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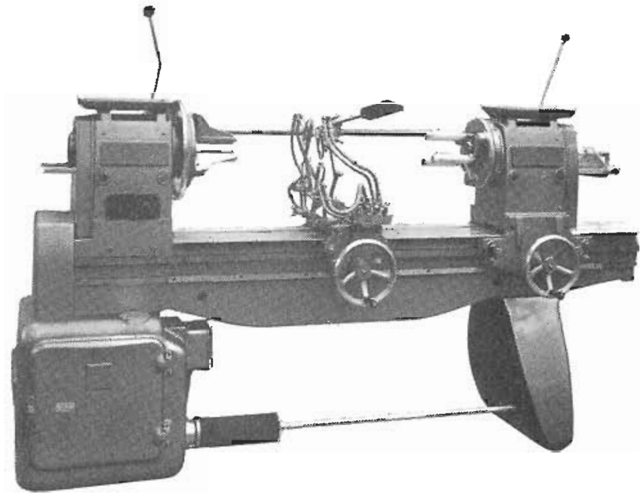

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EDITORIAL

COUNCIL MEETING 27th JULY, 1968

Among the many items considered at this Council meeting the following will be of interest to members.

Officers for 1969

Mr. E. G. Evans agreed to continue as Society chairman for a further year subject to the conditions relating to procedure at Council meetings which follow.

Both Mr. D. W. Smith and Mr. F. C. Branfield expressed a wish to withdraw from the offices of Secretary and Treasurer respectively. Votes of thanks were accorded to them for their services to the Society.

Mr. J. W. Stockton of the North Western Section was nominated as Secretary and Mr. L. Benge of the Southern Section as Treasurer.

A discussion took place on the desirability of limiting the term of Office of Society Officers and it was agreed to put this on the agenda for the next meeting.

The Editor of the Journal also asked that a replacement be found and he was instructed to publicise this in the Journal.

Fellowship Fee

It was agreed that a fee of £20 should accompany applications made to the Board of Examiners.

Membership List

The Council is not in favour of allowing the membership list to be used by commercial firms for the purpose of distributing literature to members but have agreed that advertising leaflets may be included when the Journal is distributed, for which a fee will be charged of not less than the corresponding advertising space.

Overseas members

It was confirmed that an application for Overseas Full Membership must have a sponsor but if another full member is not available, sponsorship by any other body such as the A.S.G.S. or a University could be accepted .

PROCEEDURE AT COUNCIL MEETINGS

The increasing number of items to be considered and the involved nature of Council meetings has resulted in a situation where it is felt by many that a more rigid schedule must be adopted. Mr. Evans as Council Chairman for 1969 will introduce changes which it is hoped will result in the smoother running of these meetings and termination at a more reasonable time.

(1) Only formal propositions and requests with amendment thereto which appear on the circulated agenda will be discussed and voted to a final decision.
Formal propositions and requests from Sections should be submitted through their elected representatives.

(2) Urgent and important measures which for good reason do not appear on the agenda will be dealt with under A.O.B.

(3) Less important propositions will be dealt with only if time permits and at the discretion of the Chairman.

(4) Time limits will be imposed for the discussion of each Section of the agenda.

(5) Between Council meetings emergency decisions can be made jointly by the Chairman and Secretary to be ratified at the next meeting.

It should be noted that the next Council Meeting is scheduled for the 30*th November* 1968, and items for the agenda should be sent to the Secretary by the 31st October. The Chairman and Secretary will decide on priority of items and if necessary restrict the agenda.

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.

ADDRESS

by Mr. I Maddock O.B.E., B.Sc., F.Inst.P., F.R.S.

*At the 1967 Reading Symposium**

Mr. Chairman, Ladies and Gentlemen,

First of all let me apologise for being somewhat late arriving this evening and to thank you for your forbearance. Secondly, I have to tell you that in the pique of mischief my secretary recorded this meeting in my diary as the "Association of Scientific Frothblowers"; and the concept of Scientific Frothblowing is quite a tantalising one.

I started my professional life with a long tube sticking out of one side of my mouth, with a gas flame singeing my hair (this was an implied thought to say that I had hair in those days), and with a foot pump which infuriatingly kept on creeping away from me as I pumped. But ever since those days I have had a love affair with glass technology. I think you people are fortunate in many ways because you have a subject where human skill and human wit still plays the dominant part and where the final product is beautiful and elegant. So much of engineering now has been surrendered to the machine and to the dispassionate where the final product is embedded behind grey panels or shrouded in bits of plastic, and I just wanted to say a little bit tonight about technology on the national plane, on the problem of technology to us as a nation and particularly to our industry.

We have the peculiarity as a country in that we are a great industrial nation; still among the greatest in the world, but we have virtually none of the raw materials we need for industry and we can only grow a fraction of the food we need. So as a nation we thrive on importing materials, adding value to them, re-exporting them at a higher price back to the people from whom we acquired the materials in the first instance. We have this extremely artificial type of economy but people are trying to tell you to overlook this, *they* think we have a completely viable economy. For goodness sake let us stop comparing ourselves with America who has all the raw materials she needs within her own shores, can grow all her own food and really *has* a completely viable economy. This is one of the great aspirations we have and where we frequently mislead ourselves. So what we need are industries where the material content is as low as possible and where the added value is as high as possible, and those which use vast amounts of materials all imported with low added value are not the ones you seek. Now you sit very much in the high skill, in the high intellectual industries. Yours are the kind of industries that we ought to see growing and flourishing in the country. It's interesting to see that in Japan they have almost exactly the same situation. They too have few materials that industry needs, they have a population which can't grow all its food, and have a fairly uncharitable land area so have developed low materials content, high skill, high added value industries. So we have their cameras, optical equipment, transistor radios, motorcycles and all kinds of appliances of that kind and this is the pattern for us. Now it's an unfortunate thing that our inheritance from the past has been the rather great but heavy industries which have high material content but low added value, and it is a source of concern at the moment that a large part of our exports are mechanical engineering products and in a high percentage of these in fact, if you look into distribution of the products, the peak value rises to about £300 sterling per ton which is a low added value. So what we have to do as a country somehow is to shift our spectrum to industries which have high skill, high intellect; in other words the technological industries and you have the good fortune of being in the middle of one of these.

Another of our dilemmas as a nation is different. Technology, if one looks at it in a simple minded way, thrives on research and development and so on. Theory would say that the country which spends most and has the highest effort in research and development ought to be the one which is most prosperous, should have the highest growth rate, highest output per man, etc. Now this is not confirmed by fact. The two countries in the world which spend the highest proportion of their gross national product on research and development are America (3.2%) and then comes Gt. Britain. I don't count the Iron Curtain countries because we don't know how to analyse their statistics. Yet if one looks at the league tables, the picture is different, the highest rate of growth in Europe is Germany – well below us in research and development investment. Other near countries – France and Italy – are appreciably faster growing than we are in terms of national economies. Now why is this? Well in essence we don't know, though there are obviously a great number of factors involved. One of these is a tantalising one; if one takes the cost of doing research and development as one unit, the cost of bringing that research and development into a viable product of some kind is 10 units and the cost of ultimately exploiting it on the full industrial scale is 100 units, there is the danger that you can reach the one unit and think you are jolly clever because you have done the one unit, but if you can't reach the 10 units which follow and in particular the 100 units which follow that, you get no reward for your invention.

This is why so many of our inventions ultimately end up in America because there they can reach the 100 units and therefore there is the great danger in tackling projects and embarking on activities where you can do the one unit and then maybe scramble up to 10 units and fall short of the 100 units. This is one of our great problems at this moment and why so many of our great national projects are so much under examination. It may be we can't live with them.

There is another problem which also faces us as technologists. Technology is an exponentially growing business, by which I mean the rate of growth at any time is governed by the state you reach at any time, and so gets faster and faster; also technology feeds on other technologies – I'm sure you have all been well familiar with that – and as the technological base grows wider, the rate of progress gets faster. There was an easy period in the history of man when progress was nice and slow and the father could teach the son to be a carpenter or butcher and that was sufficient training for the rest of his life. Well now, the rate of progress has got to the stage where the pattern changes quite rapidly in a lifetime and where it is no longer good enough to be taught how to be, well I can't say about butchery, but certainly a carpenter, because the skills, the techniques change. I myself grew up in electronics, which grew out of the old heavy electrical industry and in my early days it was a matter of valves, transformers, condensers and great metal chassis and one designed with the equipment and the parameters of the old heavy electrical industry. But during my lifetime it suddenly switched over to transistors, plastic boards and printed circuits and now it has gone to micro-electronics. We have seen the electronics workshop change from sheet metal shops to assembly shops, wiring shops to the printed circuit boards and transistors which look more like a biscuit factory than an electrical shop. Now it has become vacuum chambers with young ladies looking down through binocular microscopes and doing micro-manipulation.

All this has happened in a very short time and this means that in the future we will find it very difficult to label technologies or crafts or skills in some simple way; what we will have to do is give a base on which people, young people, can develop into whatever the subject is going to demand.

Let me give another example.

In the heavy mechanical workshop field evolution has been quite slow; for a long time we had lathes, we had mills, we had borers and a man could be trained in the use of these. He went through his five years apprenticeship and he developed his manipulative skills, and learnt to use a caliper, etc. Well in recent years we have seen the evolution of the pneumatically controlled machine tool and it is now possible to enshrine on a piece of tape all the skill, all the craft that is necessary to make an extremely complex piece of hardware, and providing the man's got the right machine out in Bongoland, you can post this tape to him and whether he's made a piece of metalware in his lifetime doesn't really matter, as long as he puts the right tape in and puts the metal in the right place, he can produce. Now this is a tremendous change of pattern which is occurring.

We are on the threshold of yet another development. At the present time, a new machine shop being developed where there will be a family of six machine tools – no more – where all the work will be addressed into the machine tool, the machine tool will carry out the operation, the work will be ultimately delivered back into an automatic bin system and retrieved by utterly unskilled labour. But the remarkable thing is that this workshop will work twenty-four hours a day, seven days a week and will only need one shift per day to charge it. It will work to an accuracy of a tenth of a thousandth, which is well beyond what is normal in a machine shop; but the most outstanding thing of all is this workshop will replace a conventional shop of 300 standard machine tools. Now here is a dramatic change which is happening now, not a case of talking about 'in our lifetime' but in the fairly immediate future. It will also react on design of component supply and right through to automating methods of marketing, so that the whole pattern of industrial production will change. No longer shall we be able to say 'my boy, you are going to be a turner or a miller', or whatever it is; and this is what he is going to be for the rest of his life. Whatever man can be now will change, and I mention this in particular because I know you, as an institute, are keen on training and I think you have to keep these points in mind. A great spectacular list lies ahead of us from which the ripples run out in all directions and it's worth coming back to this particular example of the fully automated machine shop which I described.

When the machine shop was conceived and designed, it was a bit disappointing because it didn't seem to give improvements which should have arisen. Well after probing about for a bit, it became evident why. The cutting rate into steel was no faster on the automatic machinery than it was manually, so whilst there were gains, the gains were not all that dramatic. The people concerned now said why do we use steel? The reason why we use steel is because it is cheap, but supposing we use light alloy, which is more expensive, would there be gains? When they looked at it they found out they could increase the cutting rate by a factor of ten and the additional cost of using light alloy was insignificant compared with gains in throughput. But this now meant redesigning all the equipment because you can't have the same designs in light alloys that you can have in steel; this was soon done because light alloy was a subject which has been handled very expertly by the aircraft industries. A lot of new thinking went into the design and a very much better product it was. Well now some new benefits started appearing because being light alloys were much lighter and also free from corrosion, so it enabled the product, formerly large and bulky, instead of having to be sailed round the world to the customer, could now be flown so that delivery time would be shortened. As it was now light enough to be put on the third, fourth or fifth floor of a factory, instead of having to be put on the ground floor, so this altered the whole concept and also it looked prettier. So here are the ripples running out from effective design, yet it is cheaper. Well now, a picturesque thing that came out of it was that once you had a system where each billet was taken to the machine, machines transferred from machine to machine etc. It didn't really matter whether each job was identical or whether each job was different, the important thing became the total throughput rather than the number of repititions and this really is a very important change in the concept of mass production. I hope you will excuse me for describing this in some detail because I think it is a good example but only one of a great number and now our technology is really gathering pace and we have enough to modernise not only our industry but our outlook in this country where we will see more changes in the next twenty years in the field of engineering and applied technologies than we have seen in the last hundred years looking backwards.

