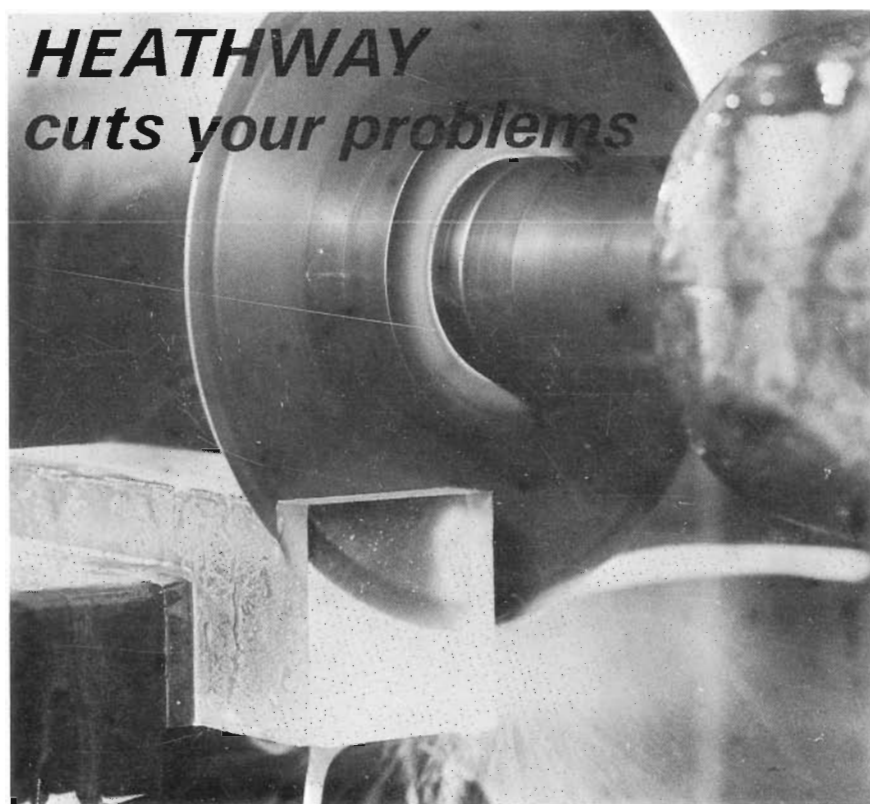


British Society of  
**Scientific  
Glassblowers**



**Journal**

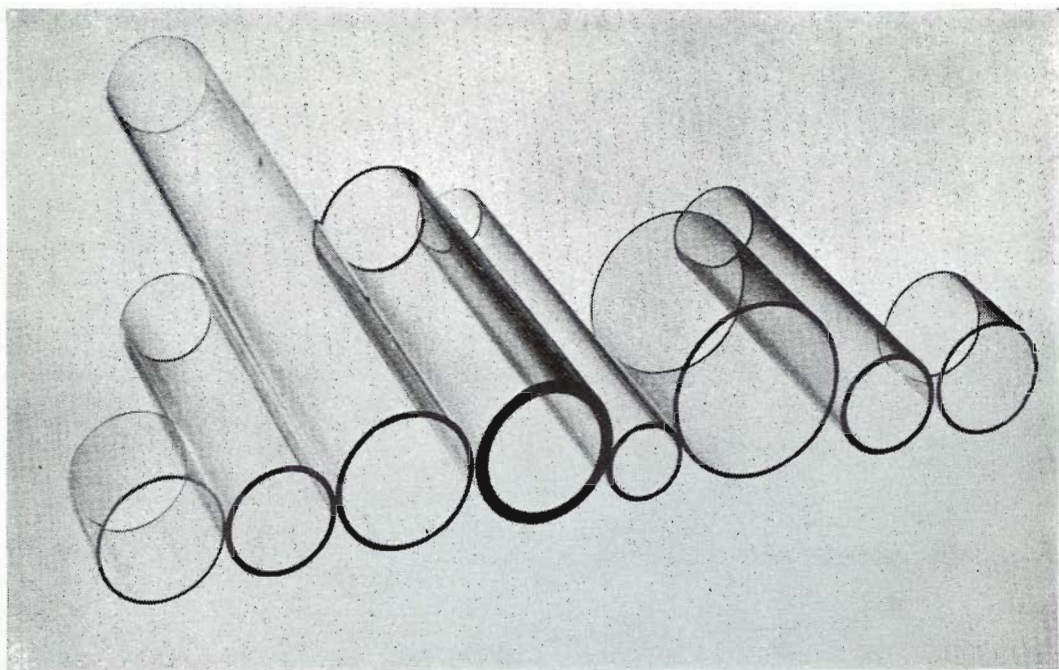
Vol. 12  
JANUARY 1974  
No. 1



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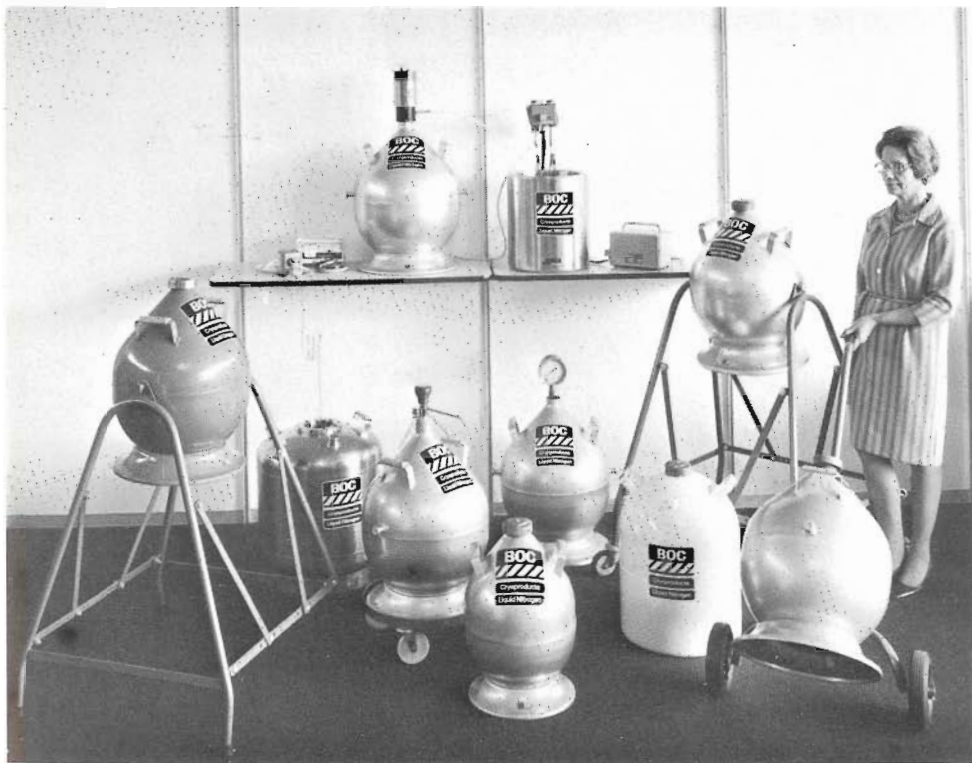
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The British Society of Scientific Glassblowers extend a warm welcome to visitors to the United Kingdom and will be pleased to assist in arranging visits to industrial and other establishments, if this is desired.

It is necessary that early notice is given to the Hon. Secretary . . . giving, time and date and place of arrival, address whilst in the United Kingdom, length of stay.

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# British Society of Scientific Glassblowers

Founded 1960

*President:* Mr. STAFFORD SCHOLES

*Hon. Secretary:* R. Mason, 53A Kennel Ride, Scot, Berks.

EDITORIAL STAFF

Vol. 12 January 1974 No. 1

R. E. GARRARD

F. G. PORTER

Journal of the B.S.S.G.  
School of Chemistry,  
University of Bristol.

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## RETIRING PRESIDENT'S ADDRESS

### WORKING WITH GLASS THE PRESENT AND THE FUTURE HEADING HERE

The future of working with glass in activities which are relevant to members of this Society can only be forecast with considerable uncertainty. This is due not only to the rapid changes occurring throughout the scientific and technical communities, but our inability to predict exactly when and where an innovation might occur which directly affects the applications of glass in technical equipment.

A brief history of glass working will illustrate this point. Somewhere in the eastern Mediterranean or Middle East, at the dawn of recorded history, man discovered glass and used it to decorate baked clay vessels and ornaments. He then used clay and metal tools to make simple glass pressings or built up hollow vessels on sand cores. Although these glass objects were useful and also beautiful, the glass working techniques were tedious and limited the shapes and sizes of the ware produced.

Just before the Christian era a most important invention was made. The discovery of the hollow pipe for glass blowing in the Roman Empire must be regarded as one of the most important breakthroughs in technology, far more important even than the modern invention of float glass.

From that moment all the various techniques for shaping glass becomes possible, from the mass production of glass containers in a multitude of shapes, to the blowing of huge cylinders for the manufacture of flat glass before the continuous process became possible.

By further modification of the glass blowing technique very elongated ware could be produced, that is, hand-drawn tubing.

