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HAZARDS OF GLASSBLOWING AND ALLIED OPERATIONS*

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The hazards of glassblowing and allied operations may be conveniently discussed under the following nine broad headings:

1. Gases used for heating: (a) Explosion or fire.
   (b) Toxic effects.
   (c) By-products.
2. Burners and appliances.
3. Explosion or implosion due to pressure or vacuum.
4. Fracture of tubing.
5. Chemicals, radioactivity or bacteria.
6. Evaporation of silica at high temperatures.
7. Machinery.
8. Personal injury: (a) Glare from burners.
   (b) Abrasives on skin.
9. Other hazards.

Headings 1–3 inclusive affect all laboratory personnel whilst headings 4–9 inclusive affect the operator only.

1. GASES USED FOR HEATING

(a) Explosion or fire

The gases used commonly for glassblowing in Great Britain are Coal Gas; Natural Gas; Acetylene; Butane and Propane. Of these, the first two named have high methane contents, 33% and 92% respectively, but all form explosive mixtures with air either in the atmosphere itself or in the pipes.

Coal Gas (0.475), Natural Gas (0.604), Acetylene (0.907) and Methane (0.554) have densities less than that of air and if they escape from containers or pipes form explosive mixtures above ground level. Butane (2.085) and Propane (1.562) have densities greater than that of air and will flow rapidly downwards on escaping to form an explosive mixture at ground level. A fire resulting from an explosive mixture of air and butane or propane is thus much more dangerous for the operator since he could be enveloped in the ensuing flames.

Hydrogen is used in Flame Spectrophotometry and as this gas is lighter than air and will rise if escaping from the apparatus, an explosive mixture will form above ground level.

Oxygen or compressed air leaking into the pipes or any available reservoir from the torch or burner chamber can penetrate all along the pipes and possibly into the gas meter itself and result in an explosion of great violence causing serious damage. At one university the main gas meter itself actually exploded for this very reason. Non-return valves must be fitted in all gas lines, as near to the working point as possible, to prevent this form of accident.

(b) Toxic effects

Coal gas contains 5% carbon monoxide, which substance is highly toxic since it combines with the haemoglobin of the blood to form carboxyhaemoglobin, a stable compound useless for transporting oxygen in the body. The affinity of carbon monoxide for haemoglobin is about 300 times as great as that of oxygen. Minute concentrations of carbon monoxide, if constantly maintained in the lungs, can thus produce very grave effects. A concentration of 200 p.p.m. can cause collapse in a few hours and a concentration of 1,000 p.p.m. collapse in an hour with ensuing death in four hours.

Acetylene, Methane, Butane and Propane are all asphxiants and are toxic in high concentrations, and Methane and Propane are narcotics also.

(c) By-Products of combustion

When coal gas and natural gas are heated to high temperatures, between 1,500°C and 3,000°C, nitric oxide gas (NO) is formed. This gas when released into the atmosphere further oxidises to nitrogen dioxide (NO_2). Figures presented by Dr. J. H. C. Van Mourik in the Journal of the British Society of Scientific Glassblowers, December, 1967, for Nitrous fumes in glass workshops, state that the threshold of perception by smell is between $2mg/M^3$ and $10mg/M^3$, and at the latter figure it is already dangerous. $60mg/M^3$ for five minutes should not be exceeded. $720mg/M^3$ for five minutes causes lung oedema and resultant death.

Experiments were performed to establish the amounts of NO and NO_2 actually produced under practical conditions. It was found that one torch burning oxygen/gas mixtures would produce $200mg/M^3$ in 30 minutes. It is evident from these values that adequate ventilation of a glassblowing shop is essential.

Large volumes of NO and NO_2 can also be formed by an electric arc in free air. Sidgwick in Chemical Elements and their Compounds, 1950, gives the following figures for NO:

1.2% by volume produced at 2,000°C and 5.3% by volume produced at 3,000°C.

2. BURNERS AND APPLIANCES

Gas Boosters

Some years ago when town gas pressures were extremely low the fitting of gas boosters became common practice. These appliances virtually suck the gas from the gas main and compress it foreward into the working line. Gas companies advise against this practice since it creates a reduced pressure in the supply line and, in the event of a flash-back through the control valves, an explosion is tantamount to a certainty.

Burners

Cannon burners make a lot of noise and this gives adequate warning of their presence. However, damage can be caused to eardrums which should, therefore, be protected by the use of ear plugs.

Premix burners, on the other hand, burn very quietly and can be used to produce needle point flames which may be both inaudible and invisible. Carelessly placed in position, such burners can damage clothing, cause severe and serious injury to the body or even burn and destroy an eye. These burners must be hung up well above head height and protected by shields both in use and when idle. A further danger with premix burners concerns the possible blockage of the outlet jet. Should this occur oxygen could well be injected into the gas line. Premix burners must, therefore, be fitted with non-return valves.

Other appliances which need special care are turret burners, chambered burners and strip burners, any of which may be led to economiser valves. These can all give unpleasant minor explosions if the gas pressure is either reduced or shut off first. The oxygen, therefore, must be shut off first. In any case, with repetition of explosions of this type, there is the risk of weakening or splitting the chamber.

Compressed Air Reservoir

Many glass blowing benches are fed with supplies of oxygen, compressed air and coal gas, and fitted with a reservoir to stabilise the pulse from compressor to burner. Since the oxygen and the compressed air are fed to the centre jet of the Cannon burner, this means that the two systems are virtually bridged. Normal working pressure would be five pounds per square inch, or thereabouts, but the second stage output of an oxygen head can be 30 to 60 pounds per square inch. Thus, if the torch valve is shut off and the oxygen valve is set to maximum, 30 to 60 pounds per square inch can be put into the air reservoir tank. This airline, therefore, should also be fitted with a non-return valve and in addition the reservoir must be able to withstand a large safety margin above whatever is the maximum load which can be applied to it. A tin tank can easily be split open by three to four atmospheres, a condition which is present here.

3. EXPLOSION OR IMPLOSION DUE TO VACUUM OR PRESSURE

The strength of glass and its breaking stress is a compound function of its chemical composition, the diameter of the vessel, the wall thickness of the vessel, the heat applied to the inner and the outer surfaces, the internal and external pressures and the duration of the applied pressures. To these must be added the shape of the vessel and any variation of local pressure or mechanical impacts which may be applied.

It is not possible, therefore, to give what might be termed general dimensional values for guidance, since each construction is individual and specific to local conditions. For general laboratory purposes, however, one must be guided by experience and then proceed with the maximum standard of caution and the minimum amount of risk.

In these terms, with vacuum, any evacuated vessel has 15 pounds per square inch applied to it by the atmosphere. This may be withstood in a small glass vessel but with a large glass container it must be assumed that, unless the vessel is deliberately designed to take a vacuum, it will not do so. All vacuum systems must be taped, wired or shielded.

Pressure is even more dangerous in a glass vessel. Glass is far stronger under compression than under tension and when the pressure is increased in a container, the glass is then under tension. Thin glass is in serious danger of explosion at one to two atmospheres of internal pressure. Pressure should never be increased inside a glass vessel unless it has been definitely established that the container can withstand the known pressure being applied.

4. BREAKAGE OF TUBING

Most accidents result from attempting to cut tubing in the wrong fashion. The only safe way to perform this operation is to make a cut mark on the tube with the tube resting firmly in a notch or groove in the bench so that the tube cannot slip sideways whilst the cut is being made. Further, when cutting up lengths of tubing, only one place should be cut for each snapping. If the whole of the tube is marked, the tube may break at one or more other cut marks simultaneously, upon snapping the first cut. Further accidents result from pushing glass tubes through rubber bungs. The glass tube must always be lubricated and never pushed through the rubber bung in a dry condition.

Stacking Glass

Tubing is safer and easier to handle if stacked horizontally. Tubes may fall over, either in single canes or in a heap, if stacked vertically and it is difficult to select a required size if stacked in this fashion. However, if glass is stacked horizontally, the storage rack must never be situated in a passageway. A protruding tube could be left protruding at face level for someone to walk into, especially in the dark. It is safer also to have a cupboard door to close in the ends of the storage rack.