Now let me come back to glass technology and it is as I say an attractive branch of technology – it's a growing one. The interaction of gas technology, by which I mean special and the rare specific gases, vacuum technology and the fact that workshops are beginning to look more like laboratories every day, is bound to give you a buoyant future and I hope, and I'm sure, that the very existence of your Society shows that you are conscious of this and that you are looking to this future and if in any way we, at the Ministry of Technology, can be of help to you, both in helping you prosper, but also possibly allowing you one or two peeps into what we think is in the future, we will be glad to do so.

Finally, let me say 'thank you' for inviting me to come and speak to you; it is always a great pleasure for anybody in the Ministry of Technology to have a captive audience. Thank you for the dinner and I hope I may come again.

**We thank Mrs. J. DARVALL for her verbatim report on this speech and while the Editor regrets the delay in publication its value remains unaltered.*

HOLES IN GLASS

A Paper given to the Western Section of the B.S.S.G. by MR. F. G. PORTER *of Bristol University.*

All of us at some time or another have been required to make holes in glass, from the large holes made by trepanning to the small holes made by spark discharge. As a first approach the glassblower will try the quick and simple methods using a flame and a few elementary tools. One of the most common ways is to blow a bubble of glass the size of hole required in the side of the tube, then to reheat the thin bulb formed and carefully blow it out. After knocking off the surplus glass, the ragged edge is run back in the flame. Quite large holes can be made this way. The fume hoods for multiple Kjeldahl digestion apparatus are made by blowing a series of bubbles large enough to take the flask necks and then knocking off all the bubbles so blown, and firing the edges. This method is used in the manufacture of 'T' pieces and of course can be used on the bench or *in situ.* Another method using the flame is to locally heat the glass and pull away glass with a rod until the spike left is thin enough to be cut off. This is a useful way when making the hole for pumping stems on large Dewars, the hole is fired back and the stem joined on after the dewar seal has been made. By using a very small flame and blowing into the tube at the same time, very small holes can be made. This method needs considerable practice and great control of blowing, but for 'T' pieces in capillary it is the best way to avoid deformation of the main tube bore. In all these operations where local heating takes place, immediate annealing with the lamp is essential.

The last hot method is the heated Tungsten Rod. Here a Rod of 1 mm. diameter is held in a pin vice after having a point ground at its end.

The rod is now heated (I find a gas air flame although slower, reduces the chance of yellow Tungsten oxide depositing on the glass) and whilst being heated it is pressed against the glass and rotated, a hole will be made by this drilling action. Once again I must emphasize the importance of annealing as you go. Of course, Tungsten rods of other diameters can be used. This application will be found useful where a series of small holes of equal diameter is required such as with glass scrubbing bubblers and the plates of the Oldershaw column. Should oxide be deposited during the drilling operation, its removal can be effected by heating in a very hot flame, care being taken to avoid contraction of the tube and consequent partial closure of the holes.

Of course it should not be assumed that all holes in glass need to be right through. Blind holes are often required. For example, the "pips" formed in Vigreux columns are in fact just a blind hole. For this operation, a length of 1/8″ diameter mild steel rod is ideal – thin carbon rods are too easily broken. A taper is ground on the rod and a round pointed end is formed – not a sharp one. The round end is less likely to puncture the glass or get embedded and the taper will facilitate easy withdrawal. The glass is heated locally with a small hot flame, the resultant molten spot is pushed slowly inwards with the steel "poker". The rod should be coated with graphite paste and pre-heated to avoid chilling of the glass. The glass which becomes thinned slightly at the lip of the hole, will harden first and with a little practise the molten lump can be pushed quite a long way without becoming too thin.

So far the "holes" have all been made using a flame. Now let us pursue methods using abrasive materials. The first which comes to mind is orthodox drilling. Starting with the cruder methods we have the Wimet tungsten carbide tipped drill which is used in an engineers drilling machine, a "dam" of plasticine is made around the spot to be drilled and a mixture of turpentine and camphor is poured in to make a pool in which the drill rotates. This facilitates lubrication and cooling whilst drilling takes place. It is important that the place to be drilled should be backed, any odd piece of sheet glass will do and I have found piciene to be a useful waxing medium, this wax is readily soluble in trichlorethylene and is easier to clean off than the beeswax resin compound often used.

Before diamond drills became available, a tool often used for drilling was the brass tubular drill. Here the brass tube was slotted for a depth of about ½ inch at about four places on the periphery and the drill run in a puddle of silicon carbide slurry of 120 grit, an electric drill being the source of power. Once again the work needs to be 'backed' if chipping on break through is to be avoided.

Nowadays the fastest and most efficient method of drilling is the diamond impregnated tubular drill. Here the drilling machine is fitted with a lubricant fed chuck, the lubricant passing through the centre of the drill. These tools (Ref. 1), if used at the speeds recommended by the makers will cut at amazing speeds the hardest of materials and treated with care, very many holes can be cut before any appreciable wear takes place. With this type of drill providing great care and the lightest touch is used on breakthrough backing is not always necessary, the amount of chipping which occurs will quite often be acceptable. Of course when lens blanks are being cut, 'backing up' is essential; indeed I have found that where only one piece of material is available, a top facing disc should be added to prevent any accidental marking. Diamond Drills can be purchased in steps of 1 mm. and special sizes can be made to order. Countersunk tools are also available. The standard engineers 'suds' is quite a suitable coolant and lubricant, the suds not only doing the work whilst drilling, but leaving a protective film which prevents rust forming on the drill table.

A tool which has found favour in many glass shops, is the Ultrasonic Drilling Machine. The instrument comprises basically an Ultrasonic generator, a transducer to which is coupled a velocity transformer. It is to the transformer that the tool is mounted. The tool is designed according to the hole to be cut. For instance if a 'T' shaped hole or a square hole is needed the tool will have a face so shaped. The tool is placed in register on the material to be drilled, the zero set on the dial indicator and the depth of cut can then be measured as it is taking place. The action which is one of reciprocation in excess of 20,000 cycles per sec. causes the silicon carbide slurry to abrade the glass away at quite a fast rate. The speed of cut is controlled generally by the size of cut being made or the amount of material being removed at one time. Large holes can be made by trepanning methods using mechanically rotating chucks. Rotating diamond impregnated tools can also be used for these operations thus eliminating the messy slurry mentioned above. However, as these tools are costly most people will find home-made tools using the slurry the most practical from a financial point of view. An excellent article on ultrasonic machining is published by the Metallurgy Division of A.E.R.E., Harwell (Ref. 2). This describes a machine which has been converted for automatic precision working of glass and ceramics. The article shows the various shapes of diamond tools used for trepanning, thread cutting, surfacing, etc. To those interested in the ultrasonic working of glass I recommend this useful monograph. The illustration is of the machine made by 'Kerry' (Ref. 3) and with it a few of the copper and mild steel tools made for producing small holes and cuts. The chuck is an old engineering chuck fixed in position and which affords rigid control of the material to be worked. Irregular shapes are mounted on the rod held in the chuck.

Most glass blowers are familiar with the sand blasted reagent bottle seen in laboratories. How many appreciate that here lies a very practical method for making holes in glass or ceramic materials. The illustration (Fig. 4) is of a small scale abrasive machine (Ref. 4), by means of which the gas blasting technique can be carried out. The control unit houses a twin vibrator which supplies an abrasive compound to the pen type guns shown, the motive force in this instance being nitrogen from a commercial cylinder at 80 PSI. Compressed air can of course be used, provided house service is available at this pressure and in a clean dry state. The principle abrasive used is Aluminium Oxide in three grit sizes 27 micron, 50 micron and 100 micron. The abrasive material is forced at high velocity through a Tungsten jet mounted in the pen, the resultant effect is the rapid removal of stock by erosion Fine cuts '008"' wide can be made quite easily. The hole is of a very precise nature with no burns or chipping. What is most important is that extremely thin sections can be worked by this cool and shockless method, even though the nozzle velocity may be in excess of 1,100 feet per second. This method has been used for making valve holes in precision bore glass tubing, where precise diameter holes with no internal burrs were desirable. The hole is limited in depth to the impacting effect created by the abrasive powder building up in the hole. Large diameter holes can be made by trepanning methods when this phenomenon does not occur. One thing I should like to add is that an extractor or dust box (Refs. 5 and 6) is desirable for doing these operations, for although the abrasive material is non-toxic, should the pen be inadvertently directed into the face, irreparable damage could be done to the eyes and, of course, grit leaving at the high velocity mentioned would soon be deposited on other machinery in the Workshop.

In conclusion I feel obliged to say a word about the spark discharge method for making holes. I hesitate to say this is a specialized application because all the methods so far referred to are specialist operations. But this one is not often used as it has a very limited application. A thin membrane is blown on the end of a tube, electrodes are placed either side of the membrane, and a Tesla coil is applied. If the membrane has been correctly prepared a pinhole will appear. The thickness of the diaphragm must be between 20 and 50 microns. The ultimate hole will be from 30 to 90 microns. This particular subject has been very well covered by an article in an issue of the Journal, (Ref. 7).

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4. S. S. White Industrial Abrasive Unit. S. S. White Ltd., New York. Agents (G.B.) Elliott Bros. (London) Ltd., Century Works, Lewisham, London S.E.13.
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GLASS FLAT FLANGES*

by I. C. P. Smith

Flanges, flat ground glass flanges for vacuum connections, are so familiar, that it might not be considered necessary to make them the subject of a special study. However, as flanges they must meet two primary requirements: (1) they must not be liable to fracture under the frequently great stresses imposed, and (2) they must hold a vacuum as and when required, using the usual vacuum grease.

Firstly then to study the stress and how it is built up: Fig. 1 (a) indicates a domed tube that

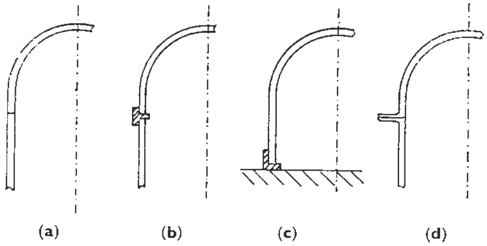

Fig I

has been cut and both surfaces faced. If this is subjected to vacuum it will withstand the stress that an uncut tube will withstand, all the thrust being in the line of the wall; from a vacuum holding point of view the joint face is small, and a rubber gasket may be employed as in (b), or on a flat plate as in (c). Reverting therefore to the all-glass requirement, it is accepted by experience that a width of joint-face of about 20mm is required, and we say we will make the flange of the form (d), Fig. 1. In ideal conditions this might work; the line of thrust is in the line of the tubing wall, and the necessary width of face for a good joint is there. Unfortunately several points need to be considered; the thrust due to vacuum on a 75mm bore joint is about 55kg, (105lb), and on a 100mm joint about 85kg (185lb). Thus, if (1) the flanges are at all out of flat, or (2) if a piece of grit is trapped. or (3) the grease does not spread as quickly as the vacuum builds up, very great local stresses will be set up and fracture can occur. Thus it is seen that there is a need for thickness of construction to accompany the width of joint face.

B.S.3423, Design of Glass Vacuum Desiccators, gives in the section on flanges, the formula:—

$$T = \sqrt{\frac{2LDp}{kf}} \quad \ldots . (1)$$

where T is the flange thickness in mm; D the outside diameter of the body or tube in this case in mm; L the width of flange face, or more accurately the cantilever length beyond the tube wall in mm; p the applied pressure in kg/cm^2; f, the maximum allowable stress in the glass also in kg/cm^2; and k a constant depending on the construction.