Meanwhile, man's increasing interest in far distant or very small objects, urged the invention of optical glasses of all kinds for telescopes and microscopes. Michael Faraday, for example, dabbled with glasses containing boron oxide, but found glass science too difficult and turned to electricity instead. The search for enhanced beauty produced the lead crystal glass. Thus the forerunners of the three most important glass working materials, soda lime, lead and borosilicate were known by the 18th Century.

It was not really until the invention of the electric filament lamp during the last century that a new type of glass worker became essential — the lamp worker. This man reshaped soda or lead glass bulbs and skilfully sealed in the conducting wires of platinum or substitute metals. Two blow pipes became necessary, one for human breath, the other for the gas/air flame.

The steady growth of the lamp industry required the mechanisation of traditional glass blowing techniques, for example, the development of the rotating Westlake machine, for blowing thin-walled bulbs. Later this technique became simplified and a linear machine was possible, the Corning ribbon machine.

The lamp working techniques of workable, durable borosilicate glasses in the late 19th, early 20th centuries, in, for example, Germany and the U.S.A. their use by the lamp working community enabled chemical research and manufacture to go forward rapidly. The impetus for this was created by the 1914-1918 World War which also expanded the electrical industry and with it the need for special sealing glasses including vitreous silica.

The rapid expansion of the chemical and electrical industries between the two World Wars produced a new breed of men. Now they were no longer called lamp workers, except perhaps in the lamp industry. In Universities and the chemical industry they were called glass blowers; in the electrical industry they were called glass engineers. They were sometimes known as bench workers.

The peak of versatility in traditional bench working occurred during the second World War and continued until the mid-1950's.

In the electrical industry very sophisticated receiving and transmitting valves were developed, each one with a glass envelope or window and requiring an assortment of complex glass-to-metal seals. This indeed was a hey day, each device was a challenge to the scientist and technician alike.

In the chemical industry, distillation and vacuum equipment became more complex, requiring a multitude of condensers, traps, pumps etc. The development of interchangeable parts became a necessity. Small companies were established to exploit quick fitting glass units and to mass produce reliable condensers and other standard laboratory glass ware.

However the 1960's showed another pattern. The exploitation of the semiconductor virtually killed the receiving valve industry and the demise of standard transmitting valves could be forecast. Those that remained would use ceramic envelopes and not glass bulbs.

Already the lamp industry was virtually completely mechanized; the glass working of special lamps was carried out as routine procedures by semi-skilled women and girls. Glass-to-metal seals were mass-produced from sintered preforms and jugged assemblies passing through sealing lehrs or centrifugal furnaces. Glass ceramics were being considered. The call at that time was for increased efficiency and robustness. Weaker glass could be replaced by stronger ceramics, glass ceramics and metals. Thus glass vacuum equipment for industrial use was steadily being replaced by metal parts.

In the electrical industry the large glass engineering workshops of the 1950's were contracting. However there still remained the very large or very small special devices, usually very involved and sophisticated, required in only small production runs, so that the contraction did not run to completion. Strangely enough, the working of silica glass revived and expanded. The demise of aluminosilicate glass for lamps was forecast but that too refused to die and its revival is confidently expected.

The 1970's have already shown new trends. For example, an increased demand for the cold working of glass, for example, very accurate cutting and polishing of glass and crystals for laser applications and the deposition of films of all kinds on glass. The mating of glass with unusual materials such as resins by non-standard techniques is also required.

Although the changes have been the most marked in the electrical industry, they have been reflected in the University research laboratory where the traditional glass blower, already a versatile man, has had to diversify his techniques even more.

Perhaps the changes are least noticeable in the manufacture of glass chemical apparatus and thermometers. However there are trends already to be seen, the throw-away plastic vessel, the all metal digital clinical thermometer.

Is the future, therefore, one of gloom and despair for the traditional glass blower, bench worker, lamp worker, glass engineer, call him (or her) what you will? No, not at all, the future is very bright, but not necessarily in the traditional areas of expertise.

For younger people, prepared to learn a wide range of glass working skills and to acquire background theory at day-release and evening school, the challenge of change should be easily met. In any case the world is theirs; the developing countries need and will continue to need technicians of all kinds, both to instruct and to set up small industries.

There is another area which could be exploited by both the younger and older glass worker, that is, in the leisure and artistic activities of ordinary people.

In every village in this country, it seems, there is a craft potter, producing good or even bad pots for sale to the passing tourist. Every evening school has a class for housewives to throw pots. Surely every village could support a glass worker, at the very least making glass animals and at the best worthwhile artistic glass.

Of course this may mean that the glass worker will also require some artistic training as well as his normal technical and scientific expertise. Well, why not?

It may appear to you, the members of the Society, that this address, my last one as President of this Society has wandered well away from its traditional pattern. As I have been speaking of change, this is quite in order. In fact, since 1960, the Society itself has changed steadily, it has grown and become more complex. The Symposia have expanded, international links have become firmly established, the standards of primary training and further education of glass workers above the primary level. Some people work loads, their problems have become involved and frequently they are insoluble. To them must be conveyed our very grateful vote of thanks.

One problem which has become prominent during the last two to three years, that of professional status, is linked with the changes which I have mentioned. Some members believe that this problem may only be resolved by forming an Institute concerned with the training and further education of glass workers above the primary level. Some people believe that this should be quite separate from the Society.

To be successful such an Institute will require a varied membership, not limited solely to the Scientific Glassblower. The Institute belongs to the future, the Society to the present and the future. Each must be resilient enough to face the changes in the next decade.

Glass has been around from prehistoric times; glass workers have overcome, not only the complex behaviour of hot glass but have met the challenges of their own times. In true tradition they will meet the future with knowledge, skill, invention and artistry.

L. F. Oldfield

## LIBRARY SERVICE

It has been brought to my attention that some members are unaware that library books may be borrowed using the Inter Library Loan Service, that is, members may take a request to their University/Works Library etc. give them my address. (Chemistry Dept., University of Lancaster, Bailrigg, Lancaster). The library will then procure the books for them, also return same, thus in fact saving postage, but most important the packaging problem.

Alan G. Thompson  
B.S.S.G. Librarian.

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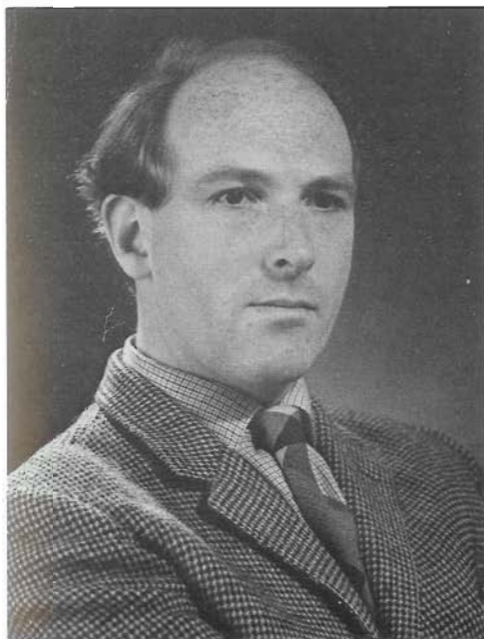
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## PRESIDENT'S ADDRESS

### Mr. STAFFORD SCHOLES



Mr. STAFFORD SCHOLES

You have done me a great honour in inviting me to the Presidency of the Society — the more so because you are asking me to follow in Dr. Lucy Oldfield's footsteps. I can never hope to be as good a President as she has been, but I can at least continue the traditions she has started and, perhaps, also help to carry through some of the things she has been responsible for initiating. So my first, very pleasant duty as President is to pay tribute to the erudition, wit, sound common sense, and — not least — the charm with which she has graced this Office during the past three years. She has, I know, worked indefatigably in the interests of the Society, especially in the field of education, and in raising the standards of the craft to which you all belong. I know that it is your sincere hope, as it is mine, that she will continue to grace our meetings, no less frequently now than when she was in office, that we may continue to have the benefit of her wisdom, as well as the pleasure of her company.

Those of you who already know me will know that I have worked with a wide variety of materials in my time, having made my way through the realms of fuels, metals, and ceramics, in order to arrive at my present state as a glass technologist. I have, therefore, come to glass with a proper appreciation of its unique qualities and potential. Like you, I am an enthusiast for this material which forms the common bond of this Society, and this is combined with a deep respect for the skill and artistry of the glass blower.

In his opening speech to the 8th. International Congress on Glass, Anthony Wedgewood-Benn — then Minister of Technology — referred to the fact that "the glass industry rests upon a sure foundation of superb craftsmanship. But this craftsmanship, far from having been a barrier to the development of new technologies, has been the sure foundation on which they rest." This Society is, I believe, unique in the way it unites craft and science: not only are the products of your skills employed in scientific work of all kinds, so that you are intimately involved in almost every new advance of science and technology, but the complex nature of the material on which you exercise your skill demands from you a degree of scientific appreciation of its nature and properties. I can think of no other calling or craft where this is so true, as it is of the Scientific Glassblower. It is this inescapable fact of your vocation, amongst other considerations, which has led to the concept of the Institute of Glass Engineers, an innovation which is exercising your minds as I write this, and will doubtless continue to do so for some time to come.

