# SCOTTISH SCHOOLS SCIENCE

# EQUIPMENT RESEARCH

# CENTRE

Bulletin No. 112. April, 1979.

# Contents

# Introduction

Much of this bulletin is concerned with safety. On page 3 we discuss the legal requirements to be met by chemists who store poisons, whether scheduled or not, in their schools. On page 6 we give what amounts to a recipe for ensuring that the domestic pressure cooker is working efficiently as a steriliser. Therein some may note that we have modified the advice given on the same subject in Bulletin 110, advice which was originally supplied in a Microbiology in Schools Advisory Committee (MISAC) sponsored publication. This is not the first time we have drawn the attention of MISAC to certain problems and anomalies and perhaps in self-defence the Committee has invited John Richardson, our biologist to serve on it. Whatever the reason, it is an honour for John to be so chosen, and it means that we shall be more continuously aware of the problems which arise in teaching the subject and more able to influence the decisions taken to resolve these, as well as being able to pass these on to our readers.

Still on safety, Allen Cochrane is a member of the A.S.E. Safety Committee Material and Processes Group, a body which has set itself the task - see Bulletin 104 - of providing detailed information on almost every aspect of safety in schools. Allen has done a great deal of work collating information on the attitudes of different regions - in England and Wales as well as Scotland - to the banning or restriction of use of certain chemicals in schools, and for the same committee John Richardson has prepared a monograph on the recommended use of pesticides in schools. The results of the Group's work will be published as a series of articles in Education in Science, and we can use the material for publication in our bulletins.

Our work on pressure cookers arose directly out of a request by a regional science adviser which itself was the result of a visit by HSE inspectors to some of the Region's schools. We appeal to science advisers, regional safety officers, and individual teachers to inform us of their safety problems in schools. We have been in touch with the head of the Education Group of the HSE who is agreed on the need for a common policy or code of practice which can be formed through the co-operation of both sides, HSE and the schools, as experience in tackling the problems which arise builds up over a period of time. He is as anxious as we are to learn of the individual decisions of an inspector visiting a school, so that where anomalies occur decisions can be made as to future policy. It seems only common-sense that those involved should co-operate in this way, which is why we appeal to readers to detail their problems to us, whether or not they have arisen as a result of an inspector's visit. The greatest drawback towards formulating a common policy is ignorance of what is in fact happening, and in disseminating such information we think that SSSERC can play an essential part.

# Opinion

In October 1972, Wireless World published details of a four function desk type calculator which could be bought as a kit and assembled by the user. Thinking that schools might want to build

their own calculator, and that we should be able to advise them on how to carry out the assembly we bought one and built it. It cost about £40. I forget if we ever had to advise anyone on its construction, but the calculator is still with us, and still works. But as everyone knows, four function calculators can now be bought for under £5, and we are selling second-hand desk types with greater capability than this at £3.

I raise the point now because we again find ourselves in the same situation, but in a different ball game. The April issue of Wireless World carries the opening article on building a scientific computer. Only this time the kit of parts costs £275. Should the schools jump in now, or should they wait a few years? If the home computer is to become even as much of a mass market as the TV games-playing adaptor, about which some manufacturers are now kicking themselves, it would be prudent to wait. On the other hand, strong encouragement to start the micro-process now comes in a note in School Science Review by Bob and Mrs Sparkes. Those who think that computers are used mainly for routine clerical or book-keeping duties should read the article. These two have converted a micro-processor to perform the functions of timer, ratemeter, voltmeter, ammeter, thermometer, photometer, pH meter, wattmeter, joulemeter which is still not naming all the functions in their list. They suggest that the digital integrated circuit is a thing of yesteryear, and knowing how long SSR takes to get articles into print, yesteryear must mean 1977 if not 1976.

A subcommittee of the Central Committee on Science is considering how best to introduce micro-electronics in schools. Perhaps their first task will be to decide whether to found their course on a micro-processor unit, or on the digital integrated circuits 'of yesteryear'. If these are really a thing of the past, how long will it be before manufacturers cease to make small scale and medium scale integration circuits? Unlike analogue devices such as the transistor, these chips are of little intrinsic use, and have to be interconnected to perform a useful function. So why continue to produce them, if their every possible interconnection can be embodied in a m.p.u.?