The term 'cantilever length' may be unfamiliar in this context; a cantilever is something like a shelf standing out from a main body that has to take a thrust; thus it has to have a strong 'root', tapering into the main body, also a 'heel' to bring the line of thrust within the flange surface. Fig. 2 shows the points mentioned; (a) is an ideal shape having 1, a build-up of wall-thickness adjacent to the flange equal approximately to the flange thickness; 2, an inner curve, not a sharp corner, between the wall and the top face; and 3, the continuation of the line of the inside wall down to the heel. This shape would rank for the highest value of the constant k, 2.25; (b) and (c) are two shapes that are often made; in (b) the heel has not been maintained, and in (c) a much too geometrical shape has been formed to the detriment of its strength owing to the sudden change in section; these would rank for values of k of about 2.0 and 1.5 respectively. In a and c the flange face width is greater than the cantilever length L by a small amount; this small 'advantage' is discounted in further calculations. If the wall is intentionally thick as in a glass pressing, advantage can be taken of this point, to make L smaller for a given joint width in the calculations, but for average construction it can be ignored.

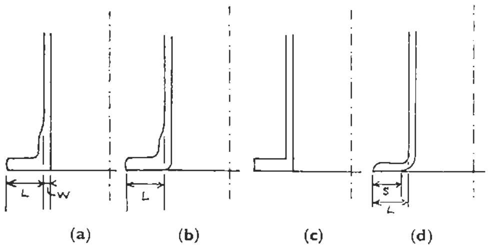

Fig 2

Fig. 2(d) shows a form of flange that is very easy to make, in which the contact face starts outside the line of the wall, and the cantilever length is greater than the face width; there is a large bending stress about the corner and this form should be avoided for vacuum use.

The familiar pipe-end form of flange is capable of taking very high thrusts, as it is fully backed, but it usually has a narrower joint face than is acceptable for vacuum use with grease only.

In applying formula (1) for calculating a series of flange thicknesses, a simplified procedure may be adopted; examining the items in the formula; by experience, 20mm width suits L for most applications; p for vacuum is 1 atmosphere or 1 kg/cm^2; k is the constant for the construction, and 2.25 will be used; and f is the permissible tensile stress in the glass, a value of 70 kg/cm^2 being accepted (1,000 psi). The formula may then be divided into two parts:—

$$T = \sqrt{\frac{2Lp}{kf}} \times \sqrt{D}$$

where the first term is all constants, and only D varies.

Putting in the values:

$$\sqrt{\frac{2Lp}{kf}} = \sqrt{\frac{2 \times 20 \times 1}{2.25 \times 70}} = 0.5$$

$$\text{and} \quad T = 0.5\sqrt{D} \quad \ldots . \quad (2)$$

Note:

1) T and D must be expressed in m.m.
2) if T and D are expressed in inches, $T = 0.1\sqrt{D}$
3) for a 25m.m. wide flange, $T = 0.58\sqrt{D}$

Table I gives a series of minimum values of T, after grinding, for some selected diameters of flange bore, allowing for the use of medium-wall tubing, and a 20mm joint face. Columns are included for o.d. of tubing, wall-thickness, W, calculated minimum thickness of flange after grinding, TF, thickness as made, Tm, and for the length of tubing needed for this, M, which is dealt with in the next section. The choice of Pyrex medium-wall tubing ensures that the wall-thickness of the tubing is not less than half that of the finished flange.

TABLE I

Flange Bore	Tubing O.D.	Wall, W	TF minimum	Tm	M length used
25	30	2.0	2.7	3.7	62
30	34	2.0	2.9	3.9	61
40	46	2.3	3.4	4.4	55
50	56	2.5	3.7	4.7	50
75	80	3.2	4.5	5.5	42
100	107	3.5	5.2	6.2	41

All dimensions in mm

Forming

This section is divided into four parts, as follows:—

(1) Quantity of glass and its quality
(2) Hand forming
(3) Lathe forming, simple
(4) Lathe forming, with rollers

(1) The quantity of glass going into the flange should always be determined before starting, and the length marked off, as it is easy to make an error of judgment, and a re-melt-up is never so satisfactory. The length of tubing, M, may be calculated from the following formula:

$$M = \frac{Tm \times L}{W} \times \frac{Di + L}{Di + W} \quad \ldots . (3)$$

where Di is the internal diameter of the tubing, and W is the wall thickness. For convenience the column M has been added to Table I for guidance, for the sizes and wall thicknesses quoted. In order to form the "build-up" adjacent to the flange, shown in Fig. 2(a), it is desirable to mark off an extra 20mm, increasing to 30mm for the larger sizes, to be thickened up to half this length.

A method of determining length that does not involve mathematics, and can also be used for uneven walled tubing is the following.

(1) Find a bottle, or a tube with the bottom sealed off flat, that is a near fit inside the tubing selected for the flange, and nearly fill with water.

(2) Find a beaker whose *internal* diameter is about the *external* diameter of the flange to be formed.

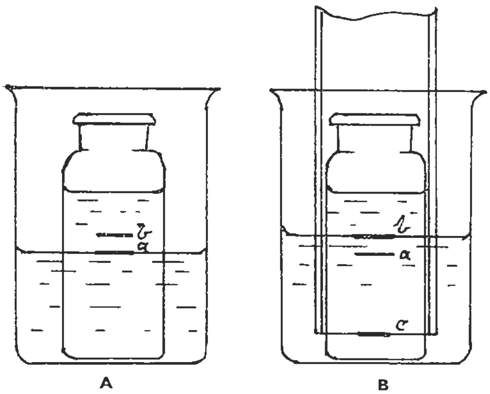

Fig 3

(3) Put the bottle (1) in the beaker, and put water into the annular space part-way up, and place crayon marks on the beaker *a* at the water level, and *b* at the required flange thickness Tm *above*. See Fig. 3A.

(4) Carefully lower the glass flange tube, end already trimmed, over the bottle and down into the water, until the water-level rises to *b*, then make a third mark *c* in line with the bottom of the tube. The length *b c* is that required for the flange. See Fig. 3B.

For marking the glass some workers prefer a small diamond or glass-knife scratch; if a crayon is used the colours white, green, yellow and red should be avoided, as they are heavily pigmented; black is pigmented with carbon-black and will burn away completely too soon; blue leaves a very slight stain that is generally acceptable.

Concerning the quality of tubing selected for making flanges, badly placed stone or air-line should be avoided, as they can lead to flaws in the grinding. Evenness of wall is desirable, as this greatly simplifies procedure, but means can be taken to correct for this; this also applies to heavy striae, but only in the worst cases is this troublesome.

(2) *Hand forming. Refer to Fig.* 4

First draw a good long spear on an ample length of the selected tubing, and form a rounded end as *a*, and mark off the lengths M and the additional 20mm from the end. Now thicken back to obtain the form *b*, giving the glass an occasional puff, or marvering or shaping with the carbon paddle as necessary, the two marks taking up the two positions approximately as shown; if the glass was at all uneven walled, the pull-off point, originally in the centre in *a*, will be now out of centre. Blow out a small bubble at the new centre *c*, and proceed to the form *d*; allow to cool a little, particularly to the left

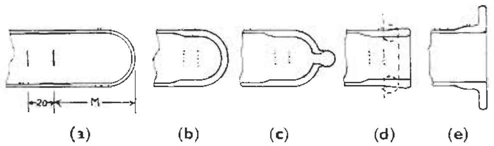

Fig 4

of the dotted line then heat to the right of the line with a hot flame, allow to bead up, then finally open out, tooling either side of the flange and also the bore, in order to obtain as good a heel as possible. Flame off carefully and anneal. If the flange and tube are at all large, the glassblower's donkey (double-wheel rest) is an advantage. If the tubing is good, one may proceed directly to the form *d* from a clean-cut or flame-cut end, as one does indeed in most cases on the lathe.

(3) *Lathe forming, simple*

The methods primarily adopted in the lathe are similar to the hand methods, with the advantages *a* of using chisel-form cross-fires for melting up a good bead, and *b* using two tools simultaneously for the shaping. The tools are (1) the carbon or graphite flat or paddle; it should be of ample size and have a small central hole to equalise pressure and an insulated handle that does not at its attachment stand above the surface of the paddle; (2) a narrower carbon flat of which one edge is shaped to form the root of the flange (see also Fig. 5). These are the two standbys, the

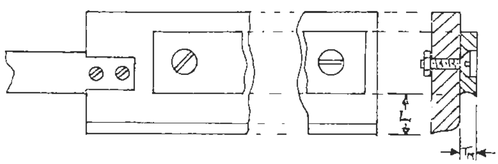

Fig 5

tool (2) being held behind the flange while the paddle is pressed against the face. An alternative for the backing tool is shown in Fig. 5 this being a wider carbon flat than (2), and having attached to it by countersunk screws a second piece of carbon, whose thickness is equal to that of the flange to be made, Tm, and the distance between the two lower edges is equal to the flange width L.

The lower edges are shaped as indicated in section, the main part conforming to the shape of the root, as does the tool (2) above, and the added part is filed hollow to give a convex form to the outer edge of the flange. Several such tools may be kept for different flanged thicknesses, having added pieces, say 4, 5, and 6mm thick. Some graphite rods, from $\frac{1}{2}''$ to $1''$ diameter are also required.

In preparing the selected tube for making a flange, it is necessary to have the remote end closed by any suitable method. The end to be worked is best cut in the lathe by diamond scratch, small hot flame, and the application of wetted cotton wool; if it has been ground, it should be finished with the finest grit and carefully cleaned to avoid milk stain. The two marks are made at the length M and plus 20 to 30mm. It is then mounted in the lathe and worked up to the stage *d*, Fig. 4. Large brush fires are preferred, two opposed if the tubing is over 40mm; if only multi-jet chisel burners are available, they should be turned through an angle, to give a wide heating band.

If, as the glass is thickening up, it shows obvious signs of unevenness, the thin part of the wall contracting back further than the thicker, two courses are open, either to remove surplus glass or to use gravity to re-distribute it. For removing surplus glass, first allow the glass to cool a little, then stop the lathe and play a hot sharp flame on the edge of the glass to be removed, pulling it away with a stroking action with a glass rod. Alternatively a longer region of the glass round the edge may be heated and the surplus cut off with an old pair of scissors. They should be flashed in the flame before use, and on no account touched with lubricant. This method is habitual with pot workers and is easy with soda-lime glass, but with borosilicate glass more slickness from practice is necessary. After either of the above treatments the end is strongly heated with chisel flames and tidied up before proceeding. The gravity method for straightening up also needs experience, but is more elegant than the first two, and with practice can be quicker. Proceed as follows: while the whole thickened-up sleeve is still somewhat mobile, the lathe is stopped and quickly turned by hand to bring the standing forward part to the top, allowing this part to fall towards the centre, but playing the glass while it cools, so that it sets with a sag part-way towards the centre. The whole end is now heated and tooled when it will be found that either complete or partial squaring-up will have taken place. A second treatment may then be necessary.

When finishing off the shape of the flange, as remarked under hand methods, at stage Fig. 4d the glass to the right of the dotted line is heated strongly with chisel flames, arranged cross-fire on the larger sizes, melting the glass back to a rounded bead whose inner surface is starting to sag inwards, then a touch back with the paddle, a touch on the inside with the rod to counter spreading inwards, and a final press up between tools (1) and (2), or (1) and (3) as available, to complete the form, aiming always at the true bore and neat corner shown in Fig. 4e. When tooling always remove or turn out the flames, so that they do not play. on the tools.