The rapid, and accelerating, rate of change in the world has been talked about and written about *ad nauseam*, but — like it or not — it is another inescapable fact. In preparing this Address, I could not help thinking of two personal experiences connected with glass which, for me at least, epitomise the dramatic changes during my own lifetime. The earliest memory I have which is any way specifically connected with glass is of being taken to see the Crystal Palace fire — surely the most spectacular glass melting event ever! Few who saw that fire could have realised that, within such a brief time, fires as disastrous as that would become commonplace in the bombing raids on London and throughout Europe. No-one who witnessed that fire could have foreseen the next piece of glass that sticks in my memory: a crude lump of fused sand — very poor glass! — from the Alamogordo desert, made radioactive by the explosion of the first test atomic bomb. The window glass of the Crystal Palace — and the float glass of today — is hardly distinguishable in composition from that made by the Romans: only the production technology has changed out of recognition. Within six years, Japan expects to be ready to build the first experimental steelmaking plant using a

nuclear reactor instead of a blast furnace, and I have no doubt that similar developments in glassmelting will follow.

I am convinced that we are on the threshold of staggering developments in glass technology, as a result of which glass will assume an even more important role in our lives than it does at present. And this will inevitably be reflected in the changing demands placed upon the Scientific Glassblower, who must be given the means to prepare himself for these changes and, as they come, to master the problems they pose. In all this, however, we must remember that there is something far more important than the fascinating versatility of the material which forms the bond of common interest embracing us all; more important than the challenge which the future developments will bring — infinitely more important than all of these is the fact that we are a SOCIETY, with all that word implies. True, just as politicians, ad-men, and media-men have taught us to debase words, so the word "society" has been down-graded in meaning, until it can mean almost anything we like, from the total population of this (or any other) country, to a synonym for "us" — the plastic, pre-packed group image with which those very word-debasers would have us believe we want to identify ourselves.

But I cannot believe that this is what those who brought the B.S.S.G. into being had in mind, nor what each one of you has in mind, when thinking of this Society of ours. Originally, the word was derived from the Latin "socius" — which is best translated "mate" — the word is used of a ship-mate, or of a fellow-soldier with all the close relationship which comes from fighting alongside and sharing privations; it was even used in the sense of a spouse! So a Society was a brotherhood of people, united by something much deeper and stronger than a mere common interest; they banded together for their common good — to share with each other, to be partners together. And in our case, there is something of the spirit of the medieval craft guilds — to uphold the prestige of the craft, and the quality of workmanship; to preserve and pass on the lore of the craft.

So, the older member, justly proud of the skill in his fingers and lips, skill acquired by long years of

devotion to his craft, will think of the youngster who is just starting that craft in a world changed out of all recognition from that in which our older members entered upon their apprenticeships. How can the youngster best be fitted for the kind of work which lies ahead of him? How can he acquire qualifications appropriate to life within the EEC, with the mobility of labour (and of craftsmanship) which will inevitably come? How can he be given the foundation from which to tackle every innovation in what must surely be one of the fastest developing technologies.

The youngster, for his part, will also remember with respect the skill of his seniors — skill and artistry which the very diversity of present-day work may never permit the newcomer fully to acquire. Such craftsmanship and experience demands, and has always received, a place of honour in our Society, and will continue to do so.

## **B.S.S.G. — A.G.M.**

Polygon Hotel, Southampton.  
1st. Sept. 1973

After the various reports had been accepted the amendments to rules took place. After some very good discussions Rule 7(I) was deleted. However it was made clear that at some future date an alternative to it may well be instituted. The rule inclusion for a Vice Chairman was also approved.

The election of Officers took place, not without some discussion, the main objection being the lack of information available about the new President and the opportunity members had been denied to discuss the matter at Section level.

President	—	Mr. Stafford Scholes
Chairman	—	Mr. R. Harvey
Secretary	—	Mr. R. Mason
Treasurer	—	Mr. G. Robertshaw

During the meeting a petition was passed around asking for the afternoon session dealing with the Institute to be brought forward to A.O.B. on the

It was inevitable, I suppose, that these reflections on taking up the Presidential reins should revolve around the issue of the Institute, which is occupying so large a place in all our thoughts at the present time. However that issue is resolved, my concern as President is for the Society, and for those ideals I have mentioned, which are implicit in the concept of a Society. I believe this is your concern also; but, like each one of you, its members, the Society must not fossilise, but rather develop. Make no mistake about it: the future will not go away if we bury our heads in the sand. The choice is ours: we can either rise to the challenge which the future poses, or we can run away from it. Either way, the consequences are far reaching: I believe it is a simple choice between the life, and growth (both in numbers and maturity) of the Society on the one hand — and, on the other, its demise. How that change is brought about it, in the long run, less important than that we all adopt a responsible attitude in our reaction to this challenge of the future, and go forward, rather than back.

official A.G.M. Due to lack of time this was not possible. To meet members wishes the A.G.M. was adjourned at 10.30 a.m. to be continued at 3.0 p.m. thus making the discussion official and on the records of the B.S.S.G. A.G.M.

At the continuation of the A.G.M. in the afternoon Dr. Oldfield outlined the history as far as she had been involved in the forming of the Institute.

Dr. Oldfield said that we should make up our minds now about acceptance of the report from the steering committee and we should not dawdle and talk for another five years. The meeting was then thrown open for discussion. This very controversial subject brought forth some very heated arguments and no holds were barred in what I can only describe as a very forceful and outspoken discussion. The outcome was the referendum with which members are now acquainted.

FGP

**B.S.S.G.  
Board of Examiners  
Report to A.G.M. — 1972/1973**

The Board has met on three occasions during the year. With the exception of the Scottish Section whose examiners do not attend on account of distance, the average attendance has been 13 out of a possible 14. As from the August meeting the Board has increased by the addition of two members from the Tyne Wear Section.

During the year Mr. S. G. Yorke and Mr. J. S. MacDonald have resigned from the Board. Both were founder members and will be much missed after such valuable service. Mr. Keith Holden was elected Chairman to take the place of Mr. MacDonald.

**Examinations**

Introduction to Elementary Scientific Glassblowing:  
11 passes; 15 credits; 3 distinctions.

Stage One Scientific Glassblowing:  
8 passes; 6 credits; 3 distinctions; 1 failure

Stage Two Scientific Glassblowing:  
1 pass; 4 credits.

Certificate of Competence;  
5 passes; 1 failure.

Isleworth Polytechnic remains the most important centre for the various examinations — a total of fifty candidates having sat B.S.S.G. examinations there this year.

**Annual Competitions**

Entries for the competitions is still disappointingly low. Again this year a total of eight entries were received in the student competitions; the quality of the submitted work was, however, very high. Five Society certificates of merit were awarded. The Jobling Cup entries were particularly meritorious.

In the David Flack Memorial Trophy Competition entries were received. Three Society certificates of merit were awarded.

**One Week School at Monkwearmouth College of Further Education.**

This course was again quite well attended and this year included more subjects closely related to the work of scientific glassblowing.

**New Work**

The most important work on the agenda for future meetings is the formulation of an examination in theory.

No amount of work has yet been done on this project, a feeling of uncertainty, arising out of the implications of the proposition to form an Institute, tending to militate against a concerted effort being made.

Norman H. Collins  
Hon. Sec. Board of Examiners.  
23rd August 1973

## EXHIBITORS AT THE 13th ANNUAL SYMPOSIUM Polygon Hotel, Southampton

### **J. A. Jobling Ltd., Laboratory Division. Stone, Staffordshire.**

Products on show were of their general laboratory ware. New products available were a multihead flange having nine ports of Clearfit sockets and screw thread joints. A high performance Chromatography Column capable of withstanding 800 PSI, a range of Rotoflow/E/MIL Burettes, and a liquid dividing fractional head.

### **V. A. Howe Ltd. 88, Peterborough Road, London, S.W.6.**

Exhibited their range of joints and fittings made by SOVIREL Ltd., also stockists of SOVIREL tubing.

### **R. B. Radley. 53, London Road, Sawbridgeworth, Herts.**

Had a good range of stopcocks up to 20 mm on display and their JUMBO joints 100 mm. Stockists for the glassblower of mould blown cylinders and good quality borosilicate sheet glass.

### **NORDSEA Ltd. Gas Appliance Co. Ltd. 42, Hythe Road, Denton, Manchester.**

Very good range of burners for natural gas now available, a new surface Mix Lathe torch, a gas air torch and a modified type of Marshall burner for natural gas use.

### **T. W. Wingent (Scientific) Ltd. 115-117, Cambridge Road, Milton, Cambridge.**

The obvious thing about this stand was the fibre optics novelty which changed colour, a good eye catcher. A splendid range of gas burners. New product was the "FLEXIHEAT" Lathe burner and an improved Silencia burner. Also available was their range of joint holders for Lathe work which covered both cone and socket type and ball joints. Their holder for dewar making was certainly a nicely made tool.

### **John Moncrieff. Perth, Scotland.**

This stand held a range of "MONAX" glassware ranging from Dessicators to Aspirators as well as part of their range of laboratory apparatus.