5. CHEMICALS, RADIOACTIVITY OR BACTERIA LEFT IN TUBES

Before working any glass tube in the flame, the glassblower must be satisfied that it is clean with regard to chemicals, radioactivity and bacteria. Chemicals may give off harmful vapours in dangerous concentrations, in particular chlorinated hydrocarbons, such as chloroform, carbon tetrachloride, ethylene dichloride and trichlorethylene, all of which are common laboratory solvents. These compounds break down under increased temperature to yield carbonyl chloride. This substance is a war gas called phosgene – a lung irritant and fatally toxic in a concentration of only $40 mg/M^3$. Usually, when a glassblower is working, it is a few seconds at least before he realises that there is a taste in the tube and in that time a lot of vapour can be inhaled. Laboratory workers have been poisoned by smoking with these solvents on their fingers alone and the effect would be much worse with a contaminated tube placed in the mouth.

Radioactivity

Examples involving possible contamination with radioactive substances are too numerous to mention in a few sentences but it cannot be stressed too emphatically that, on every occasion when a glassblower or technician is asked to seal an ampoule or a system containing radioactive compounds, he must examine every possibility that might exist of his breathing in or ingesting the radioactive substance. He must eliminate, then, every risk in advance.

Bacteria

Pathogenic bacteria may be present as unknown contaminants or the glassblower may be asked to seal up vessels containing bacteria. Relatively simple precautions can give adequate protection A cotton wool plug for example or a tower containing antiseptic in a suitable form. Old or dirty tubing is always suspect. The only safe practice is to cleanse glass thoroughly prior to using it.

6. EVAPORATION OF SILCA AT HIGH TEMPERATURES

At its working point of 1,710°C and upwards, silica or quartz volatilises to yield silicon dioxide vapour (SiO_2). This vapour can be absorbed into the lungs to cause silicosis, the effects of which are described by Haldane and Priestley, 'Respiration' 1935.

Industrially, silica tubing is worked with very efficient ventilation systems, with take-off hoods immediately above the point of working together with extraction filters. The same precautions are necessary in small workshops, even when silica is worked in very small quantities.

The working point of silica is shown as 1,710°C but the actual working range for a mass of silica is 1,900°C to 2,000°C. At these temperatures the vapour pressure of silica is in the region of 100 to 400 mm Hg. The yield of Silicon dioxide at the usual working temperature of silica is, therefore, at a dangerous level. To obtain these temperatures it is necessary to use oxyacetylene or oxypropane burners where the hottest points of the flame at the tip of the cone reach 3,000°C.

Borosilicate

The fact that borosilicate working has been performed to date without the same precautions as are taken with silica, presupposes that no silicon is volatilised upon heating borosilicate glass in an oxy-coal gas flame. But is this so? The hottest point of a premixed type oxy-coal gas burner at the tip of its cone is 2,600°C and it is certain that at least some of the borosilicate is heated a long way above the working point of 1,220°C and indeed could be raised to the region of 1,710°C the vaporisation point of silicon dioxide. Glassblowers are familiar with the condition of borosilicate heated at very high temperatures, when it appears to boil. What is the product of this boiling? Consider for instance a typical glass construction where the flame may be partially taken into the tube as for instance a Dewar type seal. The flame enters at the join, a spread occurs and a blush results on the glass wall, both inside and outside, which persists until the work is finished and the glass is cool again.

This blush is not wholly carbonaceous impurities, because some of it survives annealing at 560°C. What then is it? Is it boric oxide, sodium salts or silicon dioxide? Or is it metallic oxides from the torch or gas line? It does not follow in any case that, whatever this material is, that it will reach the mouth of the operator since it would have to travel the whole length of the glass and then traverse the operator's mouth tube.

In the case of a material more volatile than silica, for instance zinc metal which material is present as a very minor impurity in some borosilicate glasses, the distillation at 700°C to 800°C will carry the metal only three to four inches up a silica tube under a vacuum of 10^{-3} mm Hg where the zinc then precipitates as a ring deposit. Perhaps silica also does this and it is to be hoped that, whether it escapes in the form of silicon dioxide or silicon monoxide, this is what happens. However, I would like to be sure of these facts and I hope to be able to do some work on this aspect of silica work and determine the actual position.

As a closing note upon the significance of the points presented in this section, the medical relevance should be mentioned. Authoritative opinion has presented differing interpretations upon the effects of silica in the body. One interpretation is that the damaging effect of silica is greatest when the particle size is smallest. According to this interpretation silica would be in its most damaging form as an evaporation product, as in glassblowing. J. Smart in 'Synopsis of Respiratory Diseases', 1964, shows that rapid action increases with small particle size of 1 to 3 microns, and that action is not due to mechanical trauma but to silica dissolved into the body fluids, with the formation of silicic acid.

In contrast to this opinion, however, other views are expressed which hold that silicosis results mainly from the effect of silica in the massive form of dust coming from crushed rock, settling into and congesting the lungs with the formation of fibrous nodules.

Despite this divergence of expert opinion on the relative importance of the particle size, there is a wide measure of agreement among these authorities that injury from free silica shows itself in the greatly increased liability to tuberculosis infection, because the effect of silica reduces the natural defences of the lungs.

7. MACHINERY

The hazards concerning machinery are too numerous to list in full but those enumerated below are typical examples.

(a) The grinding wheel may pick up glass or a tool and hurl it at the operator.
(b) Pieces or chips may fly off a worn wheel and even total disintegration may occur. The wheel must have a tool rest and guard.
(c) A diamond loaded copper disc may buckle because the speed is too low, the water is not reaching the disc, the pressure is too great or the work is off centre. Use of a face mask is essential during this operation.
(d) Glass or rigs may be thrown out of the lathe chuck. This usually occurs at low speeds when the danger is less, but now that glassblowers are forming glass by centrifugation at high speed, much greater care must be taken.
(e) When drilling holes in glass articles under an ordinary electric power drill or a pillar drill, work spin may result if the work is not secured properly.
(f) With large lathes, utilising large cage or claw chucks, it is only too easy for the glassblower to get his clothing caught in the chuck. In one factory a glassblower was actually picked up by his clothing and carried round in the lathe. He miraculously escaped serious injury.

The safety principle for large lathes is that no article of clothing or protective clothing be worn in such a way that loose flaps can catch in the machine. Laboratory coats should have loosely fixed buttons which are not stitched in. Fixed belts should not be worn, either inside or outside the protective coat. The safest and most comfortable wear for a worker at a large glass lathe is waist fitting trousers and a reasonably close fitting shirt or vest. Some factories do not permit this, because the personal garments of the operator are not then protected from the flame and fragments of glass, and may insist on the wearing of a laboratory coat.
(g) A necktie is a serious hazard and must never be worn at the machine.

8. PERSONAL INJURY

(a) Glare from burners

The action of hot flames on glass results in the emission of red and infra red rays in great concentration and also an intense glare from the yellow sodium region of the spectrum. These emissions damage the cornea of the eye and prolonged exposure can cause cataracts leading to total blindness for unprotected eyes. The effect is cumulative so that every time glass is worked in the flame by a professional glassblower, he should wear protective glasses suitable for absorbing the radiations. The hazard has been recognised for a very long time in the glass industry. Daily working for seventeen years is known to cause total blindness with unprotected eyes. Ultra violet may also be radiated but most of this radiation is absorbed by plain glass.

(b) Abrasive action on hands

The glassworker in a small workshop, with miscellaneous operations, may alternatively roast his fingers, hands and arms, by the flame and then perform grinding operations with wet hands and wrists, probably with carborundum powder. Under these conditions, extreme chapping and cracking of the skin can result – an extraordinarily painful condition. The damaged skin can result in dermatitis. Hands and wrists should be protected daily with a non-greasy barrier cream.