(4) *Lathe forming using rollers*

If flanges are wanted in quantity, some tooling-up may be considered, and the rollers shown in Fig. 6 form one solution. Both consist of two

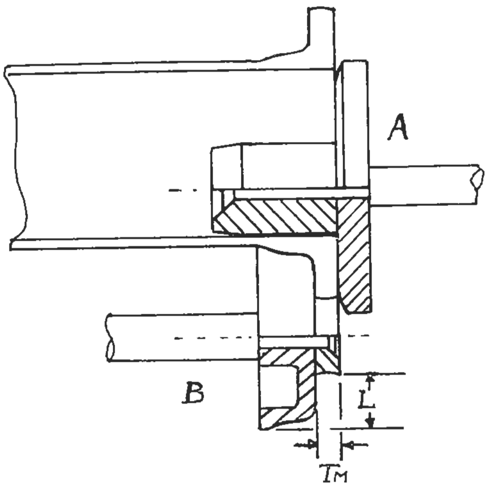

Fig 6

pieces turned from flat graphite and mounted on spindles so that they will turn freely when hot; steel has also been used for small sizes. The part A covers the bore and face of the flange, one size only being required; it needs to be positively mounted on the tail stock, so that it may be brought forward to a predetermined stop when ready. In the roller B the two wheels are so dimensioned that the difference in radii equals the flange width L, and the thickness of the smaller wheel is the thickness required for the flange. The edge of the larger wheel is bevelled to shape the root of the flange, and that of the smaller wheel given a concave form to produce a convex edge on the flange. This roller is mounted on the tool bar at a fixed position, so that it may be swivelled down to a stop. In use the glass end is brought to the final melted up bead, and the two rollers brought up simultaneously to their stops, as shown in Fig. 6, making the flange in one operation. At this stage the rollers will, with practice, help to even up the glass of an unevenly melted end.

Grinding

All flanges should be well annealed, preferably furnace-annealed, before grinding. The methods of grinding depend on the scale of production and the plant available. On a small scale, pieces of plate or float glass of ample size, are very satisfactory, one for roughing and one for smoothing. Grinding is done with a circular movement all over the plate, to keep the wear as even as possible, but nevertheless the surface loses its flatness and a plate must be discarded at a suitable stage. Driven plates should be as large as the budget will allow; cast iron is usual, but steel is quite satisfactory. In grinding the glass is moved all over the plate, but nevertheless wear takes a wave form, high at the edge, dropping at a position a little way in, then rising to a hump over the middle, and it must be resurfaced as necessary. Measurement of wear will be referred to later. Work may be rough ground on the driven plate and finished on a glass plate, or all may be carried out mechanically, according to production.

The grits used in grinding follow the experience of the operator, the better the finish of the flange as it is formed, the finer may be the roughing grit; silicon carbide of 200 mesh suits generally, only using, say 100 mesh, if necessary. The finishing grit is usually 3F corundum.

While discussing grit sizes, mesh numbers, with which most are familiar, are being soon replaced by micron sizes, as B.S.410, Test Sieves, is now under review following an ISO recommendation. All grits should be quoted in a continuous sequence of micron sizes, or at least the micron size should be part of the description. In Table III, in the section of this paper on surface textures, the grits used are given both their mesh numbers and micron sizes.

A few final remarks can be made: hold the glass as near to the flange as possible, pressing with the thumb and forefinger of both hands equally spaced round it; avoid running 'dry', especially on the fine grind, as this may cause judder; be extra careful with long tubes to avoid the toppling action, and finish off with a small hand-held plate if necessary; this is a glass plate with a piece of wood stuck on to the back as a handle.

Test for Ground Flat Flanges.

This test was originally devised as part of B.S.3423: 1962, Design of Glass Vacuum Dessicators, for testing the ground flanges of dessicators and is included in this article, as it has not been published before in detail. It assesses the rate of leakage of the clean dry flange to air at a small controlled reduced pressure against a reference plate, interpreting this as values out-of-flat in μm or .001″ units. The test usefully fills the gap between feeler-gauges on the one hand, and interference fringes on the other, covering either side of the value of about 0.001″, which is considered the tolerable limit for a greased joint

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ABSTRACTS

Compiled by S. D. Fussey A.W.R.E.

CONTROL

(524) **Simple protector for water-cooled equipment.**
A. C. MacDonald, *Rev. Sci. Instru.*, 39, 6, 931, June 1968.
A simple device utilising the force caused by the change in momentum of water flowing around a bend in a piece of pipe. An attached microswitch controls electrical circuits. S.D.F.

(525) **Production of accurate toroidal sections in Pyrex and**

GLASSBLOWING

Quartz
D. A. Brown, P. J. Daly, A. E. Danger, R. M. Dunnet and G. J. Parkinson. *Jour. Sci. Instru.*, series 2, 1, 771, July 1968.
Description of a simple semi-automatic machine to produce torus of 50.8 cm.o.d., 4.6 cm.i.d. A straight tube is fed through a flame and bent to the desired diameter, a one pound weight applying the required torque. Production time for pyrex and quartz semi-circles is 30 and 90 mins. respectively. The least accurate points of the torus are where the two semi-circles are joined by conventional methods. Diagram and photograph. D.A.H.

LIGHT SOURCES

(526) **Chemistry and Light Generation.**
N. Slagg, *Jour. Chem. Educ.*, 45, 2, 103, Feb. 1968.
The theoretical background of incandescent, fluorescent, and high pressure lamps together with difficulties experienced with metals used in the filament and glass to metal seal construction. F.G.P.

SAFETY

(527) **Asbestos – A possible cause of Cancer?**
E. Metz, Fusion, 2, 38, May 1968.
Some disturbing facts on the incidence of mesothelioma in U.S.A. Suggests scientific glassblowers should exercise extreme caution in handling asbestos products. S.D.F.

SEALS – GLASS/METAL

(528) **A bakeable and direct joint between a fused quartz tube and a metal tube.**
L. Verheyden, K. Klein and H. Kind, *Jour. Sci. Instr.*, series 2, 145, 1968.
One end of a 10 mm. quartz tube is flanged and ground: the Kovar metal housing is made to suit the flange. A braze material of titanium core surrounded by eutectic Ag. 72% and Cu. 28% is made up to form two thin rings and placed into gaps between quartz and metal. A further ring of Kovar is set on top of the braze and a weight of stainless steel tube surmounts the whole. Under vacuum and using inductive heating, a temperature of 920°C is reached in about 30 mins. Cooling time is 4 hours, pressure 0.1 mm torr. This joint will tolerate 400°C under vacuum conditions and has been at 10 atm. over pressure at a similar temperature. Large diameters may be possible. Drawings and photographs D.A.H.

(529) **Sealing glass to metal stacks using R.F. Heating.**
J. Kerbitsky, *Fusion*, 15, 2, 9 May 1968.
Lava or boron nitride jigs and r.f. sealing make possible tight concentricity and spacing tolerances. Illustrations of an electronic tube assembly and jigs with sealing process schedule. S.D.F.

SEALS – WINDOWS

(530) **Quartz working with a *CO*² Laser.**
E. K. Pfitzer and R. Turner, *Jour. Sci. Inst.* series 2, 1, 360, March 1968.
Fuzed quartz mirror substrates and Brewster angle windows have been sealed in with the aid of a *CO*² laser beam of 1.5 mm. diameter. At a speed of 1 – 2 r.p.m., the cone and socket design was found to be the best for sealing. Mirror temperature did not exceed 150°C. Drawing. D.A.H.

MISCELLANEOUS APPARATUS

(531) **Zone refining apparatus for organic compounds**
J. F. Hinton, J. M. McIntyre and E. S. Amis. *Jour. Chem. Educ.*, 45, 2, 117, Feb. 1968.
Complete manufacturing details and method of use of small-scale zone refining apparatus. Illustration. F.G.P.

(532) **Coulometric titration of cyclohexane with bromine.**
D. H. Evans, *Jour. Chem. Educ.*, 45, 2, 89, Feb. 1968.
Details of manufacture and use of apparatus for demonstrating Faraday's laws of electrolosis. F.G.P.

(533) **Apparatus for measuring spectra of oxygen sensitive reactions.**
G. H. Lalor, *Jour. Chem. Educ.*, 45, 2, 90, Feb. 1968.
Illustration of scrubbing train. Details of method used to introduce gas samples into spectrophotometer cells F.G.P.

(534) **A convenient solution and solvent dispenser.**
P. S. Chen, *Jour. Chem. Educ.*, 44, 1, 128, Feb. 1968.
A type of separating funnel with vented plug and graduated delivery stem. F.G.P.

(535) **Zeta potential determination of cylindrical fibres.**
J. A. Ciriacks and D. G. Williams, *Jour. Coll. and Interface Sci.*, 26, 4, 451, April 1968.
Details of flow system for streaming current measurements. F.G.P.

(536) **Interfacial mechanism of removal of thin films.**
W. Hamilton and W. Jennings, *Coll. and Interface Sci.*, 26. 4, 463, April 1968.
Details of (1) Immersion apparatus designed for minimum flow generated turbulence, (2) Apparatus used in determination of spreading velocities. F.G.P.

(537) **A controlled atmosphere Langmuir trough.**
T. Smith, *Jour. Coll. and Interface Sci.*, 26, 4, 514, April 1968.
Automatic surface suction cleaning device and a method of microgram sample deposition with subsequent surface tension measuring using Cahn electrobalance. F.G.P.

(538) **An improved weighing bottle for use in weighing hygroscopic materials.**
H. N. Redman, *Anal.*, 92, 1098, 584, September 1967.
A weighing *bottle design* for accurate weighing of hygroscopic materials after drying which eliminates the use of a dessicator.

(539) **Developments in laboratory combustion apparatus.**
Hans Kreietzer *Lab. Equip. Dig.*, 5, 9, 95, September 1967.
Description of apparatus and procedure for the determination of halogens, sulphur, oxygen and nitrogen.

(540) **The Use of a Quartz Contained Discharge in Atomic Tritium Experiments.**
B. S. Mather, *Rev. Sci. Instru.*, 38, 10, p. 1536, October 1967.
Using a quartz discharge bulb instead of a pyrex one reduces the loss of tritium as well as the evolution of hydrogen in atomic beam measurements. S.D.F

LIBRARY INFORMATION

The library has recently received the following publications from the Industrial Diamond Information Bureau:—

1. Diamond Research 1964.
2. Diamond Research 1965.
3. Diamond Research 1968.
4. Diamond Machining of Glass.
5. Grinding Machine Stability – Its effect on the efficiency of Diamond abrasive grinding wheels.
6. Properties of Diamond.
7. Look what they're doing with Diamonds. GLASS.
(booklet of illustrated accounts of the use of

diamonds in glass machining).

8. Look what they're doing with Diamonds. CERAMICS.
(booklet of illustrated accounts of the use of diamonds in ceramic machining).
9. Diamond abrasives for industry.

The publications on diamond research contain the following:—

1964

1. The Mechanical properties of Diamond, *Dr. J. H. Brunton.*
2. The Thermal properties of Diamond, *Dr. R. Berman.*
3. The Optical properties of Diamond, *Professor E. W. Mitchell.*
4. Diamond High pressure windows, *Dr. A. van Valkenburg.*
5. Measurement of nitrogen concentrations in Diamond by Photon activation analysis and optical absorbtion, *Dr. E. C. Lightowlers and Dr. P. J. Dean.*

1965

1. The influence of temperature on the mechanical properties of hard crystals, *D. Tabor.*
2. Nitrogen in Diamond, *L. du Preez and F. A. Raal.*
3. The Expansion of Diamond, *A. C. J. Wright.*
4. Electron spin resonance in Diamond, *B. Bleaney and J. Owen.*
5. Radiation damage in Diamond in relation to the origin of diamond in meteorites, *H. J. Milledge, H. O. Meyer, and E. Nave.*
6. The Cleavage and fracture of hard solids, *J. E. Field.*
7. The Thermal expansion of inclusions in Diamond, *R. Henriques.*

1968

1. Absorbtion and emission spectra associated with defect centres in Diamond, *C. D. Clark and C. A. Norris.*
2. Graphitized natural diamond, *S. Tolansky.*
3. Photoconductivity and thermoluminescence measurements on natural and synthetic Diamond, *E. C. Lightowlers, A. T. Collins, P. Denham* and *P. S. Walsh.*
4. The effect of pressure on the plasticity of materials, *T. Evans.*

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Stage One Glassblowing Course

A syllabus for the new "Stage One Glassblowing Course" has now been successfully applied at Isleworth Polytechnic. This syllabus can be used as a continuation to the now well established "Introduction to Elementary Scientific Glassblowing" course; it is intended to be of value to the student glassblower and other professional glassblowers wishing to widen their field of experience.

