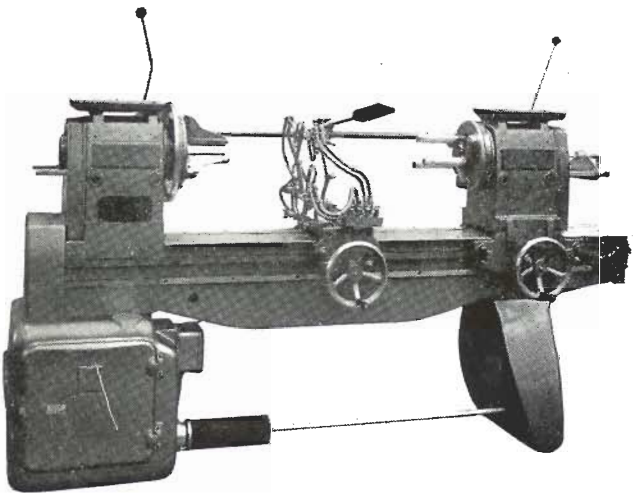
JOURNAL

OF THE

BRITISH SOCIETY OF SCIENTIFIC GLASSBLOWERS

Vol. 4 MARCH 1967 No. 1



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Editor
J. H. BURROW
H. H. Wills Physics Laboratory
Royal Fort Clifton, Bristol

Advertising & Business Manager
J. A. FROST
Chemistry Department
University of Reading

Distribution, Finance and Society Registrar
D. A. HENSON
3 Oliver Drive
Calcot, Reading

Abstracts
S. D. FUSSEY
A.W.R.E., U.K.A.E.A.
Aldermaston, Berks

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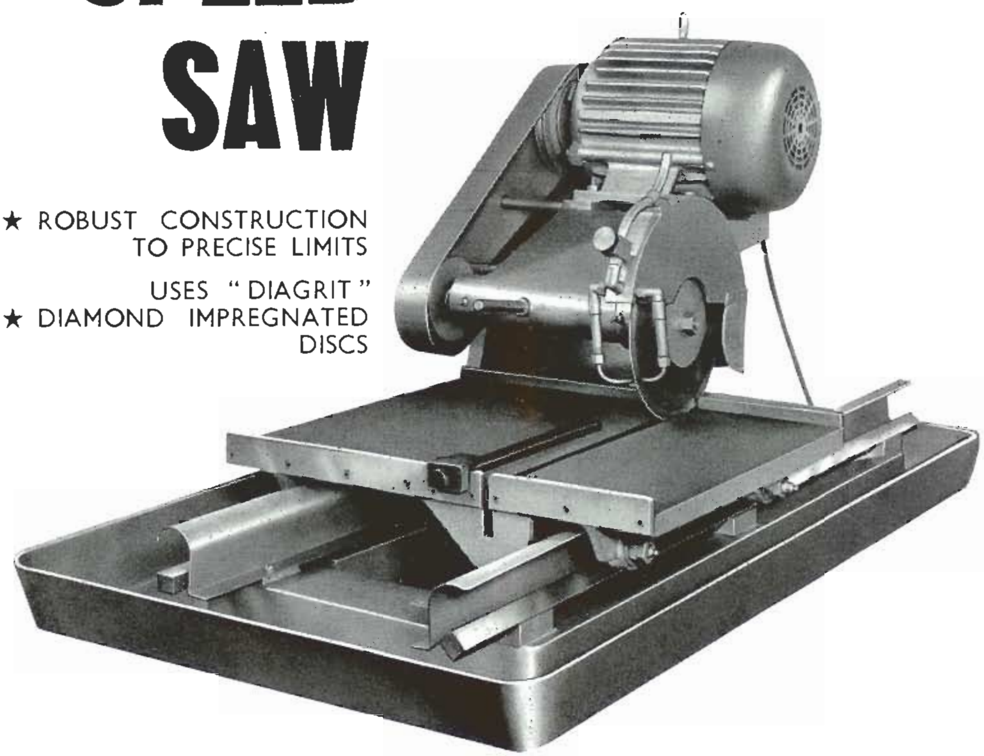