Araldite can produce the same effect on people who are allergic to it. Araldite is a condensation product of epichlorhydrin and diphenylolpropane, both of which are known to produce serious dermatitis to people who are allergic to them. Here again, hands should be protected by barrier cream and by gloves.

9. OTHER HAZARDS

Flames conduct electricity, especially high frequency discharges. Use is made of this property in the high frequency heating of glass. The Tesla Coil, a common source of high frequency, is used on a glassblowing bench for testing a vacuum or the soundness of joints and should be kept well away from the flame since it can discharge along the flame and back to the burner and operator.

Polytetrafluorethylene (PTFE), is a material widely used in association with glass. If used in compound structures, or in places where it can be heated, great care should be taken not to raise the temperature of the PTFE component. It decomposes above 400°C to produce fluorine gas. Fluorine fumes are very poisonous and they also set up severe irritation of the eyes which can lead to blindness. Small concentrations can be lethal. The maximum allowed concentration is 1 mg/M^3. The reaction in hot glass with oxygen flames could be complex with a further possibility of oxidation to carbonyl fluoride, also very toxic, or fluorine monoxide. The latter has a maximum allowed concentration of 1 mg/M^3 and is even more toxic than fluorine itself. It is very important not to heat the solid material, or sprayed PTFE films or flexible tubings, especially in a tube where the glassblower can inhale the vapour.

**This paper was given at the ISTEX Symposium in* 1969 *and the London Branch of the I.S.T. has given permission for this reproduction.*

Mr. C. H. Wiltshire is a member of the B.S.S.G. and therefore we have a special interest in his paper, though in his opinion it should be expanded to include other information which has previously appeared in the Journal.

The following extract from a letter by Mr. Wiltshire to the Editor is worth noting.

"My personal assessment of dangers for glasswork shop workers is that the greatest overall danger comes from machinery.

The ever present dangers of work-spin, abrasive wheel throw and breakage, and lathe pick-up, represent the most telling accident source for glassblowers dependent on their hands for their livelihood.

It is the scanty coverage in this section from my paper which I regard as the most important to remedy by a full length article dealing specifically with these hazards."

NORTH SEA GAS

It seems that the subject of North Sea Gas and its satisfactory use for glassworking is now predominant in the minds of many British glassblowers. There is considerable speculation as it is realised that many factors such as burner design, explosion risk and protection from glare will have to be taken more seriously than with the older and receding town gas. It is also expected there will be changes in technique directed towards shorter hot working times, which in the future will have an influence on training methods. Thus it is not surprising that there is an influx of reports of meetings and various points of view, some of which may be contradictory. As there is at the moment no final authority on the subject, from the Journal point of view the only course is to publish in the hope of advancing towards the experience which will enable us to define the best equipment and methods of working glass with the fuel gases which will be available in the future.

EAST ANGLIAN SECTION MEETING

On Friday, 8th May over thirty members made the trip to the Special Services Centre of the Eastern Gas Board, showing how important glassblowers consider the changeover to North Sea gas.

The meeting began with officials of the Gas Board showing the areas of the country which have already been converted to natural gas and those which are due for conversion in the near future. The meeting gave members an insight into how the Gas Board investigates new and special problems of conversion including the requirements of glassblowers.

The Gas Board likes to hear of complaints and inadequate conversions so that they can solve the problems for us and should anyone have special conversion needs or difficulties with equipment in glass workshops or factories, they should contact their Regional Industrial Engineer who will look into their case. If any special conversion work is needed on their equipment the information will be passed on to the Special Services Centre who will endeavour to help the company concerned.

Any company or laboratory not yet converted can have demonstrations and try out North Sea Gas on their own premises, which has been made possible by the Gas Board's mobile laboratory which is fitted up with lamps and other equipment working on natural gas.

The evening was rounded off by an inspection of the Special Laboratory whose function is design and research on conversion techniques. Many lamps of various designs were on display, some for use with town gas, and some connected with a North Sea Gas supply. Members were invited to try them and judge their performance.

I think that all members found something of interest to them and we thank the officials of the Eastern Gas Board for making the meeting at Dunstable so interesting and enjoyable.

R. A. PRYKE

NORTH EASTERN SECTION

On April 22nd the section held a meeting at the Houldsworth School, Leeds. Mr. Kershaw from the North Eastern Gas Board and Mr. Beecroft from the Northsea Gas Appliance Co. addressed members on the subject of Natural Gas.

Mr. Kershaw began by explaining that the traditional method of making gas from coal produced a town gas having a calorific value about 500 BTU/ft.^{3}. In the early 1960's processes for making gas oil began to be used more widely which produced a 'lean' gas with a calorific value of 340 BTU/ft^3 or a 'rich' gas with a calorific value of 650 BTU/ft^3 and by mixing these two together a gas corresponding to town gas, 500 BTU/ft^3, would be made.

When the first major strike of natural gas was made in 1965 the gas industry had a problem. The new gas had a calorific value of 1,000 Btu/ft^3, twice that of town gas, so they either had to mix it with 'lean' gas made from oil to produce a fuel which corresponded to town gas, or convert all gas burning appliances to burn natural gas. The chief advantage of natural gas is that as its calorific value is twice that of town gas this has the immediate effect of doubling the amount of potential heat contained in existing pipelines. Costs were weighed up for these two alternatives and it was decided that to burn natural gas would be the cheapest method.

We were then shown a film which explained why appliances would have to be converted and the problems involved in doing this. The first problem is that as the calorific value is twice that of town gas, natural gas requires twice as much air, to burn every cubic foot, therefore modified injectors have to be fitted. If this were not done the gas would not burn completely and a floppy, sooty flame would result. The second problem is that because natural gas has a lower flame velocity than town gas, flames tend to be unstable, lift off the ports of the burner and are easily extinguished. This problem is overcome by incorporating a 'retaining' flame in the burner which burns at a very low velocity thus preventing lift-off of the main flame.

Mr. Kershaw went on to explain how the change to the new fuel would affect the householder and how conversion was carried out.

We were then shown a second film entitled "The Day of the Phoenix" which took the form of a semi-documentary dealing with the problems that large engineering firms face in being converted to natural gas. The film showed the close liaison needed between Gas Board and consumer to ensure a smooth changeover.

Mr. Kershaw then handed over to Mr. Beecroft who had brought with him a wide selection of his firm's products designed for use on natural gas. Mr. Beecroft was able to demonstrate several of his burners as he had with him cylinders of natural gas and oxygen. A great deal of interest was shown by members particularly in two hand torches and a bench model as this was the first time many had seen how natural gas performs.

At question time one member asked Mr. Kershaw what was the N.E.G.B.'s policy on changing burners at conversion time. At the moment he was using a town gas bench blowpipe costing thirty pounds. Would the Gas Board exchange this for one of the same value or one costing three times as much? Mr. Kershaw replied that usually they would replace one burner with another of the same value but if glassblowers were not satisfied that the replacements they were given performed as well as their previous model the Board would have to find them a burner that did perform as well – whatever the cost. In the end, said Mr. Kershaw, the Gas Board had to satisfy the customer.

After questions members were able to use the burners on display and it was generally agreed that particularly in the use of hand torches several types would have to be used after conversion where previously one would have been sufficient.

Thirty members and friends attended this meeting and we would like to thank Mr. Kershaw and Mr Beecroft for a very interesting evening on a subject that will be affecting all glassblowers at some time in the future.

RICHARD HALL

NOTES ON THE SAFE USE OF NATURAL GAS BLOW LAMPS

by C. H. Williams of Jencons Scientific Ltd.

The Common Fuel gases used in present day glassblowing are by themselves not combustible, and therefore there is no danger of an explosion taking place in a distribution system containing only fuel gases.

To obtain the required heat for the manipulation of glass, it is necessary to introduce oxygen and/or air in to the fuel gas. As the oxygen enters the blow lamp at a greater pressure than the gas, one must always make sure the jet size being used is capable of allowing the mixture to escape. It is therefore a sensible precaution, especially when using rotary head torches to turn off the oxygen before selecting a new jet. A sudden build up of pressure in turning from a large to a small jet could force the oxygen to enter the fuel gas distribution system. If a suitable ignition force is present, then combustion can take place and depending on the geometry of the pipe work violent explosions can occur.

