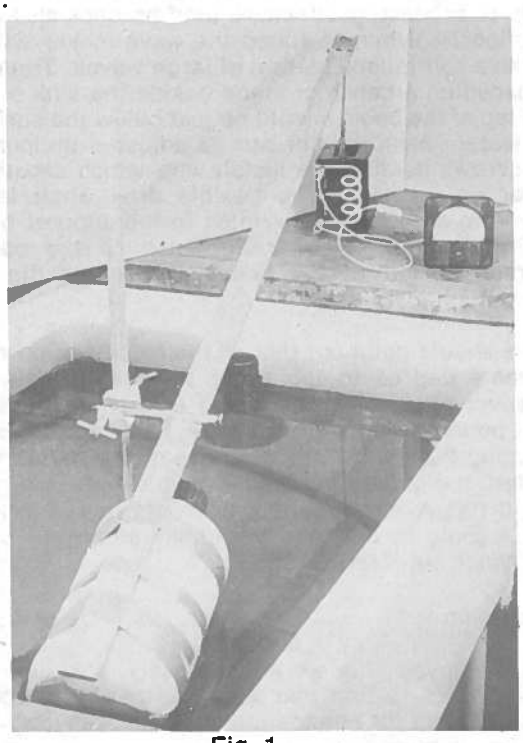


Fig. 1.

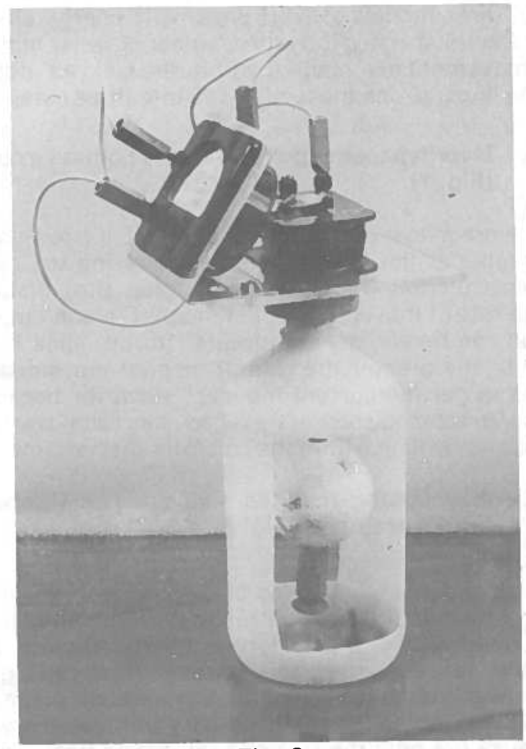


Fig. 2..

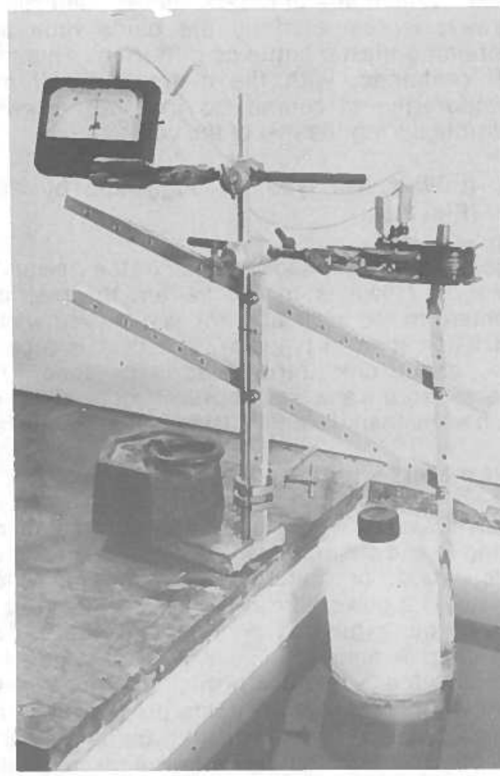


Fig. 3.

All three models convert the kinetic energy of waves into electrical energy, by the transfer of water motion to the movement of a magnet within the coil. As indicated in the illustrations the models fall into three categories.

a) **lever type**, as suggested in the Lothian examplar (Fig. 1).

Here a float is attached to one end of a lever with a magnet at the other. Clearly by altering the ratio of float/fulcrum (ff) and float/magnet (fm) distances, the rate of movement of the magnet in and out of the coil can be varied. The greater fm becomes relative to ff, the greater the rate of magnet movement and the larger the current induced. However because of the greater distance travelled for each wave, the magnet will be within the coil for a shorter time.

b) the **bobbing float**, as suggested in Dunbartonshire's examplar (Fig. 2).

In this model there is clearly no magnification of the float movement. A magnet is mounted on the 'upper' side of a polystyrene sphere. Ballast, in the form of a large bolt, prevents capsizing and movement is restricted to the vertical plane by a tubular guide. This is necessary because the waves, cause not only the rise and fall of the float but also, exert a violent lateral force. The resultant rolling and leeway, is restricted by the guide tube and the containing plastic bottle or guttering. This model is self contained, with the meter and coil attached (temporarily, of course, so that use elsewhere is possible during the rest of the year).

c) **trailing arm type**, as suggested by SSSERC, (Fig. 3).

Again there is no magnification of the rise and fall of the waves. However in this variant the restriction of movement to the vertical plane is achieved wich much less friction than in type (b). The float is a polythene bottle, about one third filled with sand. Thus it displaces more water and captures more of the energy of each wave than it would sitting just in the surface.

'Wave maker'

The necessary waves can be generated merely by dunking in and out of the tank/sink an L-shaped strip of plastic, wood, or metal. More fun, and a lot less tiresome, is a powered device. We had need of such a device for our exhibition work, so as to avoid 'dunkers' elbow when demonstrating our models. The device may also have wider use outwith this "Energy" context. It may be of interest to those doing project work on other aspects of waves. Yet again the ubiquitous car wiper motor (see Bulletin 136) came to the rescue, with little modification or construction work required. (Fig. 4 - see "In the Workshop" for details of construction and Bulletin 136 for sources of motors etc.).

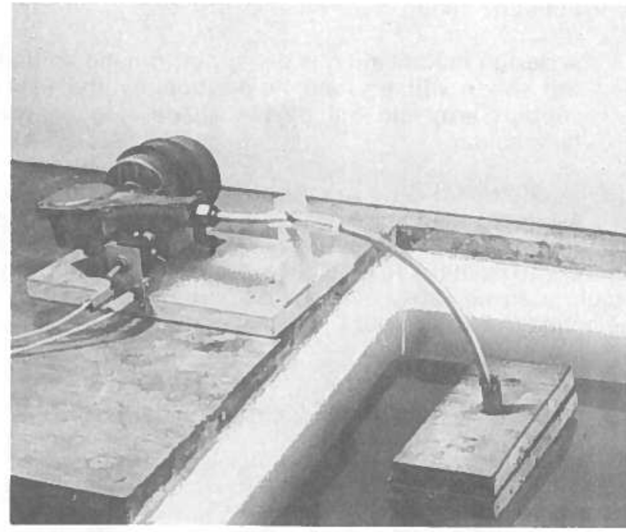


Fig. 4.

The speed of the motor, and hence the period of oscillation can be controlled by varying the voltage applied at the motor. We found that the period had to be tuned, to match the natural resonance of the sink or tank, to produce good waves (and perhaps also a very wet floor!). When so tuned the wave maker will give rise to a continuous pattern of large waves. The device is placed on a bench or stand beside the sink or tank. The top of the boom should be just below the surface of the water. Boom height can be adjusted by loosening the screws holding the saddle clip which secures the motor on its base. The flexible drive shaft is then moved to an appropriate notch in the support bracket and the clamp screws retightened. If the boom is submerged too deeply water may enter the drive mechanism.

We should point out that all the models are sensitive to some degree to the water level in the sink etc. However after a little trial and error the things soon start bobbing up and down nicely with meter pointers whizzing back and forth. Because of the nature of the motion, the generation is of a.c. so centre-zero meters (100-0-100μA7 are required. Currents well in excess of 100μA could be obtained from generators type (a) and (c). Watch out NSHEB/SSEB!

Discussion

We enjoyed this work immensely. We felt a bit guilty, not sure that this stuff was really for schools, especially not for Foundation pupils. It was far too real and far too much fun!

Seriously though, we would congratulate the author teams of the two "Energy" core topics for including this work. It has great potential. The designs shown here are only slight developments of their original suggestions. We have only scratched the surface. The possibilities for extension work by pupils are evident. As with wind power (Bulletin 135), friendly rivalry in producing grèater current output or greater efficiency may produce some useful motivation. How about seeing who can light a lamp or l.e.d. first?

The other useful aspect of the work is that it provides a link with engineering and real-life problems. Try, for example, leaving your "bobbing float" model set up for a few days in a sink full of tap water. That would teach you not to use a mild steel bolt as the ballast! Such a mistake could teach more about corrosion than a whole ranked regiment of wet nails in test tubes.

Metal bending apparatus

There is a requirement for such an apparatus in the core examplar "Materials" (Lanark version). Commercial devices are available. However we were requested to provide a d-i-y design so that those who wished to do so, might construct their own tester. The device shown below (Fig. 5) and described in more detail in "In the Workshop", is a development of an idea from a sketch given in the "Nuffield Secondary Science" publications.