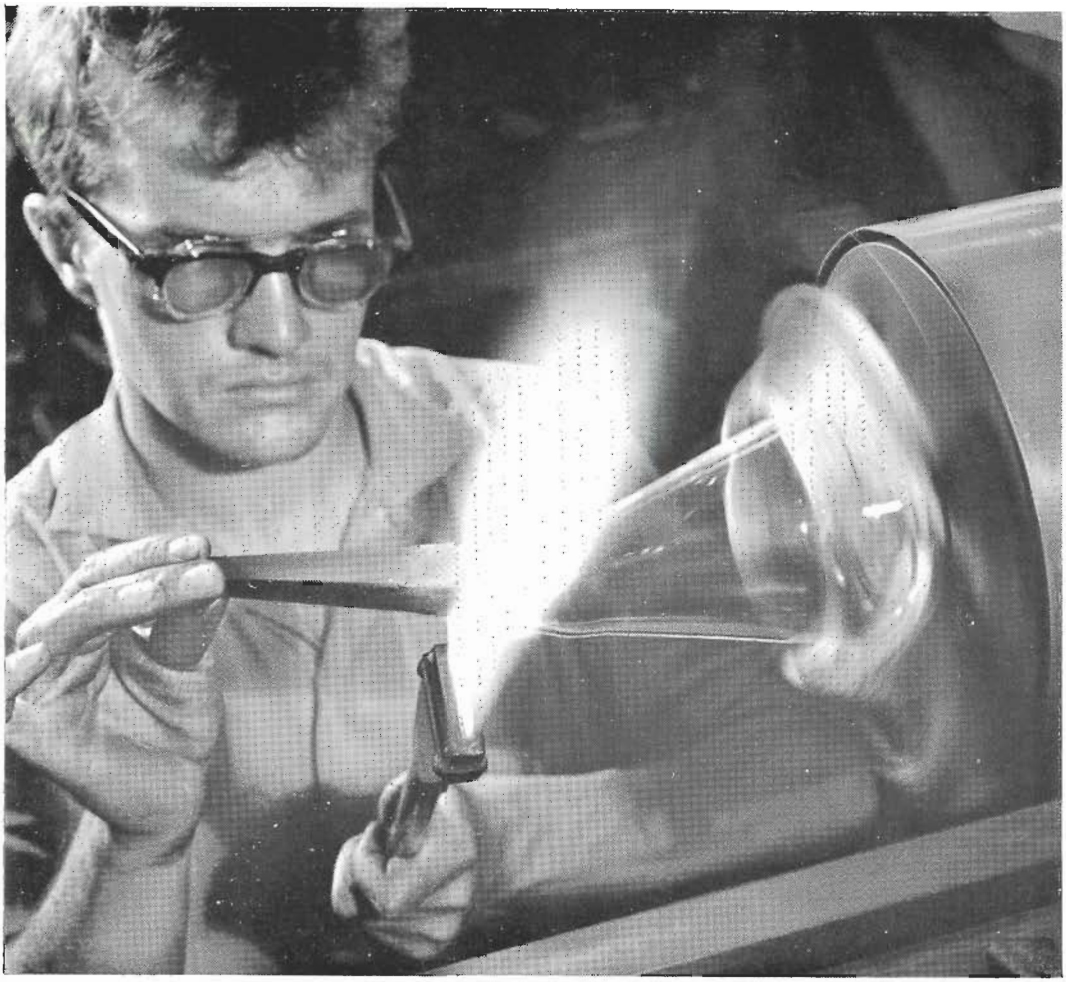

British Society of Scientific Glassblowers

Founded 1960

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E. G. EVANS
65 Frambury Lane
Newport, Essex

Secretary
D. W. SMITH
"Greenridge", Frome View
Frampton Cotterell, Glos.

Treasurer
F. A. BRANFIELD
15 Grosvenor Road
London, E.7

EDITORIAL

IT was the intention to use this page to emphasise the need for close liaison between the ordinary member, his Section Committee and the Council, and also to urge members to use to the full the existing system of representation, at the same time considering other possible methods by which it can be improved.

Finally an appeal to attend if possible the April A.G.M. so that any decisions made will be supported by a reasonable proportion of the membership.

However, the following article drawing attention to a real hazard in the use of pre-mix turret burners with town gas is of immediate and vital interest and is therefore given preference.

J.H.B.

TURRET-HEAD BURNERS—A WARNING

MOST glassblowers are now familiar with the use of the turret-head oxy-gas burners that are at present on the market; they are almost essential for miscellaneous use on borosilicate glass, and all glassblowers early make themselves familiar with the precautions necessary when using them. Once again, however, a case has been reported* of the misuse of one of these burners leading to a serious explosion—in this case with considerable material damage, but fortunately no personal injury or loss of life. The causes were apparently :—

(1) Non-return valves had not been fitted in the gas system, and

(2) an inexperienced user had left the oxygen and gas taps open, or partly open, and the turret so turned that oxygen leaked back in to the gas system, forming an explosive mixture in the meter.

It only needed someone setting a light to a burner the next morning to set off the explosion.

The first fault, of course, was that no non-return valves had been fitted; the second fault was in the user who should have known, or have been instructed (but maybe forgot) always to turn off the oxygen before turning the turret unless the burner is of the pre-set oxygen type ; also to check both taps off when turning off the burner. A third fault could be in the burner itself; all such turrets should be so designed that when turning from one position to the next, the entry port bridges two jet ports, and so there is never a completely shut-off position. And a final point, in any department using gases or any services there should be *someone appointed to go round checking off all taps, switches and cylinders at night*—unless specific instructions have been given to leave an experiment on.

It is thus the glassblowers' duty, where turret-head blow lamps are in use :—

(1) to see that approved non-return valves are fitted, not just accept a report that they are ;

(2) to see that the turret opens up the next jet before it leaves the last one on turning ;

(3) to see that all possible users are fully instructed ; and

(4) to see that all cylinders and gas taps are turned off at night, *including of course, the main gas cock* that should be fitted on the gas main to each department.

Glassblowers' turret-head burners in a glass shop are one thing ; and here they can be kept under proper control ; in a laboratory, and available for general use they are another, and there may be good reason to exclude them, and permit only cannon-fire burners that are not subject to the hazards dealt with above.

I. C. P. SMITH

* Chemistry in Britain, February 1967, p. 89

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 J. A. Frost, Chemistry Dept., University of Reading. Printed in Gt. Britain by E. G. Ellis & Sons, Willow Street, London, E.4.