In the Gas Act 1948, 3rd Schedule, Section 27, Paragraph 2, it is stated "Where a consumer of gas supplied by an area Board used for or in connection with the consumption of the gas so supplied any air at high pressure (in this paragraph referred to as compressed air) or any gas not supplied by the Board (in this paragraph referred to as extraneous gas) he shall if so required by the Board by notice in writing, fix in a suitable position and keep in use an appliance proved by him which will effectively prevent the admission of the compressed air or extraneous gas into the service pipe or into any main through which gas is supplied by the Board".

Although any one of the recommended non-return valves can service several blowlamps at one time (and this system is in use in many glass-shops) the practice is short sighted and dangerous, for one blow back could damage the non-return valve, thus bringing a glass workshop to a standstill. The cost of lost production – hold-up to research – the risk of injury from an exploding pipe is surely an effective argument for the fitting of a non-return valve to each glassblower's bench.

Jencons have for some years supplied the AMAL non-return valve which meets the current requirements of the Gas Council. This valve is designed to fulfil the duty of preventing accidental admission of air and/or oxygen into a fuel gas distribution system. It passes the normal flows of gas to be encountered giving only a small pressure drop. If subjected to a reverse or back flow of air or oxygen, the valve will immediately close so preventing the entry of air or oxygen into the fuel gas distribution system thus preventing possible dangerous conditions to occur.

One of the main features of the valve is its sensitivity. It will close on the slightest return pressure but also is capable of dealing with return pressures up to 40 p.s.i.

In operation gas enters on the inlet side of the valve and exerts pressure on the under side of an oiled leather diaphragm lifting it off a spring supported valve plate. The diaphragms have in them a central gas passage hole which allows the gas to pass through to the outlet side of the valve. In the event of the slightest return pressure, the diaphragms fall back on to the spring loaded valve plate making a first sensitive seal. Further increase in return pressure then carries the diaphragm and valve plate downwards against its spring loading until the valve plate comes to rest on a seat in the valve body with the diaphragms lying on the bottom face of the body, thus a second seal is made to withstand high back pressure and the diaphragms are supported thus preventing their rupture.

As previously mentioned, the valve should be mounted as close as possible to the point where the reverse flow of air or oxygen might occur.

The valve body is in aluminium alloy and is designed for horizontal mounting (Illustration page 33).

The valve is suitable for use in towns gas and natural gas distribution systems and will deal with the inadvertent return flow of oxygen but the valve is not recommended for installation in an oxygen line where oxygen could flow continuously through the valve.

It must be pointed out that non-return valves do not act as flame arrestors. From discussions with Gas Board officials it seems that the only flame arrestors available on the U.K. market are imported, and therefore likely to be expensive. However, the possibility of flash back and its inherent dangers is of concern to all torch users and suppliers and should not be ignored.

Some useful hints and precautions for those people using rotating head premix burners will lessen the possibility of your non-return valve being "Put to the test".

1. **ALWAYS** let the gas flow for a few seconds before lighting, especially when first igniting the lamp after a period of non-use. This will clear any oxygen or air that may have collected in the gas line.

2. **ALWAYS** shut off the oxygen before rotating the turret head. If this is not done oxygen can be forced into the gas line while the mixture feed is between the jets. The Jencons Nat-Gas Rotajet is fitted with a locating ball on the head which enables quick accurate jet selection by feel alone.

3. **ALWAYS** take care when using the lamp that the flame is not put out by excess oxygen pressure. If more oxygen is fed into the mixer than the jet can handle the excess will be forced into the gas line.

4. **ALWAYS** ensure that gas and oxygen are turned off at the taps provided when the lamp is not being used. If the lamp is to be left unattended at any time ALWAYS shut off the oxygen at the tap.

5. **ALWAYS** If it is suspected that for any reason oxygen or air has gained access to the gas line, allow the gas to run **UNLIT** until it is cleared.

6. **REMEMBER** – gas and oxygen mixed in the right proportion is a highly explosive mixture, always to be treated with respect.

7. On Completion of the days glassblowing activities make sure all taps are turned off including those from your cylinders or mains supply.

THE SAFE USE OF NATURAL GAS-OXYGEN GLASS WORKING BURNERS

Submitted by A. P. Finesilver, Nordsea Gas Appliance Co. Ltd., Manchester.

One could write a book to cover all aspects on the safe use of burners but as I have neither the inclination nor the desire to befuddle you with facts and figures, a brief summary will suffice.

It goes without saying that well designed equipment, both from the combustion and handling point of view, will go far in eliminating the causes of dangerous conditions.

Burner heads should be of sound design coupled to the correctly sized mixers and mixer tubes. This drastically reduces the possibility of flash back and back pressure. Equipment should also be entirely free from grease to avoid oxygen fires. Safety devices such as back pressure valves and flame traps can be fitted although these are not absolutely guaranteed.

Rapid loss of either or both gases can cause flash back or detonation of unburnt gases, but inexpensive protection can be afforded by the installation of low pressure cut-off switches.

Finally the correct lighting procedure on natural gas-oxygen burners will enhance the safe operation of this equipment. Turn on the oxygen, then the gas. To turn off the burner turn off the gas and then the oxygen. Many people will reverse this sequence but from the safety angle the correct procedure should be adhered to.

NON-RETURN VALVES TO BLOW-TORCHES

Several explosions have occurred recently where glassblowing bench torches are used with a mixture of natural gas and oxygen.

It appears that it is common practice in laboratories to rely solely upon the Gas Board's installation of a non-return valve between the meter and the gas tap.

After consultation with the Gas Board and various manufacturers, it seems that the safety factor should be increased by a further non-return valve in the gas line just after the gas tap which feeds the torch (i.e. another non-return valve that is much closer to the torch).

As an alternative, the Gas Board have specified that a flame arrester device, of the type manufactured by "Nordsea", can be fitted, again just after the gas tap which feeds the torch.

It should be noted that if the first method is adopted, then the valve used should **NOT** be fitted with an oiled leather seating; some non-return valves use these fittings, and it is strongly advised that this point is checked on existing valves.

I have been in touch with Amal of Birmingham, the suppliers to the Gas Board, and learn that the non-return valves supplied are the oiled leather seating type, and therefore are not to be used with 0_2 without an additional valve, or a flame arrester device, as suggested. R. Mason

The Editor wishes to remind members of the excellent talk with demonstrations given to the Society by R. Cescotti of W.S.A. LTD. Combustion, explosion and detonation were covered and his comments on antiflash valves are now very relevant.

SYMPOSIUM 70
at
The University of Surrey
Guildford
Surrey
September 10 - 12

PROGRAMME

Lectures – Theatre 'D'

Thursday 10th September

6.00 p.m.	Registration begins – Dinner
6.30 p.m.	Exhibition opens
8.30 p.m.	Cheese and Wine Party followed by a Feature Film

Friday 11th September

	Breakfast
9.30 – 11.00 a.m.	ANNUAL GENERAL MEETING
11.00 – 11.30 a.m.	Coffee/Tea biscuits
11.30 – 12.30 p.m.	Professor M. B. Waldron, Head of Metallurgy Department to welcome delegates and first lecturer: **Relationship between the Scientist and the Glassblower,** by Dr A. Everett, Wellcome foundation
12.30 – 2.00 p.m.	Lunch
2.00 – 3.00 p.m.	Lecture: **Triton Insulation,** by W. R. Everard, Esq., Morgan Ceramic Fibers Ltd.
3.00 – 3.30 p.m.	Tea/Coffee biscuits
3.30 – 4.30 p.m.	Lecture: **Natural Gas and the Glassblower,** by B. Dann, Esq., Development Engineer, South Eastern Gas Board
7.30 – 11.30 p.m.	DINNER/DANCE/CABARETTE

Registration & Exhibition – The Concourse
Lecture Theatre Block

Saturday 12th September

8.30 – 9.30 a.m.	Exhibitors' breakfast
9.30 – 11.00 a.m.	**Natural Gas and the Glassblower** A series of short talks and discussion **Panel:** D. Scott Wilson, Esq., Scientific Information Officer, The Gas Council. R. Mason, Esq., Royal Holloway College. M. Leutenegger, Esq., Tube Investments Ltd. and Representatives from the Gas Boards.
11.00 – 11.30 a.m.	Coffee/Tea biscuits
11.30 – 12.30 p.m.	Lecture and Film: **Silica Glassblowing,** by Horst Baumbach, Quartz Fused Products Ltd.
12.30 – 2.00 p.m.	Lunch
2.00 – 3.30 p.m.	Lecture: **Miscellaneous Techniques,** by J. Burrow, Esq., University of Bristol
3.30 – 5.00 p.m.	Tea/Coffee biscuits – Exhibition open
5.00 p.m.	Exhibition closes – Dinner Entertainments to be arranged for those staying Saturday evening

Sunday 13th September

	Breakfast
10.00 a.m.	Symposium closes

A coach has been booked for Friday 11th September to take the ladies to places of interest.