The standard achieved by Mr. White's students at Isleworth Polytechnic was very encouraging indeed.

Copies of the syllabus for this course should be available shortly.

EXAMINATION RESULTS

Certificate of Competence

Mr. Joseph Nyabuzoki successfully sat for the Certificate of Competence at the School of Chemistry, University of Leeds, on the 26th of June. Mr. Nyabuzoki is from the University College, Dar-es-Salaam, Tanzania.

Stage One Glassblowing Course

Successful candidates at Isleworth Polytechnic on 24th of May:

Raymond Gammon. Keith Yates. David Gill. Brian Ferris. Philip Meade. Stuart Leitrim.

Introduction to Elementary Scientific Glassblowing Course

Successful candidates in the examination held at Bristol Technical College on the 4th of April:

Ernest John Palmer. Joseph Gerard Harrison. Alan Baker Britton.

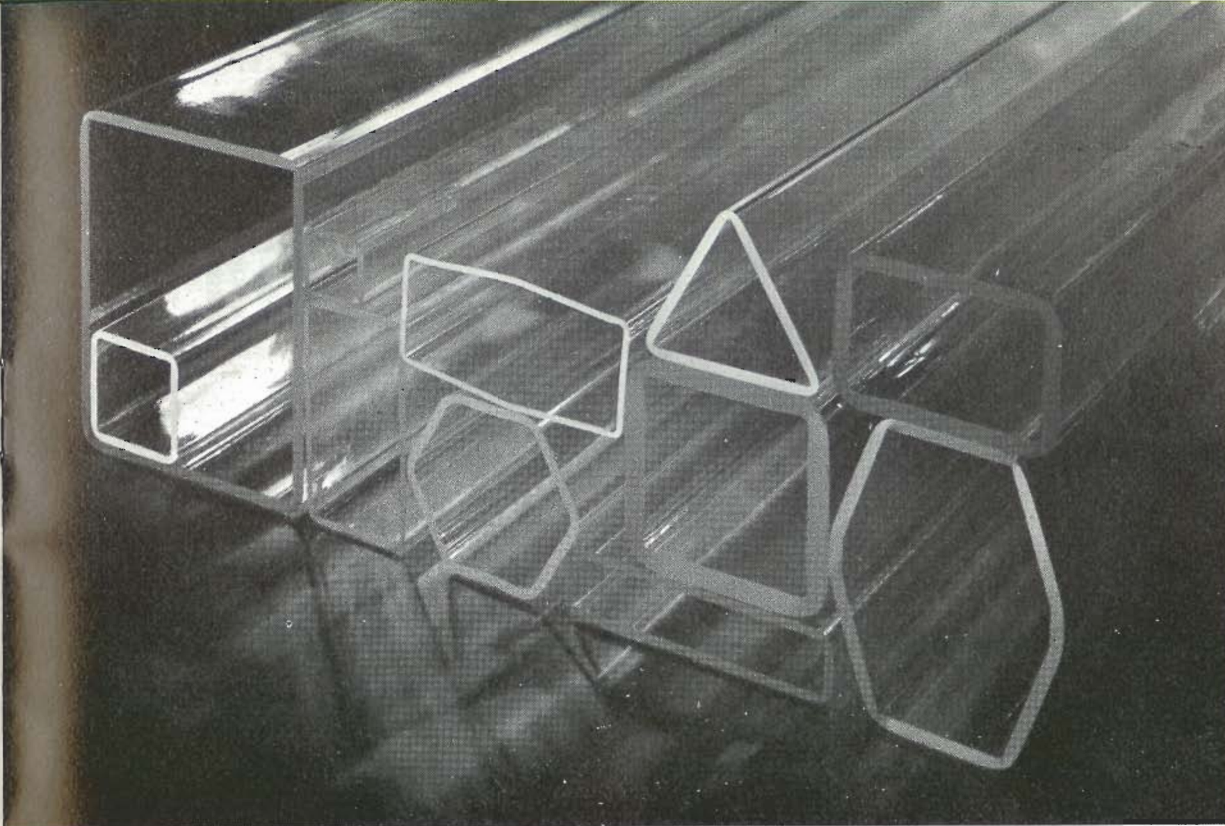
Successful candidates in the examination held at Isleworth Polytechnic on the 21st of May:

L. Butler. R. Dawes. S. Day. J. Garnett. D. Hoey. A. Joseph. H. Meyer. D. Porter. R. Sutton. C. Teader. D. Williams.

and on the 26th of June:

T. Killeen. P. Smith. P. Sutton. R. Richards. S. Tyley. E. Snowden. A. Leeson. E. Masanje-Seeruntenda.

N. H. Collins, *Hon. Sec.*



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The apparatus required for the test is illustrated in Fig. 7, and consists of a suction line with T-piece A, connected to the reduced pressure regulator B, a tall tube closed by a rubber bung, and carrying the tube C open to atmosphere; the depth of immersion of this tube in water in A

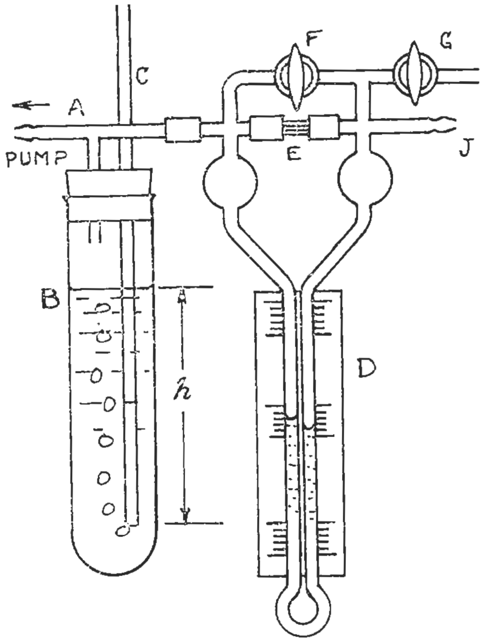


Fig 7

determines the controlled reduced pressure head h, 300mm being the selected value. The T-piece A is further connected to a conventional form of flowmeter D, having a manometer height greater than h, containing water, conveniently coloured, as the manometric liquid, and a control capillary E. For this purpose a 30mm length of 0.5mm precision-bore capillary tubing is suitable, but for more critical use this may be decreased to 0.4mm. The flowmeter is also provided with a by-pass cock F and a release cock G. The connection to the test plate is made from J by means of rubber tubing. For the suction pump a water-pump or a small rough vacuum pump with control valve is suitable. $\frac{1}{4}''$ plate or float glass is suitable for the test plate for flanges up to about 100mm bore, but for larger sizes thicker plate glass, between $\frac{1}{2}''$ and 1″, should be used, as even at the small differential pressure employed, with the $\frac{1}{4}''$ glass some flexing was evident, giving false readings. The plate has a hole about 20mm trepanned in the centre to take a rubber bung and the connection to J, (see Fig. 8).

In making a test on a flange, first see that it is clean and dry, and that there is no dust on the plate, also that there is a good closure, such as a rubber bung, on the other end, then place it over the opening in the plate, tap F being open and tap G closed, and the air tube C bubbling freely; leave for a few seconds to stabilise the pressure, then close F, allow the manometer to come to rest, and take its reading: open taps F then G before removing the flange. Acceptable flanges usually give a reading under 10mm and as low as 3mm on the small sizes. A reading between 30 and 40mm indicates about 0.001″ or 25μ out-of-flat. If an unexpectedly high reading is obtained, open taps F and G, remove the flange, check all surfaces are clean and re-test. If the flange is found to be not good enough, give it only a few turns on the grinding plate and test again. If it is still not satisfactory, it may be that the grinding plate is worn, and a new one needed.

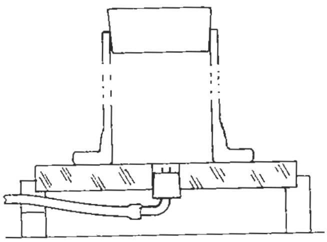


Fig 8

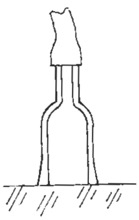


Fig 10

Evaluating the test for flanges

The method of evaluating the test was as follows; first a vacuum dessicator lid, 8″ internal diameter, had the face carefully reground, using 4F grit, until it gave the lowest reading on the gauge, when placed on the flat plate. This reading was 3mm. For control capillary the usual 30mm of 0.5mm bore was used with 300mm head of water. Then between the flange and the reference plate were placed successive thicknesses of .0005″ and .001″ Melinex foil, having a gap cut 1″ wide;

Table II

Out-of-flat values of manometer readings Channel 1″ wide; 0.5mm control capillary

Height inch	Manometer reading mm water
0.0005	16
.001	53
.0015	98
.002	153
.0025	199
.003	230
.0035	242

this gave a channel this width and up to .0035″ in height, in .0005″ stages. The resulting readings are given in Table II, and the graph Fig. 9 was constructed; this shows fair concordance of readings; it also shows the importance of obtaining leakage readings below about 10mm when testing individual flanges, for the following reason. When a flange having a place of .0005″ out-of-flat is used against a completely good flange, this is O.K.; when the flange is used against a similarly defective flange, but the two faults do not coincide, this is possibly O.K.; if, however, the two faults happen to coincide, then there is a .001″ gap, and this may lead to trouble. On the test rig these two flanges together in the first position would show about the sum of two .0005″ readings, 22mm, but in the second a .001″ reading of 48mm.

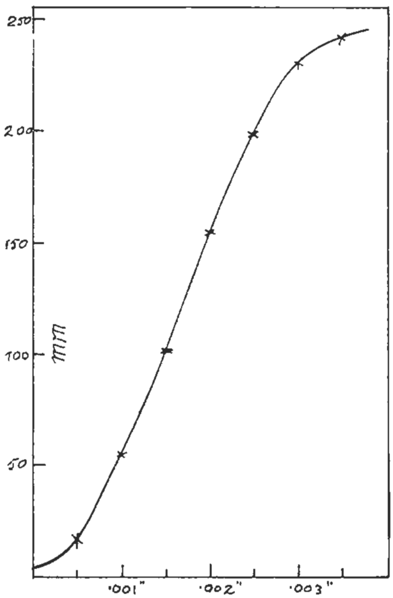


Fig 9

Some of the readings recorded in Table II were repeated using a 0.4mm capillary control; these gave: for .0005″, 39mm; for .001″, 125mm.

Test for flatness of large plates and grinding plates

In this section it is shown how the air-leak technique can be easily adapted to assess the wear of, for instance, the mechanical flat grinding plate in routine use. One answer is in the rejection of work in progress; this is intended to anticipate that. As the test can be valuable in other spheres, the joint title is given. To perform the test a robust flange, such as a pipe-end of 2″ (50mm) bore, is given a rubber-connection end and carefully annealed; it is then reground, finishing with 4F grit on a fresh plate, to give the lowest leakage figure possible, probably better than 3mm. The probe may also be made from tool steel, hardened and ground. It is now itself connected to air inlet J and used as a wander probe, see Fig. 10. The grinding plate to be tested is carefully cleaned, using soda or detergent in the water, rinsed and dried; then the probe is pressed on to it carefully, noting readings in different parts. The lowest readings will be in the centre, the highest generally between $\frac{1}{4}$ and $\frac{1}{2}$ radius in from the edge; they should also be compared with readings on a fresh plate. Experience will show at what stage a plate must be retrimmed, and this could be a routine test on a plate used for continuous production.

Test for surface texture

This uses a probe similar to the last test, but instead of a 2″ pipe-end, the $\frac{5}{8}$″ (16mm) pipe-end is used. This is given a rubber connection and also ground to the best possible finish, and connected up as Fig. 10. When it is pressed on ground surfaces of different texture, i.e. finished using different grades of grits, readings are obtained that increase with the increasing coarseness of grit and thus texture.