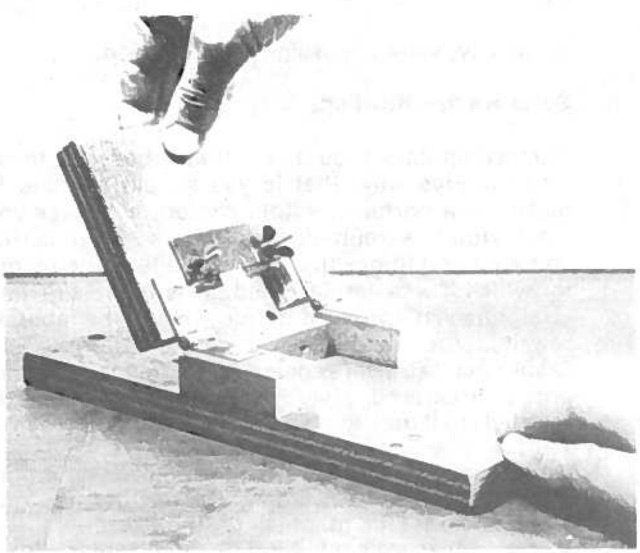


Fig. 5.

Our d-i-y model is used to compare ductility in different metals. A strip of the metal under test is clamped to the base and handle. The latter is then moved to a fro' through 180° until the strip breaks. The number of complete movements is recorded. The process is then repeated with identical strips of other metals. For example we recorded the number of 180° movements required to break aluminium and mild steel strips as 7 and 40 respectively.

The cheapest source of metal strips is probably as offcuts from the school technical department. It may be worthwhile where there is a regional science centre for sheets of metals to be purchased and guillotined into suitably sized strips. For the design given here the strips need not be as long as those required for similar testers from commercial sources. Spare strips for such testers are available. For example Griffin and George sell packs, each containing 12 metal strips (aluminium, aluminium alloy, brass, copper and steel) each measuring 12 x 300 x 0.7mm (22 swg). The brass and copper packs (Cat. nos. MBW-420-110V and MBW-420-150J) sell at £3.84 and £4.59 each respectively. Packs of each of the other three metals cost just over £2.00 per pack (Cat. nos. MBW-420-030T, -070H and 190U).

* * * *

Interfacing Notes

We are taking a short break from the series of articles on the BBC Model B. Part 3 of that story will appear in Bulletin 138 and will cover the use of the "Analogue in" port.

In this issue we balance the d-i-y coverage with information on a range of commercial interfaces. This is to meet an increasing demand for information and opinion on this type of equipment.

Review of microcomputer data capture devices

This article will describe and discuss features of some of the data capture devices that have come on the market this year. Its purpose is constructive criticism, to point to and encourage what we see as worthwhile features and warn you of, and discourage, bad ones. The article thus seeks to serve two functions. Firstly it is a crude buyers' guide and secondly tentative, ideal specifications for designers and manufacturers of commercial interfaces for school use. No one else, as far as we know, has had the temerity to suggest such 'specs'. Still, we have stuck out our necks before! The article does not cover stand-alone data capture devices such as the Harris Data Memory, WPA Memory Meters etc.

We start with a general discussion of microcomputer data capture features and finish by reviewing those devices which have come our way.

General discussion

For those not familiar with the world of electronic measurement - the key process is the measurement of voltage. All physical quantities can be converted to voltage by means of a suitable transducer. The mechanism which converts from voltage into the digital signal that the microcomputer understands is called an analogue to digital converter. We shall call it an ADC for short. Microcomputer data capture devices contain ADC'S. In their narrowest sense these are voltmeters, but in their wider sense they are multimeters where "multi" means just about everything.

In addition to enabling you to record analogue signals (voltages) some data capture devices also enable you to measure time intervals and to count pulses. Features to look out for include:

1. **Modes of data capture**

   As described above the device may, in addition to measuring voltage, be able to measure time intervals and count pulses. These latter features will chiefly interest Physics teachers.

2. **Number of channels**

   A one channel device will give you a record of voltage against time. It scores over multi channel devices on price and simplicity. (Simplicity is the number one feature).

   A two channel device should give you the opportunity of plotting one variable against another in addition to plotting two variables against time. Not all do.

   There are multi channel devices on the market. They are of interest for biological, environmental studies, chemistry and project work.

3. **Sampling frequency**

   A fast ADC will sample at a rate of 1MHz or better; a slow one at 100Hz. However microcomputers take time to process data and control the ADC. This limits fast data capture to about 125kHz. Working at this rate you should be able to display signals at frequencies up to 10kHz, say, and analyse signals up to about 50kHz using fast Fourier transforms.

   Some devices reject or reduce signal noise by sampling several values and averaging. This slows down the capture rate but will usually improve the signal.

   At the other end of the scale you may want to use the device for long term data capture work. The software should allow you to operate at any frequency from the maximum down. In general physicists will particularly want a fast ADC for storage oscilloscope use, chemists a slower ADC and biologists, those of them not apoplectic at the sight of anything with more than two wires, will, as always, want everything (very fast to very slow, multi-channel, etc.).

4. **Software**

   The device must be accompanied by good software. To appreciate the scale of this aspect one manufacturer quotes the production costs of hardware vs. software at 50/50. It should be possible to execute most instructions by single keystrokes. There should be cues to remind the user of these instructions, either on an introductory menu or appearing as prompts, as and when necessary. If there is a menu it should be attractive and easy to operate. The menu in Educational Electronics Measurement Module carries 20 items. That is a lot, but it works well. Decisions made are displayed above the menu and the user has the opportunity of editing his choice. It is important that the user feels that he is in control rather than watching with interest to see where he is taken. Certain data capture programs are more akin to a sixteenth century voyage of discovery than to a twentieth century journey with map and satellite fix.

   As we say, software design must be good.

5. **Software modifications**

   Microcomputers should, we think, be used in an emancipative way, that is you should be able to make them perform, within reason, whatever you want. Now the trouble with buying software is that you soon find things that you would like it to do but for which it was not designed. This is the software straightjacket syndrome. You should be able to rewrite the software to unfetter yourself. Commercial software should be written in a simple, open, structured style such that the user can restructure it and add his own procedures.

   One example to illustrate this point; you might want to add a screen dump to printer routine. Some devices lack this facility (the exceptions are VELA, Measurement Module and Meter Box). Therefore many users will want to add this themselves.

6. **Display modes**

   Three common display modes are:

   - large digital readout

- tabular
- graphic

Graphic displays warrant attention.

a) Real time display. This is not achievable for very fast data capture.

b) Scale, marked on graph with the option of dimming the graticule lines.

c) Axes, with the option of the x axis being central or along the bottom of the screen.

d) Superimposing graphs option.

e) Moving cursor option, the cursor can be moved along the graph with an x-y readout at the side of the display.

f) Scale change option, it should be possible to select this before data capture and to reset after data capture to change the size of the graph.

g) Windowing in, or homing in, on an interesting interesting feature on the screen.

We would suggest as a yardstick for judging the worth of a graphics display that it should be as readily manipulated as an oscilloscope trace and have many extra features. Few graphics displays to date reach above the boots of oscilloscope traces!

Beware of silly displays. One device shows an analogue meter display! We are aware of the arguments for this, but remain unconvinced. Analogue displays have the advantage of clearly showing both direction and rate of change. There are several ways of exploiting these features other than a screen drawing of a meter complete with pointer.

Range

As with oscilloscopes it should be possible to set the gain in steps of 1,2,5,10,20,50,100,etc. and to set the 'span', e.g. if working with a yeast culture whose pH varies between 5.5 and 7.0 you might decide to set the span within (another way of expressing this is "offsetting zero") these limits. This is a very useful feature, particularly for biology, where so very often you wish to examine a small change against a large background signal. It gives the crude equivalent of differential amplification.

8. **Sample Number**

The user should be able to select this. Maximum numbers on the packages we have seen are 250 to 400.

9. **Data analysis**

Two possible examples are outlined. Neither are available, though one such graph plotting package was on the market but has been withdrawn for further development.

a) step 1, data recorded in tabular form.
step 2, x-y graph plotted (points only).
step 3, curve fitting routine.
step 4, mathematical relationship derived for best fit curve e.g. to find the order of a chemical reaction.

b) data sampled repeatedly with histogram constructed in real time; average derived.

10. **Hardware design**

Again the feature to look for is simplicity. A one channel device should have one input. It doesn't require two inputs, nor switches, control knobs, etc. The three usual solutions to hardware design (assuming it is a one channel device) are outlined.

a) One input without controls. The internal hardware incorporates autoranging, bipolar devices capable of handling automatically almost any signal. This is simple to use.

b) Several inputs and controls such as

- general purpose input
- high impedance input
- special function inputs for accessories
- variable gain pot
- step gain switch
- set zero pot
- bipolar select switch

Here we suggest that the more controls there are the worse it is to work with. You have to bear in mind, however, that these features are extra facilities on your device which practice will make familiar.

The problem is one of familiarity. We are all good at operating oscilloscopes because:

1. we have been at it a long time (if you will pardon the phrase), and

2. every different make of oscilloscope has about the same set of controls (time base, X shift, etc.).

The controls on data capture devices don't share such catholicity.

c) One input without controls. The device handles one type of signal only and the user has to design and attach the hardware to interface his signal to the device. This is simple to work with if you are electronically minded, e.g. a pot to attenuate, a voltage follower for high impedance input, etc.