Short films will be shown in between Lectures and Meals. They include:

Well I'm Blowed – *Glas* – *The Kosta Glassworks*

B. Shepherd, Esq., will demonstrate glass animal making.

The Glassblowing Laboratory Room 20 AA 17 will be open for demonstrations. Any Member wishing to participate please contact the Symposium Secretary.

Liquor Bars – open normal licensing hours with Friday night extension.

Symposium Committee

Chairman: A. D. Wood
Secretary: E. White
Treasurer: W. Brench

Organisers:

Trade & Advertising:	C. Glover,	D. Gill
Programme:	W. Young,	R. Newman
Reservations:	E. White,	W. Brench
Entertainments:	R. Gannon,	L. Ratcliffe

TRADE EXHIBITION

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R. B. Radley & Co. Ltd.
Nordsea Gas Appliance Co. Ltd.
Thermal Syndicate Ltd.
R. W. Jennings & Co. Ltd.
H. Baumbach Glassblowing Tools
Quartz Fused Products Ltd.
G. Springham & Co. Ltd.
F. Yorke & Partners Ltd.
Heathway Machinery Co. Ltd.
A. D. Wood (London) Ltd.
Laboratory Glassware Manufacturers Ltd.
Quadrant Glass Co. Ltd.
Quickfit & Quartz Ltd.
The British American Optical Co. Ltd.
W. Young (Fused Silica)
Day-Impex Ltd.
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A British Society of Scientific Glassblowers Stand

AWARDS

The Jobling Cup

Donated by Messrs. James A. Jobling & Co. Ltd. and presented to the student member with 3 to 5 years experience in scientific glassblowing and who, in the Judges' opinion submits the best piece of scientific glassware in this class.

The A. D. Wood Cup

Donated by Messrs A. D. Wood Ltd., and presented to the student member with up to 3 years' experience in scientific glassblowing and who, in the opinion of the judges, submits the best piece of scientific glassware in this class.

The Thermal Syndicate Award

Donated by the Thermal Syndicate Ltd., and presented to the Student member with up to 5 years' experience in scientific glassblowing and who, in the opinion of the judges submits the best piece of Apparatus fabricated primarily in vitreous silica.

The Awards will be presented at the Symposium Dinner and Dance on Friday, 11th September.

Symposium Secretary:

E. White, 95 Buckingham Gardens, Hurst Park, West Molesey, Surrey. Tel: 01-979 9405.

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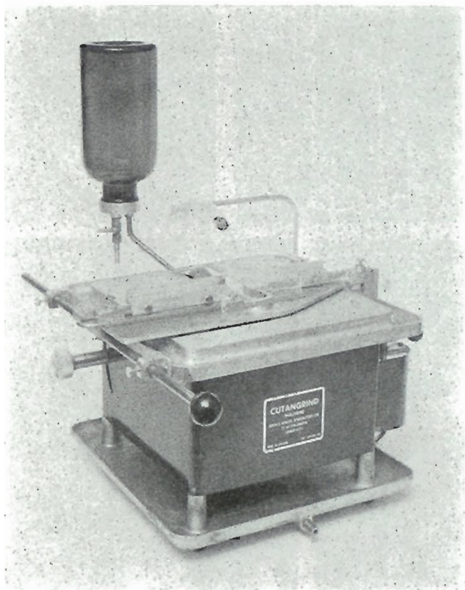

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COUNCIL MEETING 16TH MAY
SUMMARY OF MINUTES

Student Observers

The Chairman Mr. J. W. Price stated that any Section could bring a student observer to Council but he would not have the right to vote.

Dr. Oldfield's Award

Both the East Anglian and Thames Valley Section were of the opinion that the award should be used to encourage good articles on Glassblowing for Glassblowers for the Journal. The Chairman will discuss the matter with Dr. Oldfield.

Finance

The Treasurer Mr. L. Benge reported an income of £1,816.7.7d. (including the 1969 balance) and expenditure to date of £242.7.9d. giving a current balance of £1,574.

Journal

Mr. R. Garrard of The School of Chemistry, University of Bristol, was elected Editor to succeed Mr. J. H. Burrow and all Journal correspondence should now be sent to the new Editor. Mr. F. Porter and Mr. J. Martin will assist.

Board of Examiners

Sections should either confirm their existing representatives to the Board or elect new ones before the next Annual General Meeting.

In future only members serving on the Board will be eligible to officiate at examinations as the existing panel will be discontinued.

The conditions for Fellowship are under review and a draft is being circulated to all members of the Board for comment.

Entries for the annual awards should be submitted in good time for the next Board of Examiners meeting on 15th August. Mr. Fairbrother, runner-up for last year's T.S.L. award will spend a week at their training centre.

Negotiations are still proceeding on B.S.S.G. recognition by the Universities Collegiate Council.

P.R.O. Report

Mr. G. Berger reported that from information supplied by older members he is endeavouring to write a history of the Society which when complete will be published.

Mr. Berger is also endeavouring to form a permanent Symposium Committee and all Sections are invited to send representatives to an exploratory meeting. Mr. Berger also pointed out that when asked to send Society information to prospective members the amount available was limited and therefore a new Society booklet should be printed to include more general Society and Section information to help the prospective member.

Overseas Members

Mr. Mason reported that several applications for membership had been received including three from Nigeria. With regard to forming a West African Section it was agreed that more information should be obtained before proceeding further.

Ties

The general opinion was that the present design should not be altered and Mr. Stuart has undertaken to order a new batch in time for the A.G.M.

SECTION ACTIVITIES

Southern Section

Visit to Heathway Machinery Co.

On Monday, 9th March, Heathway Machinery Co. Ltd. acted as hosts to about fifty members of the Southern Section and their friends, and right royally they did it too. We were greeted in the canteen with tea and biscuits, split into groups of ten and then given a guided tour through the works by senior members of the staff.

Apart from special machines for glassworking we saw such things as a set up for producing refrigerators from sheet steel which was completely automatic, from the separating of the sheets by fixed magnets, to the lifting by suction pads and the feeding through the rollform machine where the edge shaping is performed; through another where nuts and bolts are fed in; over the roller topped slides to the final bending into the finished shape.

Seeing the giant lathes made one feel Lilliputian by comparison: beds about eighteen feet long, clearances between spindles of twelve feet, chuck hand-wheels a yard wide. Solid as these beds look, they can still warp over their length by three-quarters of an inch, yet when running they are correct to within a few thousandths of an inch.

Then there was the Cintomatic which drills, taps and shapes by magnetic tape control, and the little specialist machines like the welder for the razor blade strip material. Glass cutting wheels, grinding tables and a variety of Litton type and other jets and burners which were piped up so that we could try them for ourselves.

We then congregated in the canteen where we were to have had our questions answered but the atmosphere was so convivial, due in part to various drinks and refreshments being enjoyed by all, that it was decided to leave members to ask their questions informally as, in fact, most were already doing.