### **Thermal Syndicate. Wallsend, Northumberland.**

Quartze, always an impressive material. On show were a range of tubing and jointware, optical flats and cells. Centrepiece was a Spectrosil Rod 36 inches by 4 inches diameter valued at £1,500.

### **L. Richoux, 3, Morocco Street, Southwark, S.E.1.**

A range of burners, tools, carbon and other aids for the glassworker were on show. A new product was the multiburner which would work with natural gas/oxygen or natural gas/air, fitted with three valves it is quite versatile.

### **Heathway Mac. Co. Uxbridge Road, Uxbridge, Middlesex.**

A range of Lathe products and fittings could be seen here. New Products — Lathe Polariscope — Litton natural gas burner — NORTEL Bench burners. A new departure from the gas valve generally known, is the Lever slide valve which gave a very sensitive control. Agents for "Diamant Boart" Ltd., makers of diamond cutting wheels.

### **R. W. JENNINGS. Scientech House, East Bridgeford, Nottingham.**

More burners for the glassworker. New products — No. 2 LESCO Bench lamp, a ribbon burner for natural gas and a simple burner with three different nozzles — the TRITURRET.

### **Glass Wholesale Suppliers. 566, Cable Street, London, E.1.**

Agents for Schott Ruhr glass, they exhibited the range of Duran Tubing and cylinders, also A.R. Soda Glass Tube.

### **A. D. WOOD. London Ltd. Service House, 1 Lansdown Road, London, N.17**

Apart from their familiar products of glass and insulation materials there was an extended range of cryogenics equipment on show. They have gone into this field now in a very big way and storage vessels of 200 litres are now available.

## FORMING GLASS WITH CARBON AND METAL

E. Little, Hirst Research Centre

The main topic of the lecture was the production of Experimental Cathode Ray Tubes for Medical Science and Mr. Little explained how these were made using graphite formers shaped to the pattern required. Conical blank was used and placed over the former. The whole thing was then mounted on a Rotary Vertical Machine and heated until the glass envelope flowed to the shape of the former. The nosepiece would have a fibre optics system built in to it. The greatest problem was strength after evacuation, and to this end checks were made during pumpdown cycles using strainviewers to combat this. After a good deal of research and trial and error, C.R.T. tubes to the requirements of the customers were produced.

## SOME IMPACT PROBLEMS WITH GLASS IN AEROSPACE

A. A. Fyall, M.O.D., R.A.E. Farnborough

This lecture dealt mainly with the familiar problem of rain erosion. Mr. Fyall explained to us that the damage was caused to aircraft on forward motion due to rain at 12 — 1500 m.p.h. In 1945 the first research was set up after damage was observed to fibre glass domes on the American flying fortress bombers. We were shown slides of damage done to a Hawker Hunter raydome by ice particles at 50 mu., erosion had gone through three layers of material. Another problem was erosion on navigation light glasses. a slide was shown giving a chart of rain levels and it was noted that during July at 40,000 ft. up to 50% rainfall occurred in certain areas of the world. Erosion on raydomes of only a few thousandth of an inch would distort signals.

Mr. Fyall went on to talk about the Rocket sledge at Pendine in South Wales which was subjected to intense research using a simulated rain machine, up to 7 ins. of rain per hour could be simulated.

Super speed photography was used in their researches, a drop of water on a fibre would be used, a projectile fired, and the effect shown on a photograph. The speed of photography was two flashes  $\frac{1}{6}$ th of a millionth of a second apart. Further illustrations of eroded aircraft parts were shown and Mr. Fyall concluded this most interesting lecture by saying how his department was involved in research to overcome this very taxing problem.

## STRAIN IN GLASS

J. Frost, Reading University

The lecture began with the usual disarming grin and chit-chat with which members who have already heard this lecture are familiar. Then Mr. Frost gave the definition of Stress using the stilleto heel on lino as an illustration of a point of stress, i.e. concentration of pressure on a small area. Glass is stronger in compression than tension. A chart which indicated how strain left in glass built "INSITU" would cause fracture was drawn and is as follows —

TIME	STRESS — KILOS per sq. cm.
1 second	920
1 minute	680
1 hour	550
1 day	490
1 month	460
1 year	410
100 years	380

Mr. Frost went on to say that he was not going to get mathematically technical since this was not his strong point and he believed that simplicity was easier to assimilate. Glass heated to 200 degrees centigrade would crack in water but apparatus put in an oven at 500 degrees centigrade would not, this is because heated up all over the glass was strong in compression — since glass is strong in compression it does not crack.

Annealing cycles differed greatly. Optical glasses were annealed slowly, scientific apparatus quickly, time schedules were different.

With the aid of slides Mr. Frost illustrated temporary stress and devitrification of glass due to prolonged heating. To round off the lecture we were shown the very impressive demonstration of the fracture of a Prince Ruperts drop, and to make things even more forceful, the smashing of a milk bottle (which he had acquired from a manufacturer) and had not been annealed.

Finally to much applause and laughter he held up for our inspection quite the largest Ruperts drop I have ever seen, which he was keeping until his old age when he would find a suitable reason for "letting it off".

*(Above papers presented at 1973 Symposium)*

# SEALING SILICA WINDOWS

W. C. Tys,

Research School of Chemistry, The Australian National University, Canberra, A.C.T.

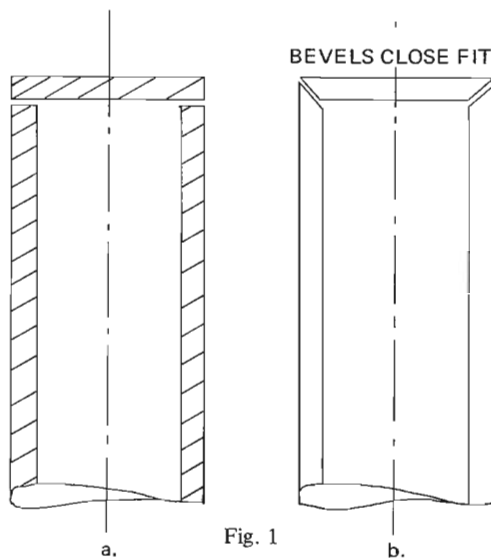
## Introduction

The usual method of sealing on silica windows is by fusing the outer edge of the windows to the silica body with a sharp  $H_2 - O_2$  flame. The fusing may be done with flat or prepared bevelled edges as shown in fig. 1 a and b.

This method meets most normal requirements in that the seal is able to withstand high vacuum, high baking out temperatures and produces no distortion over the greater middle part of the window.

For certain applications or when more stringent requirements must be met a method different to that described above must be adopted. For example when no distortion in the window or in the body of the cell either can be tolerated or when Brewster angles are involved it will usually be necessary to fuse the windows on with a suitable glass emulsion or glass transfer tape whose melting temperature (usually  $900^\circ - 1000^\circ C$ ) is below that of the temperature deforming quartz or silica ( $1700^\circ - 1800^\circ C$ ).

Certain problems arise however when using emulsion or transfer tape. These are associated mainly with the weights used to hold windows in place and include:



The emission of fumes from the weight, clouding or fogging the windows. Keeping the windows in place while fusing occurs. This is particularly difficult if Brewster angles are involved and normally requires the construction of expensive jigs able to withstand high temperatures. Normally only one cell window at a time can be fused, the process having to be repeated for the opposite window.

The purpose of this paper is to describe an alternative method of maintaining silica or quartz windows in position while fusing takes place. Basically the method involves the maintenance of a vacuum within the workpiece (cell) throughout the fusing period. This is achieved by means of a waterjet pump connected to the workpiece through a side tube.

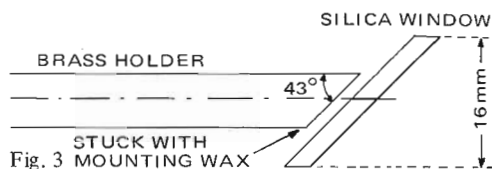
In view of the specific difficulties encountered in fitting Brewster angle windows this alternative method is particular advantageous to that application.

For the purpose of this paper the method has been described as applied during the construction of a Dye laser cell. (see fig. 2).

#### Construction of a Dye laser cell.

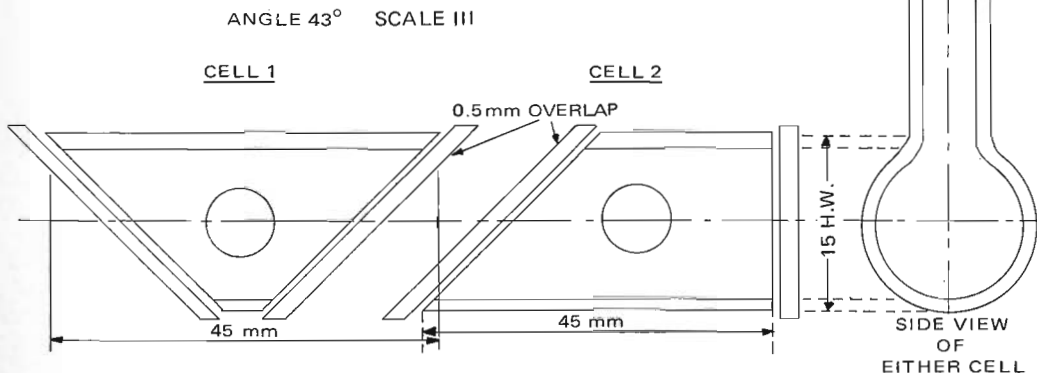
Figure 2 indicates the basic construction of a Dye laser cell. The following preparatory work was undertaken:

1. The silica tube was cut to the appropriate length (slightly oversize) and angles.
2. The cut tube was ground to the exact specifications very accurately. A "Makino" grinding machine was used for this purpose. The windows were ground while held by means of a brass holder as shown in fig. 3.