THE STRUCTURE, MANUFACTURE, PROCESSING AND USE OF "PYREX"

Talk given at the Leeds Colloquium, 24th September, 1966
by F. C. SEDGWICK
Product Development Manager, Laboratory Apparatus Division, James A. Jobling & Co. Ltd.

AT the beginning of the present century the expansion in the chemical industry resulted in the demand for glasses capable of withstanding severe chemical attack and thermal shock.

In 1916 Sullivan & Taylor, of Corning, New York, filed a patent for a glass later to be known as "Pyrex" brand borosilicate. This glass met these requirements and completely revolutionised the uses of glass, not only in laboratories and industry, but also in the kitchen, where, for the first time, cooking in glass became possible.

In 1921 the Corning borosilicate glass was manufactured under licence in the United Kingdom by James A. Jobling & Co. Ltd. Although the basic formula of this glass has varied only slightly, the techniques of production and control, together with the applications, have greatly advanced.

Jobling glass is a hard borosilicate containing silica, alumina and oxides of boron and sodium. The typical chemical analysis of its constituents and also details of its physical properties are already well known.

With conventional glasses, the addition of fluxes, such as alkalis, helps to reduce the melting temperature. The level of these fluxes has been kept low in "Pyrex" brand borosilicate glass in order to maintain the characteristic low expansion coefficient and high durability.

As a result of a minimum of fluxes the high melting temperature required has presented problems concerned with firing conditions, furnace design, and processing equipment—problems only overcome by long-term research at considerable expense.

The raw materials used in the manufacture of Jobling glass comprise silver sand, dehydrated sodium borate, boric acid, alumina, and small amounts of sodium chloride.

Strict control is applied to ensure that all raw materials meet the agreed specification for purity and physical characteristics, with particular attention being paid to avoiding contamination.

Accurately weighed amounts of raw materials and "cullet" (waste glass) are mixed to specific time cycles, and the resulting batch is automatically fed into the furnace. The material is sintered and melted into glass by the use of oil firing, supplemented by electric boost heaters.

The glass in the working end of the furnace is conditioned or cooled to the forming temperature at which it is to be processed, depending upon the method of processing—blown, pressed, or drawn.

There are two methods of manually blowing glass, in the first of these, the paste method, glass is blown and rotated into a mould which is lined with an absorbent material saturated with water. The resultant steam acts as a cushion and lubricant between the glass and the mould and helps to produce a high surface finish to the article.

The other manual method uses a "hot iron mould" where the glass is blown into direct contact with the surface of the mould; this method is used when the design of the article will not permit rotation.

Glass can also be automatically blown where large quantities of articles are required and the design of the item is acceptable. This is achieved with the turret chain machine, which cuts extrusions of molten glass to defined amounts and feeds them into a system where controlled blowing is applied in a series of moulds fitted to an endless chain.

While glass is usually automatically pressed, this type of processing can also be accomplished by "hand" methods.

A skilled operator cuts the correct weight from a "gather" of glass and transfers it to a mould. A plug sliding through a ring forces molten glass sidewards and upwards until it is halted by the ring which rests on the upper surface of the mould.

Early tubing was, and in instances, is still produced (in factories) by skilled operators manually drawing and blowing glass. Such a technique will not meet modern requirements for quantity and close tolerances of heat resisting borosilicate tubing.

Joblings manufacture several thousands of miles of tubing a year in diameters which range from a few millimetres to nine inches, and in several wall thicknesses. Methods of manufacture are the catenary—"horizontal drawn" for diameters up to about 1½ ins., and the "down draw" method for larger diameters.

In the "down draw" tubing machine, homogeneous glass at a controlled temperature is fed into a platinum covered annular orifice in a refractory bowl and a constant level is maintained. The glass is drawn through the orifice, the bore being formed by air and a controlled drawing rate.

Two methods are used to produce precision bore tubing. For diameters of up to about one inch, carefully selected ordinary tubing of bore greater than that required is drawn over a heat resisting steel mandrel made to precise dimensions and lubricated with a film of graphite, heat being supplied by miniature electric furnaces maintained at controlled temperatures.

For larger bores, selected tubing is heated and shrunk on to a vertical mandrel of predetermined precise dimensions.

The modern highly skilled scientific glassworker rarely encounters difficulties with "Pyrex" brand glassware, and while he accepts the high standard of quality he may be unaware of the exacting controls necessary to achieve this quality.

As an example of this control it is worth mentioning that although Joblings publish the rate of expansion for their glass as $33 \pm 1 \times 10^{-7}$ per °C, the control aim is directed at a tolerance of $\pm$ 0.5. Such a consistency of expansion means that glasses manufactured at varying periods of time can always be successfully joined without any mismatching.

To satisfy the technicians who frequently ask for information concerning such things as "bloom", the identification of "Pyrex", and working "Pyrex", Joblings have produced a useful booklet entitled "Working with Pyrex".

Because of the careful controls applied to maintain the expansion of the glass within close tolerances, it is possible to greatly extend the range of manufactured articles by fusing together items made from completely different processes.

For example, whereas it would be impossible to produce a sphere with multiple outlets by a single blowing operation, it is possible to weld tubing to a completed sphere in a two-stage operation to achieve the desired result. Wherever possible electric welding is used for the fusion.