Like the calculator I mentioned earlier, digital integrated circuits have fallen steadily in price. When first advertised in Wireless World in March 1971, the SN7490 cost £1.97½; now it can be bought for around 30p. But this price low will not persist for ever. If production of s.s.i. and m.s.i. circuits falls off or stops, the price will climb out of the trough, even after allowing for inflation. Some weeks ago we retired to the scrap heap an oscilloscope which has been in use for many years, rather than pay £10 each for two valves it needed to make it serviceable. Around the time that the 74 series first came on offer, these valves were selling at 24/6d. For many of the products of twentieth century technology, one could postulate a price trough, and even define a bandwidth as the time during which the cost, corrected for inflation, remains below twice the minimum. While we may measure the bandwidth just now in years, how long will it be before the words of a former science H.M.I. come true - if it works, it's obsolete?

One final word on the cost of obsolescence. Did you know that the simple brass cantilever balance, the single beam and scale-pan type in a glass case that everyone over the age of 50 was brought up on, is now being bought by antique dealers at £40-50 each? If you can throw in a full set of brass weights in their fitted wooden box you will get considerably more. So look in your attics, all those chemistry teachers who complain about the age and inconvenience of

their labs. You may have a minor fortune there. It might even pay you to rescue the balance cases from their current duty as insect cages or whatever.

# Chemistry Notes

How often, we wonder, have the dreaded words 'scheduled poison' or, by the cognoscenti, 'Schedule 1 poison' been used to threaten and intimidate the lab. technician when he has left an open bottle of some particularly noxious chemical on the prep. room bench when masking the staff tea? There is the implication that dire penalties are laid down in some regulation for anyone who does not keep such substances locked up, and to be signed for at each opening of the cupboard. It is part of the myth and mystery which has surrounded the handling of poisons probably since the days of Sherlock Holmes.

Being no better than the average teacher in this respect, we found this out only when asked to clarify this tangle, specifically to determine what regulations govern the storage of poisons in schools. The short answer is that there are none, other than the general duty under the Health and Safety at Work Act, whereby the employer must make 'arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances' (Section 2, para 2(b)). The Act also states in its preliminary, that it is intended to control 'the keeping and use of ..... dangerous substances, and generally prevent the unlawful acquisition, possession and use of such substances' (Section 1, para. 1(c)). Apart from this blanket requirement, there is no regulation governing the storage of non-flammable dangerous substances in schools. (Flammables are dealt with under the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972, and one aspect of their storage was discussed in Bulletin 111).

The Poisons Act 1972, or more specifically the Poisons Rules 1978 which form part of the Act specify the conditions under which certain substances which are thereby legally defined as poisons may be sold or supplied for non-medicinal use, and lay down conditions for the storage of poisons in premises where they are to be sold or supplied. The same substance, supplied for medicinal use is not subject to the Poisons Act, but is controlled by the Medicines Act 1968. Hence one can see that it is the intended use, not the degree of toxicity, which determines whether a substance is a Schedule 1 Poison. This will explain some notable omissions from the list of Schedule 1 poisons, such as antimony compounds, barbituric acid and its salts, nitrophenols, dinitrophenols.

Ignoring the restrictions on the sale of Schedule 1 poisons, the regulations on storage state:

> 'It shall not be lawful to store any poison except in a container impervious to the poison and sufficiently stout to prevent leakage from the container arising from the ordinary risks of handling.
>
> It shall not be lawful to store any poison included in Schedule 1 in any retail shop or premises used in connection therewith unless it is stored -

(a) in a cupboard or drawer reserved solely for the use of poisons, or

(b) in a part of the premises which is partitioned off or otherwise separated from the remainder of the premises and to which customers are not permitted to have access, or

(c) on a shelf reserved solely for the storage of poisons and -

(i) no food is kept directly under the shelf, and

(ii) the container of the substance is distinguishable by touch from the containers of articles and substances other than poisons stored upon the same premises.' (Poisons Rules 1978, Section 22).

Notice that (a), (b) and (c) are alternative, not additive conditions.