11. **Triggering**

The on-set of data collection is called triggering. It should be possible to achieve this in two ways, manual or automatic. In manual triggering the user would start the on-set by depressing a key. In automatic triggering the onset is started by a change in signal level. The user should be able to specify the size and type of transition for automatic triggering, i.e. whether positive or negative transition.

We should point out that a device must have an automatic triggering facility if it is required for use as a fast storage oscilloscope.

12. **Control**

An interesting field to forage in is that of operating experiments under computer control. You should be aware of the distinction between this activity and automatic data capture. The latter is but a sub-set of the former. In computer control, the computer alters one of the variables, call it x, which it monitors continually. Variable x affects variable y (and z) which is (are) also monitored. Hardware requirements for this, which should be on board the data capture device, are:

- 2 (or multi) channel ADC
- digital to analogue converter (DAC)
- array of automatic switches

The computer controls variable x either by switching things on or off (heaters, motors, lamps, etc) with the automatic switches, or by altering the variable in a direct linear fashion with the DAC (Fig.1).

The Unilab interface has all such hardware on board.

13. **Open ended ("Free") usage**

The documentation should be such that a user with the technical know-how can readily operate the device in a freely original way.

14. **Memory**

There should be the facility for the permament storage of data. We suggest a two tier structure:

a) Stack storage, data is automatically stored on a stack which is four deep.

b) File storage, the user has the option of storing permanently, in a file, anything which is on the stack.

The user should at any time be able to recall data from the stack or from a file to superimpose over the current graphics display.

15. **Documentation**

Features which should be present are:

a) what is does,
b) description of the inputs and controls and how to wire it up,
c) the limits to which the device can be subjected,
d) how to load the software,

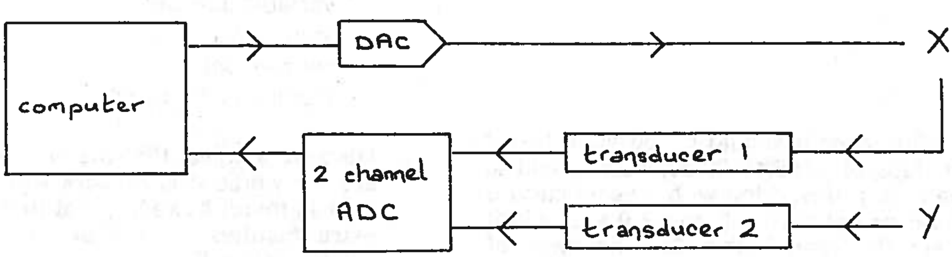


Fig. 1.

e) how to operate the software,
f) examples of use and applications,
g) technical descriptions of hardware and software.

16. **Ease of use**

It is possible to obtain devices, and most in this survey are in this category, which can be unpacked, and put into operation within a span of 30 minutes. You should not, with such a device, be expected to write software, nor indeed be at all knowledgeable about programming. Moreover neither should you have to make up connectors nor have other hardware assembly tasks.

17. **Protection**

There should be a certain degree of security in-built to the device which protects:

a) the microcomputer,
b) the device itself,
c) the user.

Whilst it is possible to make hardware more or less 'fullproof' (should it be foolproof?) the cost of this exercise is not worth paying. There should be protection against common mishaps such as over-voltage, by about an order of magnitude, wrong polarity and short circuiting outputs.

It may not be worthwhile paying for high voltage protection, (though watch inductive spikes), and a biological input. In connection with the latter if you already have biological amplifiers (which have opto isolation between input and output) they can be connected between microcomputer interface and transducer.

The main features of a range of commercially available devices are summarised in Table 1 below. In fairness to manufacturers and suppliers we have to point out that:

— caution is needed in comparing devices one against another and with our somewhat idealised 'specifications'. The devices don't all set out to achieve the same ends - a lot depends on what you want to do.

— the table includes nearly all the devices of which we have had some hands-on experience. Because of the variable nature of the equipment (see above) we were not able to follow our usual practice of submitting all the devices to the same standard test procedures. The table is an opinionative review **not** a test summary.

— the review does not pretend to be complete. The Centre cannot accept complaints due to ommissions, or errors thereof, or changes in specifications occurring since the equipment was examined. The field is expanding and changing so rapidly, that publication of specifications for various categories, over the whole range of available hardware, would mean no publication at all.

— The devices appear in table and review in the same order as that in which they were examined (deadlines, deadlines!). No hierarchy should be construed.

Safety

Only two of the devices are directly powered from mains supplies. The separate power supply for one of these devices was being redesigned. The other device contained a transformer with rectifying/smoothing circuits etc. Apart from a few minor features, mostly matters of opinion, the earthing and other safety arrangements appeared satisfactory.

These following notes are on each of the items tested and supplement the information contained in Table 1.

Measurement Module—Educational Electronics

from **Philip Harris**

P87284/8	Spectrum 48k	£148.40
P87286/1	BBC'B'	£134.40
P87288/5	380Z/480Z	£141.12

each with cassette software and connecting lead included.

(These are also directly available from Educational Electronics, along with versions for Apple and Apple 2E. Note that Philip Harris only supply the Measurement Module complete with microcomputer adaptor. Educational Electronics can supply the adaptor board separately so that the Module can be attached to other microcomputers and is, to a certain extent, future-proof).

This item merits attention for its simplicity of use. Educational Electronics are, in our opinion, one of the market leaders in developing easy to operate software. Most instructions are carried out with a single keystroke. The 20 instructions are displayed on a menu that is neatly designed and easy to work with. Each decision taken is logged at the top of the screen and you can edit this if you wish.

The device was developed for English 'O' level Physics courses. This explains its slowness in data capture as there is no call for a rapid data capture device if you want to restrict your experimentation to such a standard repertoire.

Name of device	Measurement Module	Single Channel A/D Interface	Harris A to D Converter for BB'B'
Manufacturer	Educational Electronics	Blackboard Electronics	Philip Harris
supplier	Philip Harris E.E..	Philip Harris B.E.	Philip Harris
microcomputer(s)	Spectrum 48k, BBC'B' 380Z/480Z, Apple, Apple 2E.	380Z, Pet, Vic, Oric, BBC'A', 'B', ZX81, Spectrum	BBC'B'
analogue channels	2	1	1
other data features	none	none	none
DAC	0	0	0
switched outputs	0	0	0
I/O lines	0	0	0
analogue sample time	0.5s - 1 hr	9μs -	33μs - 24 hr
sample number	240	not known	1 - 240
sample averaging	yes/peak reading	no	no
range adjustment	before sampling	before sampling	none
adjustable span	fixed	fixed	fixed
display	graph/table/lge dig [1]	graph/lge digital	graph/table/lge dig
comparison modes	y-t/y - x	y - t	y - t
graph scale	scale/graticule	no scale	scale/graticule
axes	x-bottom	x-variable	x-bottom/centre
superimpose	yes on y - x	no	yes
cursor x - y readout	no	no	no
window-in technique	no	no	no
memory	no [2]	no	yes [1]
data analysis	no [2]	no	no
analogue inputs	6	2 voltage/1 resistance	1
bipolar	no	automatic/y shift pot	switched
autoranging	no	step switch/gain pot	no
triggering	manual	manual	manual/automatic
calibrated	yes/peak reading	no	yes
simple to use [1]			
hardware	x x	x	x x x
software	x x x	x x	x x x
menu or cue	x x x	x x	x x x
keystrokes	x x x	x x x	x x x
free usage	x	x	x [2]
documentation	x x x	x	x x x
[1] the more crosses the better	[1] can alter resolution [2] under development		[1] can transfer data from table to graphh/can rub out all but last graph. [2] refer to technical description xxx by M. Summers, The Independent Schools Microelectronics Centre.

Meter Box	Microcomputer	I-Pack Interface
Cambridgeshire Ed. Comp. Philip Harris	Unilab Unilab	DCP Microdevelopments Ltd. Griffin
BBC'B'	BBC'B'	Spectrum 16 k [1] and 48k
1	4	8
none	timer/counter/freq	timer/counter/freq
0	1	0 [2]
0	4 at 1 amp	4 out/4 in
0	8	8 out/8 in
10ms - 100s	8µs upwards	200µs upwards
2000	up to 1500 [1]	200 [3]
no	no	no
before sampling	before/during sampling	no
fixed	fixed	fixed
graph/lge dig/analogue	graph/lge digital	graph/lge digital
y-t	y-t/y-x	y-t
scale	time only	y axis only
x-bottom	x-bottom/centre	centre/bottom
yes	not known	yes
no	no	no
no	no	no
no	no	no
no	no/under development	no
voltage/resistance	4	8
no	automatic	no
gain pot	yes, by software	no
manual	manual/automatic	automatic
no	yes [4]	no [4]
x x	x x x	x x x
x x x	[2] x /x x x [3]	x x
x x	[2] x /x x x [3]	x
x x x	[2] x x x/x x x [3]	x x x
x x	x x x	x x x
x x	[2] x /not out [3]	x x

Microcomputer:

[1] depends on program/memory
[2] original software
[3] UNICOS software
[4] several % out

I-Pack Interface:

[1] programs listed in booklet will operate on 16k RAM, however programs on cassette will not.
[2] supplied as accessory
[3] depends on program
[4] manual explains how to do this.

