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British Society of Scientific Glassblowers

Founded 1960

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EDITORIAL

The introduction of the Fellowship of the Society has already produced a response from several interested members and as suggested in the March Editorial has also brought an appraisal of the functions of a scientific glassblower. At a recent Western Section meeting the result was that he should be fully skilled in the hot working glass tubing to produce scientific apparatus, plus perhaps the related cold working such as cutting and other abrasive processes.

But few will be content with this goal as the ultimate state in their career and will undoubtedly extend their interest to other technological processes involving glass – some moving towards the organization of glass workshops with its attendant paper work.

The last item is the main point of this column as too often are we hearing the comment that glassblowers cannot write, for which there is some justification as the highly practical nature of the craft is foreign to handling a pen. So although there is much in the way of glassworking hints and processes that should have been put in writing, little has been done and on the whole (although the present issue is a welcome exception) this Journal suffers from a lack of articles from active glassblowers.

In few cases is the writing of articles spontaneous, the final product being the result of constant practice with much scrapping and re-writing, just as with a first-class lecture which although apparently delivered with ease involves hours of preparation and rehearsal.

Now the Fellowship will require a written thesis and those who undertake this exercise will have to go through these stages and what better start could there be to gathering this experience than putting thoughts on paper for the Journal. A few conscientious section reporters and others are already doing this and it is noticeable how the standard of their efforts improves with time, but there are gaps and one feels that someone in every section must be capable of recording its activities.

It can also be assumed that in the distant future Fellows will gravitate into the more responsible jobs of the profession and from time to time they will find that a proposal has to be submitted or a report written – an added reason for taking the first steps as early as possible. Further, any higher academic qualification or scientific work is incomplete until written up in a manner which will stand for all time, and if this is not done it could be lost for ever or, what is more frustrating, left to someone twenty years later to record as a new development.

It is all a matter of self-discipline, the more one does the easier it becomes and one very desirable by-product of the Fellowship will be that more technology will be recorded.

Members are fortunate in having their own Journal in which to record their experiences and we shall welcome a larger flow of articles from them, especially those concerned with glassworking techniques and equipment. Who knows what hidden talent exists in the Society!

In this issue we are glad to be able to give some badly needed information on Natural Gas Burners and while we are in general indebted to all our advertisers for their support, special mention must be made of those manufacturers who are concentrating on these burners making it unecessary to import from other countries. Possibly we shall be able to follow with users comments at some future date.

J.H.B.

The Journal is published quarterly by the B.S.S.G. and is available free to members and at 10s 0d per copy (or 35s 0d per annum) to non-members. A limited number of back copies are available. Editorial communications should be addressed to the Editor, c/o H. H. Wills Physics Laboratory, Royal Fort, Clifton, Bristol 8, and enquiries for advertising space to C. H. Glover 'Saraphil', Highfield Lane, Cox Green, Maidenhead, Berks. Printed in Gt. Britain by Sawtells of Sherborne Ltd., Sherborne, Dorset.

QUASI-FUSION OF OPTICAL CELLS*

By F. J. RUMBLE, *Pilkington Perkin-Elmer*

The process which is to be described was developed to facilitate the manufacture of sample cells or cuvettes used in absorption spectrophotometry.

A brief resume of the manner in which these cells are used will indicate the need for the accuracies attained in their manufacture.

Absorption spectrophotometry has become a very widely used analytical technique and the demands for precision in component parts which are optical have risen steadily in the last few years.

Basically a spectrophotometer consists of a light source, a monochromator unit which can select a narrow band of the spectrum and has means of scanning the whole range of which the instrument is capable, a sample cell or cuvette of the type under discussion and a detector which can measure the amount of radiation falling upon it after passing through the sample.

Any substance which can be made into solution can be analysed in this way and all substances show characteristic absorption patterns. By this means the spectroscopist carries out his analysis, comparing the sample under test with a known sample or with acquired or published data on the absorbance curves of the particular substance.

There are many variations on this theme and accessories are made for the analysis of gases, liquids on the move etc., but time does not permit the discussion of the use of these things.

The most important characteristics which the cells must display are accurate internal light path length, reasonable flatness of the transmitting end plates and parallelism of transmitting surfaces. The British Standard 3875 for optical spectrophotometric cells puts a tolerance of plus or minus 0.02 mm. on the internal path length, the end plates to be flat over the working area to four Newton fringes per centimetre and that a cell filled with distilled water shall not deviate a transmitted light beam more than five minutes of arc in any direction.

The cells must withstand the effects of various organic solvents, mild acids and alkalis or probably anything that does not attack the material from which the cell is made.

These conditions have brought about the need for a system whereby assembly can take place without losing the accuracy demanded by the specification or having the joints between component parts suffering failure when in use.

From what has been said up to now it can be seen that to satisfy the specification, fusing, in the sense that the material is brought to a molten state and then joined together is not feasible, neither is any system of blowing into moulds. It is therefore necessary to produce the component parts to the desired accuracy and assemble them without deformation beyond the finished tolerances.

Much of the success of the procedure depends upon the work put into the preparation of the parts prior to assembly.

This consists mainly of the ability to produce precision optical components and is of a similar nature to the type of facility needed to make lenses, prisms etc. We do in fact mix up the manufacture of cell parts prisms, instrument mirrors and other optical elements in our glass-working departments.

Most of the optical elements that we make other than cell parts are components of the instruments in which the cells are later used.

The materials used in cell construction are glass, which is spectacle crown in drawn sheet form and fused silica which is obtained in various forms according to the use to which it is put. Fused silica is subdivided into three optical grades according to its spectral transmission characteristics. The most expensive is synthetic fused silica which transmits usable radiations from 0.185μ to 2.0μ (microns) at which wavelengths some of the far Ultra-Violet, the whole of the visible and the beginning of the Infra-Red spectra are available. Another grade which is made by fusing and refining natural silica is somewhat cheaper and transmits from about 0.220μ to 2.0μ (microns). This does not go down so far into the Ultra-Violet but is nevertheless widely used. The third grade is usable from 0.220μ to 3.5μ (microns) and so enables analysis to be made further into the near Infra-Red. A non optical grade is used for parts which do not tansmit. The glass used transmits from 0.365μ to 1.0μ and so serves the whole of the visible spectrum.

The optical working of the cell parts is similar for all materials but the techniques vary accordingly to the hardness and the form of the material at the time in question.

The grades of fused silica are all of similar

*This talk was given at the Reading Symposium September, 1967.

hardness and receive much the same treatment but the glass is very much softer and so the working of it generally presents less difficulty.

The typical open cell is of dimensions $12.5 \times 12.5 \times 45$ mm. externally and consists of three parts, a separator and two end plates or windows. The separator may be bent into a U-shape or may be made from three pieces. The bending of the glass is done in a gas fired furnace but fused silica is heated with a torch using a mixture of oxygen and coal gas in order to reach the softening point of fused silica.

The parts are optically worked by assembling them on to flat metal discs of twelve to thirteen inches in diameter. They are stuck on with various resin and wax mixtures according to the shape of the particular pieces. These blocks of parts are first ground on a vertical spindle surface grinder equipped with a diamond grinding wheel to remove the major part of the excess stock and to produce a flat surface parallel to the blocking tool.

They then are lapped with loose abrasives and water on revolving flat cast iron tools. Several grades are used starting with silicon carbide and going on to aluminium oxide for the finer grades. The important thing with this grinding and smoothing process is to keep the grades of abrasive separate and observe scrupulous cleanliness when transferring the blocks from one grade to the next. The grain size of the final abrasive is from 12 to 15μ depending upon the material or form of the pieces being ground.

The parts are polished with a mixture of cerium oxide compounds and water on a flat lap.

This lap is a cast iron disc faced with either hard felt, a wax mixture, or refined swedish pitch brought to the desired viscosity by boiling away some of the volatile solvents.