Does this not dispel the myth of the Schedule 1 poison? Surely Section 22 is a frail reed for the safety-conscious teacher to lean on for support? Before the introduction of the Health and Safety at Work Act one could answer the original query on the legal requirements for storing a poison in school quite succinctly - put it in a strong enough bottle. None of the other conditions of Section 22 has relevance to the school situation.

We had originally thought to list all Schedule 1 poisons in this article, and to indicate what the requirements of the other schedules were. It now seems pointless to do this, since the Poisons Act caters for a different set of circumstances. Clearly it sets out to control the conditions under which a limited number of toxic substances may be sold or supplied for non-medicinal use. It does not claim to legislate for the storage of legal poisons, or other dangerous substances in premises to which the general public is denied access, and it is a mistake to attempt to apply its provisions to the school situation. Our advice to the teacher or technician in doubt about a chemical is simple - consult the SSSERC Hazardous Chemicals Manual. We have tried, in the sections on handling and disposal to interpret the spirit of the H.S.W. Act as set out in Section 2. If the doubt remains, write to us or ring us up. We will answer where we can, and where we can't we will do our best to find out, and we have highly placed contacts able to provide advice on almost every chemical the school is likely to receive.

The story, however, does not end here. There is a newcomer on the scene, the Packaging and Labelling of Dangerous Substances Regulations 1978, which are now in force. Nearly a thousand chemicals are listed in the regulations, which specify that they carry a label setting out the nature of the risk and precautions required. It is this regulation which requires that containers shall bear hazard warning symbols, with which we are gradually becoming familiar e.g. on petrol tankers. The regulations have as many as 40 risk phrases, and 45 safety precaution phrases, and they spell out for each chemical what combinations of these phrases must be shown on the label. For example, trichloroethylene must have a symbol (black St Andrews cross on yellow background) to show it is harmful, must have the risk phrase 'Harmful by inhalation and if swallowed', and the precaution phrases 'Keep out of reach of children' and 'Avoid contact with eyes' on the label. Some phrases are two halves of the same coin, viz. 'Avoid contact with eyes', and 'Wear eye/face protection'.

This might be thought to be a useful guide on how chemicals should be treated in schools. Clearly, it goes further than the Poisons Rules - the first safety precaution phrase is 'Keep locked up' - and moreover we have it on the authority of an official of the Poisons Board that the PLDS Regulations take precedence over the Poisons Rules where a substance is affected by both sets of legislation.

However, closer examination of the regulations does not bear this out. There are a number of very curious anomalies, and to understand how these may have come about it is necessary to be clear on what is being discussed. The PLDS regulations make it unlawful for certain substances to be sold or supplied unless they are labelled in accordance with the regulations. Part of the label is a statement of safety precautions required, and provided that the supplier uses the phrase or phrases specified in respect of the particular substance, plus a few other irrelevancies like the size of lettering and colour of label the law has been complied with. The regulations do not require the purchaser or any other user to comply with the safety precautions stated on the label. The only requirement on such a person is the general one of Section 2 of the HSW Act.

None of the following substances carry the warnings 'Keep locked up' or 'Keep out of reach of children' - barium salts, bromine, ethanal, hydrobromic acid, potassium metal, sodium metal! None of the following carry the warning 'Wear eye/face protection' - bromine, oleum, sulphuric acid! These are only examples; there are others equally anomalous from a safety point of view. On the other hand, sodium hydroxide solutions in concentrations between 1 and 5% and sulphuric acid in concentrations between 5 and 15% require to be labelled 'Keep out of reach of children'. The chemistry teacher would find it difficult to teach his syllabus of the PLDS Regulations were made mandatory on the user.

So much is fact: what now follows is conjecture, our own unconfirmed opinion of how the legislators may have arrived at the decisions evidenced in the regulations. We believe that the legislators have recognised the impossibility of providing complete safety information on the label of a bottle. It is also likely that they recognised that if they sought to provide the maximum possible, there was a danger that people might believe it was the complete story and not seek safety advice elsewhere, and that it might defeat its own purpose by being so voluminous or in such small print that the user would ignore it. They then had to identify amongst the possible purchasers of these substances those who would be most at risk and provide for them such information as they considered necessary and compatible with the constraints mentioned above.