There are three display modes, but you cannot record data in the columnar mode then graph it. (Educational Electronics hope to incorporate this feature in a later version). Nor can you store data, though you can superimpose one graph on another. The range selection option is annoying. It goes in steps of 1,10,100, so it is a matter of luck if the trace fills the graphics screen, unless you tailor the input signal accordingly. We understand that a second generation software package will be available in the autumn which will incorporate the ability to store data together with other features such as windowing, cursor movement, etc.

The hardware inputs could be better designed. It has two DIN sockets for special probes and four pairs of 4mm sockets. As a two channel device it should ideally only have two inputs. We can excuse the specialised DIN inputs which are single function inputs, but the others merely sow confusion.

The device is claimed by Educational Electronics to be fully calibrated, a feature which few of its competitors even aspire to. Bear this in mind if you are interested in measurement. Also bear in mind that it measures power and energy in addition to more pedestrian quantities. Digital Joulemeters are pricey items. Temperature and magnetic field probes can be bought as accessories.

One last feature which we must point out, as it is reflected in the price of the Module, is the high degree of protection circuitry on board, both to protect the microcomputer and to protect itself.

COMMENT Merits serious consideration if its range of functions meets your needs and your main desire is for easy to use software.

Single Channel A/D Interface Blackboard Electronics

from Philip Harris (and Blackboard Electronics at same price)

P97020	Interface box	£79.00

software and connecting leads are extra.

380Z	P87026/8	£13.50	P87065/7	£30.00
PET	P87030/9	9.50	P87070/0	20.00
VIC	P87035/9	9.50	P87068/2	20.00
BBC'B'	P87040/2	9.50		
BBC'B'	P87040/2	9.50	P87080/3	20.00
BBC'A'	P87041/4	9.50	P87075/9	20.00
ZX81	P87045/1	9.50	P87085/2	30.00
Spectrum	P87050/5	9.50	P87090/6	30.00
Oric	P87055/4	9.50	P87095/5	30.00

A fast A/D converter. The software is easy to use but there is a sense of unease in using it. You don't know what the instructions do but you get to know with practice what effect they have and there are mercifully few instructions anyway (we understand they are being rewritten). The graphics have no scale, (versions other than Spectrum), a bad omission.

There are 3 inputs, high impedance, moderate impedance and resistance. In addition there are four controls: two step switches and two pots (one of the step switches has two entirely different functions, as does one of the pots). The controls are confusing. This is not a device you can master straight off, nor make effective use of at infrequent intervals. On the other hand because there are these facilities you can manipulate signals so that they take up the size and position that you want on the display.

Software and connecting leads are sold as accessories though they would be required for standard use. Other accesssories are e.c.g. interface and temperature probe.

COMMENT Has drawbacks for the naive user.

Harris A to D Converter for BBC'B'

from Philip Harris

P89250/1	with cassette software	£49.50
P89260/4	with disc software	£49.50

Of all the devices we have tried this is the simplest to operate. On the hardware side there is one input and one switch (monopolar/bipolar). However this leaves you to tailor the magnitude of your input signal to suit its specification (0-5V or -5V to +5V) such as using an external amplifier to boost small signals.

The software is good. Most of the instructions are single key. They are all described in a well written handbook and you know that you are in control of the device as opposed to being taken by the nose. The display is divided into three quarters graphics, one quarter text, where cues for instructions are given. Instructions can be changed, once taken, if so desired.

The graphics display is particularly pleasing. It is easy to read off V - t values because it is scaled and has graticule lines. However the time axis always has 12 subdivisions so that if you are working with a maximum time of 1.0s then you get awkward interpolations. The maximum time depends on 2 factors, both under your control, sample time and sample number.

You can superimpose several graphs and have the facility of scrubbing out all but the last one drawn. Another feature we like is that of switching from table mode to graphics mode with the same set of data, a simple feature which we haven't seen in other devices.

COMMENT An apparent "good buy" with good software and ease of operation.

Meter Box Cambridgeshire Educational Computing

from Philip Harris

P87100/5	Meter Box for BBC'B'	£33.00
P87105/4	Software	£8.19

A simple, one-channel (voltage or resistance), data recording device which gives three displays: large digit, analogue and graphic. The analogue display is controversial. There are occasions in measurement where it is necessary to use an analogue display such as monitoring a variable while it is changing; the flicker which is characteristic of a digital display being unacceptable. Whilst it seems crazy to use a microcomputer for an analogue display, there is a paradox. It isn't. The microcomputer can be programmed to provide any sort of display and the more facilities available at the pressof a button, the more powerful the package. See however our comment under 6 on p.11

The device uses the internal ADC in the BBC 'B'. Therefore its minimum sample time is 10ms which is slow. The user can, if he wants, calibrate the voltage scale using the gain control and a reference voltmeter. Changing range involves recalibrating and possibly adding a multiplier (resistance in series with input).

The designers have set out to make the device easy to use with adequate documentation, a cue card and a list of instructions on the screen. There is no mention, however, that data capture (in the graphics mode) is commenced by pressing the SPACE bar, an example of how a good design is rendered useless by a single omission. We also dislike being asked to select the range in the analogue and graphics mode to find the request being ignored.

One final quibble, its use is slightly limited in not handling bipolar inputs.

COMMENT Worth thinking about if you are looking for something simple.

Microcomputer Interface Unilab

532.001	**BBC'B'**	**£163.00**

As this is a complex device it merits a lengthy write-up. Dealing with the hardware first it provides

1. 4-channel analogue input with 8μs conversion time. The mode of operation, monopolar and bipolar, is handled by software as is the range selection. You can choose from 3 set ranges, 0.1V, 1.0V or 10V, or from a variable range between 25mV and 2.55V. It can therefore be operated as an autoranging voltmeter.

   The device does of course have an automatic triggering facility, the trigger level being set by a pot.

2. One analogue output (DAC). This is extremely useful in experimental work because it allows you to control one of the variables. You will however have to add a bit of hardware to the analogue output for most applications in order to boost the power output. You could either use a high impedance amplifier or a 741 op amp with darlington driver (see "6502 Interfacing" pp87-88). It is a pity that Unilab did not include an output buffer with the DAC.

3. Four changeover relays rated 1A. Another very useful facility for automatic experimentation and control. However the relays would be more useful if they had a higher current rating.

4. Latches to the DAC and relays. This is important for process control so that a parameter or state may be set by the computer and then remain unaltered while analogue or digital inputs are monitored for changes consequent on that output state.

5. Eight digital I/O lines. The Unilab interface has a 6522 microprocessor (VIA) on board to which the 8 parallel I/O lines are wired up. The decoding circuitry is unusual and consequently software control is unorthodox since it depends on the quirkiness of the internal design. Unilab say they could have used more complex decoding circuitry to overcome this. It would have put the price up. Nonetheless it is a pity they didn't. We feel that users, because of these difficulties, may prefer to work directly with the BBC user port I/O lines.

6. Electrical protection. All the front panel connections have been protected against accidental misuse so that pupils can be allowed to operate the device themselves without much chance of harm.

7. Computer connection. The 1MHz bus terminal is used giving you the additional facilities of the user and analogue ports on the BBC for complex control work.

Hardware Summary

The Unilab interface provides all the basic facilities required for data capture, automatic experimentation and control. It comes in a robust box (sock you, Acorn), the user connections being 4mm sockets. Layout is good and despite the many terminals it is easy to wire up. Just regarded as a piece of hardware, forgetting for the time being the software that accompanies it, and in spite of our criticisms above, we think this is a useful buy if you have a BBC'B'. It is also the only available device in this review suitable for automatic experimentation with the BBC'B'.

Moving on now to the software which Unilab provide with the interface we would draw your attention to the difference in approach between this and software for the other devices reviewed.

1. There is a suite of programs provided for data capture. This is for those of us who do not write such programs.
2. Technical information on software control of the device is provided so that you can control the device yourself by writing your own programs. We called this "free usage" earlier in the article, "free" in the sense of allowing you to do your own thing.
3. A special programming language called "UNICOS", on which development work is almost complete. This greatly simplifies writing your own control programs.

Going through these three approaches to software in turn:

We are not impressed with the suite of data capture programs. The suite comprises 18 programs on themes of timing, counting and analogue measurement. These programs are not as simple as they might be to operate. This is partly because program documentation is poor (sparse details), and partly because screen instructions appear one by one. It is another example of watching with interest to see where you are being taken and on more than one occasion your reviewer has resorted to a keyboard glissanda to get anything to happen.

We should couch our criticism in consideration of Unilab's viewpoint. They regard this first generation software as being primarily a "teach yourself interfacing" pack. They do not set out to produce idiot proof software, rather they expect users to construct their own software based on routines provided in their suite of programs. Second generation software is being developed, the first package of which, UNICOS, is reviewed below.

We welcome Unilab's approach to free usage. The instruction manual is aimed at this and provides a comprehensive guide to the control of the interface. The guide stops short of looking like something from the technical press. It does not have the interface circuit diagram, nor details of 6522 VIA control. This is probably a good thing in that those who need further information will know where to look.

UNICOS is an operating system for the BBC'B' and Unilab interface. It allows the user to control the interface without requiring either:

1. to program in BASIC or 6502 assembly language
   or
2. to understand how the interface is controlled.