3. The side tube hole was drilled in the ground tube.
4. The so far completed workpieces were then carefully cleaned in an acid bath, detergent etc.
5. A B7 cone was fitted in the side hole to act as a temporary handle and a silica rod fused to the opposite of the side tube hole. The B7 cone was then removed.
6. The rough edge of the side tube hole was fused and reamed out with a tungsten reamer to form a slight shoulder.
7. A 8 mm O.D. tube was fused on to the hole and heated and reamed out repeatedly from the inside. As both ends are open, blowing was not possible. Care had to be taken to avoid tungsten deposits on the silica.
8. The workpiece was then flame cleaned ( $H_2 - O_2$  flame) to remove most of the white  $SiO_2$  film. The sharp ground edges were carefully avoided and the workpiece was acid cleaned afterwards.

Fig. 2



9. All the edges were then ground flat by "hand lapping" on an optically flat 1/4" thick glass plate with Alundum oxide 750-1200-1600 grit size respectively.
10. The workpieces and windows were meticulously cleaned again.

The next stage in the construction was associated with the preparation of the workpieces for fusing. The following steps were undertaken:

1. The glass transfer tape was applied to the edges of the workpieces according to the manufacturer's instructions. (see footnote for particulars)
2. The silica windows were placed on the glass bodies at both ends.
3. The side tube was extended to enable the subsequent connection of a rubber vacuum hose. (this extension may be done earlier)
4. The cell was connected to a running waterjet pump in order to obtain close contact between the tape and cell body.

The remainin stage of the process, the actual fusing, involved the following steps:

1. The silica cell was then placed in a 6 ins. wide x 10 ins. deep x 3 1/2 ins. high laboratory oven in such a way that the actual cell was not in contact with the oven interior. This was achieved by clamping the long side tube in the slit of the guillotine type door. The remaining openings were closed with ceramic wool.
2. A thermometer couple was inserted into the oven through a slit and connected to a precision Pyrometer.
3. The controls were set and the temperature was kept at 925° C. The complete heating cycle took 3 hours: 1 hour heating up and 2 hours at a constant 925° C.

4. The oven was then switched off and allowed to cool slowly. Pumping was continued until the Pyrometer indicated 600° C at which time pumping ceased and the cell removed from the oven.

The finished cell showed perfectly fused windows. Very few small air-bubbles were visible and the windows and the cell body had been thoroughly "wetted" by the glass transfer tape.

The above method of keeping windows in place during fusing has been used in a number of different applications. In one such application, windows were fused to a number of cells at the one time by connecting each cell to a manifold and on each occasion excellent results have been obtained.

#### Conclusion.

The normal method of using weights to maintain quartz or silica windows in place while fusing occurs is for many applications less then satisfactory. The main problems which can arise have been outlined above. The alternative method of using a vacuum to keep windows in place overcomes most of the difficulties associated with the conventional method and can be extended to many different applications. However, while the method as described may appear to be relatively straight forward, two factors are critical to the success of the process. The fact that the temperature maintained during the fusing be in accordance with the specification of the transfer tape manufacturer. Too high a temperature will result in distortions within the cell at the other extreme inadequate fusing will occur.

The second factor concerns the degree of the vacuum but this is largely a matter of trial and error. If the temperature is right the vacuum created forces may differ within limits.

One concern expressed was that the glass tape would be sucked away, but it was found that the windows would be hollow distorted before this occurs.

#### Footnote

"VITTA" Wilton, Connecticut 06897 U.S.A. Cat. No. G-1015 Glass transfer tape for sealing quartz materials.

## BRITISH STANDARDS COMMITTEE QUALITIES OF GLASSWARE

**B.S.S.G. representative Dr. L. F. Oldfield**

Report of Committee Meeting held on 26th April 1973  
at Hampden House, Green Street, London.

Much of the discussion was concerned with details of the methods of analysis for the chemical durability of glass, for example, the respective merits of the whole article tests and grain tests.

One topic of especial interest, that of the compatibility of borosilicate glasses of expansion coefficient  $3.3 \times 10^{-6}$  was discussed at length. This topic involves exchange measurements organised by Dr. Oldfield under the cover of the International Standards organisation Committee Working Party ISO/TC WG F. A meeting of the latter committee is due in October, 1973.

The work hitherto has been concerned with the accuracy and repeatability of thermal expansion measurements by dilatometer or block seal tests. A new development is the assessment of the compatibility of the various borosilicate glasses of this type with each other. Glasses from various manufacturers in Europe and the U.S.A. will be sealed together and subjective comments made on their comparative workabilities, ease of intermixing, behaviour in various flames and quantitative assessments to be made of the residual stresses at the seal boundaries.

Dr. Oldfield recommended that this assessment could be carried out with a larger number of collaborators through the British Society of Scientific Glass-blowers and its co-operation with International Glass-blowing Societies. This was agreed. The relevant committee of the International Commission on Glass will also be approached.

## OBITUARY

It is with deep regret that we record the death of Mr. C. E. Walker, following a heart attack early in the morning of Saturday, December 8th. Cyril, one of our most well-loved members, always went out of his way to be helpful, and to make life as pleasant as possible for those around him.

After many years at the General Electric Company's Hirst Research Centre, working on a variety of their research projects, he moved to Chelsea College of Science and Technology, setting up a glass blowing workshop that earned the respect and confidence of students, academics and technical staff alike. In addition to coping with standard work his greatest delight was the tackling of the more difficult tasks. Being by nature both curious and inventive, he made an excellent glass man. He was always at his best with those problems where his total knowledge of the behaviour of glass enabled him not only to achieve success for himself, but to point out lines of approach whereby success could be achieved by others. Although a strong trade unionist, he nevertheless felt it a mistake to group people together under an artificial label, believing the personality of an individual being of prime importance.

He was deeply interested in all matters involving the environment, and enjoyed walking in the remoter parts of Epping Forest, or fishing the local ponds. It pleased him when facilities were provided for youngsters in a crowded area to enjoy these simpler and more natural aspects of life.

In spite of the mental pressures of having such a heart condition (his first serious attack was in 1961) Cyril was always cheerfully confident, he did not allow his delight in living to be spoiled, he treated each day as a bonus, and set out with enthusiasm to enjoy it to its utmost.

He leaves a widow, and two teen-aged children. To these we offer our deepest condolences. He will be sorely missed by all.

B. BROWN C. HARDY

## CHAIRMAN'S ADDRESS TO B.S.S.G. 1973 AT ANNUAL SYMPOSIUM

























R. W. HARVEY










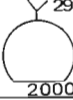












During the past year or so the Society has become much involved with the Overseas Societies, particularly with the European, and a close liaison is being built up between all the glassblowing fraternities. A lot of the work in the laying of this foundation is being put in by our Hon. Sec., Ron Mason and the culmination of this effort will be in the form of an International Symposium. The British Society has the opportunity of being the host nation to give the first ever International Symposium and if we accept this it will mean quite a lot of hard work in the planning, organisation and administration. The close co-operation of these societies has already provided a great deal of technical and informative interchange of thoughts and ideas and a closer and even more valuable relationship will no doubt further evolve.

The recent referendum relating to the proposed Institute, resulting in the rescinding of the original resolution, has given Council the direction required to ascertain where our energies are most needed. We now have to move along those lines indicated, within our financial scope, to provide the Board of Examiners with the means of extending their scope to this end. The Board, with many a hard Saturday's work behind them, has achieved much, and I am sure the future will see them playing an ever bigger part in the forming of future glass technicians and I hope too that the glassblower at the bench will be considered to a greater extent than heretofore. His development is as necessary as a the young apprentice just coming into our profession.

International co-operation allied to educational and technical advancement then is what I feel we should work for. past Chairmen in this Society have always set a high standard and I will do my best and honour this office as you have honoured me by putting me in the chair.