The separator parts of the cells are polished on the edges which are to come into contact with the transmitting end plates. The important dimension on the separators is the distance between these polished edges as this forms the internal light path length when the cell is assembled. As mentioned before this has a tolerance of $\pm$ 0.02mm. The quality of the polishing here is not of very great importance from the appearance point of view but it must be free of obvious surface defects.

It is essential for these surfaces to be flat to the order of 1 Newton fringe per cm. as deviations at this stage can induce deformation of the transmitting plates and difficulty in producing good seals without applying excessive heat.

The transmitting plates are optical components and so must not only be flat to match the separators but also must be free from surface defects in the working area. They receive an extremely critical examination both before and after assembly. Very small marks on the surface can cause rejection and so the assemblers have a great responsibility as the parts are of considerable value when they reach them.

The separators receive considerable attention after polishing to ensure that they are thoroughly cleaned as the polishing compound tends to adhere to the surface which will become the inside wall of the cell at a later stage. They are first degreased to remove the wax used to stick them down during the polishing process and then boiled in chromic acid in order to clean off the polishing compound.

The transmitting plates must be handled with extreme care and these are cleaned by immersion in solvents. They are carefully swabbed and removed from the trays of solvent and placed in methylated spirit. from whence they are finally cleaned and inspected.

The most important single condition in assembly is cleanliness of the surfaces being brought together.

We have now arrived at the stage of the quasi-fusion and the object here is to bring two polished surfaces together without any other matter between and to apply just sufficient heat for the pieces to unite. Little is known about the precise nature of the union produced by this means but satisfactory seals can be made without appreciable distortion although some slight deformation is inevitable.

The processes for the quasi-fusion of glass and fused silica are different because of the great difference in melting points so it will be best to describe them separately.

The glass components are again cleaned thoroughly by the assembler, put together cold and placed in a jig with a suitably shaped weight on the cell. A number of jigs are filled at a time and they are placed in an electric furnace which is cold. The temperature is then raised to the level which has been found by experience to suit the particular cell in the furnace.

The current is then switched off and the furnace left to cool. The cells are removed from the furnace when cool and examined before being passed for final trimming to correct external size and chamfering.

The temperature to which the furnace is raised depends upon the material involved (we do use materials other than drawn spectacle sheet occasionally, these being pyrex or optical glasses) and also on the shape and size of the cell being made. The aim is however to use the lowest temperature that will give the desired good seal.

The fused silica components are first cleaned by the assembler and placed together cold.

The parts are then heated with a torch burning oxygen and coal gas and gently pressed along the joints with a tool tipped with a material which can withstand the intense heat.

The object here is to heat the parts just sufficiently to obtain a good seal with the minimum of pressure. There is considerably more skill in the assembly of the fused silica cells due to the amount of handwork involved but we are working on ways and means of mechanising the process. The possibility of assembling in the same fashion as the glass cells has often been investigated but the difficulty of obtaining a suitable material for use as jigs and fixtures has always prevented this.

Because of the manner in which they are assembled with local heat, the silica cells must be annealed after assembly to remove strain which affects the optical performance and can in extreme cases lead to fracture.

General observations which apply to all quasi-fusing are:—

The flatter the surfaces prior to fusion or the better they match each other then the better will be the result.

The wider the face being joined the flatter the surfaces must be and the more difficult is it to obtain a good seal over the whole surface.

Materials of equal thickness tend to give the best joints as the assembly of two dissimilar thicknesses tends to introduce strain which can cause fracture of the thinner member.

It is always essential that the materials are identical in expansion characteristics as any differences will cause the destruction of one or both pieces.

Again it must be emphasised that cleanliness of the surfaces prior to joining is absolutely essential as any dirt, fluff, grit, grease etc., which is trapped between the faces will preclude proper joining at the spot and lead to possible deformation of the end plate and unsightly marking of the joint.

With the variations in path length, material and form we manufacture about one hundred different varieties of cell apart from special prototypes. The assembly of the transmitting plates is similar in all cases and is in fact a very simple process. As mentioned much depends on the preparation prior to fusing and this forms a considerable part of the labour cost of a cell.

This process is used occasionally for the permanent assembly of optical components of like materials but over any sort of large area the difficulties of obtaining absolutely clean surfaces are so great that it is only resorted to on extreme occasions.

Experience has shown that on a production basis the best width of join to make by this process is something between 1.5 and 4 mm. wide.

Anything narrower than this is difficult to make flat and wider joints are very rarely clean.

Use over many years has shown this type of joint to be quite robust and in the case of some accidents that have occurred, generally the material of the cell has fractured rather than the joint coming apart.

We believe that the methods described here are the best that can be devised at the present stage of our development but we are always experimenting with new methods and techniques in order to improve the product and reduce its cost.

HISTORICAL BACKGROUND OF FIBRE OPTICS

by C. D. Reid

Fibre optics are comparatively novel optical components, but the manufacturing techniques used are of quite respectable antiquity. Glass has been made for some 4,000 to 5,000 years, the first processes being worked somewhere in the Near East; possibly Egypt was the originating country, but it is certain that by 2,500 BC Egyptian glass objects were well known. The earliest uses of manufactured glasses (as distinct from natural glasses such as obsidian) appear to have been decorational. Beads, glazed pottery, and small decorative mosaic ware were all being made by 2,500 BC. It may be that utensils were also made at that period, if so nothing seems to have survived or has been positively identified.

To return to the present day however, fibre optics are of two main forms: solid, and flexible bundles. They have been fairly extensively described in many books and periodicals: one of the most recent general accounts being given by Maloney, 1967. Briefly, light is transmitted along a fibre by a process of total internal reflection. To help insulate the fibre from its surroundings and thus prevent loss of light by accidental contact and contamination, the usual practice is to enclose a core of high refractive index glass within a sheath of glass of a lower refracture index. In these sheathed fibres, the reflection takes place at the interface between the two types of glass.

The fibre can be formed either by fusing and pulling down a composite core-tube assembly, or by drawing the fibre as a composite directly from a double crucible, the simpler process for the workshop being the one in which separate rods and tubes are assembled before fusing. The control of a double crucible is likely to be difficult, but clearly the scheme has its attractions for the glass manufacturer.

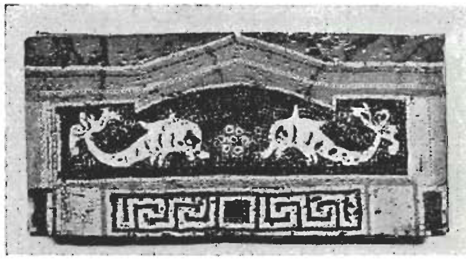
Once the fibre has been formed, it can then be collected to form the basis for the fibre optic either by laying short lengths together which will then be fused to form a solid fibre optic, or by being formed into a long bundle which will be fused or glued together at the ends only. Flexible fibre optics may be of two varieties, coherent, in which the mutual arrangements of the fibres at the ends of the bundle are pre-determined, and incoherent in which no fixed arrangement exists. Coherent bundles will transmit images if there is an exact match between the two ends of the bundle, incoherent bundles transmitting diffused light.

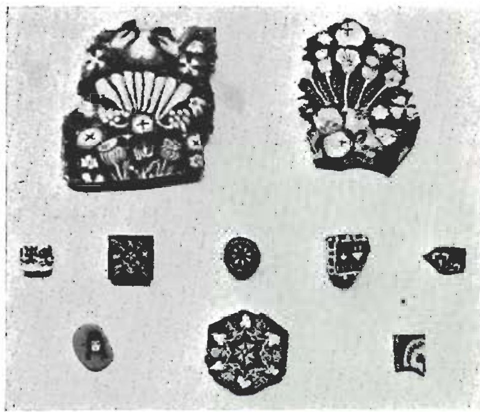
The glasses used for the core and sheath of the fibre have to satisfy a number of requirements including high transparency, the right refractive index relationship, and thermally must act alike. The actual choice of glass is rather restricted, and efforts are being made by the glass makers to produce better glasses for use in fibres.