Programming the interface with UNICOS is very simple and because the usual complexities of software control have been removed it will allow teachers, and especially pupils, to manipulate the interface in a highly creative way. It seems particularly suitable for solving problems in a computer control situation, either in technology/engineering or in automatic experimentation. In the latter field, by way of example, it takes a seven line 'UNICOS' program to ramp up the voltage across the base of a transistor, monitor both the base and collector voltages and plot these in real time. We repeat that this process is controlled by only seven instructions.

UNICOS operates on a BBC'B' with disk drive since it consists of a suite of programs which continually interplay. You can of course save programs, written with UNICOS, on your own disks.

COMMENT Universal hadware with minor design irritants. First generation software is poor, but second generation superb.

I-Pack Interface DCPMicrodevelopments

from Griffin and George

CRA-776-F	I-Pack interface	£34.77
CRA-778-530-K	cassette software and manual	£15.00

Available for Spectrum now and for BBC Model B in near future.

Although the I-Pack interface for Spectrum has been around for some time the cassette software and manual is not quite ready for release at the time of writing. We have however obtained pre-production software and manual and this, along with the interface, forms the basis of this review.

The I-Pack hardware consists of

1. 8-channel analogue input with minimum conversion time of 200µs using this software. It has a set range, 2.55V, and is monopolar. The manual gives a circuit of a variable gain amplifier with which to tailor an input signal. Input impedance is rather low (10k to 100k) and you can expect signal degradation for some inputs. Accuracy is ±20% and the manual explains how the device can be calibrated with a software conversion factor.
2. 4 relay outputs, single pole, single throw, rated 12V at1A. As we mentioned in the review of the Unilab interface, this 1A rating is not high enough to operate directly many standard laboratory items. The 4 relay outputs can be operated in parallel.

3. 4 switched inputs have been designed to operate (in a digital sense) with a variety of transducers, such as light dependent resistor or photodiode. There was a bug which appeared intermittently on reading the input register. The inputs should set or reset the 4 low order bits of the input register (63), but sometimes some of the high order bits were erroneously reset. This snag cannot be overcome by logical masking since the Spectrum's logical operators do not operate bit-wise on binary numbers. The instruction

```
LET x = (IN 63) - 240
```

should therefore be replaced with the following routine

```
100 LET x = IN 63
110 IF x <16 THEN GOTO 140
120 LET x = x - 16
130 GOTO 110
140 PRINT x
```

4. 8-bit input port and 8-bit output port. These are TTL compatible and unlike the inputs mentioned above, all of which have 2mm sockets, the two 8-bit ports use 10-way Molex connectors. Griffin supply a Molex connector pack, CRA-778-540H, at £2.60, however they can be obtained more cheaply elsewhere, e.g. RS Components, 10 x 10-way plugs, 467-582, at £1.83 and 10 x 10-way cable shells, 467-633, at £0.90.

   We like the idea of having separate input and output ports as they are inherently simpler to operate than a single input/output port. In essence they can be controlled using the ideas for parallel processing outlined in "6502 Interfacing" and Bulletin 135. However beware of the Spectrum's logical operators. They do not function in a similar fashion to those in the articles mentioned. This we see as a defect inherent in the Spectrum. It is not well suited for parallel processing control in BASIC.

5. DCP bus expansion port. This provides all 8 Spectrum data bus lines, 4 control lines and power lines. It can either be used for d-i-y devices or for accessory equipment from Griffin. One such accessory which is worth obtaining if you are interested in computer control is the DAC-pack, CRA-778-510Q at £15.58, a digital to analogue converter.

6. Electrical protection. The I-pack is buffered to protect the Spectrum. However the I-pack itself is only lightly protected and could be damaged through misuse. On the analogue port you should get away with a two or three times over voltage or reverse polarity.

Hardware summary

The I-Pack in conjunction with the DAC-Pack provides the universal hardware required for computer control, at a very competitive price. Be warned, however, that connections are not standard 4mm. However lack of space precludes detailed treatment here of the 2mm etc. v. 4mm debate. This would be the basis of a separate article!

Documentation and software summary

Dealing now with the manual and software the approach is aimed mainly at instructing the user on how to write his own control programs. The manual deals with each port in turn giving a variety of short control programs and applications, along with wiring diagrams Software control is simple because the Spectrum's operating system has IN and OUT commands, which should not take a newcomer long to master.

The set of taped programs, 15 in all, covers timing, kinematics, counting, pulse outputs and analogue measurement. The programs are simple to operate though with the draft versions occasionally we were left not knowing what to do next through incomplete write-up and cueing. The data capture programs don't, in our opinion, have the sophistication of some of the others reviewed in this article. One feature which is worth bearing in mind is the simplicity of obtaining a screen dump from Spectrum.

Finally, as we have already mentioned for other devices, Griffin have further software for this product under development.

COMMENT The I-Pack together with software are very good value for money. The manual which accompanies the software is indispensable, giving a clear account of how to operate the I-Pack.

* * * * * *

In the Workshop

Wave power generators

A common feature of the designs shown is the use of materials that should be readily to hand in most school science departments. This is necessary because money is tight and special purchase of items for this course is very difficult - so our spies tell us! The more expensive items such as coils should be available, for example, as parts of electromagnetic kits. We used Unilab coils because "they were there". Schools with the Griffin or Harris equivalents should find they will serve just as well.

We are always interested in receiving ideas, such as those shown, which put existing apparatus to novel uses.

(In the diagrams which follow all dimensions, unless otherwise stated, are in mm. Drawings are not to scale).

(a) **Lever type** (Fig 1)

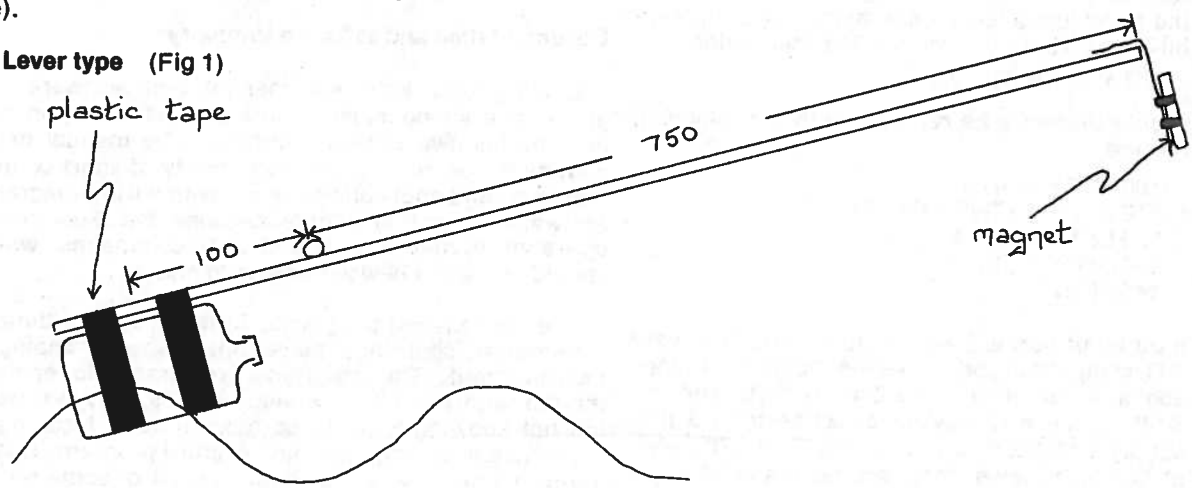


Fig. 1.

The lever is a meter stick. The fulcrum is placed so as to give a velocity ratio of approximately 7:1 (see dimensions). This enables the magnet to pass through the coil centre sufficiently rapidly to generate appreciable current ($\geq$ 100uA). Because of the angle of entry of the magnet and its rapid movement, a coil with a relatively wide centre is preferred for this model (e.g. Unilab 10,000, 10,000 turns 011.432 or equivalents). Smaller cored coils are suitable for the bobbing float and trailing arm designs described below.

Details of the fulcrum and its attachments are shown below (Figs. 2 and 3).

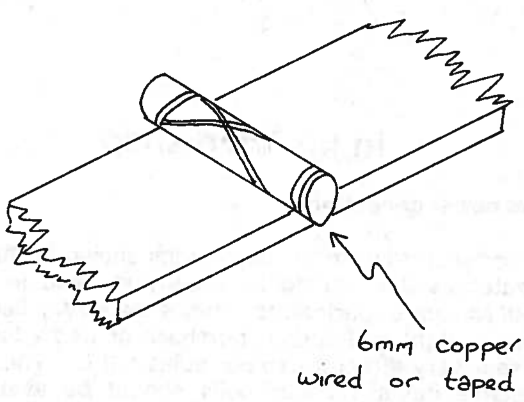


Fig. 2.

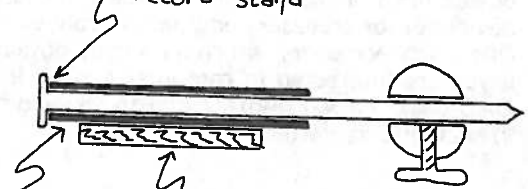


Fig. 3.

A simple clip for holding the magnet onto the end of the metre stick is easily fashioned from a piece of wire (Fig. 4).