An interesting, informative and, above all, an extremely cordial evening for which, on behalf of all members present, I should like to thank all the Heathway staff.

March Meeting

To a rather disappointingly small but interested audience Mr. Reicher of Laser Associates gave a

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March Meeting

To a rather disappointingly small but interested audience Mr. Reicher of Laser Associates gave a condensed lecture on optics which, for me, was only too short. Carefully avoiding mathematics, which in itself is virtually an impossibility on this subject, Mr. Reicher took us from the elementary nature of light on to lens systems used in various optical instruments.

He began his talk with a description of light waves, likening the oscillating electric and magnetic field of force to the rippling of water when a pebble is dropped into it. Although analogous in behaviour they are not identical with waves of water because the particles of the medium through which light travels do not vibrate. In fact light travels freely through a vacuum, each ray moving in a 90 degree angle to the wavefront. This corresponds to a line from the pebble in the water to the ripple ring.

Ingenious methods of estimating the speed of light were described. The Danish astronomer, Roemer, first measured the speed of light by observing that the eclipses of Jupiter's satellites varied according to the relationship of Jupiter and our own world, the varying distance between Earth and Jupiter affecting the predicted eclipses. From this he calculated the time it took light to travel the diameter of the earth's orbit.

On lenses Mr. Reicher showed how a spherical shape caused shortening of focus; a more difficult to manufacture lens, aspheric, cured this. Another method is to have a second lens behind the first with opposite curvature and, with correct refraction or dispersion, the faults of one cancel out the faults of the other.

Lens systems of binoculars, telescopes, microscopes and interferometers were described but, as I said before, only too briefly. Perhaps we shall be lucky enough to have a return visit from Mr. Reicher.

April Meeting

This consisted of a talk in two parts. The first was given by Mr. A. D. Wood in which he told us how he started in the trade at the age of fourteen, working in the Neon side of the business for seven shillings and sixpence a week. For this he worked a fifty-three hour week, finishing at 1 o'clock Saturday lunchtime. Being a seaonal form of work, Neon took one of its intermittent rests and our narrator found himself filling in by making syringes. Always interested in the making of stop-cocks he eventually found employment as a scientific glassblower in 1935, making the glass stop-cocks with which he was so fascinated.

In those days soda lime was the glass in general usage and tubing was mostly hand drawn. Because of this, tolerances on ovality, wall thickness and O.D., etc. were not as well maintained as today. Variations in the diameter from one end to the other of ten millimetres or so were not uncommon, rather it tended to be the rule.

When Pyrex first appeared on the scene, one foreman apparently tried it for a while in his gas and air flame, simmered gently to a boil (the foreman, not the glass) then dumped it violently in the bin with the succinct remark "I'm not using that ***** amateur's friend."

Mention was made of the German glassblowers using a bowl of tallow with a wick in it, then blowing through a tube across the flame to give a flame hot enough to work their glass! I wonder how they blew into their glass to shape it?

Workers on the first X-ray tubes were an unfortunate lot, they tested the tubes on themselves without any knowledge of the effects on their health. Hair and teeth were the first to go, apparently.

Hearing that John Logie Baird had once been absentminded enough to take a taxi and then later enquire of the driver where he was supposed to be going, reminded a member of the audience of the time when he had worked for Baird in the very early days and were trying to produce a 24″ C.R.T. They started the pump to evacuate the tube, which was in a box, when the tea trolley arrived: this literally proved to be a lifesaver because owing to incorrect geometry and a too thin faceplate, the tube imploded. Ordered never again to make a 24″ C.R.T., Baird immediately started planning a 20″.

Someone raised the query as to the 1 in 10 taper on stop-cocks. Where did it originate? Nobody knew the answer although it was stated that the Germans used to use a 1 in 5 taper – without intending to be 'punny' that sounds a bit steep to me. Even if the English did not use a taper of that order they did use a chair leg – to grind the tap barrel.

Ceramic Fibres

Mr. Wood then introduced Mr. W. Everard who told us about ceramic fibres. A workman making refractory bricks in Georgia, U.S.A., sometime during 1940, made what turned out to be a remarkable discovery. A high pressure air hose from a pneumatic drill had a leak. The bricks, made of clay china, which is called Kaolin in the States, were hot and the temperature and air pressure happened to be just right to blow fibres off the brick. This combination happens to be rather critical and it was not until 1944 that the making of these fibres was proven. Fortunately, the workman had taken the trouble to photograph the unusual event and because of his observations he was retired on a pension.

Nowadays the manufacture of ceramic fibres is tightly controlled and each droplet of alumino silicate is elongated into a long stream by air through a venturi tube. The fibres so formed are the finest known to man and the average diameter is around 2.8 microns. The uses of this new material are gradually spreading away from it being a replacement for the furnace brick, although as a lining for furnaces it is exceptional in its heat insulating and resisting properties. As the material cannot yet be spun it cannot be produced as protective clothing but, no doubt, it will not be long before our asbestos gloves have a competitor. So far it has been used for making Army tanks napalm proof, in aircraft black boxes, nuclear pressure vessels, and in Italy a transporter is used to convey liquid aluminium from Turin for a distance of about two hundred miles. There is also a lorry with a built-in furnace being used in an oil refinery, this too is lined with this Triton Kaowool ceramic fibre material.

It is supplied in blanket form, bulk fibre, strip, paper, castable, spray mix and can be vacuum formed into various shapes. The manufacturers are Morganite Ceramic Fibres Limited.

R. J. HARVEY

Scottish Section Meetings

The following report covers the period since the Scottish A.G.M. at Stirling University in December, 1969. The meetings have been fairly well attended by the usual "hard-core", being occasionally supplemented by a new face or two.

At our December meeting Mr. George Finnie, of Glass Appliances, Aberdeen, gave the section a talk on glass working lathes, mainly directed at those interested in equipping a workshop. He briefly summarised the relevant points regarding the lathes available in this country and those on the American market. The requirements of the research and of the production glass workshop would of necessity vary, and he discussed at length the types of chucks, the variety of burners and the tooling facilities available. There followed comprehensive question-and-answer time, with which George dealt in his usual competent fashion.

A welcome diversion from the serious business of glass-working was provided by Mr. Jim Fairgrieve of Emihus Micro-components, Glenrothes, Fife. Mr. Fairgrieve preceded his talk by displaying a variety of cut and polished rock samples also a large number of tumble polished pebbles. Jim described in detail the procedure for categorising stones, setting up the tumbler polisher and passing the stones through the various polishing media to obtain the final finish. Also exhibited were some examples of Jim's work, pendants, cuff-links, bracelets, brooches and rings. The talk was greatly appreciated, as was Jim's offer of some gratis rock samples!

Our February meeting took place at Edinburgh University, when Dr. Malcolm Reid of the Electrical Engineering department gave an illustrated lecture on the theoretical and practical construction of transistor and integrated circuits. He covered comprehensively the technique for constructing P-N-P and N-P-N type transistors, how controlled deposition of impurities by carrier gas in a quartz furnace resulted in the different types, and how, by using masks, integrated circuits of the transistor/resistor type could be made. Also covered were the methods of attaching conductors, i.e. gold or aluminium wires, to the devices. On display were devices in all stages of manufacture, from silicon slices (the basis of the transistor), to self-contained circuits ready for equipment installation. We extend our thanks to Dr. Reid for a very enlightening lecture.

After lunch, Mr. David MacDonald of the Biochemistry Department gave a talk and practical demonstration on constructing thermometers and hydrometers. Dave served his apprenticeship with a local firm who specialised in this sphere, and, with their permission, put on display a large range of instruments, some of which, though still quite serviceable and beautifully made, dated back to the 1890s and could justifiably be classified as antiques! Also on display were the various types of glasses used. Mr. MacDonald then showed members how a dual purpose instrument (i.e. thermometer and hydrometer unit) was made, the technique for mercury filling, and the jigs used in the fabrication process. Dave's informative "speil" on this little discussed topic was of great interest to us all.