The actual manufacturing operations required to make fibre optics are comparatively simple but the need to produce the highest quality components makes their manufacture quite tricky. There must be a rigorous attention paid to cleanliness, temperatures at which the glasses are fused and worked, and the rates at which the various operations proceed. The aquisition of know-how is always a lengthy business, and it is only now – some twenty years after practical fibres were first demonstrated – that reliable fibre optics of all kinds are becoming commercially available.

In principle the operations for forming fibre optics are, firstly the formation of the fibre, secondly the arrangement of the fibre in the desired pattern or array, and thirdly the fixing or fusing of the resulting pattern. Now let us see what has been done in the past.

Many museums have in their collections pieces of ancient mosaic glassware. The art of making glass mosaics apparently originated in Egypt in the XVIIIth dynasty, i.e., about 3,500 years ago. The Egyptians did not blow glass – that seems to have been a Roman contribution to glass technology – but they were well used to forming and moulding glass. They could form glass rods by dipping a rod into a crucible of molten glass and then drawing out a filament of moderate diameter. Sometimes, as is clear from museum specimens (particularly the collection at the Ashmolean, Oxford, which has some of the contents of a glass-maker's workshop), they laid many filaments together side-by-side and then fused the mass. Sometimes they evidently took a bead of glass of one colour, dipped into a pot of another, and then pulled the composite bead out into a rod.

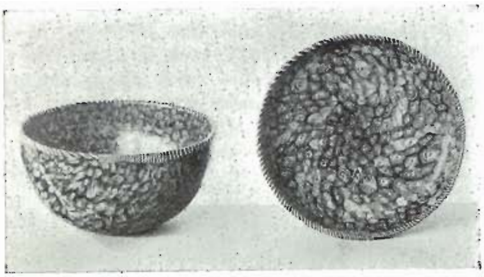




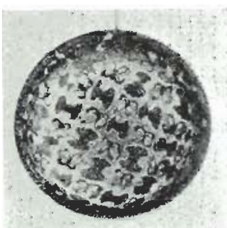
Examples of ancient Egyptian mosaic glass.

Having made for themselves sufficient rods of different colours and constructions, they laid appropriate lengths side-by-side to build up a mass which displayed a pattern in its cross-section. When this arrangement was complete and fused, small sections could be cut out which would display that pattern. These patterns are often very complex and some are quite beautiful. Examples can be seen in the Ashmolean Museum, the Victoria and Albert, and the British Museum, besides other odd pieces in many provincial museums.

Some of these very ancient specimens indicate that big complex patterns may well have been built up from "sub-assemblies" repeating the same pattern, but generally the Egyptians seem to have made mosaic blocks which were then sliced up in sections.



Millefiori dishes. Rome or Alexandria 100 B.C.—100 A.D. V and A Museum.



Millefiori dish. Alexandria 100 A.D. Metropolitan Museum of Art, N.Y.

In Roman times the millefiori process was developed in Alexandria. This form of mosaic ware is made by assembling edge-to-edge a lot of little plates or tesserae of glass which are then fused and moulded into whatever final shape is required. There are numbers of Roman period millefiori bowls in existence all of them demonstrating a wonderful dexterity in handling glass. Sometimes the plates were homogeneous pieces, sometimes they were cut from mosaic blocks.

In any event, it will be appreciated that the glass technologies required for making millefiori ware and solid fibre optics are astonishingly similar to more recent techniques and without a doubt a lot can be learnt from a study of the manufacture of this decorative ware. It is perhaps needless to add that although the art of millefiori went into a decline for over a thousand years, it was re-developed in Venice, and more latterly in France and this country. It is still made in Scotland.

Flexible fibre optics have a rather different manufacturing history. Early in the last century a technique was devised for producing spun glass – very fine glass fibre. Masses of this fine fibre were bundled together to form decorative masses – ferns, feathers, fans and so on. The fashion for these products seems now to be dead, although they were still quite readily available before the second World War.

We can see, therefore, that the glass-working arts needed for making fibre optics have existed for a very long time. What, then, is different about fibre optics?

In the first place, fibre optics are optical components through which light is passed. The older products are all decorative, and do not require any light to be transmitted. Ideally, it would be delightful if fibre optics could be so well made that the "grain" they display were negligibly small, whereas part at least of the beauty in mosaic ware lies precisely in the variation of colour and texture shown by that grain. The two products are thus seen to be practically complementary.

In conclusion, one has the feeling that were it possible to engage some of the craftsmen who could make those exquisite little plaques, they could make very useful contributions to the art of manufacturing fibre optics – three thousand five hundred years later.

Sources

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SCIENCE MUSEUM, LONDON S.W.7

Members will be interested in the opening on the 19th June of a new Glass Technology Gallery at the Science Museum. This will show the development of the manufacture and applications of glass from the earliest times to the present day with a glimpse into the future.

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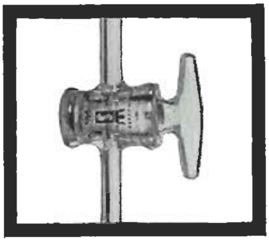

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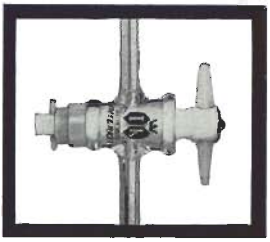

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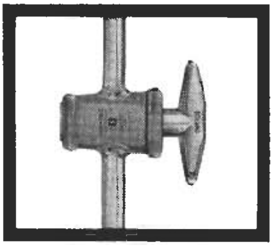

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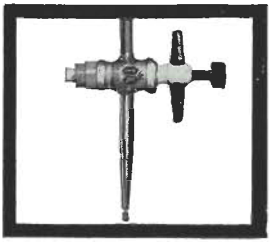

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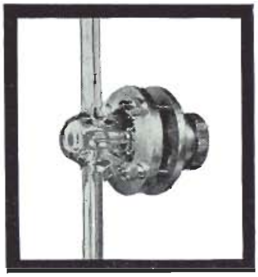

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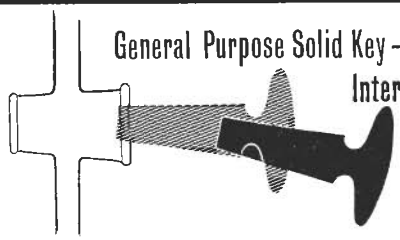

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ABSTRACTS

Compiled by S. D. Fussey

ANALYSIS

(495) Determination of Small Amounts of Fluorine in Rocks and Minerals
W. H. Evans and G. A. Sergeant, *Anal.*, 92, 1100, 633, Nov. 1967. A shortened method intended to cover the determination of fluorine in concentrations down to the normal lower trace levels in rocks. B.R.W.

GAS CONTROL

(496) An Improved Automatic Toepler Pump for a Gas Measurement System
K. G. McLaren and W. T. Williams, *Jour. Sci. Instru.*, 44, 12, 1033, Dec. 1967.
Features are improved reliability, safety and ease of operation with a wide range of sample sizes. Gas transfer is quantitative and the control unit is cheap to make. Electrical circuit and detailed drawing of pump. D.A.H.

MEASUREMENT

(497) Accurate Measurement of Gas Volumes by the Soap Film Method
O. Hello, *Jour. Chem. Educ.*, 44, 10, 568, Oct 1967. A very sensitive measuring device for small gas volumes, claimed to be 1,000 times more sensitive than mercury filled gas burnette. 0.5 μl of air in 400 ml. volume has been indicated. F.G.P.

SAFETY

(498) Safety in the Chemical Laboratory
D. D. Libman, *Lab. Equip. Dig.*, 5, 10, 99, Oct. 1967. This article covers many aspects of safety in the chemical laboratory; e.g. design of the laboratory, rules and regulations, education, propaganda, glassware, toxic and corrosive chemicals together with a list of references. B.R.W.