To us this would mean the unprofessional, ignorant (in its literal sense) public who would not know where to turn for safety advice. Hence we think the legislators selected those substances which the general public were likely to purchase either directly, as with sulphuric acid for filling car batteries or as the active ingredient in preparations, as with sodium hydroxide in paint strippers, and give particular emphasis to these when deciding what safety advice the labels should bear. Supportive evidence for this argument can be found in the list of chemicals which have to carry the instruction 'Keep locked up'. A great many of them are agricultural pesticides like paraquat and diquat, fonofos and carbifuran, etc. On the other hand, nitroglycerine does not require to be labelled with the advice to keep it locked up or out of reach of children which only makes sense if it is considered that though the precautions may be necessary, the

advice is superfluous since children and the general public are not going to come into contact with it.

Hence we would say to teachers and technicians, do not depend solely on the safety advice given on bottle labels. It is almost certainly inadequate, since it has been assumed that you have access to more thorough advice elsewhere. Treat the warnings on the labels as an instruction to seek such advice in our own or other hazardous chemicals manuals. Nor should you assume that the absence of a warning means absence of risk. Any container less than 125cm$^3$ capacity, no matter what it holds, does not require to have safety advice on its label. The PLDS Regulations do not require you to repeat the warnings on any container to which you transfer the chemical after purchase, although you may feel it advisable to do so as part of your responsibility under Section 2 of the HSW Act. This remains the only legal responsibility on the user of dangerous substances.

# Biology Notes

In Bulletin 110 we gave advice on the necessity for a system of checking the efficiency of sterilising procedures for the preparation and disposal of microbiological materials. We have since received information which would make such regular performance testing mandatory rather than merely advisable.

Following the inspection of a school where a domestic type pressure cooker was in use as an autoclave, the HSE have made the following points to the Region involved:

H.M. Inspectors (of the HSE) will accept the use of domestic type pressure cookers for the sterilisation of microbiological materials but certain conditions should be observed:

(a) The limited capacity of the cooker should be borne in mind. Overloading may mean that the contents do not reach the necessary temperatures for the requisite time.

(b) Care should be taken to ensure that the pressure cooker is rated to achieve a pressure of 103kN/m$^2$ or 15lb/in$^2$ and that it continues to achieve this pressure. It should be borne in mind that 103kN/n$^2$ is normally the MAXIMUM working pressure of a domestic pressure cooker but that this must be maintained for 15 minutes for effective sterilisation.

(c) Microbiological work involving the use of a domestic type pressure cooker as an autoclave should be restricted to standard, recommended media and non-pathogenic organisms obtained from a reputable supplier (see Bulletin 98). If cultures are prepared using non-standard materials e.g. soil samples, more stringent sterilisation conditions may be required to ensure that all potentially harmful organisms have been destroyed. Such sterilisation conditions could not be achieved using a standard domestic pressure cooker.

The point (a) is one we made in Bulletin 98 in connection with the use of autoclaves in general. Point (b) lends great weight to our arguments for performance testing, made in Bulletin 110.

Point (c) suggests that if work is done at SYS level with home-made 'enrichment' media containing ingredients from a natural source such as soil, an autoclave proper would be required. In Integrated Science, and 'O' and 'H' grade work, where organisms are cultured from the environment e.g. soil, the air, particular care should be taken to ensure that used materials are properly sterilised before disposal.

Whilst we are correct in stressing the need for a testing system, we were wrong to suggest a testing method involving the use of autoclave indicator tape. The use of the tape has been described in MISAC literature and elsewhere, and we apologise for not having verified the performance of the tape for this purpose.

The tape manufacturers, who are 3M (UK), say that "the tape should not be used as a time or temperature indicator. The colour change is intended to differentiate processed from unprocessed items and should not be inside a package (sic) in an attempt to measure quantitatively the heat treatment actually received. The appearance of the tape should not be used as a guarantee of sterility".

It is clear that what we said in Bulletin 110 was in error. The fact that others have previously made the same mistake will be of little comfort to those who have already bought autoclave tape on our advice and to them we can only apologise. We have now tested a number of pressure cookers in different schools, trying various testing methods. The results suggest that, as long as the cooker is in good condition and is properly used, adequate steam sterilisation is achieved.