Our next meeting, in May, again took place at Stirling, which is centrally situated for most members, the subject being a film and lecture on electric lamps by Mr. Wilson of Phillips Lamps, Hamilton, the main manufacturers in Britain of most types of lamps. Mr. Wilson began by commenting on light transmission, frequency and colour co-relation of some lamps, i.e. visible, ultra-violet and infra-red, the insulating properties of commonly used glasses, and the types of inert gas fillings used. The film showed the various lamp types, i.e. filament, carbon-arc, and gas discharge; the buffering effect of argon, and increased light intensity obtained by filament coiling; and how "neon" lighting colours varied with differing gas fillings.

Mr. Wilson commented on glass-to-metal seals in common use in the lamp industry, copper-nickel-iron (Dumet) in ordinary lamps, molybdenum in quartz-iodine lamp, and also the electrode-types used in the carbon-arc lamps.

On display were several examples of lamps in common use, and Mr. Wilson gave a full description of the manufacture process of the sodium discharge lamp, or, more familiarly, the "yellow street light", and how the present lines of development utilised an aluminium oxide discharge tube and niobium metal lead-ins. This lamp is a direct development of research done in the N.A.S.A. programmes.

This comprehensive lecture was one of the most interesting the section has had, and we hope to continue to extend invitations to other industrial concerns in the area to lecture to the section.

The circulation of a News Letter, containing a report of the Section meetings and lectures has helped to keep members informed of the Section activities, and also to keep members in touch with each other.

Section Officers:

Mr. T. P. Young, Stirling University – *Secretary.*

Mr. G. A. S. Finnie, Glass Appliances, Aberdeen – *Treasurer.*

Mr. J. D. M. Fraser, Edinburgh University – *Chairman & P.R.O.*

J. D. M. FRASER

Midland Section

The Midland Section held its A.G.M. on 4th February 1970, at the School of Molecular Sciences, University of Warwick. The turn out was extremely poor, with only four full members in attendance. The appointment of officers was as follows:

Chairman:	Mr. J. Huckfield
Secretary:	Mr. K. Holden
Treasurer:	Mr. J. Hill
Councillor:	Mr. K. Holden
B.O.E. Rep's.:	Mr. S. Yorke – Mr. K. Holden

It was generally felt at the A.G.M. that a determined effort was needed during 1970 to revitalise the section into once again a viable section of the Society. It was decided to circulate, to past and present members of the section, a general letter stating the position of the section, and asking for support for the forthcoming programme during 1970.

On the evening of Friday, 13th March 1970 Mr. J. Huckfield, Senior Glassblower in the School of Physics, University of Warwick gave a most interesting demonstration and discussion entitled "Silvering Techniques". Mr. Huckfield stressed the point that, as with many glassblowing techniques the recommendation of a particular method was not necessarily because it was superior to others, but that it is the one the person concerned has had most experience with and at the same time achieved good results.

Mr. Huckfield discussed the merits of four silvering formulae, two in detail, one being the familiar 'BRASHEAR' method, and the other as follows.

1 **Solution "A"**
Ammonium Hydroxide 150 ml. in 1000 ml. distilled water.
Solution "B"
Silver Nitrate 40 grammes in 1000 ml. distilled water.
Solution "C"
Sodium Hydroxide or Potassium Hydroxide 100 grammes in 1000 ml. distilled water.
Reducing Solution "D"
Sucrose 16 gramme.
Tartaric Acid 4 gramme.
Methyl Alcohol 36 ml.
Distilled Water 1000 ml.

Boil Sucrose and Tartaric Acid in 500 ml of distilled water for about 20 minutes – there will be a loss of water by evaporation so make up to original level with distilled water – when cool add 500 ml. distilled water and Methyl Alcohol.

To use mix equal quantities of A, B, C and D together.

The following points must be observed:

1 Always use a set procedure when silvering. If anything should go wrong this will enable you to check back.
2 Weigh out chemicals as accurately as possible.
3 Always use distilled or de-ionized water.
4 Cleanliness is important. If the vessel is clean after being annealed it can often be silvered with good results. If dirty, clean with "Chromic Acid" or "Decon 75" concentrate, and wash thoroughly with distilled water.
5 For the silvering of dewars with clear viewing strip, chill solution to between 10°C to 12°C, this slows the deposition of the silver as well as leaving a sharp edge to the strip. For complete silvering of dewars use solutions at room temperature. Application of heat i.e. hot water, will speed deposition of the silver to within one minute.
6 When silvering solution is spent and precipitate forms it is important to remove solution. This is essential because solution left in contact will result in the silver being lifted off or tarnished.
7 After silvering is complete the vessel is rinsed out to remove the sediment adhering to the vessels. After a final rinse with distilled water and a rinse with Methyl Alcohol, the vessel is dried by alternately exhausting and filling with air using of a rotary pump that has been adequately trapped.
8 The chemicals used in silvering solutions may form compounds which are violently explosive which can detonate as a result of the slightest disturbance. Therefore all remaining silvering residues, etc. must be disposed of without delay. The addition of sufficient Hydrochloric Acid removes all danger of explosion as well as precipitating the remaining silver.

There were eight members present at the meeting, and by the amount of discussion that took place after the most interesting talk by Mr. Huckfield, I feel sure that we all learnt a great deal concerning this important part of a scientific glassblowers work. Many thanks were offered to Mr. Huckfield for the effort and preparation that went into the meeting.

It is planned to arrange a further four or five meetings during 1970, using the same theme of "Workshop Practice", as this would appear to be found the most useful and interesting type of programme.

K. Holden

Western Section

Report of the March 1970 Meeting

Held at the works of Mr. D. Jones (Sec./Treasurer), Downend, Bristol.

The meeting opened with a short situation report by the Chairman. The new stationery was shown to members and except for the Section title which was incorrect, the new motif and heading was approved by those present. It was reported that posters with section heading had been requested by Mr. Fowler for the occasions when meetings were open to the public.

The Chairman, introducing Dennis Jones, expressed his appreciation for the invitation, especially since it was learned that Dennis had that day received hospital treatment for a very troublesome complaint and was suffering considerable discomfort.

The first of the simple aids and ideas shown was a T-piece holder, consisting of a brass rod, to which was brazed a flat strip; to this strip was soldered two Terry clips. The second clip was soldered with a piece of tube already in the clips, Dennis explaining that if the clips were soldered with a tube "*in situ*" no distortion of the tube occurred when the side arm was joined on.

Next a simple glass swivel was shown, which although vulnerable to breakage, was easily replaced and certainly very cheap.

We were next shown a new cement which had very good qualities from an applicability point of view. It had an extension stress of 300 lb. per sq. in. and was quite transparent.

A simple lathe vacuum chuck was next demonstrated. It consisted basically of a large cup-shaped funnel which had been packed with a ring of asbestos maché. A flask had been pressed into this creating a spherical seating. On drying, a vacuum sealing ring was formed which was soft enough to hold spherical vessels quite adequately. The holder was pumped via a swivel by an ordinary rotary pump.

The new "Nordsea" ribbon burner was next shown in use. With it, on the bench, a 30mm. 'U'-tube was made with the greatest of ease. On the lathe a second Nordsea burner was demonstrated. These burners were really first class and particular interest was shown in the fact that no "snap-back" occurred.

There now followed a short talk and demonstration on simple techniques, from the forming of asbestos paper spacers to simple tool making for various shapes.

In order to give Dennis a break, the Chairman than produced a standard engineers' dividing head and explained how he had used it to make a particular piece of apparatus. The University of Bristol had been doing work on anomalous water and a silica vessel had been required to study the water in capillary tubes. A silica holder was required with some 120 holes around the periphery of a 30mm. disc. By mounting the disc on the dividing head and by cutting with a diamond dental saw, a silica gear wheel had been made. A fine silica rod was then fused around the edge to produce a series of holes.