GLASS-TO-METAL SEALS

(499) The Formation of Glass-to-Metal Seals by High Frequency Induction Heating
P. J. Salt, *Jour. Glass Tech.*, 8, 5, 127-130, Oct. 1967.
Description of high frequency techniques of making Nilo K and Molybdenum to glass seals, together with a brief survey of the mechanism of adhesion between glass and metal. The use of accurately made components and jig assembly techniques are required to prevent damaging movement of components during working. S.D.F

THIN FILMS

Highly Reflective, Adherent Thick Aluminium Films on Glass
E. L. Bahm, I. C. Peabody, W. Vedder, *Rev. Sci. Instru.* 39, 2, 125-126, Feb. 1968.
Aluminium films of 1μ thickness are produced by careful control of substrate temperature. Evaporation is carried out in two stages. (*i*) A small amount with substrate at approximately 250 C to obtain good adhesion. (*ii*) The remainder with substrate at approximately 150°C to achieve good optical quality. J.D.

VACUUM – APPARATUS

(501) A fast Cryopump System for Ultra-high Vacuum
A. Venema, *Phil. Tech. Rev.*, 28, 12, 352, 1967. Using a two-stage gas-refrigeration machine to cool the wall of the system to about 50 K, a pressure of 10^{-9} Torr can be reached in the short time of one hour. Full details with diagrams and graphs. D.A.H.

(502) Attainment of a Vacuum of 10^{-9} Torr by Unrefrigerated Diffusion Pumps Employing Polyphenyl Ether
M. L. A. Alashpevich and V. I. Mirimanova, *Instru. and Exp. Tech.*, USSR., 6, 1448, Pub. Trans. June 1967. Drawings graphs and comparison tables showing the possibilities of using ethers to achieve 10^{-9} Torr with water-cooled traps. D.A.H.

– GAUGES

(503) The Behaviour of Quartz Spoon Gauges at Elevated Temperatures
D. A. Geary and T. H. Lemon, *Jour. Sci. Instru.* 44, 10, 866, Oct. 1967.
In experiments at temperatures up to 920°C. it has been concluded that (*i*) gauges must be annealed, (*ii*) gauges must be nulled continuously to check against permanent deformation. Graph. D.A.H.

(504) An Improved Method of Sealing the Compression Capillary of a McLeod Gauge
G. R. Reid, *Jour. Sci. Instru.*, 1 series 1, 60, Jan. 1968.
The end of the capillary is cut off, ground and polished back to a reference mark. A glass disc, ground and polished, is cemented on.
Details given of a suitable silicone-based thermo-cement Photograph. D.A.H.

(505) Avoiding Parallax Error when Reading a Mercury Manometer
H. F. Carroll, *Jour. Chem. Educ.*, 44, 12, 763, Dec. 1967. When graph paper is used as the scale for reading an ordinary mercury manometer, a reflection of the graph paper is usually seen on one or two sides. By lining up the lines on the graph paper with their reflections in the mercury so that a straight line is seen on the nearest division to the bottom meniscus, parallax error is minimised when reading the top of the meniscus. F.G.P.

– SEALS

(506) Window Seals for Ultra-high Vacuum Use.
R. W. Roberts, J. F. Harrod and H. A. Poran, *Rev. Sci. Instru.*, 38, 8, Aug. 1967.
Full description of techniques for joining windows of lithium fluoride, magnesium oxide and quartz to pyrex, quartz and silver. Seals are suitable for thermal cycling at 300°C. - 350°C. and may be used in ultra-high vacuum systems. S.D.F.

(507) Oxidation Resistant, High Temperature Ceramic-to-Metal Seal Compatible with Caesium.
Russel J. Hill and C. F. Knopp, *Rev. Sic. Instru.*, 38, 8, 1067 - 1) 68, Aug. 1967.
Nickel-titanium braze material wets ceramics such as sapphire and forms vacuum-tight seals. Brazing is done easily and quickly in an argon stream and the seals which are very stable and resistant to liquid metal caesium, may be used in air up to 800°C. for long periods of time. S.D.F

(508) Infra red Windows for Ultrahigh Vacuum Use.
Leon J. Schkolnick, *Rev. Sci. Instru.*, 39, 2, 122 - 123, Feb. 1968.
A technique for sealing I.R. windows to stainless steel flanges with a low vapour pressure silicone resin, "Vacseal". Claimed advantages are repeated cycling at 450°C. and ability to maintain a pressure of 10^{-12} Torr. J.D.

MISCELLANEOUS APPARATUS

(509) A Separating Vessel for the Isolation of Viscous Sediments Particularly Applicable to the Fractionation of Polymers.
P. Molyneaux, *Lab. Pract.*, 16, 12, 1492, Dec. 1967.
The vessel consists of an inverted conical flash with a 34/35 joint sealed to the top and a standard taper tube sealed to the bottom. An insert is ground to fit this and having a centre tube which serves as a handle for the easy removal of the precipitate. Sketch and references. B.R.W.

(510) A Kjeldahl Digestion Unit.
M. I. E. Lang and B. Marshall, *Lab. Pract.*, 16, 10, 1260, Oct. 1967.
Efficiency, cleanliness, cool running and relative cheapness are claimed advantages of this unit. B.R.W.

(511) A Stabilized, Direct Reading Conductance Apparatus.
John T. Stock, *Jour. Chem. Educ.*, 44, 10, 573, Oct. 1967. Circuit of conductance device and details of hydrolosis cell. F.G.P.

(512) A Simple Distillation Apparatus.
A. N. Fenster, *Jour. Chem. Educ.*, 44, 11, 661, Nov. 1967. Modification to Kugelrohr short path distillation apparatus using small quantities of materials, simple test tube with sidearm and receiver. F.G.P.

(513) Graham's Law of Diffusion and Effusion.
E. A. Mason and B. Kronstadt, *Jour. Chem. Educ.*, 44, 12, 742, Dec. 1967.

Demonstration diffusion apparatus. A burette joined to a sintered funnel of pore-size 0.9 - 1.4w is immersed in a cylinder of water and rate of diffusion measured. F.G.P.

(514) **Recrystallisation Apparatus for Esterification.**
M. Benton Noff and Anna S. Noff, *Jour. Chem. Educ.*, 44, 11, 681, Nov. 1967.
A standard apparatus with ground joint used to perform an esterification reaction F.G.P.

(515) **Improved Polymer Tubes.**
W. E. Maycock and C. B. Hoelzel, *Jour. Chem. Educ.*, 44, 12, 717, Dec. 1967.
Modification to standard polyester tubes having a sidearm and small nipple at the bottom. When polymerisation is complete the nipple is broken off and the polymer extruded with compressed nitrogen. F.G.P.

(516) **Conductance Experiments Utilizing a Wide Range D.C. Meter.**
T. S. Carlton, *Jour. Chem. Educ.*, 44, 12, 769, Dec. 1967.
Describes glass and electrical components required for making a cheap, semi-quantitative conductance meter and simple glass hydrogen chloride generator. F.G.P.

(517) **The Thermodynamic Properties of Ammonium Carbonate.**
M. J. Joncich, B. H. Solka and J. E. Bower, *Jour, Chem. Educ.*, 44, 10, 598, Oct. 1967.
An experiment demonstrating the decomposition of ammonium carbonate. Details of dissociation pressure measurement. apparatus. F.G.P

DIAMONDS

(518) **Diamonds in the Laboratory.**
S. Tolansky, F.R.S., *Lab. Pract.*, 16, 12, 1469, Dec. 1967.
An introduction to special articles on the use of diamonds.

(519) **Diamonds in Technology.**
D. Flook, p. 1470.
In order to show why diamond tools are desirable in many applications the author describes the properties of diamond, its synthesis and the various forms in which it is used.

(520) **Diamond Tooling for the Machining of Metal.**
N. R. Smith, p. 1473.
The automotive industry is one of the largest users of diamond tools. Types of tools are described for machining, trueing and profile grinding of metals within this industry.