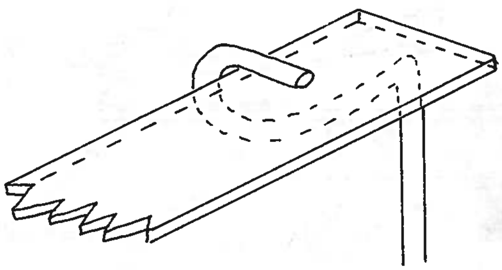


Fig. 4.

An even simpler model can be made with the lever fulcrum and means of attachment all from one wire coat hanger. This was how our first prototype was constructed. Such a crude design is suitable for quick d-i-y work by pupils within one lesson (Fig. 5).

The pivot was wound on a 100mm nail and supported on the same. Although this variation works well it produces some 'whiplash' owing to the non-rigidity of the lever. The magnet will of course stick to the coathanger.

(b) **Bobbing type**

The construction of this model should hopefully be fairly obvious from the diagram (Fig. 6) and we will keep the 'waffle' to a minimum.

Two panels of material 80 x 120mm are removed from opposite sides of a 1 litre (1dm³!) plastic bottle. The guide tube (12mm i.d.) for the magnet is cut from a length of plastic tubing (e.g. a hollow plunger from a 10ml disposable syringe). This is fitted with a bung and thence to the neck of the bottle. A 15mm thick, 50mm diameter cork ring is bored out to be a tight fit on this plastic guide tube. A perspex platform (ca. 100 x 150mm) to carry coil and meter, and to act as a splashguard thereto, is then glued onto the upper surface of the cork.

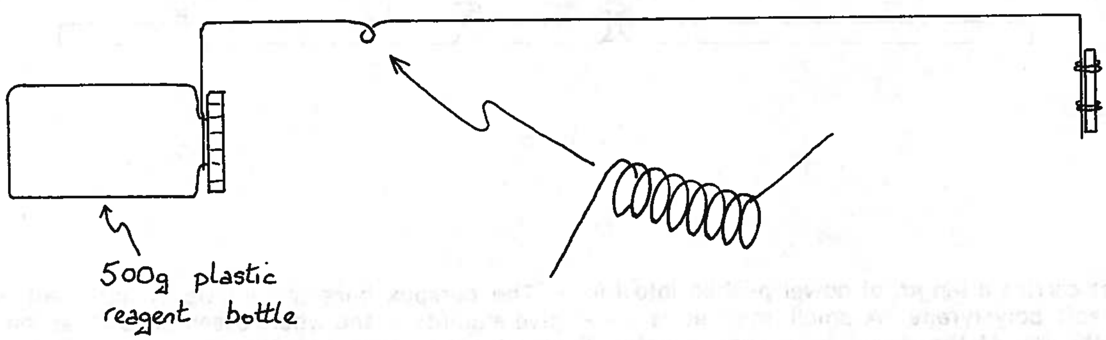


Fig 5.

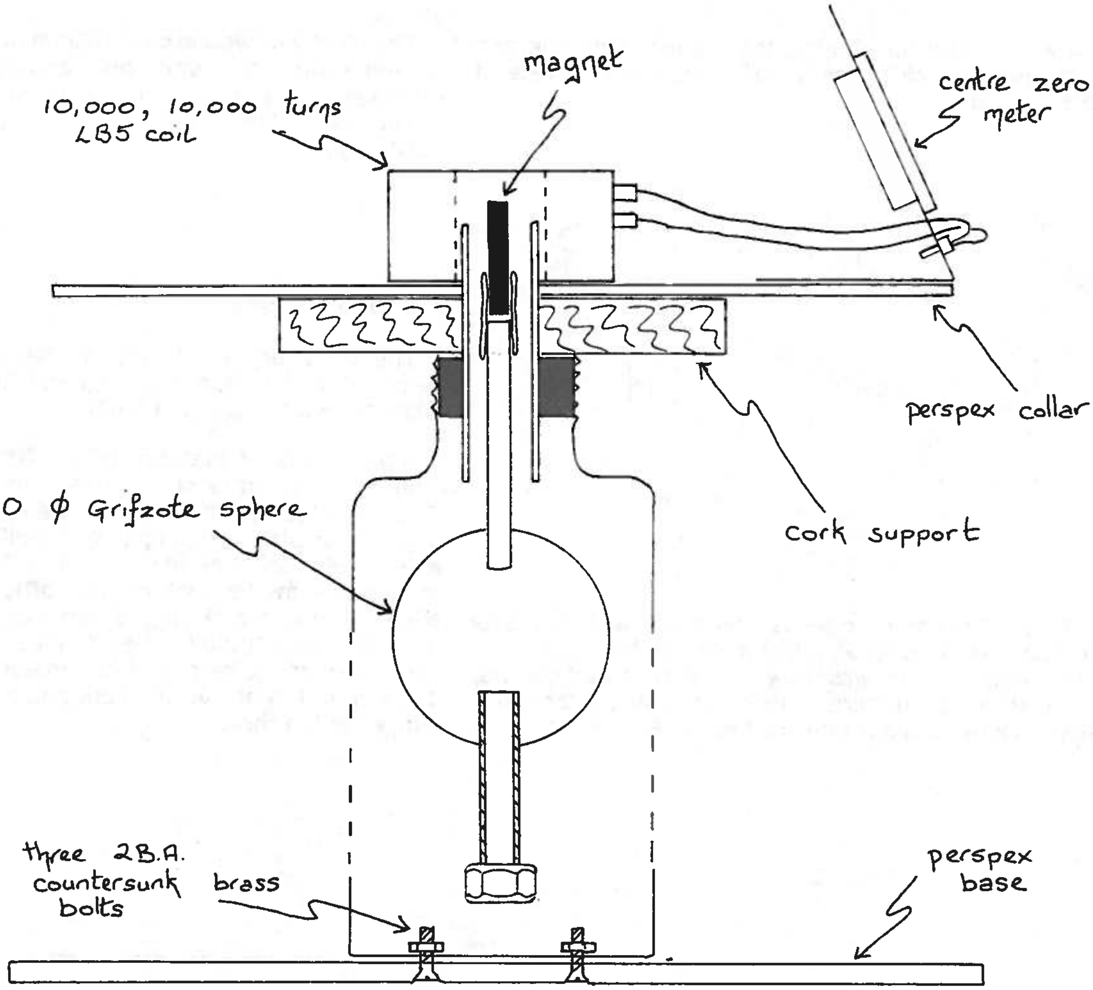


Fig. 6.

The float carries a length of dowel pushed into the relatively soft polystyrene. A small magnet is connected to the top of the dowel by a short length of rubber tubing. The counterbalance or ballast is provided by a large (12mm) bolt, if necessary further weighted with nuts. Brass, stainless steel or bright dipped bolts, although more expensive than ordinary steel ones, will suffer less spectacular corrosion.

Few of the dimensions given are critical. However the magnet should be relatively small, its dowel support rod short, and the counterweight sufficiently large. If suitable magnets are not to hand, the small 'Alcomax' type of 8mm diameter and available from the usual schools suppliers (Griffin, Harris etc.) will fit the bill nicely.

The perspex base should be of sufficient area to give stability to the whole assembly so that the device is not moved bodily by the waves. Our model used a base approximately 150 x 400mm.

(c) **Trailing-arm model** (Fig. 7)

The same ballasted plastic bottle as that in (a) is employed but the geometry of the set up is designed to be adjustable. For the trailing arm assembly we used 12mm square softwood sections ca. 200mm long. The holes, drilled at 30mm intervals, allow adjustments to suit different sizes and shapes of sinks. Within the limits indicated the overall dimensions of the rig are not critical. It was only after we had made our proto-