## PROPOSED INTERNATIONAL SYMBOLS FOR GLASS PRODUCTS

No.	Designation	Product	Symbol
1	Glass rod		 $\phi 8$
2	Glass tube		 $\phi 12 \times 1$
3	Capillary tube		 $\phi 12 \times \phi 1$
4	Interchangeable conical ground joint cone		 19/26
5	Interchangeable conical ground joint, socket		 19/26
6	Interchangeable spherical ground joint ball		 S 13/5
7	Interchangeable spherical ground joint, socket		 S 13/5
8	Flat flange joint		 $\phi 150 \times \phi 110$
9	Flexible tubing adapter		 SV 9/5
10	Tube with screw thread and cap		
11	Erlenmeyer flask		 500 ml

No.	Designation	Product	Symbol
12	Erlenmeyer flask with ground socket neck		 19/26 500 ml
13	Round bottomed flask		 1000 ml
14	Round bottomed flask with ground socket neck		 19/26 500 ml
15	Flat bottomed flask		 2000 ml
16	Flat bottomed flask with ground socket neck		 29/32 2000 ml
17	Tube condenser		 SV 9/5 300 SV 9/5
18	Tube with bulbs		 50
19	Allihn condenser		 SV 9/5 300 SV 9/5
20	Spiral tube		
21	Coiled distillate condenser		 SV 9/5 300 $d_1=8$ $d_2=25$
22	Straight bore stopcock		 boring 2,5 mm



# SYMPOSIUM

## 74

To be held at the University of Lancaster, 29th-31st August, 1974.

Lancaster University is situated close to the M6 motorway between Preston and Lancaster.

Accommodation is in pleasantly furnished study bedrooms. Most contain their own washbasins, and there are bathrooms and toilet facilities convenient for all bedrooms. Most rooms are centrally heated.

Breakfast is on a self-service basis. There is a waitress service for all other meals.

### CONFERENCE BOOKING PROCEDURE

At six months before the starting date of the conference, an estimate of the number of delegates attending is required.

At three months before the starting date of the conference a guaranteed minimum number of delegates attending the conference is required.

As Lancaster University is an extremely popular Symposium venue, we are committed to give provisional booking well in advance. The probable charges would be £3.70 per head per day plus Symposium fee.

### Early Booking

Please notify as early as possible:

Mr. P. Le Pinnet,  
99 Liverpool Road,  
Warrington, Lancs, WA5 1AS

STICHTING GLASTECHNIEK  
(Holland)  
ABSTRACTS 'Glastechnische  
Mededelingen' 1973

No. 1, March 1973

- Sound and noise hindrance (*J. C. Hendriks, Eindhoven, 6 p., 5 fig.*).  
After an introduction a treatise is given on noise sources and countering noise hindrance.
- Visual perception in glass instrument making (*H. F. Wilbrink, Eindhoven, 4 p., 6 fig.*).  
A review is given on the use of T.V. circuits - with mini compact vidicon camera - when working at extreme small glass parts and apparatus.
- Glass joints with the aid of elastomere resins (*L. van As, Leiden, 2 p., 4 fig.*).  
The application of film shaped adhesives (*elastomeres*) for joining glass parts is being discussed, including heat treatment.
- Sorting tubes of fused silica for H. P. mercury lamps (*Ir. P. H. Havas, Eindhoven, 3 p., 3 fig.*).  
A mechanised device using T.V. - and pulse techniques is described, used for exact measurement control of tubing to guarantee a constant quality of H.P. mercury lamp production (*mass production*).
- Universal mould for making flanges (*H. van Amerongen, Arnhem, 1 p., 3 fig.*).  
A simple graphite mould (*plate*) is described for making flanges on a glass lathe.
- Making tubing connections (*P. G. T. van Bergen, Arnhem, 1 p., 1 fig.*).  
Describes the making and use of a graphite mould for tubing connections.
- Level regulator for liquid nitrogen (*R. S. Sigmond, Trondheim, Norway, 1 p., 1 fig.*).  
A device for controlled suppletion of liquid nitrogen in the high vacuum technique is given.
- Normalisation G.T.M. (*1 p.*).  
Contains a review of present activities in the field of glass standardisation.

- Proceedings 1972 'Nederlandse Vereniging voor Glasinstrumentmakers (*1 p.*).
- Information (*1½ p.*)  
Foreign contacts, standardisation, symposia.  
Excursion Group West (Unilever, Vlaardingen).  
Fiberfrax - H. Carborundum Company.  
Co-ordination Group Glassblowers in the Netherlands, contacts with N.V.G.I.  
Business news Corning, U.S.A., European activities.  
Use of glass building blocks as laboratory containers etc.  
Teflon connectors in glass techniques.  
Shaping lenses with ion rays.  
Scrap glass as material for glass fibres.  
Use of high pressure liquid jet for cutting materials (*Brit. Hydromech. Research Association*).

No. 2, May 1973

- Aspects of blowing fused silica (*P. Heller, Eindhoven, 9 p., 20 fig.*).  
The following items are discussed:- various fused silicas, safety precautions, lamps and tools, pretreatment and finishing, construction difficulties, 'clean' working of F.S.
- Mould for making glass flanges (*F. W. Estoppey, Amsterdam, 4 p., 12 fig.*).  
Describes a device for making flanges on tubes on a glass lathe.
- Chromatography (*Drs. D. H. van den Eijnden and W. van der Hoek, Amsterdam, 4 p., 4 fig.*).  
Various methods are briefly described:- absorption, dispersion, paper, gas, ion exchange, gel filtration and thin layer chromatography, as a general information.

- Information (2½ p.).  
Book review  
Precision drawn tubular glass, Sanders-Roe Developments Ltd.  
Generator with superconductive rotor.

### No. 3, July 1973

- Research in enamels and glass (*Dr. J. de Jong, Delft, 7 p., 7 fig.*).  
Research results on cristall mechanisms in titanium enamels and glass ceramics, different ways of glass and enamel reinforcement, chemical attack and the effects of thin layers scratch and chemical resistance, colour and gloss.
- Glowing glass (*Jim Keulemans, 7 p., 7 fig.*).  
Report on a visit to the glass technical department, Kon. Shell Laboratories, Amsterdam.
- Perception and measurement of tension in glasses (*Dr. Ir. H. de Waal, Delft, 5 p., 5 fig.*).  
The principles of the polarimeter is given and the theory and function of polarizing plates (*Nicol or Polaroid*) and the 'red first-order-plate'. The compensator and the relation between traject difference and tension.
- Examination 1973 first level (*8 p., 11 fig.*).  
An extract of the theoretical and practical examination is given. This was the second examination on a national scale.
- General meeting of the Vereinigung Deutsche Glasbläser, Cologne April 1973 (*Ir. W. Luiten, 1 p.*).
- Symposium 1973, Utrecht (½ p.).  
Motto: 'Diversity in tensions', provisional programme, Saturday, 20th October.
- Information (1 p.).  
Applikon B.V., Schiedam: trade information, Sanders-Roe Developments Ltd.: - precision tubular glass etc.  
Gas packed in a 'tube'.  
Bottles to glass fibre.  
Electricity from blood.

### GLASSBLOWING FILMS

1. Philips (Holland)  
Machining of Glass  
Diamond Cutting  
Running Time 10 minutes  
Quality Good
2. Philips (Holland)  
Forming Glass in Hot Pressings  
Running Time 12 minutes  
Quality Fair
3. Eindhoven University (Holland)  
Glass Techniques  
A Helium Cryostat  
Running Time 12 minutes  
Quality Poor  
Note: Film No. 1 superior quality
- 2 copies.  
No. 1. — magnetic sound.  
No. 2 — optical.
4. Jobling (England)  
Looking into Glass  
Running Time 20 minutes  
Quality Good
5. University of Bristol  
Making a Spherical Dewar  
Running Time 10 minutes  
Quality Fair
6. General Electrical Labs.  
Glass Engineering  
Running Time 20 minutes.  
Quality Good
7. University of Bristol  
Glassworking Techniques  
Running Time 10 minutes  
Quality Good

*Details from Hon. Secretary.*

# NEWS FROM

## NORTH EAST

A visit to the Rank Precision Industries Leeds was held on the 27th September, 1973. The evening began by the safety and training officer, Mr. Ketteringham and his colleague Mr. Meredith, explaining the relationship of the Optics division to the rest of the Rank organisation which has interests in many spheres such as entertainment and office machinery. After splitting into two groups, we saw some of the processes used in the Manufacture of Fibre Optics such as assembling, polishing and testing but not drawing, this we were told was a secret process. Many of the Fibre Optics made at Leeds are used in illuminated motorway signs, which are mainly exported to the U.S.A. Also shown were Computer switching units and devices used for the examination of complex machinery such as jet engines.

Mr. Ketteringham explained, that as the company made high quality components, it was necessary to have accurate mounts for them and for this purpose, the company had a large engineering section. Here we saw several automatic lathes and milling machines as well as more conventional machinery.

The factory at Leeds has extensive workshops for the production of lenses up to 8 ins. in diameter for use in gun sights, cameras, projectors, binoculars etc: Flat glass including prisms is also ground and polished to be used in many products, including Xerox copying machines. The company obtains its blanks from several sources in this country and overseas,

including France, Germany and Japan. All grinding and polishing processes are carried out automatically once the blanks are set up in either wax or pitch. We were told of the difficulties experienced by the Company in obtaining trainees for optical polishing, out of every eight men only one would turn out suitable. We finished with a tour of the clean rooms, where we saw lens components being assembled by means of epoxy resins and vacuum coating units in use for the aluminising of mirrors and the blooming of lense surfaces.