Pieces of flat glass had been prepared using several grades of grit and examined under the Talysurf, the C.L.A. texture readings† being noted in inch and metric measurement. The same pieces were now tested under the probe described, but using for the control capillary E, 30mm of 0.4mm tubing, also increasing the head h to 500mm. The results are given in Table III.

TABLE III

Grits, Surface Textures and Air-leak readings

Grit		C.L.A. by Talysurf		Manometer
mesh	μ m	μ in	μ m	reading, mm
80	185	260	6.6	148
180	84	120/130	3/3.5	28
220	71	100	2.5	20
3F	34/8	30	0.75	13

Considering the variability of the grinding operation, these figures show fair concordance: they also show that the C.L.A. figure is very approximately 1/30 of the grit size. They show further, that the air-gauge reading, carried out as described, can be used as a check for textures, not only of ground glass, but also of machined metal surfaces.

The work described in this paper was carried out in the Glass Engineering department of E.R.D.E. Ministry of Technology, Waltham Abbey.

†B.S. 1134 : 1961, Centre-line-average method for the assessment of surface texture.

*Delivered to the Southern Section Jan. 1968

SUMMARY OF PAPERS AT 1968 SYMPOSIUM

LABORATORY DISTILLATION

DR. J. L. HALES – N. P. L. TEDDINGTON

The author referred to the three purposes of distillation, namely (a) purification, which is the removal of dissolved solids, tarry bodies, etc., (b) separation or fractionation of mixtures of liquids of different boiling points, and (c) analysis or in its lastest form gas/liquid chromatography. Most of his lecture was concerned with section (b) fractionation, and after discussing vapour pressures and the conception of the theoretical plate, he described the still used for determining actual boiling points of liquids, a number of fractionating columns and suitable insulating jackets, and the types of reflux heads now commonly employed. He also covered those means employed for awkward pairs of liquids, such as azeotropic distillation, and carrying out fractionation at reduced pressures, and also molecular distillation. Gas-liquid chromatography which is now practised universally in the analysis of liquids and vapours is an ultimate form of fractional distillation, employing up to 1,000 theoretical plates but using very small samples.

INFRA-RED STUDY OF SILICA SURFACES

DR. J. HAYES, Unilever Chemicals Development Centre, Warrington

The method for producing the silica gel used as a drying agent was first described, including the incorporation of cobalt chloride employed as an indicator. The silica gel is a polymer formed from H_4SiO_4 which successively loses molecules of water until a silica matrix remains in which the residual OH groups tend to be near the surface, and can be removed under high tempreature and vacuum conditions in the form of H_2O, leaving however a small residue that is locked inside. The evidence for this is in infra-red spectrograms, and the study was assisted by replacing hydrogen by deuterium. The silica was examined in the form of thin discs formed from powder under high pressure; the remainder of the lecture was concerned with describing the fabrication of the cells employed, accompanied by a film showing most of the procedure. The cell made of transparent silica carried leads for vacuum and for the thermocouple, sealed inside was a carefully preformed and located silica shelf against which the disc was pressed; it was given a wrapping of heating wire cemented in position, and ample insulation and outside sheathing; the end plates of calcium fluoride were held in position with screwed metal and neoprene vacuum tight holders. A Grub-Parsons spectrum master was employed.

GLASS DIFFUSION PUMPS

DR. D. F. KLEMPERER – Research Associate in Physical Chemistry, University of Bristol

After a short but comprehensive historical introduction Dr. Klemperer went on to give a critical survey of the types of pumps now available for producing vacua of 10^{-6} torr and better; these included, besides the familiar types using mercury or oil vapour, those designed for high-pressure steam, and the turbomolecular pumps. He described the standard test procedure and produced a chart of performance of some 24 pumps chosen from the U.K., U.S.A. and Continental sources. Having reviewed the theory that has been applied to diffusion pump design, he discussed the various merits of umbrella and annular jets, adequate condensing surfaces and the provision of good traps, which (a) could be baked out with the pump, and (b) provided the right kind of baffle to rectilinear back-diffusion. By taking all precautions diffusion pumps can achieve vacua down to 10^{-12} torr; also mercury ejector pumps were available for the range 1 torr to 0.01 torr to act as backing pumps.

MEASUREMENT OF PRESSURE

J. C. SNAITH, Demonstrator in Physical Chemistry University of Bristol

The physical principles involved in the operation of various types of gauges led to the classification into groups and examples of each were discussed together with their application all being summarised in a final chart.

TEMPERATURE MEASUREMENT

DR. J. L. HALES – *National Physical Laboratory, Teddington*

It is not always realised that temperature is not itself measured, but an analagous quantity is measured, e.g. the expansion of mercury or another suitable liquid, or raising the pressure in a closed gas system. The first mention has been assisted by the very accurate determination of the density of mercury.

The requirements of choice come under the headings: Accuracy, Sensitivity, Response, Stability and Robustness. Under the last heading are included the gas thermometer, a metal bulb with Bourdon gauge, and the bimetallic strip. Liquid in glass thermometers covered the ranges from —200°C (pentane), —80°C (alcohol) —39°C to +500°C (Mercury) and higher still in silica. Points to watch were slow response and stem corrections.

For special application were thermal paints and Seger cones. Electrical temperature measuring instruments include (a) Platinum resistance thermometer, (b) Thermistor, (c) thermo-couple (d) optical pyrometer, and (e) radiation pyrometer. Both (a) and (b) employ a resistance bridge; (a) has been used from nearly absolute zero to +1500°C and has been attached to a digital recorder. The radiation pyrometer has been constructed with a response of 1 micro second.

I. C. P. SMITH

ANNUAL GENERAL MEETING

CHAIRMAN'S REPORT

It is good to see so many members attend this A.G.M. and on behalf of the Society I would like to thank you all for coming to St. Annes.

During the year your Officers have served you with sincerity and have attended many meetings on your behalf. Many decisions have been taken, the main ones being the implementation of Fellowship and the raising of Subscriptions.

Fellowship Many long meetings have taken place and the Board of Examiners have spent a great deal of time writing this up and putting it into an account which has been printed in the Journal. You may not agree with everything but you must agree that it will be an honour worth achieving. This implementation is asking for your vote today.

Subscriptions This was a hard decision that we had to make, but in doing so the Society has been rendered solvent, to the extent that we now have a more reasonable reserve of funds. At Council meetings arguments have been raised on so many issues, the majority of which have been resolved.

I have noticed that during Council meetings calls of 'Dictatorial' and 'un-Diplomatic' have been made. I have also noticed that it has been said that the Chairman is too easy and too hard. This of course is the natural criticism that must come in a Society like this, which has a Council made up of so many different shades of opinion.

On the other hand I have noticed that some members of Council and many members of the Society have been conspicuous by their silence and reluctance to come forward when volunteers for positions of office and other help have been required. At the last A.G.M. I did appeal for volunteers but none have come forward, so again I must ask you, we need more help from members especially towards the Journal – anybody who feels that they can play a small part will be appreciated.

I told you two years ago that one of my endeavours would be towards Education and last year a member of the Ministry of Technology opened the Symposium, at which he stated that he felt sure the Ministry of Technology would help us in some way. I am pleased to inform you that I have, with the help of others, moved in this field. The Collegiate Council has been approached so that the B.S.S.G. can be officially recognised by Universities and Colleges, it appears that here we are going to be successful, and all glassblowers in Universities and Colleges will benefit from this.

At my meeting with the Officers of the Ministry of Technology, it was agreed by them to look into many points concerning the Scientific Glassblowing Fraternity, I will later read the summary of action points arising from discussion at this meeting.

Thermal Syndicate Award This has now been established and will follow the same lines as the A. D. Wood and Jobling Cup competitions. In addition T.S.L. have agreed that the Society select a suitable student to attend a short course at Wallsend-on-Tyne.

Trade Stands The enthusiasm shown by Companies to exhibit their products at our Symposiums, must prove that the B.S.S.G. is at least recognised as a substantial and worthwhile body and obviously shows that the B.S.S.G. offers good facilities for advertising. We thank them for their generosity in this respect.

The 1969 Symposium will be presented by the East Anglian Section who are already working on this, but the venue has not yet been decided. I would ask you all again to try to attend your section meetings more fully, as so much hard work is being put into arranging these meetings.

You will hear that a change of Officers has been decided upon and you are asked to vote for their appointment to Office. The Officers who are recommended by Council have proved in the past to be dedicated and reliable men – I am sure their presence will be most beneficial to the Society in the future.

I would like to thank all Society Officers and Council for their support in the past year and look forward to another year with full support and renewed vigor.

I will conclude by saying that I hope you will enjoy and take full advantage of this year's Symposium as I know that the North-West Section has put every effort into making it a complete success.

E. G. Evans

SYMPOSIUM SECRETARY'S REPORT

The 1968 Symposium

The Symposium this year was held in the Hotel Majestic, St. Annes on Sea, Lancashire on the 13th and 14th September. It occurred to us beforehand that Friday the 13th was not the day to start anything as ambitious as the '68 Symposium but nevertheless we defied superstition. To our surprise we now find that everything went without a hitch, even the weather being kind to us and we had a mild heat-wave in spite of the fact that the southern part of the country became submerged overnight.

On the Thursday I arrived at the hotel at 9.00 a.m. and spent an hour getting some details, such as the time schedule, sorted out. This was done around coffee tables in the main Lounge. On returning to that same Lounge six hours later

I was amazed at the transformation that had taken place. Instead of the coffee tables and chairs there were nineteen trade exhibition stands arranged in a display which was, to say the least, extremely impressive.

The first day of the Symposium proper (Friday) commenced with the A.G.M. and in comparison with other A.G.Ms. this one went off fairly well. Of course there were the usual differences of opinion and objections etc., but this is what meetings are for.

The Symposium was officially opened during the Friday Lunch by the Mayor of Lytham St. Annes, Councillor E. Porter, J.P., who welcomed the Society to St. Annes and hoped that they would enjoy the facilities in and around St. Annes for which we had been given complimentary tickets.

The afternoon continued with the first two of the scheduled lectures and the day finished with the members enjoying either a trip around Blackpool Illuminations for which we had arranged a special tram, or a visit to one of the theatres in Blackpool. Some, of course, followed their own private pursuits.

The Saturday proceedings contained three papers and the presentation of the Awards.

This part was the highlight of the Symposium and was admirably performed to everyone's enjoyment by Jack Douglas the famous Television and Stage personality, who is appearing at the Grand Theatre, Blackpool. He answered questions put to him by those present and his quick 'off the cuff' remarks added the right amount of relief to the seriousness of the occasion. After presenting the cups he toured the Trade Exhibition stands and left after four hours sporting a gold pen inscribed B.S.S.G., a Society tie and some glass souvenirs of his (quote) "very enjoyable and interesting visit".

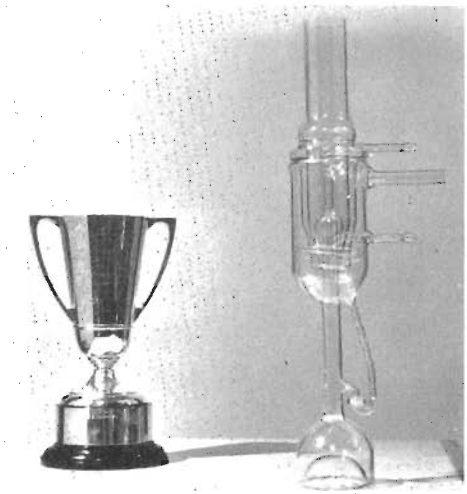
The success of the affair was due also to the Hotel facilities which were available to us. We were able to arrange a full trade exhibition, lecture theatre, banquet room, and overnight accommodation all under one roof.

The general opinion seems to be that we had a good series of lectures, a good trade exhibition, some pomp, some humour, some entertainment and above all, a thoroughly enjoyable time.