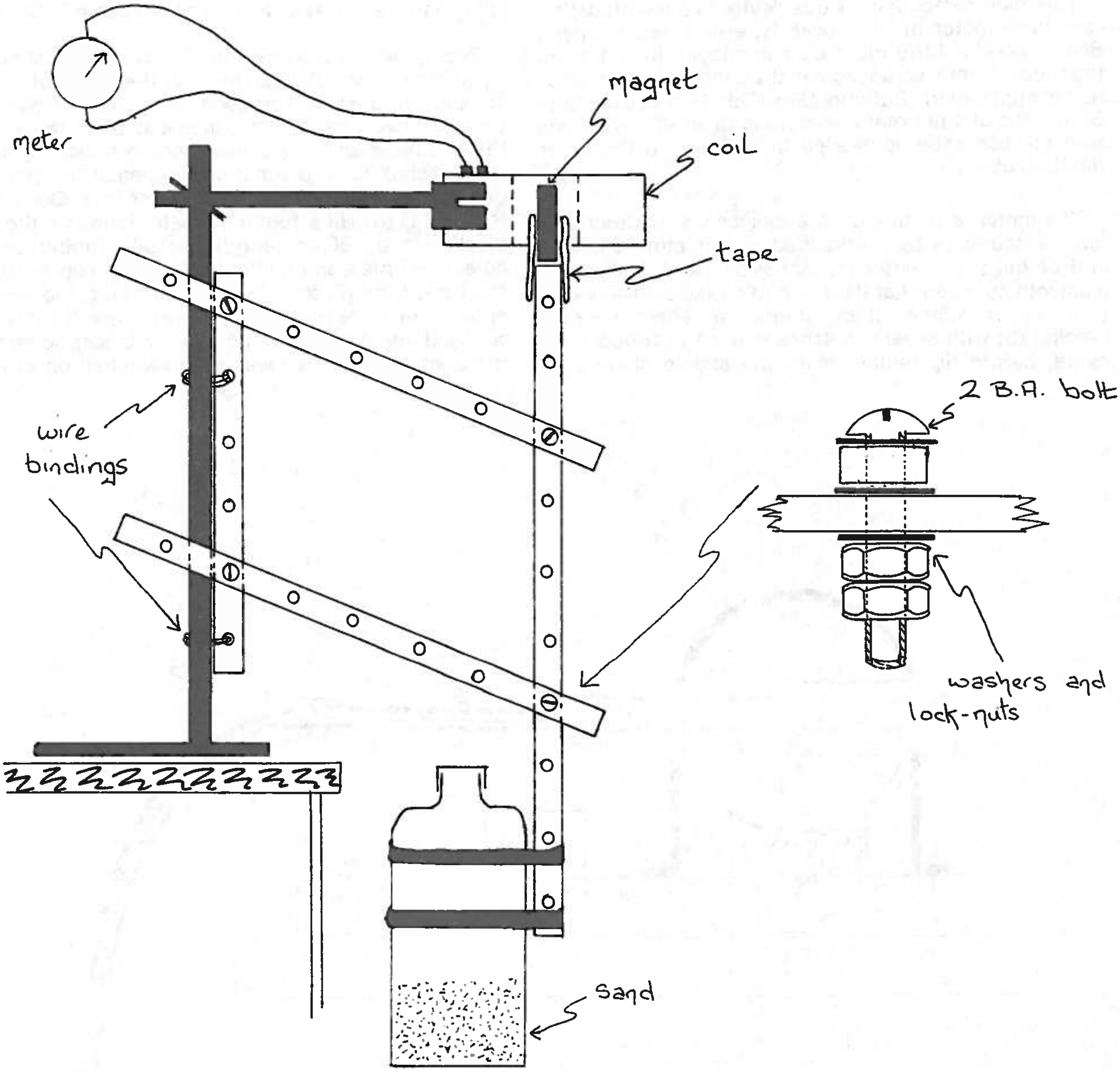

meter
magnet
coil
tape
wire
bindings
2 B.A. bolt
washers and
lock-nuts
sand

Fig. 7.

types that we realised the similarity of our d-i-y wooden 'Meccano' to components in the 'Craigie' kit.

Powered wave maker

The main component of this device is a reciprocating car wiper motor of the Lucas type as fitted to many British cars. A little more care is needed in removing the motor from a scrapped car than for the fabric wear tester application (Bulletin 136). This is because some 30 or 40cm of outer metal sheathing (o on Fig. 8) on the transmission cable is needed in addition to the inner flexible cable (f).

The motor is mounted on a baseboard as described for the fabric testers described in Bulletin 136. The end of the metal outer transmission cable is bent in a smooth curve so that its free end projects downwards (Fig. 8). A 1.5mm thick aluminium sheet support bracket (b) with several notches is used to support the cable, before tightening down the saddle clamps (s) onto the motor. A short length of plastic tubing (t) of internal diameter 8mm is split lengthwise and fitted as a protective sleeve around the outer sheathing where it is held in a notch of the support bracket (Fig. 9). If the notches are tapered (in our model from 18 down to 13mm) this ensures a tight fit of the cable in the notch.

Boom dimensions are not critical but it should be large enough to take up much of the width of the sink or tank being used. The boom of our device was made up from two pieces of blockboard, 80 x 180 x 19mm thick, pinned and glued together. In attaching a boom to the cable some precaution is needed to prevent ingress of water up the transmission cable. Our solution to this was to drill a 16mm diameter hole into the upper block to take a 50mm length of plastic tubing. Another hole, this time a small pilot was drilled, concentric with the first, through the lower block. The cable was then entered into the plastic sleeve and the flexible inner screwed into the smaller hole in the blocks so attaching the boom. The motor was then switched on at a slow

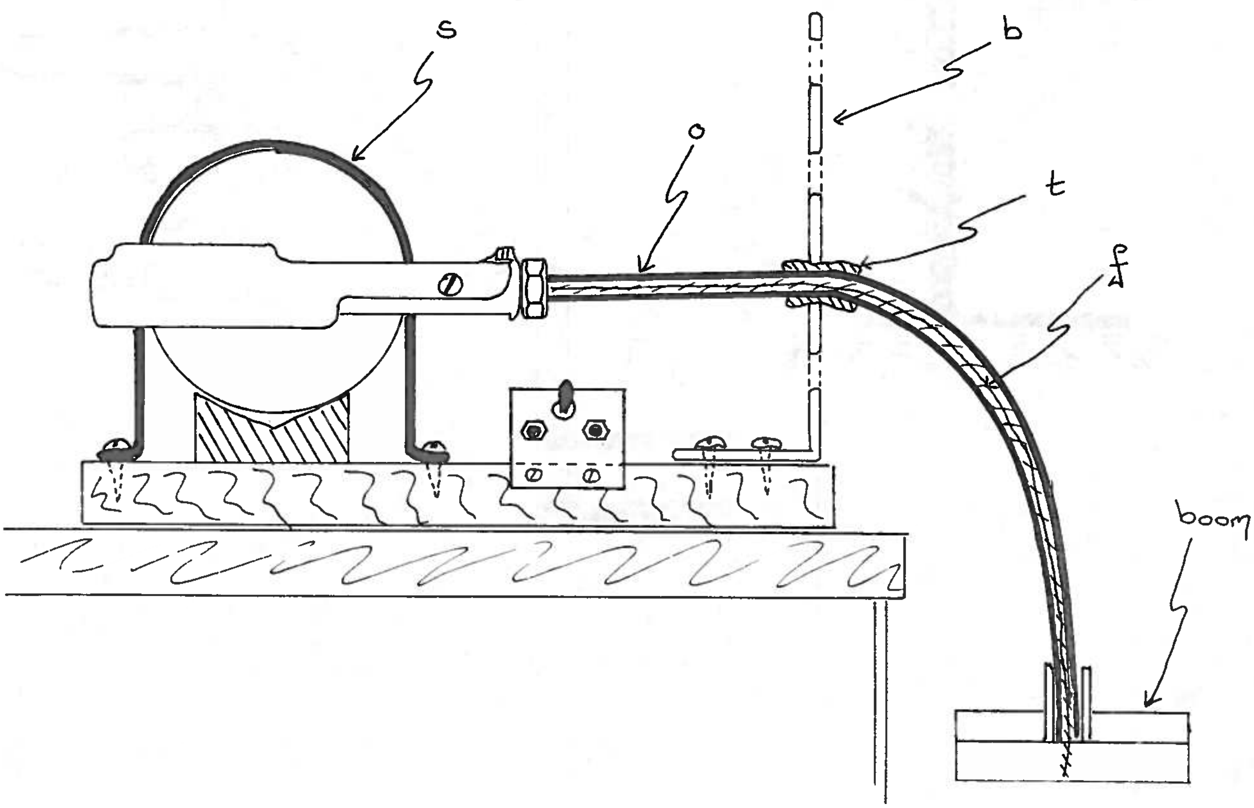


Fig. 8.

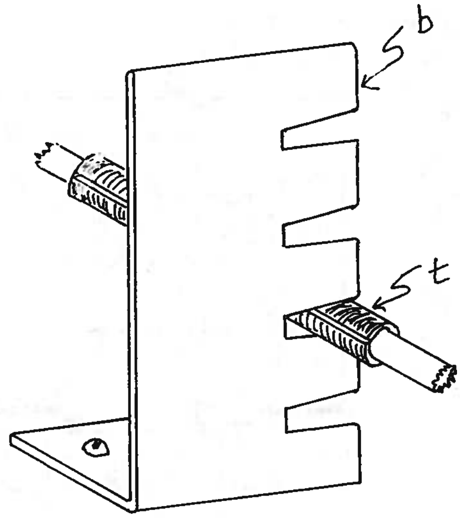


Fig. 9.

speed and the boom rotated so that it screwed up until it just failed to prevent full travel of the drive. The surplus end of the flexible cable projecting below the booms was then snipped or sawn off.

Being only low voltage (12V d.c.) and robust these wiper motors are particularly suited to this type of application. The motot itself is safe enough for use near water. However long leads should be used and any mains operated power supply for the 12V to the motor sited well away from the sink or tank.

Metal strip bender

The salient features of this device are shown in Fig. 10, 11 and 12. The dimensions given are those which allow free movement of the handle with clearance for the butterfly nuts (used to clamp the strip) during its movements. These 'butterfly' or 'wing' nuts are used to allow easy clamping of the strip. Note that no stops are required. The tester is easier to use if the handle, at one end of its travel (position X Fig. 10) overlaps the bottom of the base, but at the other extreme (position Y Fig. 10) some 20-30mm of the base is exposed so that it may be held to steady the whole apparatus.