While the many and varied uses of "Pyrex" brand borosilicate glass cannot all be covered here, some of the more recent applications are of interest.

The doors of modern domestic heaters are now incorporating panels composed of borosilicate glass strip or rod. These doors afford the necessary air control for conventional heating and smoke reduction while still maintaining the attractive glow of the fire. As the temperature of the glass usually reaches 400—500°C, "Pyrex" brand glass is the obvious choice, and is completely unaffected.

Flat borosilicate glass, in a variety of shapes and sizes, is used extensively for observation in reaction vessels, boilers, and furnaces. Clarity at high temperatures, resistance to chemical attack, mechanical strength, and its heat resisting properties qualify it for these types of installation.

The chemical resistance of Jobling borosilicate glass has made it a basic construction material in many chemical plants, and glass pipeline and recording jars are also widely used in the dairy industry. Because of the high standard of hygiene required for milking equipment it is necessary to regularly clean milk lines and containers "in place" with very hot alkaline solution. "Pyrex" brand tubing and jars have withstood endless cleaning cycles without showing any signs of deterioration or loss of optical properties. The latter are particularly important to the farmer, as he is able to see when internal surfaces are clean.

These examples represent only a small cross-section of the applications of "Pyrex" brand borosilicate glass for engineering and industrial purposes. These applications are increasing rapidly and the material will continue to be a vital one for many years to come.

"JOBLING EVENING"

THE first of these was held at the Grand Hotel, Bristol, on the 30th January, 1967. The guests were members of the Western Section and their ladies, together with visitors from the North-Western and Southern Sections. in all a total of over 40.

The meeting opened with a welcome by Mr. Garrard, Chairman of the section, to all those present—the proceedings being then conducted by representatives of Messrs. James A. Jobling Ltd.

Mr. P. J. Hesslop gave a short history of the firm and said that although there has been glassmaking in the area for a very long time, apart from one small works producing very fine stained glass, the major part of Sunderland's glass industry was now invested in Joblings. The town's main contribution to glassmaking was manpower, skill and brains, but all the ingredients from which " Pyrex " is made, sand, chemicals and even the fuel, are now imported.

Mr. Hesslop then made reference to the beginning of glassmaking in England and an early reference was by the Venerable Bede in 674 to the fact that glassmakers from Gaul were commissioned to make stained glass windows for the monastery at Monkswearmouth. They glazed the windows and taught the local people and by the 19th century some two dozen firms were engaged in glassmaking.

There was then a decline and ultimately James Augustus Jobling took over the works of Angus and Henry Greener. His nephew, Jobling-Purser, became manager and chief technologist and in 1921 acquired the license from Corning's to produce " Pyrex " in England.

The first borosilicate glasses made at Sunderland were used for the manufacture of casseroles and basins, and this still forms an important part of present production.

In 1965 the decision was made to concentrate consumer glass production into one division and a further division was formed to produce and market industrial glassware. A new laboratory apparatus division also with its own separate production and marketing organisation is now fully established.

Mr. Hesslop then introduced his colleague Mr. H. J. Johnson, who gave a short talk on Joblings of today. He commenced by saying that such was the confidence in the future of "Pyrex" that the Tilling Group, now the parent company, are investing considerable sums of money in the business to ensure the continuance of service to industry and education, and to improve where possible on existing efforts. Mr. Johnson, as Sales Manager, Laboratory Apparatus Division, spoke of the need for a much closer contact with the users of laboratory ware. Most of their products were available only through wholesalers whose representatives were an indirect contact between Joblings and customers. He referred to the questionnaire which had been sent out to users all over the country asking for comments on tubing and hoped it would be filled in. "Help us to help you" was his request.

The next speaker was Mr. E. G. Evans who gave a shortened version of his paper on " Centrifuging of Glass Tubing." This has previously been published in the Journal.* Even though little time was available all the vital information was given and the talk was supplemented by some excellent slides of machines, tools, centrifuging operations being carried out, and other activities in the glass shop at Fisons. Mr. Evans also referred to the Jobling questionnaire and reminded members that Joblings were ready to back the glassworking profession as a whole and the Society in particular. While in the U.S.A. he had heard many complimentary references to the firm.

The final speaker was Mr. G. Hindemarsh, Jobling's Production Manager, who gave a history of the making of scientific apparatus. He said the earliest instrument made was probably the thermometer—the first closed end one being about the end of the 17th century. Glassblowing originated in Italy and tubing was made in Thuringia, Germany, as early as 1643. Mr. Hindemarsh followed with a survey of the sources and manufacture of tubing and laboratory glassware over the last 150 years which led up to the methods now in use at Sunderland for producing from 3 mm. to 9 inches diameter tubing.

Lamp-working at Joblings was not established until 1930 when only four people were employed. From this the present factory developed which, other than Cornings in the U.S.A., is the largest in the world. Joblings have a separate division for pipeline tubing and with the installation of the "Woods Updraw Machine" in 1942, large quantities can now be produced, one order alone requiring 12 miles of 2 inch pipeline.

The technical part of the evening was concluded with the showing of the Dutch film " Glass," which gives some very entertaining views in colour of some of the more spectacular operations in a glass works producing an endless stream of bottles and packages.