J. W. Stockton, October 1968

PRESENTATION OF AWARDS

A. D. Wood Trophy won by G. Howcroft, University of Lancaster



J. A. Jobling Trophy won by M. R. LOCK, School of Chemistry, University of Bristol.

1968 SYMPOSIUM TRADE EXHIBITORS RERORTS

British American Optical Co.

The British American Optical Company has a history going back to 1905 and its activities are spread over a wide range of medical, optical and industrial applications.

Primarily manufacturing opticians, it was not long before BAO began to make safety goggles to prevent injury from flying particles. But over the years, the growing list of complex industrial processes gave them an opportunity to use long established skills and expertise so as to make the more sophisticated protective devices. Recent developments have included a series of special lenses with which to protect against the hazards of laser radiation . . . . . each lens compounded to shield against a single specific and coherent wavelength, often powerful enough to punch a hole in steel plate !

With the Glassblowing industries in mind, BAO have also developed a number of products and devices to meet the special needs of this kind of work. For example, Didymium lenses are now in standard use in laboratories throughout the world so as to eliminate the sodium or yellow bands of the visible spectrum. And, by using a unique vacuum-coating process, BAO can produce bi-colour lenses in almost any combination of shades and densities for silica and other hot glassworking techniques. Where spectacles are normally worn, these lenses and many other tints and shades can be made to the wearer's personal prescription. The advantages need no further emphasis.

In addition, BAO make a wide range of other items for industrial accident prevention. These include respirators to protect against a wide field of atmospheric contaminants; ear defenders to keep out deafening and high-pitched noise; goggles of all kinds and for every possible hazard; safety hats and caps; and many other types of protective equipment.

If you would like to know more about what BAO can do to help you, or if there is a particular safety problem on which you would like up-to-date information, please contact: Dennis Rousell, Manager, Technical Services, British American Optical Company, Radlett Road, Watford, Hertfordshire.

HEATHWAY ENGINEERING CO. LIMITED
UXBRIDGE ROAD, HILLINGDON, MIDDX.
Tel.: UXBRIDGE 36345.
Represented by MR. C. H. GLOVER

On display on the Heathway stand was the latest addition to their glass lathe range, a small 2″ bore glassworking lathe, but with the facility for carrying out centrifuging via the variable speed range of 50–2,000 r.p.m.

Also on show was the latest quick-acting chuck, which has recently been designed specifically for centrifuging, which incorporates in the design the facility that when the chuck rotates at very high speeds, the gripping power of the chuck is increased. Therefore, this chuck can be used for other applications, such as the grinding as well as forming of glass, i.e., sockets.

A full range of burners manufactured by The Bethlehem Apparatus International Co. Inc., U.S.A., was shown. These burners are primarily designed for use with natural gas, as well as bottled propane.

A series of photographs were also on display, and one of these, the Wilt Oven, again being of American design, seemed to be of great interest, being a bell type opening and not a conventional oven.

JENCONS (SCIENTIFIC) LTD.
Represented by Mr. John Beeson

The equipment displayed by Jencons (Scientific) Ltd., at the B.S.S.G. Symposium was of great interest to all visitors to the stand.

The TYSLIDE cutting and grinding machine proved to be an obvious essential for all glass technicians. The new recirculating step tank, rise and fall spindle, together with angle cutting, micrometer slicing, and rip fence units, and the choice of using cutting, grinding, or peripheral wheels confirmed this point. Details were also available of the complete range of TYSLIDE saws.

A new grinding and polishing machine (POLYMAC) was also on display. This compact unit is supplied with three 6″ diameter plano tools and concise instructions for the user. Discs up to 6″ diameter can be polished to a superb optical finish. Detailed literature is available on request, and demonstration can be arranged.

A leak sealant in aerosol form for high and ultra high vacuum will prove useful to people who are unable to obtain the services of a glass technician to remedy leaks in their system. This "SPRAYSEAL" aerosol is supplied with applicator tube enabling the user to treat leaks which may not be easily accessable. For ease of use a snap-on trigger control is available.

The Jencons NATGAS Turret Head bench burner, was of immediate interest. It is designed to give the user central or offset flame, and used with Natural Gas and oxygen will work silica efficiently. It is also perfectly suitable for use with today's town gas, but the supply must be boosted.

Emphasis was also given to grease-free vacuum systems in the form of UNIFORM vacuum stopcocks and UNISEAL PTFE connectors. Worthy of separate mention are the ROTOLUX ball and socket joints incorporating a silicone rubber ring and PTFE sleeve. A leaflet is available on request showing a complete range of equipment for the glass technicians.

JAMES A. JOBLING LTD.

At this year's B.S.S.G. Symposium, held at Lytham St. Annes, James A. Jobling & Co. Ltd. for the first time displayed examples of their new P.T.F.E. Stopcock range.

That the new Stopcocks are already making an impact upon glassblowers was well illustrated by a beautifully produced piece of apparatus exhibited by I.C.I. Blakeley, and which featured the new Jobling P.T.F.E. Stopcocks.

Also on show at the Jobling stand were representative examples of "PYREX" rod and tubing, (including precision bore tubing), as well as sintered discs. More standard catalogue lines were displayed in the form of colour-coded graduated, cotton-mouth, bulb, and Ostwald Folin pipettes. Supplementing the glassware was a wide selection of literature including "Joblinglass", which is always of interest to scientific glassblowers.

On the final day of the Symposium the presentation of the Jobling Cup took place. This year the winner was Mr. M. R. Lock, of the School of Chemistry, University of Bristol, his entry being a mercury diffusion pump. The presentation was made by Jack Douglas, the guest celebrity, while Mr. F. C. Sedgwick, Product Development Manager, represented James A. Jobling.

NORDSEA GAS APPLIANCE CO.
42 HYDE ROAD,
DENTON

One of the leading specialists in this country on working flame burners and equipment, this Company had on demonstration their C.C. burner, Universal Torches, high velocity burners and various Ribbon burners operating on North Sea Gas and Propane, air or oxygen. A Glassblower was in attendance, demonstrating the versatility of these burners, and another glassblower was making various novelties from coloured glass.

Also on display was a console cabinet, showing Round Ribbon fishtail, fishtail, single fired and radiant cup burners, these being mounted on two manifolds with a venturé mixer and solenoid valves and operated by push button. A full range of fine threaded metering valves, crossfired set ups, bench and lathe burners and a complete range of bunsen burners, gas and air blowtorches were on display. Any of the equipment on exhibition could be shown working 'live'.

This company also have available a complete engineering service and are available for consultation in any problems arising from conversion from one gas to another.

The glassblowers demonstrating the equipment were using soda, borosilicate and quartz glass.

QUADRANT GLASS CO. LTD.
THE PINNACLES, HARLOW, ESSEX,
Tel.: HARLOW 21315.
Represented by E. G. EVANS Technical Sales

The stand and exhibits were designed and arranged to afford maximum publicity and display for our comprehensive range of products, the emphasis being applied to our 'Standards'.

These were shown in the form of Silica interchangeable ground joints, glass to metal seals, graded seals and high vacuum stopcocks.

Our stand was comprehensive because of our displayed ability to produce complex special apparatus in the shape of Mercury diffusion pumps, Venema traps, Oldershaw columns, Vapour dividing heads in Pyrex glass, Stacking and Slice holding jigs, flasks and flanges in Silica, square section tubing in L.92 glass, Nilo 'K' to Kodial, or through a graded seal to Pyrex, Soda or Silica.

Our selected range of Optical Cells completed our allotted visible space, available at St. Annes, but behind the scenes we are constantly designing and fabricating apparatus in all glasses.

Our stand showed that we are covering all aspects of Industry and Research and that our glass apparatus is of high quality backed by technical knowledge and design yet still remaining pleasing to the professional eye.

SPEMBLEY TECHNICAL PRODUCTS
TRINITY TRADING ESTATE, SITTINGBOURNE
Tel.: Sittingbourne 5252
Represented by Mr. D. J. Bethal

For the first time Spembley Technical Products were invited to attend the B.S.S.G. Symposium held this year at St. Annes, Lancs, and display our range of temperature indicators in conjunction with thermocouples. As technology advances more knowledge as to ways and means of increasing production and taking some burdens off the shoulders of the manufacturers and glass blowers is needed in this day and age.

Spembley Technical Products portable temperature indicators and thermocouples alleviate one problem, this being the awareness that knowledge of temperature indication and control is necessary today and in the future; temp. range from absolute zero – 2,300°C.

Specially designed thermocouples have increased production in a well known Glass Manufacturers simply by eliminating an awkward temperature indication problem.

We have designed and manufactured thermocouples specifically for the glass industry through B.G.I.R.A. with great success.

Glass blowers in general offer a service to the instrument department, one facet being to manufacture thermocouples. In this respect we can offer two units of Welding Equipment, one being extremely versatile, i.e., for welding thermocouples, spot welding .0005 wires etc., the other requires no skill, producing thermocouples to a high degree of accuracy in the minimum of time.

We hope to be advertising in your B.S.S.G. journal shortly on this aspect.

G. SPRINGHAM & CO. LTD.

This Company exhibited a comprehensive display of High Vacuum and General Purpose Stopcocks.

Their world renowned Interkey range of interchangeable key stopcocks enables users to have guaranteed non-leak stopcocks with the added efficiency and economy of spare keys and barrels available at all times.

The added advantages of being able to replace glass keys with 'no grease' P.T.F.E. stopcocks, has proved to be a great asset to many users.

The range of High Vacuum stopcocks are individually tested and guaranteed to 10^{-6} TORR. Each one is produced to uniform dimensions within each size range and enables glassblowers to carry out any replacements within the space available.

The extended range of High Vacuum greaseless stopcocks enables a wider usage of this much used valve offering vacuum control to 10^{-6} TORR, without the need for grease.

Fully illustrated catalogue available upon request.

THERMAL SYNDICATE LTD.

The Thermal Syndicate exhibit consisted of items in transparent and translucent vitreous silica, to typify both items made by their own blowpipe workers and also to show standard components available to other glassblowers.

Items of blowpipe work ranged from the various combustion tubes required for British Standards methods of analysis to a multi-stage reflux fractionating column, to show the kind of special apparatus which could be manufactured.

Other fabricated components shown made use of grinding and polishing techniques, as well as blow-pipe manipulation, including spectrophotometer cells and a range of machined and slotted jigs for use in semi-conductor processing.

The Stand was manned by three of the firms technical representatives, Mr. K. B. Barratt (North West England), Mr. L. Cant (Northern England and Scotland) and Mr. G. G. S. Couldwell (Midlands), who answered questions relating to products, and by Mr. M. Lawther (Manager, Manipulation Dept.) who discussed problems relating to the working of vitreous silica.

HAROLD TURNER & SONS
35 RADCLIFFE NEW ROAD,
WHITFIELD, MANCHESTER. M25. 7QZ
Tel.: 061-766 2016

Harold Turner & Sons, as agents, represented the following companies:

Messrs. Sadla-Vac: Manufacturers of inexpensive quality vacuum gauges, including Thermo-couple, Pirani & Penning. It is hoped that this company will shortly be adding a new type of rotary pump to its range.

Messrs. Kaymar Trolleys Ltd: Manufacturers of instrument and special purpose trolleys. Specials are a pleasure and not a problem to this Company. Also shown, the KS.20 Kirk Step.

Messrs. Carborlite Co. Ltd: On show was an 18″ cube, glass annealing furnace, suitable for temperatures of 800°C. A full range of these furnaces are available and whilst they're not the cheapest, the quality in our opinion, is worth the extra cost.

Messrs. Northern Scientific (York): Manufacturers of a general range of laboratory glassware and are also producers of high vacuum specials in glass and metal. They are also agents for Optiglass spectrophotometer cells, stopcocks, which a selection was shown.

Messrs. Chem-Lab Instruments Ltd: On show were two items from this Company, a magnetic stirrer and a mini laboratory jack, both competitively priced. They also market a wide range of laboratory instruments. Further details on request.