It is worth considering for a moment just what is required in order to sterilise media for use or materials for disposal. Bacteria which the sterilising process is to destroy can be regarded as existing in two forms - vegetative forms and spores. All bacteria occur as vegatative cells, but only some of them form spores. These spores, which are in a resting state, are very resistant to destruction by heat and other agents. The types of bacteria supplied for use in schools are usually non-spore forming. These vegetative forms have a thermal death point of about 60°C. They will all be destroyed after 30 minutes at this temperature and much more rapidly in boiling water. However cultures may well be contaminated with spore forming organisms, some of which may be potential pathogens. The chances of this occurring are substantially increased if cultures have been inoculated with a natural material such as soil.

Destruction of spores in the dry state requires prolonged exposure to a very high temperature (typically at least 1 hour at 160°C). They are more easily destroyed by steam, but this must be applied for a considerable time at a suitable temperature, which means at an increased pressure, in order to ensure complete destruction.

Elaborate studies over the years have yielded comprehensive information on the thermal destruction of spores of pathogenic bacteria. These studies have shown that the process has a very definite time/temperature dependance. This is explained by a number of factors not the least of which is the variation in susceptibility within a species, or even within a particular strain. Therefore it is essential that the TIME of exposure to the steam be adequate for the TEMPERATURE, which in turn depends upon the PRESSURE employed, and that a proper MARGIN OF SAFETY is left when fixing a standard.

With these factors in mind the Medical Research Council has published the following times for treatment by steam at the given temperatures:

(a) 3 minutes at 134°C (206kN/m² or 30lb/in²);

(b) 10 minutes at 126°C (137kN/m² or 20lb/in²):

(c) 15 minutes at 121°C (103kN/m² or 15lb/in²).

It is standard (c) which is most likely to be applicable in the school situation and which must be achieved or surpassed when sterilising materials for use or disposal. How then can we ensure that this is done? The first requirement is for a proper use of the pressure cooker, or autoclave, and the second for a test that will indicate whether the necessary conditions for sterilisation have been achieved. The safe use of an autoclave proper was given some attention in Bulletin 98. In the use of a pressure cooker the following points are particularly important; some may seem to be stating the obvious but we think that they will bear to be repeated.

1. All the weights, or parts of a spring controlled assembly necessary to give the full 103kN/m² loading should be present.

2. If the loading is provided by the common type of device where a set of weights has a tapered shaft which seats in the steam outlet, ensure that it is not worn and that the shaft and seating are undamaged.

3. Inspect the sealing ring and the rubber of the safety valve. Ensure that they are not perished and that the latter is properly seated.

4. If the cooker is an old one inspect it carefully for signs of corrosion, especially pitting of the walls or bottom. This can reduce the wall thickness and make the cooker potentially hazardous.

5. The correct volume of water should be used. For most cookers this will be approximately 1 litre for a 15-20 minute sterilising time. Note that this is a greater volume than that recommended by the manufacturer when vegtables etc. are being cooked, because the sterilising time is considerably longer than the usual recommended cooking times. Should the cooker be boiled dry it may become badly distorted. In the unlikely event of a failure of the safety valve the consequences would be more serious.

6. Do not overload the cooker. Enough space should be left between items to allow the steam to penetrate and the air to be displaced.

7. If autoclavable disposal bags, or roasting bags, are used they should only be two-thirds filled and closed with a wire-cored paper tie. They should <u>not</u> be sealed as stated in a number of accounts, including our own Bulletin 98. Similarly any screw caps or jars or bottles should be loosened slightly. If air is trapped it may burst containers in being prevented from escaping. However after autoclaving disposal bags are sealed before incineration or placing in the refuse bin.

8. When placing the lid in position take care not to nip or distort the seal. Some lids will only fit properly in one position and usually this is indicated by engraved marks on the lid and lower part of the cooker.

9. For heating the cooker, a gas ring or electric hotplate is much safer than the commonly used two tripods/two bunsens arrangement.

10. Bring the water to the boil and allow a vigorous escape of steam

for 1 or 2 minutes before placing the weight in position. This is to allow air to be expelled from the cooker.