Our two groups rejoined for a discussion over tea and biscuits in the canteen. On behalf of the ten members present, Mr. Butler our chairman thanked Mr. Ketteringham and Mr. Meredith for a most enjoyable evening.

R. Hall.

## THE WEST

A visit to Messrs Harveys the Wine Merchants on October 20th started the Winter series of meetings of the Western Section. A party of 32 comprising members and their friends gathered at the Denmark Street premises in Bristol where we were met by two charming hostesses who gave us an introductory history of the premises and the background to the present business of the company. As we were the second of the two parties visiting the premises, our meeting was held in their very fine museum. (The waiting list for

visits is now two years). Our hostesses gave us a very comprehensive lecture on the methods of controlling the quality of sherry and port wine, and explained that although Bristol Cream was their proprietary name, Bristol Milk was used by many other companies and that people should remember this fact when they make a purchase of sherry. Next we came to what for me was the highlight of the evening, a tour of their glass museum. It would be almost impossible to convey to the reader a true picture of the splendour of the glassware on display. Some of the complex stems on the glasses were most ingenious, one of which contained some 50 air twists. The engraving on some of the memorial goblets was absolutely fantastic. A most impressive decanter wagon in Gold work was to me the most impressive of all the exhibits. Other exhibits around the museum were examples of early wine making and storage equipment and a showcase filled with silver name plates of the many types of drink made. The next part of the meeting was a film made for Messrs Harveys in Spain and at their Plant at Whitchurch Bristol which explained pictorially all that our hostesses had told us.

To conclude the evening we took part in a Sherry tasting session. Each member of the party received six glasses of sherry from the dry FINO to the sweet Bristol Cream. Between each sherry we received cheese and biscuits and an explanation on the merits and blend of the respective sherry, names like Olerosa, Manzannilla, Ammontillado now at least for me mean something. It would be of interest to readers to know that the best glass for sherry is thin in the wall, conical in shape being narrower at the top and of clear plain glass. This facilitates rolling of the sherry in the glass before taking the bouquet and facilitates better observation of the colour. The glass itself is called a Copita.

A most enjoyable evening and one doubtless to be repeated in the future. Should any of you readers ever visit Messrs Harveys for one of these visits, be warned, go by coach.

F.G.P.

## SCOTLAND

The October meeting was held at the Scottish Gas Industrial Development Laboratories in Coatbridge. As for most of us in Scotland, conversion to natural gas is now imminent, there was much interest in this meeting. For many of us, this was the first introduction to the new fuel and it proved a good opportunity to try out various available torches.

Catering for Glassblowers is only a small part of the laboratories activity. All conversion problems for Scotland are dealt with here as well as special applications, space heating etc; Especially impressive was the demonstration of the burner used in a furnace for annealing pig iron. The flame in this case is not allowed to impinge on the objects in the furnace. A swirling effect is therefore imparted on the gas and air mixture, with the result that the flame spreads on emerging from the burner mouth and only heats the furnace wall. So effective is this rotary action that it is possible to walk up close to the flame and insert your hand into the burner mouth.

We extend our thanks to Mr. Robertson, the industrial development officer, Mr. Lockheart the conversion engineer, and their staff who gave up their Sunday to make this meeting possible.

F. AKER BOOM

## EAST ANGLIA

A Meeting was held at the Playhouse, Harlow on Friday, 12th October, 1973, which took the form of an Educational Lecture on the Use and Abuse of Diamond Tools.

The Meeting started fifteen minutes late due to a bomb scare, but once started it went through on a well planned programme set by Mr. R. Adnitt.

Two members of Diagrif Diamond Tools Ltd., Mr. D. Brighty (Technical Liaison officer) and Mr. M. Hammond (Area Representative) gave very good lectures, backed by two films:—Diamonds and Ceramics, and Diamonds and Glass. They left us with the feeling we had a

lot more to learn, and would benefit more by a further events.

Due to good timing, we had a lively question period, which brought to light a keen interest in single point diamond cutting, it was also possible to fit in a film from Holland on the making of Helium Cryostat.

It was a very good evening, twenty five persons attended, and Mr. Brighty offered to extend this Lecture and Films to other Sections if they are interested, or possibly at a Symposium.

R. S. Briggs.  
Hon. Secretary.

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## BREAK SEALS

BY A. THOMSON

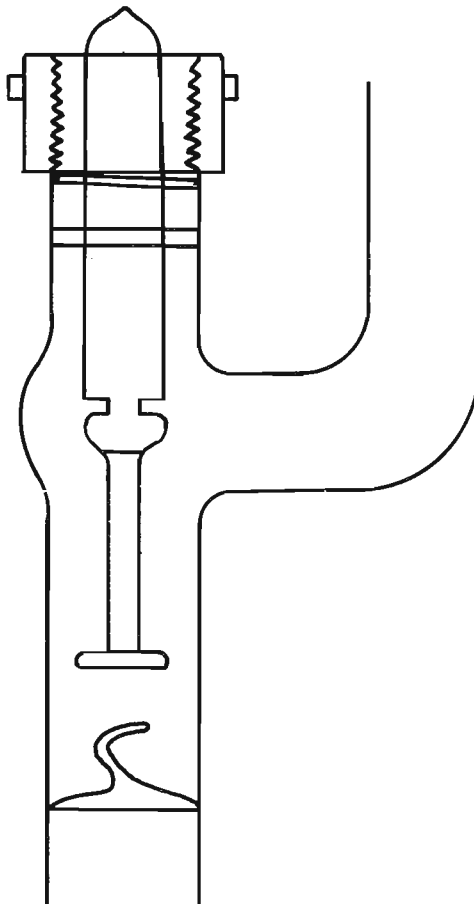
There seem to be three problems concerned with the manufacture of break seals:

- a) that the seal should be thin enough to break *when* required;
- b) that it should not be too thick so as not to break *at all*;
- c) that the manufacture of large numbers is very time consuming.

One way round the problem is that research graduated and the like should manufacture their own break seals but this of course whilst diminishing (c) increases (a) and (b).

Across is a sketch of a modified Young's tap which solves all the problems.

The bottom P.T.F.E. O ring is removed and a rod of suitable diameter joined on, the two side arms are increased to a diameter suitable for the job in hand and that's that. You now have a mechanical method of breaking seals which under test has proved 100% successful, the rod can easily be lengthened by the user and a flat-end added if the thin spear type seal is used.



## MERCURY CLEANING USING ULTRASONIC CLEANER (abstracted from S.G.S.A. Journal)

The dirty Mercury is filtered in the usual way, it is then placed in a suitable container in the Ultrasonic bath. On top of the Mercury a  $\frac{1}{2}$  in. layer of Freon TF Solvent is poured. The Mercury is then ultrasonically treated for about 15 minutes during which time the Freon TF Solvent will dissolve any grease present and form a sludge on the bottom of the vessel. The clean Hg is poured off and then rinsed with distilled water. It is claimed that no distillation is necessary with this method and that very good results are obtained.

# The Problems of Sealing Capillary Sidetubes to High Precision Micro Silica Cells and a Solution

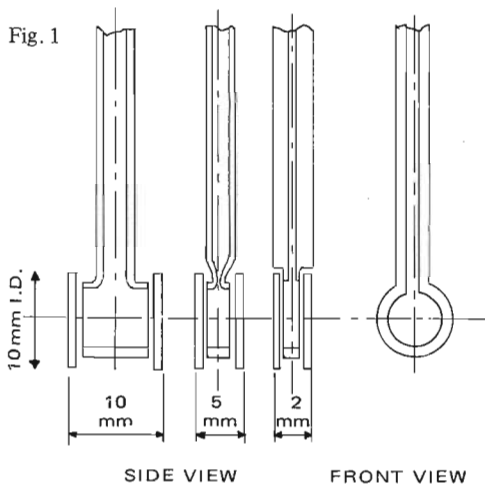
W. C. Tys,

Research School of Chemistry, The Australian National University, Canberra, A.C.T.

## Introduction

In the construction of high precision micro silica cells, the difficulties encountered in sealing sidetubes to the cell body increases as the length (i.e. path length) of the cell decreases. Even with larger cells, problems of distortion in the sidetube and cell body are normally evident.

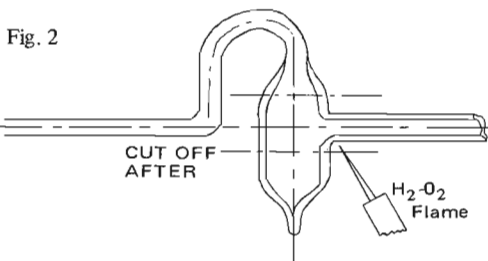
This paper outlines another approach to the sealing of sidetubes to cell bodies and has been found to not only overcome the inherent difficulties associated with the construction of micro cells but also provided a significantly better result than if normal methods had been used.



## Application

Three high precision silica cells were required of the following dimensions: cell body 10 mm I.D., length 10, 5 and 2 mm respectively. An optically ground and polished window was to be fused at both ends of the cells and each cell required a sidetube (see fig. 1).

The conventional method of sealing the sidetube to the cell bodies is as shown in fig. 2.