(521) **Choosing and Using Diamond Grinding Wheels.**
R. Sharp, p. 1476.
The development of individual types of abrasives for particular applications and improvement in the bonding of wheels had led to increases in the uses of grinding wheels. As the available range widens, so do the hazards of wrong wheel selection. The author discusses the characteristics that must be considered when choosing a wheel for a particular application as well as the factors to give maximum performance.

(522) **Diamond Powders and Pastes.**
R. Farrar, p. 1480.
The production of sieve and sub-sieve powders is described and the special problems pertaining to crushing, sieving elutriation and sedimentation are outlined. Particle shape, size and strength are discussed, together with how these properties affect the grading and end use of the products. Indication is given on the uses of various types of natural and synthetic diamond powders with information on bonding media used.

(523) **Diamond Wire Drawing Dies.**
W. J. Clements, p. 1484.
An historical account of the techniques of making wire. It is only in comparatively recent years that diamonds have been used in the drawing process. The dies must be made from the best quality natural diamonds; as yet no suitable synthetic diamonds have been produced. B.R.W.

PROCEEDINGS OF THE TWELFTH SYMPOSIUM OF THE A.S.G.S. 1967

The Processing of R.Z.-2 Glass.
Duane H. Groweg, pp. 9-16.
Full description of a rapid heat-up, protective atmosphere, R.F. furnace for making silica/RZ-2/ silica seals. Description of seals, component preparation, glass application, firing and annealing, together with table of thermal, mechanical, optical, electrical and working properties and suggested uses for Owen-Illinois RZ-2 low expansion copper glass.

High Power Carbon Dioxide Lasers.
L. A. Weaver, pp. 17-33.
Solid state and gaseous laser systems of current interest are described, with special emphasis directed towards recent developments in high power carbon dioxide laser. The principles of operation are outlined, and promising applications to the cutting and fusing of materials such as metals, plastics and quartz are presented. (Author)

Sealing of Gases under Positive Pressure
Edward C. Brosious.
In the preparation of optical pumping cells, a non-contaminating, positive pressure seal has been evolved. Sealing has been accomplished at 20 p.s.i. by the softening and fusion of a small diameter soft glass tube within a larger silica tube. Seals have been tested up to 40 p.s.i. limiting pressure should be the bursting pressure of the glass.

Outgassing from Glass by Bombardment with Electrons.
P. H. Dawson, pp. 37-41.
Workers and Corning Glass Works and General Electric Research and Development Center, using high and low energy electrons respectively, have detected oxygen as the only gas released from glass subjected to electron bombardment. A mass spectrometer was used by both teams to identify the gas. A simplified outline is given of the mechanism of release of oxygen by electrons at different energy levels.

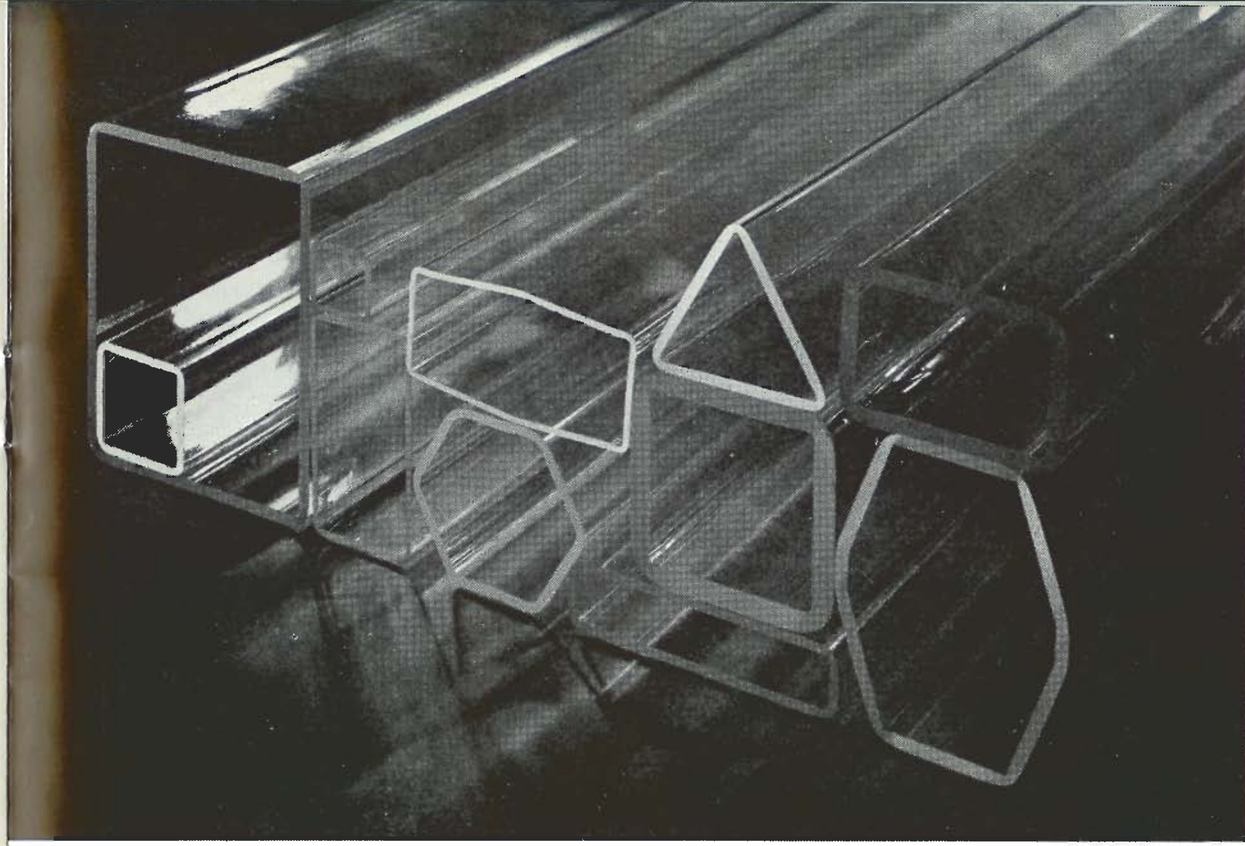
Properties of Molten Glass at High Temperatures: Expansion Coefficients.
E. F. Riebling, pp. 43-52.
The nature of expansion coefficient changes that occur when a glass is heated through the strain point (viscosity η $10^{14.5}$ poise) to annealing point (viscosity η 10^{13} poise) region are discussed.
Iso-expansion coefficient contours are compared for glasses and melts in several ternary oxide systems. The results suggest a relatively high sensitivity of melt expansion coefficient contours to structural changes that accompany composition changes. These findings are therefore in agreement with proposed glass and melt structure changes that have been based on recent extensive density, viscosity and electrical conductance surveys. (Author)

Superconducting Glass-to-Metal Seals.
John Lees, pp. 53-55.
Alloy wires of Niobium-Zirconium or Niobium-Titanium of about .010-in. diameter, are used to make a "heat switch" to control heat flow into a metal chamber. A nickel flash followed by copper plating enables these alloy wires to be sealed directly through lead glass, although the Niobium-Titanium alloy requires close control of the copper thickness. Seals, either single wire or pressed into multiple pinch type, are vacuum tight and tolerant of sudden and repeated immersion in liquid helium. Variation in working during sealing is assumed to be the cause of considerable changes in the critical current of the seals fat 4°K.

The Physics of Glass.
George W. McLellan, pp. 56-64.
A simple explanation of stress, strain, types of stress, annealing and tempering, with explanatory diagrams.

Suitability of Iron-Nickel-Cobalt Alloy to Glass Seals for Cryogenic Use.
Carl J. Hudecek and John B. Finn, pp. 65-70.
Catastrophic fracture of iron-nickel-cobalt alloy to glass seals may take place during thermal cycling over the temperature ranges encountered in cryogenics. This is due to a low-temperature phase transformation from gamma to alpha phase which causes the alloy to change in dimension, in thermal expansion coefficient and in resistivity. A method is described whereby the glassblower can decide the suitability of an alloy for making seals for cryogenic use.