The final part of the evening took place in an adjoining room where an excellent buffet supper had been prepared. Guests mixed and talked freely with the organisers.

At the conclusion Mr. M. Morgan, Marketing Manager for the glassware division, thanked the guests for supporting the first Jobling evening.

Without doubt this was a great success and the Western Section also tender their thanks to Messrs. Jobling for their hospitality.

F. PORTER

School of Chemistry
University of Bristol

* Vol. 3, No. 2, page 22

PHYSICAL AND MECHANICAL PROPERTIES OF CARBONS AND GRAPHITES

by J. C. CAMPBELL

*Senior Development Engineer, Morganite Carbon Ltd., Battersea Church Road, London, S.W.*11

Supplementary information to article on the "Application of Carbon and Graphite in the Glass Industry." *See Vol.* 3, *No.* 4, *page* 50

TABLES 1, 2, 3 and 4 describe some typical room temperature characteristics of plain carbons and graphites used for mechanical applications. All these materials may be subjected to inhibition and densification treatments. However, purification may only be applied to graphites, as this treatment is performed at very high temperatures (2,600°C-2,700°C), in excess of the range at which the graphite transformation takes place.

The inhibition and purification treatments have little or no effect on the properties found for the plain grades. Densification by virtue of the fact that it reduces accessible porosity modifies the properties advantageously. Table 5 gives some idea of the improvement over the properties of plain grades that may be expected as a result of the treatment, for an extruded and moulded (pressed) material.

TABLE 1

EXTRUDED CARBON

Mechanical Properties

Grade (Link)		CY3	CY9	CY115	CY124
Size		up to 4″ dia.	up to 4″ dia.	up to 4″ dia.	up to 4″ dia.
Bulk Density g/cc ...		1.75	1.61	1.70	
Hardness Scleroscope ...		93	50	70	40
Tensile Strength	P		2,000		
lb/in²	T		1,700		
Transverse Bend	P	8,000	6,200	6,700	6,400
Strength lb/in²	T	6,200	4,400	5,250	3,850
Compressive Strength	P	28,500	13,600	19,800	
lb/in²	T	21,700	8,900	16,800	
Youngs Modulus	P	3.15	2.00	2.25	
10^6 p.s.i.	T	1.70	1.20	1.40	

Physical Properties

Thermal Expansion	P	2.60	1.45	2.45	
$\times 10^{-6}$/°C	T	3.10	4.10	5.00	
Thermal Conductivity	P		0.101	0.030	
Cal/cm. sec. °C	T	0.02	0.055	0.022	
Specific Resistance	P	12.50	7.50	10.0	5.00
$\times 10^{-4}$ ohm in.	T	14.00	15.5	15.6	7.50
Porosity %		8	16.5	12	20

P = Parallel to axis of extrusion
T = Transverse to axis of extrusion

TABLE 2

EXTRUDED GRAPHITE

Mechanical Properties

Grade (Link)		EY1			EY106		EY4	EY9	EY110
Size		1-3″ dia.	3-6″ dia.	6-12″ dia.	1-3″ dia.	3-18″ dia.	1-4″ dia.	1-4″ dia.	1-4″ dia.
Bulk Density g/cc ...		1.67	1.69	1.71	1.68	1.72	1.60	1.70	1.81
Tensile Strength	P	1,350	1,350	1,300	1,400	1,450	—	1,800	—
lb/in²	T	—	1,000	1,200	—	1,250	—	1,200	—
Transverse Bend	P	3,000	2,700	2,400	2,800	2,400	3,800	5,800	4,200
Strength lb/in²	T	1,300	1,800	1,850	1,300	2,000	3,000	1,900	3,300
Compressive Strength	P	—	5,650	5,200	—	5,600	6,250	7,500	7,160
lb/in²	T	—	5,250	5,200	—	5,950	5,900	3,300	7,000
Youngs Modulus	P	1.75	1.60	1.55	1.80	1.50	0.89	1.05	1.25
$\times 10^{-6}$ lb/in²	T	0.80	0.95	1.00	0.85	1.10	0.55	0.55	0.60

Physical Properties

Thermal Expansion	P	0.95	1.60	1.95	1.35	2.20	1.46	1.80	1.86
$\times 10^{-6}$/°C	T	—	—	3.40	—	3.75	4.41	4.00	3.90
Thermal Conductivity	P	0.390	0.375	0.375	0.375	0.360	0.200	0.150	0.26
Cal/cm. sec. °C	T	0.235	0.225	0.305	0.235	0.280	—	0.090	0.130
Specific Resistance	P	3.10	3.10	3.10	3.20	3.30	5.20	7.90	5.50
$\times 10^{-4}$ ohm in.	T	5.20	5.50	4.00	5.10	4.30	15.40	16.50	9.30
Porosity % ...	...		21		20		19.50	15	13
Permeability ... cm²/sec	...		50		20		5×10^{-1}	1×10^{-2}	5×10^{-2}

TABLE 3

PRESS FORMED CARBON

Mechanical Properties

Grade (Link)	CY1	CY2	CY10	CY4728	CY9106
Size	11″×4″×4″	11″×4″×4″	11″×4″×3″		11″×4″×2″
Bulk Density g/cc ...	1.60	1.65	1.55	1.58	1.58
Hardness Scleroscope ...	65	60	65	78	85
Tensile Strength lb/in² ...	3,000	1,500	4,000		3,500
Transverse Bend Strength lb/in²	5,200	4,000	7,500	4,300	4,200
Compressive Strength ... lb/in²	20,000	15,000	24,000	15,200	25,000
Youngs Modulus ... $\times 10^{6}$ lb/in²	1.30	1.50	1.70	0.97	1.70