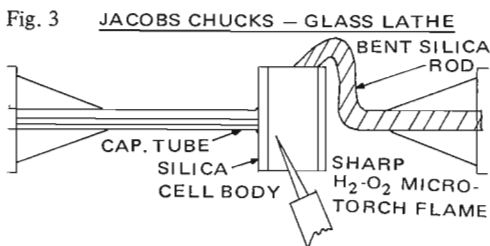
The method can be used provided the outside diameter of the sidetube is less than the path length of the cell. In cases where the tube diameter exceeds the path length, an alternative approach could be to heat and draw out the end of the sidetube until its outside diameter is less than the cell's path length.

However as mentioned earlier, this method is usually associated with undesirable distortion in the sidetube as well as in the cell body. In addition, when the path length of the cell is extremely small (for example, the 2 mm cell required) the constricted sidetube can become so thin and fragile, that extreme difficulties can arise.

The method devised to overcome these problems is described below. It can also be applied with advantage in the construction of cells with relatively longer path lengths, even though the conventional method is able to be applied.

**Method.**

Pieces of silica tubing (10 mm I.D.) for the cell body were cut well in excess of the required path length. a temporary silica rod was fused to the end of the cell body (i.e. beyond the actual path length required) and then bent to enable the cell body and rod to be clamped in the Jacobs chuck of the tailstock of a small glass lathe (see fig. 3).



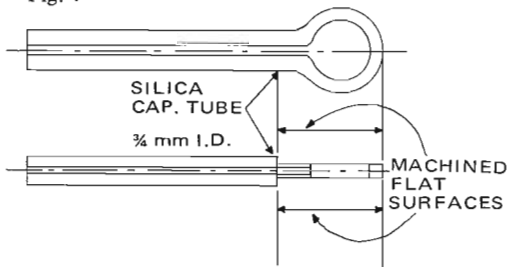
A piece of capillary (1 mm I.D.) was clamped in the headstock of the lathe.

The capillary and cell body were then fused together, **without** first making a hole in the cell body. The required hole in the cell body was made by applying a sharp  $H_2 - O_2$  micro torch flame to the inside of the cell body at the appropriate spot, and at the same time blowing through the capillary (a blow tube was attached to the capillary for this purpose).

The result was a perfectly sealed on sidetube, with minimum distortion in either tube or cell body.

To complete the cell's construction, the cell body was cut as near as possible to the correct path length and was then, together with the capillary wall of the sidetube, machine ground to accommodate the windows (see fig. 4).

Fig. 4



The windows were fused into position using the method described in a paper entitled "An alternative approach to seal on silica windows" by the same author.

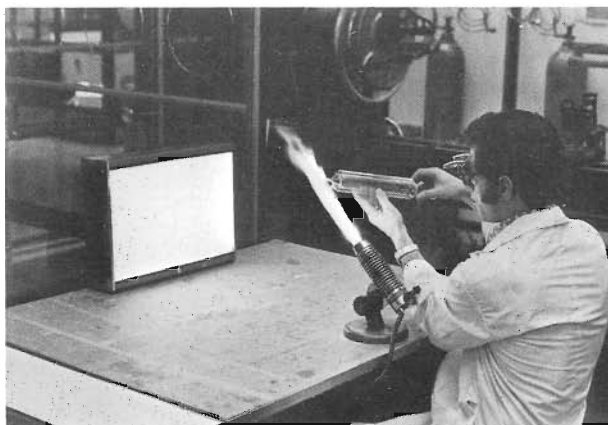


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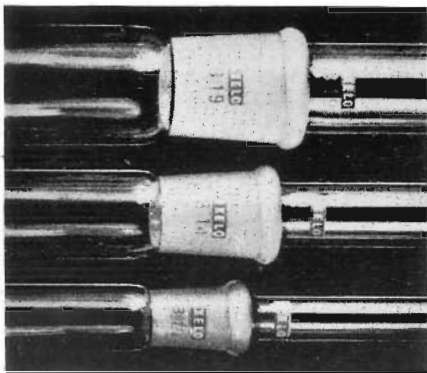
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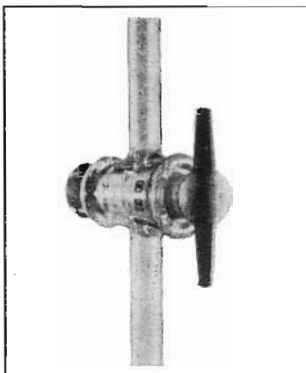


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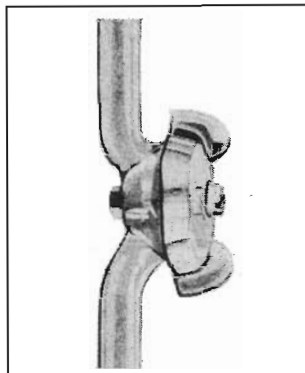
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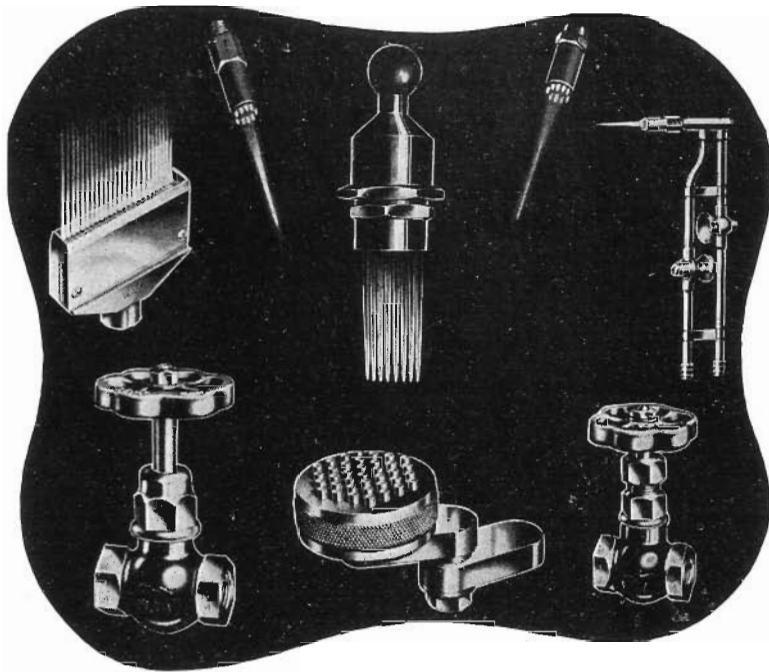
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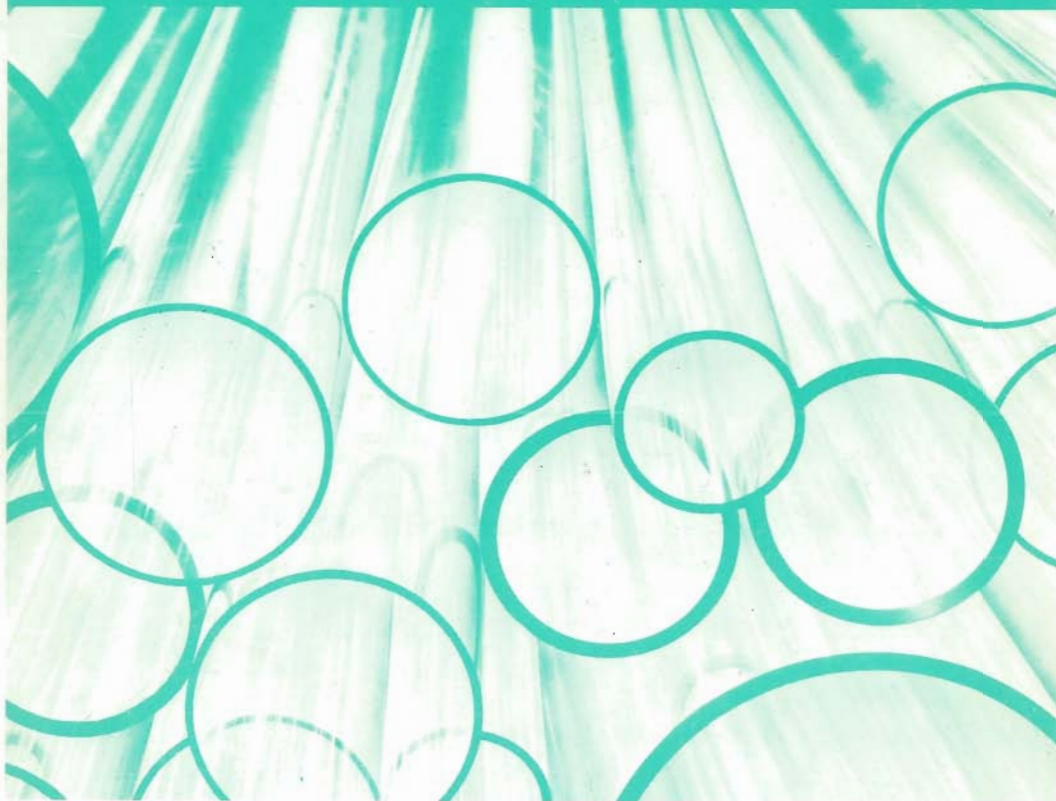
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