A Simple Comparator for Comparing Sealing Glasses.
J. L. A. French, pp. 93-99.
Description of a simple comparator based on the principle of measuring the displacement curvature of a twin fibre made by drawing out a pair of longitudinally fused glass rods. Using one high and one low expansion glass as controls gives coverage of glasses normally encountered by glassblowers. S.D.F.



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NATURAL GAS BURNERS

Recent developments

Gas and glassblowers are inseparable, no gas, no glassblowing. This has not always been so, early prints of glassblowers show them using oil lamps as a source of heat, controlling the direction of the flame and raising its temperature by blowing a jet of air from a foot bellows, across the flame.

To most of us gas for glassblowing has meant coal gas, and we have rarely stopped to consider what a very convenient fuel it is. Take almost any diameter tube, put a simple injector at one end make a couple of holes at the bottom for the entry of air, connect it to the gas main light up and we have a hot stable flame which can be used for all sorts of heating operations around the laboratory or workshop. Glassblowing torches and bench lamps were, until very recently of almost equally simple construction. Two concentric metal tubes with taps to control the flow of gas and air were all that was necessary to produce a wide range of flame sizes and intensities. The use of oxygen first added to the air supply and later used "straight" with coal gas began to raise complications, so that burners and lamps specifically designed to burn oxy-coal gas and oxy-propane mixtures then became available. This is the position at the moment most glassblowers working borosilicate glass using some form of rotating turret oxy-coal gas premix burner.

We use the term coal gas, but of course it is no longer coal gas and in many places it has not been coal gas for some years. Gas works have been adding various "oil" gases and in some places "natural" gas to the gas they supply, towns gas or city gas is a better or more correct name. Towns gas is and always has been, like "coal" gas a mixed gas, that is to say that it contains or is made up of about seven different gases plus other different components which perhaps might be described as vapours. Under the various Gas Acts the suppliers of gas, nowadays the Area Gas Boards, have to supply gas of a declared calorific value, usually 550 British Thermal Units per cubic foot, so it is necessary for them to continuously monitor the gas they produce, enriching it or making it "leaner" to compensate for the variations in the quality of their raw materials. The other property they must ensure is kept within close limits is its density or specific gravity, for obviously if its density varies then it will emerge from a burner orifice at different velocities causing considerable fluctuation in the flame. This particularly applies to flames of the Bunsen type for example, gas cookers and industrial ovens, but it also occurs on air-gas mixtures where the flames are of the fixed focus type as on glass sealing machines, used for sealing the "pinch" into electric light bulbs, radio valves or fluorescent tubes. Thus it can be appreciated that there is rather more to the making of towns gas then cooking up any old coal in retorts, washing out some of the impurities and selling the resultant product at a profit.

The speed at which towns gas burns is about 6.6 feet per second, and it has a wide range of inflammability, burning with air in mixtures from about 5% to 30%, these two properties among others which make it a very convenient fuel.

Towns gas contains about 25% methane, and although there are slight variations between the two sources, natural gas whether from Algeria or the new wells in the North Sea, is about 95% methane. The flame speed of methane is only about one third of that of towns gas and its range of inflammability is much less (from about 5% to 15%), but it has about twice the calorific value of towns gas. It is therefore apparent that natural gas is very different as a fuel than town gas and any burner designed to use it correctly will be markedly different to a comparable town gas burner.

We may confidently say that the problem of burning towns gas and oxygen in a variable flame burner has been solved, albeit with differing degrees of success, by several manufacturers and any defects that may be alleged to exist are as much due to the idiosyncrasies of the glassblower as of the burner. We must however qualify this statement by adding that although the problems of flame character, i.e. control of size of flame, intensity and shape of flame, have been largely solved, the problem of backfiring or flashback and the subsequent risks of serious explosion have not. Therefore it cannot be too strongly emphasized that non-return valves and flash arresters or flame checks must be fitted in the gas lines, the local Gas Board's Officials should be consulted about this*.

The problems involved in the design of a blowlamp for burning natural gas or methane, are however much more difficult. The slow flame speed means that the variations in the volume of gas which will pass through a given orifice if the flame is to still remain alight must be kept to a minimum, in other words the gas supply cannot be turned up or down too much without the flame lifting off the burner face. The limited range of inflammability means that the amount of air or oxygen that can be mixed with methane has to be kept within fairly narrow limits, or when that control valve is opened the flame will go out.

When natural gas becomes available to all of us for glassblowing, new blowlamps will be necessary, or drastic modifications of existing ones will have to be carried out. Manufacturers of gas heating equipment are of course fully aware of this, and in our own specialized field several manufacturers have suitable blowlamps either actually in production, on the point of production, or in an advanced state of research. At a recent meeting held in the Midland Gas Council's Research Station at Solihull (ref. below), some thirteen burners from American, British, Dutch and German manufacturers were on show, some were designed to work on natural gas-air mixtures some on natural gas-oxygen and some on all three. They were bench burners, lathe burners, hand burners and specialist burners for tube bending.

At this date the writer has information from several British manufacturers who have blowlamps in production.

Heathway Machinery Co. Ltd.

Have more than one lathe burner which functions on natural gas oxygen mixtures, and a bench burner of American origin for natural gas oxygen mixtures.

Jencons (Scientific) Ltd.

Have available a new and completely redesigned Rotajet bench burner for natural gas. It has a rotating turret with six jets and an extremely solid swept-back base giving it great stability. The normal working position of the flame is top centre, but a feature of this blowlamp which will interest all glassblowers is that there is a simple means of adjusting the flame to right side, centre or left side centre which in some circumstances could prove invaluable. Another interesting and useful asset is that it is perfectly efficient with towns gas. Many of these burners have been sold overseas to countries where natural gas is already being used.

R. W. Jennings of Nottingham

Have taken over the patent rights, and the manufacture of the New Lesco glassblowing bench lamp formerly manufactured by Peebles and Co. of Edinburgh. This lamp has now been completely redesigned, the redesigning includes two special size venturi which by their incorporation into the lamp almost eliminate the possibility of the oxygen feeding back into the gas supply, it also has a small non return valve as an extra precaution for the oxygen supply. But of course it should be remembered as has been said earlier this does not excuse the glassblower from fitting other devices in the line as required by the Gas Boards. There are two models available of the New Lesco lamp one for towns gas and the other for natural gas.

W.S.A. Engineering Co. Ltd.

Have available a solidly based adjustable bench burner for natural gas-air mixtures or it can be used for natural gas-air plus a little oxygen. By fitting a different head, an operation which is easily and simply carried out the burner will then burn natural gas and oxygen mixtures.

All these burners are available now but no doubt others are being developed and will soon be in production.

One thing however is certain, gone are the days when a simple adjustable burner could be knocked together for a few pounds. The burning of natural gas oxygen mixtures over the wide range of dilutions, intensities, and flame sizes asked for by the glassblower poses many difficult problems in gas engineering, problems which cannot be solved very simply, therefore any good blowlamp which goes a long way towards solving these problems is going to cost money. It is interesting to note in this connection that several of the blowlamps from overseas which were displayed at the meeting held at the Midland Gas Council's Research Station, were priced at over one hundred pounds.

10th June, 1968 J. A. Frost

Reference. Small Burners using Natural Gas. *Lab. Practice* 17. 5. 615, May 1968.

*Dangers of Turret Blowlamps. 1. C. P. Smith *B.S.S.G. Journal* Vol. 4 No. 1 p. 1.

SECTION ACTIVITIES

Scottish Section

The first inaugural meeting of this section took place on 30th March at the New University of Stirling, Mr. D. W. Smith, Secretary of Society, acting as Chairman. At this meeting a committee was elected to run the section for the first six months and at a further meeting on 27th April, Mr. W. McMillan of I.C.I. Grangemouth, was elected section Chairman. Two Council representatives were also elected and various suggestions for future lectures and meetings were examined. It is hoped that the first lecture will take place on 8th June at the University of St. Andrews and the subject being "Lasers, their fabrication and application".