11. Allow the cooker to come up to pressure so that steam escapes audibly from under the weight. Timing should start at this point and not before. If pressure of work allows, it does no harm to give 20 minutes rather than the recommended 15, especially if 'non-standard' materials are being autoclaved prior to disposal. It may be necessary to reduce the heat supply if the escape of steam becomes too vigorous. However the weight should be 'dancing' during the whole of the sterilising period.

12. If the cooker is being used to prepare agar or liquid media do not cool it rapidly, otherwise they may boil over because of the resultant partial vacuum, and be wasted.

Having inspected the cooker for obvious faults and used it in the correct manner, how can we be sure that the required conditions have been achieved inside it? The surest test would be a biological one, using heat resistant spores as described in Bulletin 110. However, the standard spore-strip method involves the delay of a 4 day incubation period. This causes practical difficulties for anyone wishing to know whether materials are 'safe' before using or disposing of them. 3M have recently launched a convenient, self-contained, biological monitoring system called 'Attest' which contains spores and media in one package and which involves only a 2 day delay. For schools this has the disadvantage of expense, each test costing at least 30p.

Non-biological methods can never yield direct information on sterility but, as long as their limitations are recognised, they can be very useful. Many hospitals and microbiology laboratories use the 'steriliser control tubes' (known as Browne's tubes) made by Albert Browne. These use colour changes like a traffic light sequence. The liquid in unheated tubes is red; as heating proceeds the colour changes through a brownish-amber to green. If, after treatment the liquid remains red or amber, the materials have to be re-sterilised and a fresh tube used.

Browne's tubes cannot prove that sterilisation has been achieved but they can give information about the temperature inside the autoclave and the time for which the material has been treated. The colour change to green will take place rapidly at very high temperatures but at such temperatures spores are quickly destroyed. However, the change can never be made instantaneous. The high temperature must be held for a definite time. A variety of temperature/time combinations will make the tube contents turn green, but a margin of safety has been allowed such that, at temperatures where the complete destruction of spores cannot be guaranteed, the time required by the tubes is beyond anything that any user of an autoclave would ever give. Albert Browne therefore claim that their tubes are well adapted to working conditions, only turning green if the treatment has been adequate with a satisfactory margin of safety. The results of our own tests confirm the major claims made by the manufacturer. The full green colour was only given at a particular temperature if the time of exposure was adequate. Treatment for shorter times or at lower temperatures resulted in the tubes remaining red or only turning to amber.

Four types of 'Browne's tubes' are available, two of which will be of interest to schools. Type 1 (black spot) is used for 'ordinary' autoclaves and turns green after 16 minutes at 120°C. Type 3 (green spot) is for ovens and sterilisation by 'dry heat' turning green after

60 minutes at 160°C. The tubes are sold in boxes of 100 together with instructions and a colour chart at ca. £3 per box. We bought ours from Mackay and Lynn. At about 3p per test they give a relatively inexpensive but useful indication of autoclave or oven performance. Frequency of testing of the equipment will obviously depend upon frequency of use. However it would be wise at least to test a sterilising system whenever it is brought into use with the first and last batch of a set of materials and at intervals if a large number of batches is to be treated. One factor which may influence the rate of use is that the tubes have a definite shelf life, and should be used before the date stamped on the box. They should be stored if possible in a refrigerator, but in any case at a temperature not above 70°F, and should keep for a year or more.

# Trade News

A school has asked us to advertise the following cassette loop projectors for sale: one super 8 model 205R in working order and almost new at £35, and two standard 8 model 105R at £10 each, all from THD Manufacturing. Both standard models give a jumpy picture and will need slight attention. For further information, contact SSSERC.

Many children find it impossible to stick a needle deliberately into themselves to take a blood sample. One device, called an Autolet, may help with this problem. It consists of a spring loaded device which is fitted with a sterile needle and a sterile platform. The platform is held over the fingertip, a plunger is pressed and the spring is released, causing the needle to descend through a hole in the platform to prick the finger. A stop prevents the needle from penetrating too deeply and after puncturing it is instantaneously retracted clear of the finger. The device was developed so that diabetic patients could monitor their own blood glucose levels at home. The Autolet is obtainable from Owen Mumford at £4.99; a carton containing needles and platforms (500 of each) costs £17.50.