Messrs. N.G.N. Ltd: We showed this company's education and small laboratory vacuum pumping unit, comprising of a 1″ diffusion pump and 1 cu.ft min. rotary pump. We shall, from October, be factors for this Company, and any enquiries for this equipment will be promptly dealt with. Finally, we showed two special laboratory light fittings: These take the standard tube, but are sealed against (a) explosive atmospheres, i.e. ether, and (b) are completely weatherproof. Further details again from the above.

F. YORKE & PARTNERS LIMITED

Our Parent Company, Diamant Boart S.A. Brussels, manufacture an extensive range of machinery and diamond tools for the working of glass.

At the British Society of Scientific Glassblowers 1968 Symposium we had the pleasure and opportunity of exhibiting to their members a small selection of our diamond tools.

The tools exhibited consisted of:—

Diamond Impregnated Continuous Rim Cutting Discs for sawing flat, hollow and optical glass.

Diamond Impregnated Core Drills for drilling holes in glass or producing blank cores.

Electro Deposited diamond male and female reamers for the production of standard taper necks and stoppers and the grinding of taper joints for laboratory tubes.

Various types of diamond impregnated grinding wheels for working flat glass – grinding edges of plates – bevelling and engraving decorative glass ware.

In conclusion we should like to express our thanks to the members for the interest shown in our products.

W. YOUNG (FUSED SILICA)
Represented by Mr. W. Young

Apart from the artistic exhibits for which we are well known W. Young (Fused Silica) this year displayed a range of gas laser tubes and related equipment, with a selection of the more 'Usual' silica ware thrown in for good measure.

Centre piece of the stand was an operating helium-neon laser, R.F. excited with an output of two milliwatts at 632.8mμ (visible red).

This laser, together with a tape recorder was intended to demonstrate a communications link-up but unfortunately the photo diode required failed to arrive in time, (the tape recorder however provided pleasant background music to the exhibition).

Other laser tubes on show ranged from small d.c. excited helium-neon with an output of one milliwatt, to argon ion lasers capable of 250 milliwatts multimode.

The firm have over five years experience of laser work and looks forward to a prosperous and interesting future in this growing industry.

FIELDEN ELECTRONICS LTD.
Represented by MR. G. M. MCCLAREN

The equipment demonstrated by Fielden Electronics Limited, (Instrument Division of George Kent Limited), at the Symposium indicated the range of equipment available from this Company.

On display were a series of Bikini 6000 temperature indicator controllers, Bikini temperature controllers, a Telstor multipoint level indicator, and a typical Telstor level indicating controlling system.

The Bikini 6000 instruments, used for example to indicate and control the temperatures in lehrs and of molten glass, are available in a number of configurations depending on the control requirements, which may be simple on/off, time proportioning anticipatory (T.P.A.) or proportional at either one or two adjustable set points. A further alternative gives proportional control with manual reset.

The output of the Bikini 6000 equipment can be used to control an electrical circuit either directly from its own relay or through a slave contractor or by means of a silicon controlled rectifier (SCR) control unit. Alternatively, the output of the Bikini equipment is used to control the operation of a solenoid, diaphragm, or motorised valve if the flow of a fluid is to be controlled.

The use of a level indicator to show how much sand, silica or soda ash is contained in a silo leads immediately to an increase in efficiency of the plant through reducing the number of man-hours spent checking levels. Indicators may be grouped in one central position to enhance this. Each of the Telstor range of level indicators measures the capacitance detected by an electrode mounted in the silo. The measured capacitance is converted to a d.c. signal by an encapsulated circuit in the head of the electrode and transmitted over long cables, if required, to the indicator. As an additional feature, control may be added as for the temperature measuring instruments.

Any further reports will appear in the next issue
ED.

SECTION ACTIVITIES

Midland Section

On 15th December 1967 a lecture/demonstration entitled "Hints on Resistance Welding" was given by Mr. R. G. Carter and Mr. S. H. Edwards of Intercal Ltd. at the School of Physics, University of Warwick.

We were shown how and why a weld is formed not only in the more common metals but how, with the use of the "sandwich" method metals of a dissimilar nature can be spot welded successfully. In all it proved to be a very entertaining and constructive evening. Thanks again to Mr. Carter and Mr. Edwards.

Before the A.G.M. which was held at the School of Physics, University of Warwick two technical films from J. A. Joblings were shown entitled "The Nature of Glass" and "Looking into Glass" which were very informative and well worth seeing.

The A.G.M. was well attended and the following officers elected:

Chairman: L. Haynes
Secretary: S. G. Yorke
Treasurer: A. Hill
Councillor: S. G. Yorke
Committee: S. Marshall, J. S. Huckfield, M. Coope, K. Holden

Fifteen members attended the lecture and film show at the West Midlands Gas Board, Solihull. This proved of great interest to everyone but, during the discussion that followed it was generally felt that the engineers at the Gas Board were not fully aware of the problems facing the glassblower. As everyone was interested in burners the curriculum was altered to enable the party to have a look around the Engineering and Development Laboratories and to "try our luck" with the natural gasburners available.

As a result of this visit both sides were able to appreciate each others difficulties and it is possible that due to the comments that were made during the visit a more precise demonstration will be held during the autumn.

Although only 7 members out of a possible 40 attended the visit to Jencons on June 12th we were very well received by the Managing Director, Mr. C. H. Williams, who had been good enough to arrange lunch for us and specialist demonstrations were given in the workshops afterwards.

Everyone enjoyed this visit because of the relaxed and friendly atmosphere of the firm and in the unguarded way that all questions were answered.

Thanks again to Mr. C. H. Williams, Mr. J, Williams and Mr. J. Beeson for their help and guidance throughout the afternoon.

Due to the poor turn out and lack of affirmative replies to the rest of the year's programme there is every likelihood that other items will reluctantly have to be cancelled.

It would appear that there is a small hardcore of enthusiasts who are prepared to put time and effort into organising and attending functions but, alas many of the Midland members obviously "know it all" or are just simply apathetic.

J. S. HUCKFIELD

Southern Section

1968 – 1969 *Programme*

All meetings will be held in the New Chemistry Building, Queen Elizabeth College, Campden Hill Road, London, W.8. Nearest Underground Station – Kensington High Street.

16th Oct. 1968 – Burners and Flame Technology (Mr. Cescotti, W.S.A. Ltd.)
20th Nov. 1968 – Properties of Glasses (Dr. L. Oldfield, G.E.C. Ltd.)
18th Dec. 1968 – Silica – Talk and Demonstration (W. Young)
15th Jan. 1969 – Section A.G.M. Followed by a discussion
19th Feb. 1969 – Neon Signs (Mr. J. Jones, Signs & Components Ltd.)
21st Feb. 1969 – Stag Dinner at Horse Shoe Hotel, Tottenham Court Road
19th Mar. 1969 – Vacuum Techniques (Mr. S. M. Dickinson, Leybold Hiraeus)
16th Apr. 1969 – Natural Gas Burners (Mr. Thomas, L. Richoux Ltd.)
21st May 1969 – Lasers (Mr. A. J. Rankin, Laser Associates Ltd.)
May/June 1969 – Visit to National Physical Laboratories, Teddington

Visit to Hirst Research Laboratories

On the 12th June, 1968, a party, consisting of 17 members, was welcomed by Mr. Harris and divided into two parties to begin the tour of the Laboratories.

Commencing with development and testing of Sodium and Mercury vapor lamps for standard lighting purposes, we then moved on to a special application where we saw warning beacons, landing aids etc.

The subject then changed drastically to integrated circuits, where an introduction to this technique was made and supported by glimpses through microscopes of the finished circuits.

After a welcome tea break the visit continued with a run through the mixing, fusion and testing of special glasses and their application and led on to glass ceramic seals.

The visit terminated in the glassblowing shop where many novel techniques and devices were demonstrated and discussed at length. In all a very interesting and informative visit.

This report on the Hirst visit was provided by Mr. W. Young.

T. J. MAPLE

Western Section

In June the Section Annual Outing took place – a visit made to the Dartington Glass Works at Torrington, North Devon.

The firm, managed by the Dartington Trust employs ten Swedish craftsmen with an equal number of local assistants and makes ornamental and domestic glassware to Swedish designs. The soda line glass used is made in four colours in electrically heated furnaces, otherwise the methods used are similar to the traditional ones for this type of production. A full tour of the works was made inspecting all the processes involved and finishing at the sales department where there was an opportunity to purchase "seconds".

Although the weather was not the best some 25 members, wives and friends made the journey, being met at Torrington by two members from the University of Exeter who were very welcome, as normally distance prevents them from attending Section meetings.

The July meeting was held at the New School of Chemistry, University of Bristol, and took the form of a discussion on ideas to encourage members to take the Society's Certificate of Competence examination. A proposal was formulated that there should be a new grade of membership – Senior Full Member – the qualifications for which should be the passing of the Certificate of Competence examination and five years practical experience of glassworking.

A Student member passing the examination should become a Graduate "Full Member" and automatically a Senior Full Member after five years experience.

The present grade of Full Membership should remain for those not wishing to qualify.

At this meeting membership certificates were distributed to those present.

Future Meetings

October 1968 – Air Gauging methods by I. C. P. Smith, at Cardiff.
November 1968 – Visit to D. Jones Signworks, Bristol.

North Eastern Section

The only meetings this year for this section up to now have been as follows. On the 19th April we had a Jobling Evening which was held at the Hotel Metropole, Leeds. Mr. P. G. Heslop the Publicity and Advertising Manager and his colleagues, Messrs. Johnson, Price and Airey, gave talks on how they play their respective parts in the Jobling Company. Slides were shown to illustrate the new factory at Sunderland. Afterwards the members and their wives were given a small piece of 'Pyrex' as a momento of the occasion and the evening was concluded by informal talks with the Jobling representatives during the buffet meal.

On the 21st June at Leeds University, a lecture and demonstrations on Silica was given by Mr. Powell, Mr. Lawther and Mr. Middlemiss of Thermal Syndicate Ltd. After a preliminary talk by Mr. Browell on the various forms of silica, Mr. Middlemiss gave a demonstration on bench-blowing transparent silica tubing, illustrating large to small joints, 'T'-pieces and bends. Mr. Lawther then gave a demonstration on how to work large pipeline translucent silica *in situ*, showing straight joints, and side arms. Question time was well used and members stayed on afterwards to have a look at exhibits and the pieces that were made during the demonstrations.

The experts in working silica showed all present that it is not as hard to work silica as some of us might imagine.

D. H. BANCROFT

East Anglian Section

The East Anglian Section is organising a **One-day Symposium** on Natural Gas Burners at Harlow Technical College on November 9th for which a fee of £1 1 0 will be charged to cover costs. Mr. R. Adnitt would like to hear from those interested by October 25th.

Officers for 1968:
Chairman: E. G. Evans
Secretary: A. M. Willis
Committee: Messrs. Leutnegger, Wellstead, Czapiewski, Smith, Hines, Adnitt and Hardware.
Council Representative: Mr. Leutnegger

A. M. Willis

INSTITUTE OF SCIENCE TECHNOLOGY

The 1968 Exhibition is being held at Paddington Technical College on December 17th, and the Society is asked to man a demonstration stand between 10.30 a.m. and 7.30 p.m. Volunteers are requested to contact Mr. E. White, 13 Perkins Road, Newbury Park, Ilford, Essex.

NEW MEMBERS

Southern Section
A. H. Behrens (F) — 10 Headcorn Road, Thornton Heath, Surrey.
North Eastern Section
J. N. Nyabuzoki (F) — 251 Hyde Park Road, Leeds.
East Anglian Section
H. A. Butler (F) — 55 Uplands Avenue, Hitchin, Herts.

EDITOR'S NOTE

The Editor regrets that owing to pressure on space his usual column has been omitted.

SITUATION REQUIRED

Full Member seeks change of employment. 10 years experience includes Bench and Lathe work with glasses ranging from lead to silica, Glass Metal Seals, Graded Seals, Vacuum Techniques, Solder Glass Techniques, G.R.T. production etc. City and Guilds Technicians Certificate in Electronics. Present work mainly development carrying a salary of £1,250 per annum. Testimonial if required. Replies to the Editor or Tel.: 061-633 4244

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