At the moment there are some thirty names on the mailing list and it is hoped that most of these will become members of the Society. One great difficulty in the operation of this section is the large distances that members and lecturers will have to travel. but it is hoped this can be overcome and a subscription list is being opened to meet part of the extra expenses needed.

T. P. YOUNG, *Hon. Sec.*
Coneybrae, 123 Henderson Street,
Bridge of Allan, Stirling.

Southern Section

March Meeting. Mr. E. Lister of James A. Jobling Ltd., gave a talk on "The Manufacture of Glass Tubing", in place of Mr. L. Morrell who was unable to be present.

This event was outstanding, not so much from the great number of members present but because of the number of new members who were there. It was also surprising that quite a number of old regular members who attend these meetings were absent on this occasion. Even so there was a total attendance of 26.

Mr. T. Parsell introduced the Speaker to the meeting and the talk got under way, a little late, at 7.25 p.m.

Mr. Lister explained how the smaller sizes of tubing, that is up to 26 mm. diameter, are drawn on the Vellow machine horizontally. The larger sizes are drawn on the "down draw" machine. This method produces diameters up to 130 mm. By using the blackboard Mr. Lister illustrated these machines and pointed out the differences. He also mentioned the difficulties in drawing tubing. He said that recently the tubing had been improved in section owing to new methods and that Messrs. Joblings were engaged in perfecting a method that would eliminate irregularity altogether.

Many members had questions to ask Mr. Lister, which he answered in detail.

Mr. Lister was thanked for his talk and the members responded with a goodly round of applause.

May Meeting. The last meeting at Queen Elizabeth College, Kensington, this season, was held on 15th May. Mr. T. Parsell introduced Mr. Bryce Thompson, Investigation Officer of the Safety Department of The British Oxygen Co. Mr. Thompson gave a talk on "Handling and Using Compressed Gasses", the accent being on safety.

It was stated that there were 3 incidents per day, or 1,000 per year, 20% of which were fires. Photographs were shown to illustrate the effect of heat on cylinders. Generally cylinders do not fragment but split, very great heat being required to cause this splitting.

Mr. Thompson asked the members if they knew the difference between an acetylene and an oxygen cylinder: these differences are a left-hand thread for a combustible gas and a right-hand thread for non-combustible gas. The acetylene is in liquid form and the cylinder is packed with a charcoal mixture; in the base is a bursting disc.

A further 20% of the incidents are caused by leaks. Mr. Thompson recommended a mixture of soap and water be used when searching for leaks and was strongly against the use of glowing splints or flames of any kind. He stated that the users of such methods had so far been very lucky in only having small leaks. With a large leak the risk of fire was very great. A very important precaution when removing a regulator that is leaking is to shut the valve first.

Another 20% of incidents are caused by flash back. Again Mr. Thompson had photographs of welding torches that had melted owing to flash back. Here the preference for spark ignition instead of a flame for lighting a torch was strongly held by Mr. Thompson, because the spark cannot be applied before the gas is flowing.

Mr. Thompson apologised for not having copies of the *Safety Manual* with him but promised to let the Secretary have a supply of these. No doubt the Secretary will let interested members have copies.

In order to stop flash back the following precautions were recommended: (1) Correct pressure (2) Purge the hoses; blow through each hose separately, the time required will depend on the length of hose. (3) Correct application of the light (spark lighter).

Miscellaneous incidents make up the remainder: the causes are the operator supporting the torch on the cylinder or placing the torch in such a position that the flame plays either on the cylinder or the regulator. It was emphasised that oil should in no circumstances be used on the regulator or cylinder valve. If the threads become stiff the regulator should be reconditioned or replaced.

The members plied Mr. Thompson with many questions, all of which were answered in an expert manner.

Mr. Parsell closed the meeting with a vote of thanks and Mr. Thompson was roundly applauded for a very interesting and educational evening. Attendance at this meeting: 25 members

T. J. MAPLE

Western Section

The March meeting was held at the University of Cardiff but the scheduled demonstration of "Glass Novelty" making by Mr. R. C. Heard, could not take place owing to illness. As an impromptu substitute three members of the audience volunteered to give displays, Mr. Easterbrook with great skill, born of long practice, constructed a galleon from glass rod; Mr. K. Davies making ornamental swans to be filled with coloured liquids and Mr. E. Turner made from tubing, the largest baby's dormer ever. The operators received a great ovation and the evening instead of falling flat, became a memorable occasion.

The April meeting took place at the School of Chemistry, University of Bristol, Mr. R. Garrard giving a talk on Coil Winding. All types of spirals and the methods by which they are made were given, some wound by hand, some using the glass lathe, other cases such as gas chromatography spirals and pressure gauges being made on machines designed for the purpose. A long discussion followed, after which members adjourned to the adjoining glass workshop to see practical demonstrations and to try for themselves coil winding on a glass lathe. A very successful and well attended meeting.

The first part of the May Meeting , also at the School of Chemistry, University of Bristol, was occupied with business items such as the definition of the term Scientific Glassblower.

Following this there was a joint exhibition of simple devices used in glassworking, which included various holders for awkward shapes, some recent and some of historical interest; several jigs used in Dewar construction, a micro multi-jet burner, tube cutting hints and a lipped bar for freeing cones from sockets. Several members had brought items which they had devised themselves and the discussion which evolved led to suggestion of others.

In the "Gimmick" display the main interest centred on the "Dipping Duck", which had been constructed by a member of the Chemistry Department, and a full discussion took place on how it works and various liquids used for filling.

East Anglian Section

A very interesting Lecture by Mr. P. Browell of Thermal Syndicate Ltd. was given on 24th March at the Club-house of Messrs. Fisons.

His subject was Silica and after broadly outtining its structure, the many forms and grades which are made were discussed, together with special points relating to working, such as extreme cleanliness and the avoiding of contamination by finger marks. There was also a good selection of exhibits which were described in detail and following the talk many questions were asked all of which Mr. Bromwell answered without hesitation. Thanks are due for the talk and to Messrs. Fisons for the use of the club. A talk on Natural Gas, in June, should also be of great interest to members and a lecture in July on Metal-glass seals is being negotiated with Mr. J. B. Patrick.

E. G. EVANS

MIDLAND SECTION

Report received but held over.

1968 SYMPOSIUM

The final programme has now been circulated to those members whose names appear on the March 1968 membership list and any further enquiries re accommodation etc. should now be addressed to J. W. Stockton, Unilever Research Centre, Bank Quay, Warrington, Lancs.

Student members are reminded that competition exhibits should be in the hands of the Board of Examiners by the 30th June 1968.

There will also be a stand at the Symposium for the exhibition of equipment and special pieces of work by full members who are invited to bring them along: at the moment, however, there is no award for this section of exhibits.

NEW MEMBERS

North Western Section	
P. Halliwell (F)	11, Alva Road, Oldham, Lancs.
(*Associate*) S. Davies	Nordsea Gas Appliance Co. Ltd. 42 Hyde Road, Denton, Manchester.
(*Associate*) C. E. Dickens	9 Kendal Gardens, Woodley, Cheshire.
I. A. Hollow (S)	27 Lancaster Avenue, Thornton, Lancs.
Thames Valley	
T. D. Rodwell (F)	Boundary Hall, Tadley, Nr. Basingstoke.
Western Section	
P. M. Byrne (F)	19 Lennox Place. Portobello, S.C.R., Dublin 8.
H. Anderson (F)	17 Belvedere Park, Belfast.
Southern Section	
B. Lewis (F)	24, Cloverfield, Harow, Essex.
W. B. Rice (F)	59, Garendon Rd., Mordon, Surrey.
East Anglian Section	
G. W. S. Roberts	31, Cliffse Grove, Leigh-on-Sea, Essex.
E. A. Smallwood	17, Springfield Rd., Linslade, Leighton Buzzard, Beds.
Overseas	
Y. Williams (F) (*by examination*)	Department of Chemistry, University of Ife, Ibadan Branch, Nigeria.