Physical Properties

Thermal Expansion ... $\times 10^{-6}$/°C	3.30	3.30	3.50	4.14	4.50
Thermal Conductivity ... Cal/cm. sec. °C	0.022	0.022	0.02	0.016	0.017
Specific Resistance ... $\times 10^{-4}$ ohm-in.	15.00	15.00	16.00	24.00	20.0
Porosity %	16.00	12.00	13.00	19.50	11.0

TABLE 4

PRESS FORMED GRAPHITE

Mechanical Properties

Grade (Link)	EY10	EY4728	EY9106
Size	11″ × 4″ × 2″		11″ × 4″ × $1\frac{1}{2}$″
Bulk Density g/cc ...	1.64	1.52	1.70
Hardness Scleroscope ...	52	42	50
Tensile Strength p.s.i. ...	1,800	1,400	2,000
Breaking Strength lb/in²	4,500	3,000	4,500
Compressive Strength ... lb/in²	10,000	7,500	10,000
Youngs Modulus ... × 10^6 lb/in²	0.60		0.80

Physical Properties

Thermal Expansion ... 10^{-6}/°C	3.20		4.20
Thermal Conductivity ... Cal/cm. sec. °C			0.12
Specific Resistance ... × 10^{-4} ohm-in.	10.00	4.70	9.60
Porosity %	19		14

TABLE 5

Grade (Link)		EY110	TYX10	EY9106	TYX14
		Extruded	Extruded	Moulded	Moulded
Specific Resistance	P	5.50	5.50	9.60	9.60
Ohm in. × 10^{-4}	T	9.30	9.20	9.60	9.60
Transverse Bend	P	4,200	4,800	4,500	8,100
Strength lb/in²	T	3,300	3,700	4,200	7,800
Thermal Expansion	P	1.90	1.90	4.20	4.30
10^{-6}/°C	T	3.90	4.00	4.50	4.70
Thermal Conductivity	P	0.26	0.28	0.12	0.14
Cal/cm. sec. °C	T	0.13	0.15	0.11	0.13
Hardness ... ... Shore/Scleroscope		45	45	50	60
Bulk Density g/cm³ ...		1.80	1.85	1.70	1.80
Porosity %		14	8	14	6

Metal Glass Seals

A VERY wide range of metals can be joined to glass and the sealing can take place in two ways; either the glass is sealed directly to the metal under conditions in which no oxide is left, e.g. platinum and bright tungsten seals, or as in most cases, the seal takes place through a controlled oxide layer on the metal which bonds strongly to both metal and glass. The adherence of the oxide layer is one method of judging the probability of glassing a metal and in the case of copper is very sensitive to impurities such as arsenic and phosphorous. Various forms of metal glass seals are made; wire or rod through glass either as single seals or multiples pressed together to form a pinch seal. Another common form is a series of electrical leads glassed into an outer flange which can be soldered to metal. Tubular seals are frequently used in vacuum construction and also windows and disc seals.

Oxide seals have characteristic colours, e.g. those to copper are red, to chrome iron green, iron-nickel-cobalt greenish grey, tungsten golden brown and molybdenum chocolate brown.

Metal glass seals can be further sub-divided into two types, matched seals in which the expansion coefficient of the glass used is very close to that of the metal, and unmatched seals in which the metal is made very thin at the sealing region, expansion differences being compensated by plastic deformation of the metal.

Matched seals

In this type of seal, providing certain conditions are satisfied, the metal can be thick so that the final seal is very robust. Glasses are available which seal directly to tungsten, molybdenum, nickel-iron-cobalt alloys (Kovar), nickel iron and copper-plated nickel iron, chrome iron, iron, copper and platinum. Tungsten is normally used as wire or rod up to ¼-inch. diameter, but most of the other metals are available as tube, sheet, and bar.

However, in addition to matching expansions of glass and metal other properties of the sealing glass contribute towards successful seals, such as elasticity which helps to counteract strain left after making and also strain introduced by thermal gradients created during use, e.g. through passing currents, or cooling in liquid nitrogen or helium. Another requirement is that the sealing glass should have good flow properties during the making of the seal so that no re-entrant crevices are left as starting points for cracking.

Thus in the case of tungsten it can be sealed through both "Pyrex" and "Phoenix" but the resulting seals will not be as robust mechanically or thermally as when one of the sealing glasses designed for this metal is used.

The most durable matched seals are made from nickel-iron-cobalt alloys which are readily available, under various names such as Kovar, Nicosil, Nilo K, Fernico, etc.

Unmatched seals

In 1923 Housekeeper succeeded in sealing thinned copper discs into soft glass which were used to carry electrical leads, and these were followed by tubular and other types which are sometimes given the same name. Even though the matched seal is frequently used many examples of unmatched seals are also made. Copper and stainless steel tubing are sealed to borosilicate glasses, strip copper is sometimes sealed through lead glass, and thin molybdenum strip through silica. Copper and silver disc seals are made and fused silica windows are sealed to sheet molybdenum. Copper and molybdenum besides being good electrical conductors are non-magnetic which is sometimes an essential requirement. Non magnetic stainless steel is also available.