To conclude the programme, we were shown a film of Dennis demonstrating the design and construction of neon signs. The film was commentated by him and covered the whole range from planning permission, layout, jig and fixture making, the various stages of bending, colouring, filling and pumping. The film was taken in colour by a professional photographer. It was first rate and with a sound track added would be a worthwhile start to any library.

A second film entitled "E.D.N.A." was shown and consisted of various operations and glassblowing techniques being performed by his very capable assistant Mrs. Hanford.

Thank you Dennis for a most enjoyable evening.

F. G. Porter

STAINED GLASS WINDOWS

Two recent Western Section meetings were devoted to a talk and demonstrations on the art of making stained glass windows.

Mr. G. A. K. Robinson, the famous Bristol artist who has long family traditions in this field, gave at the first meeting an account of the types and sources of coloured glass used for the purpose both in ancient times and in the present era. Some coloured glass is blown into square moulds and panels of uneven thickness cut out of the sides; some is made by first blowing cylinders, then splitting and flattening; some sheets are "flashed" from which by selective removal of the flashing designs can be assisted, in addition to which thick blocks are also cast and then cut to size.

Pictorial work is done by first covering completely with stain (often iron oxide), then carefully removing unwanted stain, followed by firing into the glass. Silver oxide can also be used in this way to give yellow stains.

Design and artistic preparation form a very important part of the work and a full scale drawing is made for any serious subject. A description was given of methods of construction by first cutting the sections accurately to the design, the method used depending on the thickness of the glass. The pieces are then laid out in a frame prior to joining up by the traditional lead strips or the modern setting resins.

Mr. Robinson then showed a series of colour slides of both ancient and modern subjects which had been either restored or made in his workshops and these included some very striking examples which have been incorporated in modern architecture. When asked about time and costs he said that a large window could involve hundreds of hours and the cost would depend on the complexity and the glasses used, as some colours are expensive and difficult to obtain. Some are made in England but many have to be imported from specialist glass makers in other countries.

The second session took place in Mr. Robinson's workshops in Park Street, Bristol, where section members were shown all the techniques used in manufacture. It would be difficult to give a full description but they included design preparation, art work prior to firing of design, cutting of coloured sections by wheel for thin glass. Shaping of thick panels is done by chipping with a tungsten carbide hammer which is also used to make conchoidal surface markings.

The various types of lead strip were shown, some of which were wire reinforced, and the leadding process was demonstrated. Examples of resin bonded constructions were also inspected.

Firing of designs was carried out in a special oven using dental Plaster of Paris as a supporting bed. Using a series of trays which are pre-heated below the firing chamber makes the process semi continuous.

All around the extensive workshop were examples of every type of stained glass work in various phases of construction and restoration and the store room for the coloured glass gave an indication of the enormous stock needed to meet the requirements. The library containing many works on stained glass windows was also very impressive and some of the books must be extremely valuable.

No one could fail to be interested in both Mr. Robinson's talk and demonstrations showing that the art of making stained glass windows is still very much alive and in fact some of the modern examples are just as effective as the more familiar ecclesiastical types.

The Western Section would like to thank Mr. Robinson for the time and effort spent in these two evenings which was much appreciated by both members and other visitors.

Thames Valley Section

5th March 1970, at The Royal Holloway College, Egham.

Thames Valley A.G.M. followed by a workshop session.

After the chairman's, secretary's and treasurer's report, the following members were elected to office for the coming year:–

Chairman:	J. Macdonald.
Secretary:	A. Gardner.
Treasurer:	F. Morse.
Councillor:	R. Brown
Section Representative:	A. Gardner.
Student Representatives:	G. Reed and T. Williamson.
Section Reporter:	S. Fussey.

Following the A.G.M. the workshop session consisted of discussions and the trying out of various burners for use with natural gas. Most of the manufacturers had supplied burners and leisurely examination and testing helped many members to make their choice of equipment ready for the time that natural gas reaches their area.

2nd April 1970, at Reading University.

Mr. Evans of G.E.C. Research Centre gave a very informative paper on Some Aspects of Modern Electric Lamp Design and Construction. Types of lamps, essential factors to be considered in lamp making and detailed description of manufacture, testing and performance brought us fresh insight into the sphere of lighting.

Mr. Evans used a number of different lamps to illustrate his talk, the radiation and luminous efficiency aspects being very forcefully demonstrated. Finally, our speaker gave us a brief look at some of the more exotic materials from which lamp envelopes of the future may be made.

28th May 1970, at Reading University.

"Cryogenics" by A. G. Hutchins, Esq., of Oxford Cryogenics Ltd.

Our speaker opened his lecture with a resumé of the facts and figures of the rare gases and their liquefaction followed by data on the geographical disposition of the larger fields of helium, its extraction, storage and transport in both gaseous and liquid form. A full description of the super-insulated transportation tanks, each capable of carrying up to 4,000-gallons of liquid helium from America for world-wide distribution by both sea and air, really highlighted the difficulties of handling this important commodity.

Our lecturer then described many of the uses of liquid helium and other gases and showed a number of slides relative to his subject. Finally, he described and demonstrated the transfer of liquid helium from a storage dewar to an experimental dewar.

This was the final meeting of the 1969–70 season and after the lecture, our chairman guided us through some outstanding section business including the first-time voting for the Thames Valley Award.

Without doubt, the Valley has had yet another good season, and on behalf of our members, I thank our chairman and his officers. S.D.F.

North Eastern Section *See also page* 22

During 1969 the North Eastern section of the B.S.S.G. held four meetings which all took the form of 'workshop' sessions'. These were as follows:

1) Glass ro Metal Seals by Mr. H. Butler of Leeds University.
2) Stopcock Making by Mr. A. Flannigan assisted by Mr. G. Robertshaw of I.C.I. Fibres Ltd., Harrogate.
3) Silica by Mr. W. Young.
4) Graded Seals by Mr. H. Butler.

After the demonstrations those present were invited to "have a go" and several members took advantage of this opportunity.

East Anglian Section *See Page* 22

Obituary

C. H. Simms, B.Sc.

Friends will be sorry to hear that Charles Simms died on 12th April at his home in Harwell. Charles who was aged 60, although never a member of the Society was prominent in the field of Scientific Glassblowing. He used his scientific knowledge to further (among other things) the development of glass to metal seals, precision bore tube, and photo electric cells.

A colleague for many years of the late Mr. R. L. Breadner at the GEC Research Laboratories (Hirst Research Centre) at Wembley, he moved in 1963 to take over the Glass Engineering and Special Techniques Group at UKAEA Culham which he lead until his death.

Although he had been suffering from heart trouble for some time, his death was quite sudden and we extend to his widow and family our heartfelt condolences.

J. B. PATRICK,
Hirst Research Centre,
Wembley

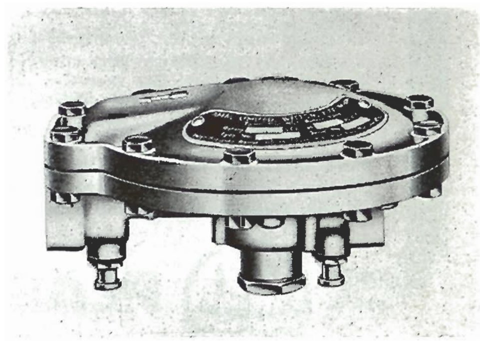
CORRECTION

Vol. 8 March issue, p. 7, 2nd line after Example 0.1cm. should read 1.0cm.

T.S.L. AWARD

The British Society of Scientific Glassblowers, which is supported in many ways, has awards to present annually, which were originally given by various companies holding a prominent position in the Glass Industry. Amongst others, Thermal Syndicate Limited will present a silver cup each year with a small replica.

In addition to this award, there is a bursary which takes the form of one week's apprenticeship for an individual whose work is of such a high standard that he would benefit in this way, and from May 18th to the 21st, Mr. Fairbrother, who works for Pye Unicam Limited in their Cathodeon Laboratories, Cambridge, will be in the works of Thermal Syndicate Limited.



Amal non-return valve referred to in Mr. C. H. William's article on page 24.