In connection with the trade news item on Microtouch gloves in Bulletin 111, we apologise to readers for failing to point out that A Young and Sons have a minimum order charge of £10 for invoiced orders, although they will supply a single box of 100 for a cash sale. There are various surgical suppliers in Aberdeen, Dundee and Glasgow who stock Microtouch gloves and who have no minimum charge (see addresses under (Microtouch) on p. 12.).

As arranged by CLEAPSE, Optical Instrument Services are offering a small kit of materials needed for microscope maintenance, cost £13. The kit includes two grades of Rocol lubricant, two Selvyt cloths, 25 books of lens tissue, 3ml oil and some hardwood pegs. The Selvyt cloths and special lubricants form the major part of the cost.

We mentioned in Bulletin 107 that Unilab were now the only firm producing what could be described as a 'pupil' oscilloscope, albeit at a cost of over £80. This has prompted a reader to bring to our notice an oscilloscope made in Israel, and supplied by Henry's Radio at £83.25. The screen is 3in (sic) diameter, Y sensitivity 100mV/cm, time base range 100ms/cm - 1μs/cm in 5 steps.

# Physics Notes

In Bulletin 109 we published an article giving a t.t.l. circuit which would 'gate' the Harris and Griffin scaler/timers, in the sense that the momentary interruption of a light beam would flip the circuit, so that it would stop a count which had been proceeding on the timer. It has been pointed out to us by a lecturer in Jordanhill College of Education that without adding much more than a second photodiode, the circuit can be used for both starting and stopping a count. The time for a small object e.g. a free falling ball bearing to pass between the two photodiodes can be thus measured.

The logic diagram is below; the diodes feed two Schmitt triggers, and their outputs go to a NAND gate, so that either photodiode being blanked off drives the gate into its opposite state. The inclusion of a NAND gate between the Schmitt trigger and the flip-flop means that the pulse is now of the wrong polarity, and another NAND gate is put in as an inverter. Both NAND gates are spares on the SN7401 chip already in use to drive the timer. Fig.2 is the wiring diagram, from which it will be seen that another pair of input terminals, and a few connections are all that require to be added to the circuit of Bulletin 109.

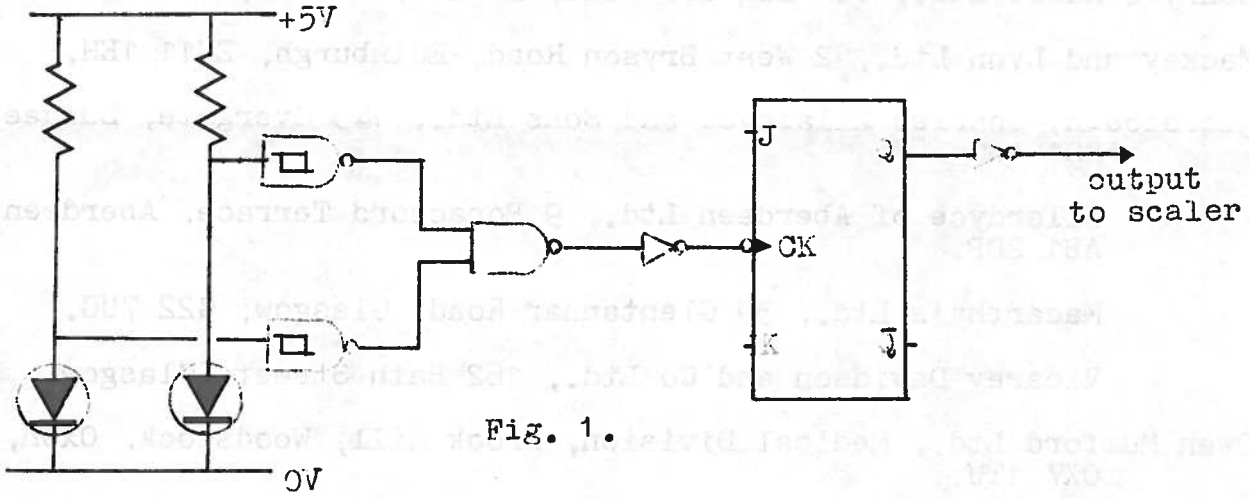


Fig. 1.