B.S.I. ACTIVITIES

Two British Standards of interest to glass-blowers have recently been revised, B.S. 1797: 52 and B.S. 2071: 54.

Table for the use in the Calibration of Volumetric Glassware. B.S. 1797: 1968.

This standard, first issued in 1952, and not revised since, has been the standby of all engaged in calibrating glassware, and of those who prefer to re-examine graduated ware before use. All B.S.I. specifications are subject to review at five-year intervals, but it had not appeared necessary to revise this one. After 15 years, however, this revision was decided upon, and the opportunity has been taken:

(1) to recalculate the figures on the basis of the adoption of the S.I. Units, based on the cubic centimetre, instead of the millilitre (1 ml. equals 1.00028 cm^3). This is a small change which would not be apparent in most apparatus. The term millilitre (ml) may still be used, but it will be understood that it is another name for the cubic centimetre (cm^3).

(2) to make allowance for weights of density 8.2 g/cm^3, instead of 8.4 g/cm^3.

(3) to give the current value to the cubical expansion of the soda-lime glass at present used, 27×10^{-6} per degree C, instead of 30×10^{-6}.

The tables are all extremely easy to use and were produced by computer at the N.P.L. and graduators and others are greatly indebted to the Director of the N.P.L. for this type of service.

Soxhlet Extractors B.S.2071: 1968

The specification for Soxhlet extractors fitted with standard ground joints (1954) has been re-examined in the light of experience, and includes both smaller and larger sizes than previously, the whole range being 6, 20, 40, 60, 100, 200, 600 and 2,000 ml, and it has been confirmed that thimbles will be available to fit all sizes except the largest, which would be impracticable. The two largest sizes are provided with flat-flange joints, and suitable adapters for use with the usual condensers provided with standard cones. The two types of syphon tube are continued from the previous issue, and the tube diameters carefully considered. A table in the appendix gives convenient sizes of thimbles, flasks and reflux condensers for use with the different sizes of extractors.

Looking through the table of recommended dimensions a rather excessive figure for the wall-thickness of the 2 litre size of extractor has crept in, and this could be reduced to, say 3.5 mm. The illustrations should not be taken as good examples of the draughtsman's art.

I.S.O./T.C.48: This Committee concerned with internationally agreed specifications for a number of items of laboratory glassware is meeting in the last week in June in London in the B.S.I. Rooms, and the B.S.I. holds the Secretariat. Subjects under discussion will be: Agreed shapes and sizes of beakers and flasks; sizes and wall-thickness of glass-tubing – particularly hard borosilicate glass; sintered filters, a tidy-up of the range, and methods of ensuring quality; methods of testing glass; a glossary of terms for glass faults; items of volumetric ware, cylinders, pyknometers; general purpose thermometers and others; a glossary of accepted names for apparatus in three languages; and discussions on the compatibility of glasses for lampworking which are intended to lead to an acceptable specification for a hard borosilicate glass, to be producible by different makers and acceptable to glassblowers. A busy week !

I.C.P.S.

SELECTED ITEMS FROM LISTS OF BRITISH STANDARDS

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3423: 1962 Recommendations for the design of glass vacuum desiccators. 7/6.

679: 1959 Filters for use during welding and similar industrial operations. *Add.* Dec., 1960, July, 1961 and Nov., 1963. 5/-.

3517: 1962 Methods for thermal shock tests on laboratory glassware. 3/-.

3787: 1964 Glass condensers with standard joints. 7/6.

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TOOLS FOR ULTRASONIC DRILLING

To use an ultrasonic drill to its full advantage an easy source of cutting bits of various sizes must be available so that worn ones can be replaced and new shapes quickly made.

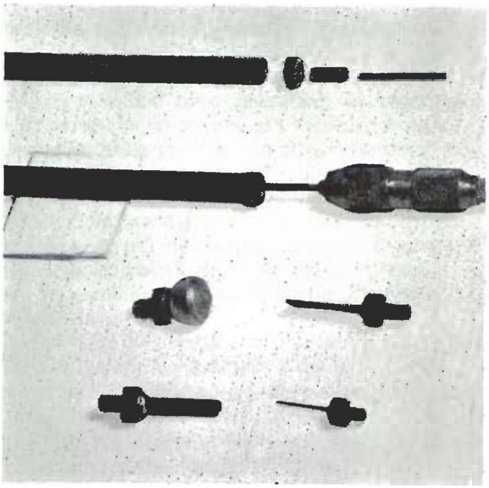
For most requirements in the glass shop high accuracy is not required and only when a precision finishing tool is needed it is necessary to call on the mechanical workshop.

The writer has for some time constructed these cutting bits from nuts and bolts of the correct thread to fit the transformer and an assortment of round and square section silver steel rods, tungsten rods for small holes, high speed hack saw blades for slotting tools and ball bearings for countersinking these materials having a very good wear resistance.

One needs a piece of mild steel rod which is drilled and threaded to carry a short length of the screw plus the nut, this assembly being held in a small engineers chuck placed in one of the glassworking lathe chucks. A second piece of rod is drilled to the size of the round or square stock to be joined on and this is similarly held in the second glass lathe chuck. The sprung holder normally used for plate sealing or a pin chuck are alternative holding methods.

The lathe is then rotated and the parts centred by light knocking following which the joint between screw, nut and stock is made with "Easiflow" solder, care being taken that the solder penetrates the screw thread.

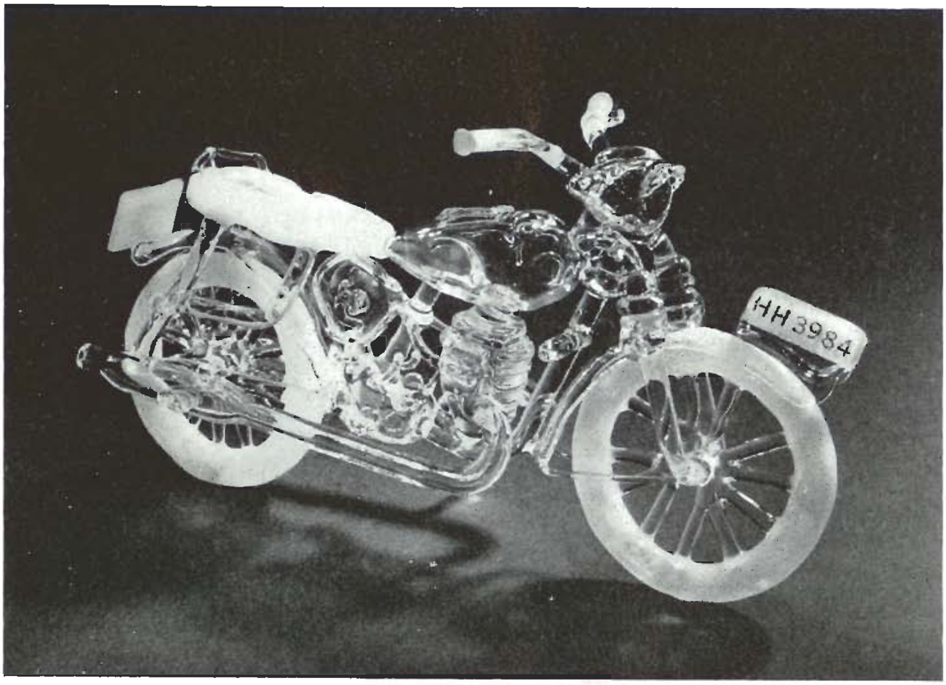
The assembly is then removed from the threaded holder, flux removed and the stock shortened and ground in any way needed.



Tungsten rods can be further thinned by electro polishing.

The illustration shows the components and holders used with a few completed tools.

J. H. Burrow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