However, because of the thinning of the metal required these seals are in general weak mechanically and if copper seals have to be heated they must be covered with a protective varnish to minimise oxidation.

Manufacture

The feasibility of making metal glass seals in a glass-shop depends largely on the possession of both sealing glasses and metal in the required form and unless good mechanical workshop facilities are available the glassblower is likely to be limited to forms of material which can be directly purchased plus perhaps an occasional turned feather edge on copper or stainless steel.

Where large quantities of seals are required, stampings and pressings will be produced from sheet for each type of seal and giant tubular seals are made from sheet rolled and heli or argon are welded at the joint. Feather edges on copper seals will be rolled. The actual glass-working processes involved are reasonably straightforward but full scale production of metal glass seals is a specialist job with many mechanical aids. A normal glass-shop can only be expected to produce a limited number of

continued on page 9

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ABSTRACTS

Compiled by S. D. Fussey

CHROMATOGRAPHY

(370) **A continuous chromatography column.**
R. H. Nealy, *Journ. of Chrom.*, 21, 2, 312-313, February 1966.
Information on development and use of column. Diagram. G.H.

(371) **International survey of equipment for gas chromatography. Part I—Gas Chromatographs.**
R. P. W. Scott (Introductory Essay), *Lab. Practice*, 15, 8, 881-905, August 1966.
A world-wide survey of the most recent instruments manufactured for gas chromatography. B.R.W.

DEWARS

(372) **A Tail-Dewar for liquid helium.**
D. J. Kroon, *Journ. Sci. Instr.*, 43, 831, November 1966.
Using a metallic radiation screen in the tail, difference between inner and outer diameter is only 10 mm. Detailed drawing. D.A.H.

FLOW-CONTROL

(373) **A simple flow-sensitive switch.**
H. Bairnsfather, *Journ. Sci. Instr.* 43, 10, 767, October 1966.
A failure warning switch for use on water cooled equipment where flow rates are up to 5 gall./hr. Detailed drawing. D.A.H.

GAS—DISCHARGE

(374) **A gas discharge switch with a cold cadmium cathode.**
R. W. Young, *Journ. Sci. Instr.* 43, 10, 740, October 1966
An argon filled switch with hold off voltage of 12 KV. and passing peak currents of 2,000 amps. Detailed drawing. D.A.H.

GLASS—COATING

(375) **The burning-in of bright platinum on glass.**
G. Jeromin, *G.I.T.* (in German), 10, 8, 697-700, August 1966.
The adherence of burned-in noble metal preparations to glass depends on the cleaning, burning-in temperature, rate of heating, rate of cooling and air flow in the furnace. The influence of these factors on the adherence of platinum to two types of glass is investigated and burning-in instructions given. S.D.F.

(376) **Tin Oxide : What can we do with it.**
H. D. Coghill, *Proc. 11th Annual Symp. A.S.G.S.*, 1966.
The author discusses the preparation of films on glass and silica, electrical, optical, and physical properties, failure mechanisms on glass substrates, uses and possible applications, and concludes that the relative high cost of substrates has prevented these films attaining commercial significance.

GLASS—DECORATING

(377) **Dutch glass artists start a Diamond Engraving Renaissance.**
Isa Van der Zee, and Henric Donia, *Industrial Dia. Rev.* 27, 314, 26-27, January 1967.
Mrs. Isa Van der Zee and an amateur, Henric Donia, are helping to revive popular interest in diamond engraving of glass. This was once a thriving hobby in the Netherlands. W.V.B.

GLASS—FORMING

(378) **A method of producing accurate glass domes.**
G. S. Weaving, *Journ. Sci Instru.*, 43, 9, 641-643, September 1966.
Description of a method of producing small domes from flat discs of glass. The design of the manufacturing jig is discussed and details given of a practical design. Detailed instructions on the manipulation of the jig and glass; the performance of the domes is compared with those made by other processes. S.D.F.

GLASS—GRINDING

(379) **Smoothing down the Sheets.**
P. Daniel, *Indust. Dia. Rev.*, 27, 314, 13-17, January 1967.
At Chance-Pilkington Optical Works glass sheets for aircraft cabin windows are diamond ground on the largest Blanchard vertical spindle machine in the U.K. W.V.B.

GLASS—PROPERTIES

(380) **New developments in Glass Technology.**
G. W. McLellan, *Proc. 11th Annual Symp. A.S.G.S.*, 1966.
This paper describes and gives uses for glasses which respond in various ways to light of different wavelengths. Also gives information on glasses which have been chemically pre-stressed to have strengths of ten times that of normally annealed. Spherical shapes under high compressive stress are used in deep underwater experiments. S.D.F.

GLASS—STRESS MEASUREMENT

(381) **A technique for evaluating and controlling the sealing characteristics of glass.**
H. E. Powell, E. M. Tom, *Proc. 11th Annual Symp. A.S.G.S.*, 1966.
A fast, accurate method of evaluating and controlling the sealing characteristics of production glasses is described. Stress is measured in an annealed, blow-lamp made glass-to-glass seal of the butt type between a sample and reference glass. The method also applies to glass-to-metal seals of similar configuration. Full information is given to make a polarimeter. S.D.F.