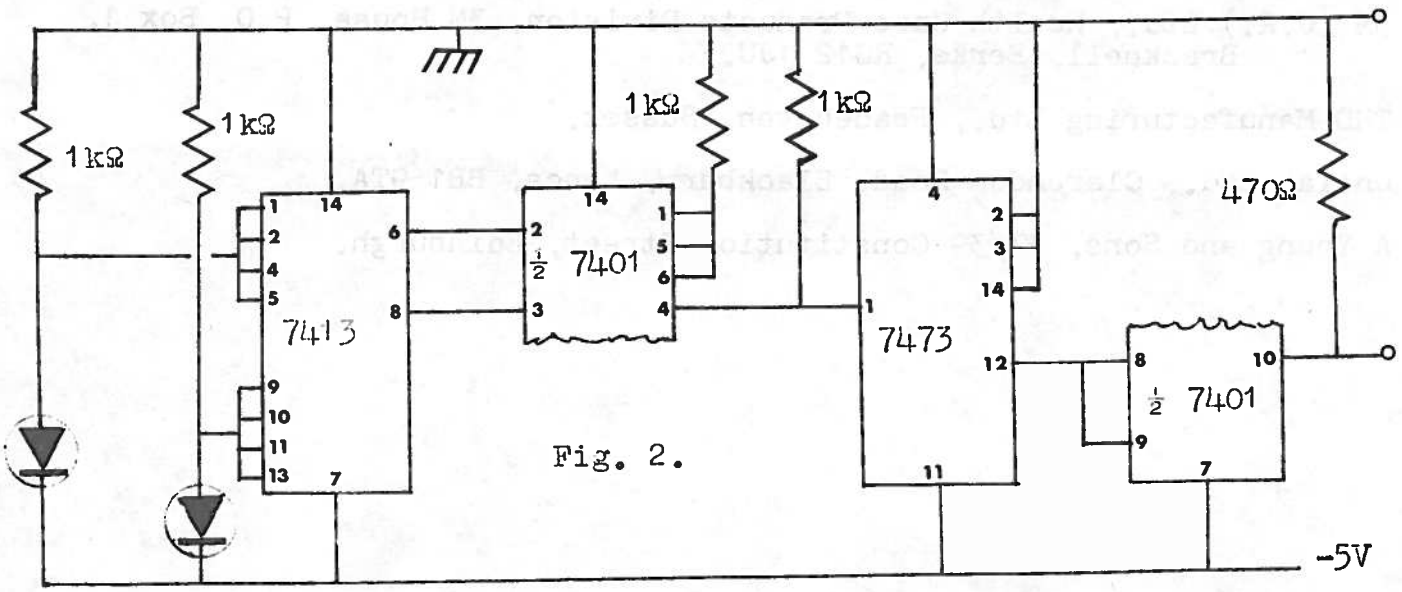


Fig. 2.

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

Albert Browne Ltd., Chancery House, Abbey Gate, Leicester, LE4 0AA.

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

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

Philip Harris Ltd., 34/36 Strathmore House, Town Centre, East
Kilbride, Glasgow, G74 1LQ.

Henry's Radio Ltd., 404 Edgware Road, London, W2 1ED.

Mackay and Lynn Ltd., 2 West Bryson Road, Edinburgh, EH11 1EH.

(Microtouch) Charles Allardyce and Sons Ltd., 145 Overgate, Dundee
DD1 1QG

Allardyce of Aberdeen Ltd., 9 Bonaccord Terrace, Aberdeen,
AB1 2DP.

Macarthy's Ltd., 39 Glentannar Road, Glasgow, G22 7UG.

Vicarey Davidson and Co Ltd., 162 Bath Street, Glasgow.

Owen Mumford Ltd., Medical Division, Brook Hill, Woodstock, Oxon,
OX7 1TU.

Optical Instrument Services Ltd., 166 Anerley Road, London, SE20 8BD.

3M (U.K.) Ltd., Health Care Products Division, 3M House, P.O. Box 1,
Bracknell, Berks, RG12 1JU.

THD Manufacturing Ltd., Peacehaven, Sussex.

Unilab Ltd., Clarendon Road, Blackburn, Lancs, BB1 9TA.

A Young and Sons, 37/39 Constitution Street, Edinburgh.