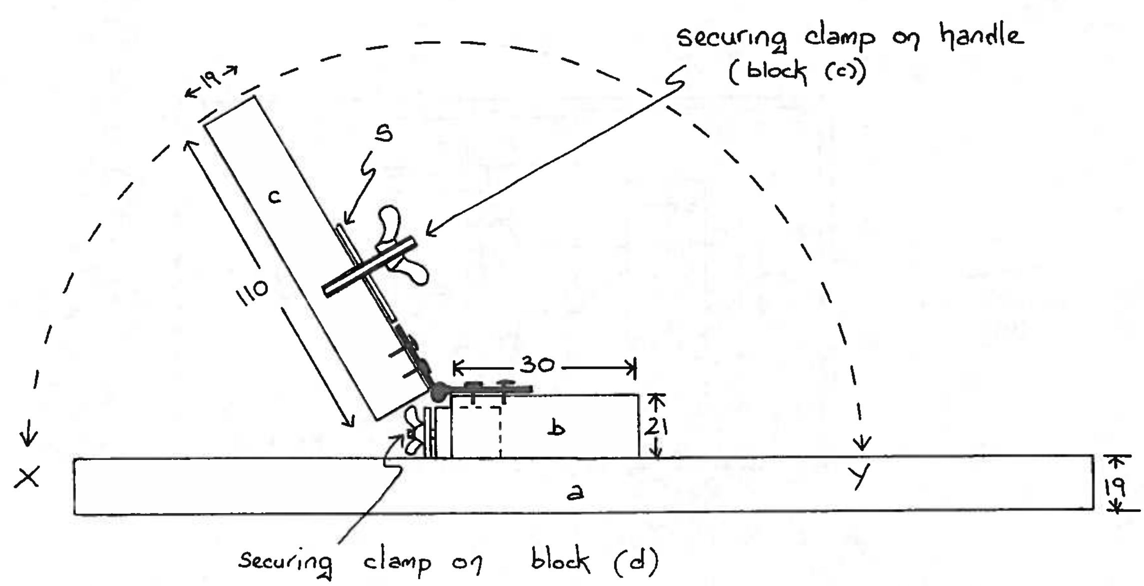


Fig. 10. side view

Assembly instructions are given below:

1. first mount the blocks (b) on the base and then mount the wooden handle (c) on the hinges and blocks (b). It is better if (b) is slightly thicker than (c) or (d).

2. Move the handle to vertical position and laying a test strip against it mark the position of block(d). The edge of this will be slightly forward of the edges of the blocks (b) depending on how the hinges have been mounted. Secure block (d) with two bolts to the base. Fit block (d) with the two screw rod studs and butterfly nuts to carry a small clamping piece of 2mm thick aluminium sheet with two holes drilled through it in suitable positions.

3. Move handle through90° i.e. to horizontal position in both directions and mark out the amount needing to be checked out of the handle to give clearance to the butterfly nuts on (d).

4. Fix the metal strip securing plate by two studs to the handle (c) in the same way as was done for the block (b).

If preferred, in 2 and 4, the studs could be replaced by tightly fitting bolts tapped through from the opposite side.

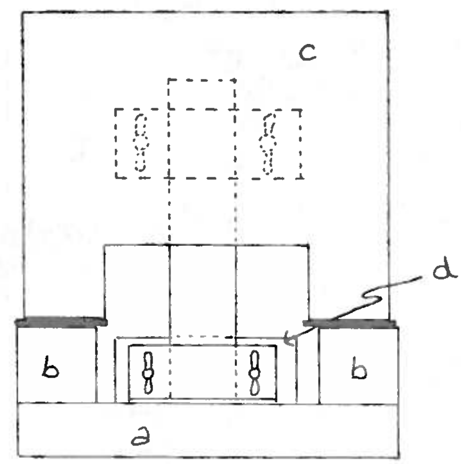


Fig. 12. end view.

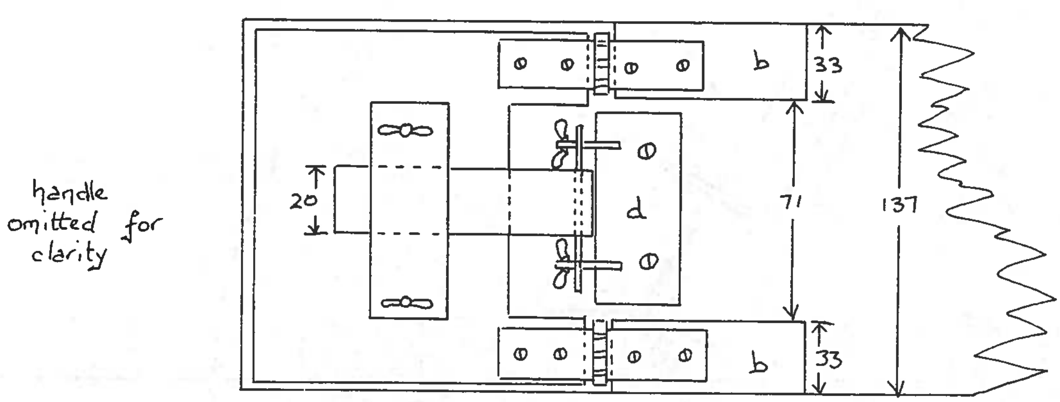


Fig. 11. plan

Trade News

Space is at a premium in this issue. We apologise for the somewhat staccato style in what follows but trust that it may prove useful.

Changes of address (see inside fron cover).

A.R. Horwell have moved and so have asbestos substitutes supplier **Refracpac.**

Timers

A number of new simple and relatively inexpensive digital laboratory timers are coming on the market. For example a Smiths "Count down timer" (made in Scotland!?) at £11.00 from Horwell and a similar "mini-timer" at £11.95 from **Cranwell.**

New to us:

Suppliers: of biological materials apparatus and specimens - **Forth Laboratories;** of projector lamps and other AVA materials (at seemingly competitive prices) **Lloyd Paton** and **"The Lighthouse"**; of 'Helios' stroboscopes and a dual power supply - **Branime Marketing** and of parts and proper spares, such as photocells, meters, etc., for EEL instruments - **Diffusion Systems** who also service EEL apparatus.

Ice cream spoons

Yes you read it correctly! Following our piece about useful plastics items fro, amongst others, **Brodie, Hamilton and Melrose,** we received a note from Craigroyston High, Lothian. This described how the technician, Margaret Thompson, had the bright idea to use disposable, ice-cream spoons as spatulas in S1, S2 work and for cheek cell scrapes. (No, not in that order - separately!) Brodie et. al. sell these spoons at £2.20p per 1,000.

Keep an eye on the joint!

Ever had the problem of ground-glass-jointed distillation or reflux systems falling apart unless clamped all over like builder's scaffolding? Two aids to avoiding this clutter are:

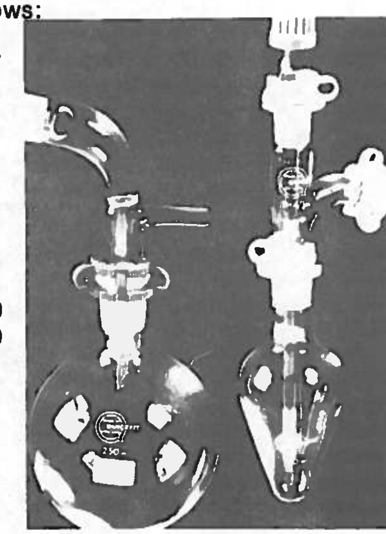
(i) The 'Duoclamp' available from **Spiring Enterprises** and which we have mentioned before in this section of the Bulletin. It is essentially a long metal plate, which can easily be clamped onto a stand by means of a rod at right angles to it and which carries two 'Terry' clips of the approximate size for B14/23 joints. Both clips can be rotated. The distance between them can also be varied by moving one of them in a slot cut in the backplate. Thus glassware can be set up for different operations very easily.

A set up for refluxing can be altered in seconds to one for distillation. With a flask and still-head on one clip, the condenser on the movable clip can be moved towards the end of the stillhead. Both pieces can be twisted to any angle at the same time This facilitates what can, using retort stands and clamps, be not only a difficult operation, but one likely to leave the joint under strain and possibly lead to breakages.

(ii) A second device produced by J. Bibby is a series of polyacetal plastic clips.

These consist of two open rings situated concentrically one above the other and connected at the sides by flexible bows. The smaller ring can be snapped onto the smaller side of the joint e.g. reflux condenser and the larger one onto the flask into which it is fitted. Sizes are colour coded and are available as follows:

Joint Size	Cat. No.	Qty. per pack	Price
14/23	KC14	20	£.80
19/26	KC19	20	£10.40
24/29	KC24	20	£10.80



The manufacturers that these joint clips can support a 1000 cm^3 flask of liquid up to 50°C ambient or at 80°C through the joint itself. We have tested the smallest size as a clip on a flask whilst refluxing water and found it to distort slightly. Therefore we would recommend these for use in lower temperature applications only and would exclude its use on glassware likely to be heated above the quoted temperatures. One good use would be that of holding a receiving flask at the outlet end of a condenser during distillation.

'Gipsi' and 'Vela'

More information is now available (from Griffin and Educational Electronics respectively) on these pieces of microprocessor based laboratory instrumentation. Literature describing the nature and uses of 'Gipsi' is obtainable Griffin in the shape of a 7 page promotional leaflet. Vela of course has been chosen as part of the "Micros in Schools Extension Scheme". We are unable to speculate in these pages as to how Griffin feel about that, especially since it is obvious that the development of Gipsi didn't start just yesterday! Readers should note that their order of appearance here is strictly alphabetical! As yet we can express no preference. We hope to fully evalulate both devices fairly soon and report on them in the Bulletin before the turn of the year.

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

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