GLASSBLOWERS

(382) **The Scientific Glassblower in Petroleum Exploration Research.**
T. J. Weisman, *Proc. 11th Symp. A.S.G.S.*, 1966.
Developments in analytical instrumentation have helped to provide techniques to solve petroleum formation and location problems. The scientific glassblower has played a key role in the development of basic components and speciality apparatus. S.D.F.

SAFETY

(383) **Protective Glasses.**
Manufacturing Optician International, 19, 6, 338-339, December 1966.
Discussion of eye injuries, complications and economic factors of eye protection. S.D.F.

(384) **Nitrogen Dioxide in Glass Workshops.**
Ir. J. H. C. Van Mourik te Eindhoven, *T. Soc. Geneesk*, 45 (1967), 49.
Experiments have shown that increased atmospheric pollution in glass workships by nitric oxide occurs when coke oven gas is replaced by natural gas. The measures necessary to bring the concentration of nitrous fumes back to an acceptable level are indicated. J.R.B.S.

VACUUM—CONTROL

(385) **A constant pressure device.**
C. E. Oxley, J. Stockton, *Journ. Sci. Instru.*, 43, 10, 767, Oct. 1966.
Using a photocell and magnetic valve, this instrument is highly sensitive over the range of 760 Torr to the lower limits of the vacuum pump. Drawing. D.A.H.

VACUUM—GAUGES

(386) **Combination Toepler Pump—McLeod Gauge.**
O. J. Klejnot, J. E. Wreede, *Journ. Vac. Sci. and Tech.*, 3, 5, 288, Sept./Oct. 1966.
A new two-in-one instrument for measuring small gas quantities and pressure. Sketch. S.D.F.

VACUUM MICROSCOPE

(387) **Demountable and Bakeable Glass Field Ion Microscope.**
H. M. Montagu-Pollock, T. N. Rhodin, *Journ. Sci. Instru.*, 43, 9, 667-668, September 1966.
A glass vacuum microscope with demountable screen chamber allowing access to the interior including the specimen, screen, mantle and metal vapour source. Diagram. D.A.H.

VACUUM—VALVES

(388) **Interchangeable Manual and Electromagnetic Operation of greaseless vacuum stopcocks.**
D. Verdin, *Journ. of Sci. Instru.*, 43, 8, 605, August 1966.
A level mechanism is described giving rapid operation of greaseless vacuum stopcocks. May be manually or electromagnetically operated. Diagrams. D.A.H.

VALVES—ELECTRONICS

(389) **The Harp Cathode.**
Gerlach, *Phillips Tech. Rev.*, 26, 10, pp. 309-315, 1965.
Sketches and full description of new valve cathode with warm-up period of only 0.35 secs. S.D.F.

MISCELLANEOUS

(390) **Transfer Apparatus for Degassed Solutions.**
Moreau, Tyler and Weiss, *Jour. of Chem. Educ.*, 43, 8, Aug. 1966.
An all glass sampler which is sealed off the vacuum line after filling and degassing operation. F.G.P.

(391) **Coulometry Series Experiment.**
K. Van Lente, *Jour. of Chem. Educ.*, 43, 6, p. 307, June 1966.
Diagram of iodine, silver and gas coulometers with explanation of experiment. F.G.P.

(392) **Mercury Spillage Prevention.**
T. Carlton, *Jour. of Chem. Educ.*, 43, 6, p. 321, June 1966.
A simple glass adaptor for use when pouring mercury from one bottle to another. F.G.P.

(393) **Liquid Phase Dehydration of Isopropanol.**
D. Mears and J. Benson, *Jour. of Chem. Educ.*, 43, 6, p. 325, June 1966.
Complete description of process with full details of apparatus used. F.G.P.

(394) **Discovery of the Noble Gases and Foundations of the Theory of Atomic Structure.**
J. Frey, *Jour. of Chem. Educ.*, 43, 7, p. 371, July 1966.
Short resume of experiments with Helium, Neon and Radon; also illustration of apparatus for identification of Helium obtained from Radium Bromide. F.G.P.

(395) **Manometric Apparatus for Vapour and Solution Studies.**
Tama, Grigsby, Johnson, Christian and Affsprung, *Jour. of Chem. Educ.*, 43, 8, p. 433, Aug. 1966.
Gas or liquid samples of known mass composition are admitted into a closed system using an apparatus with a fine sintered disc. F.G.P.

(396) **Simple apparatus for investigating fast reactions.**
A. Bhatic, *Lab. Practice*, 15, 11, 1265, November 1966.
A simple device with about one second mixing time for investigating organic reactions. B.R.W.

(397) **A flow-through cell for use with pH meter.**
R. J. Leeming, *Lab. Equip. Digest*, 4, 11, 84, November 1966.
Describes apparatus capable of 200-300 determinations per week. Sketch. B.R.W.

(398) **A small sample cell for spectroscopic investigations over a wide temperature range.**
B. A. Morrow, *Journ. Sci. Instru.*, 43, 7, 487, July 1966.
Constructed from Pyrex—used for examination of solid and gaseous samples: temperature range −196 to + 500°C. Minimises amount of metal in contact with sample. Diagrams. D.A.H.

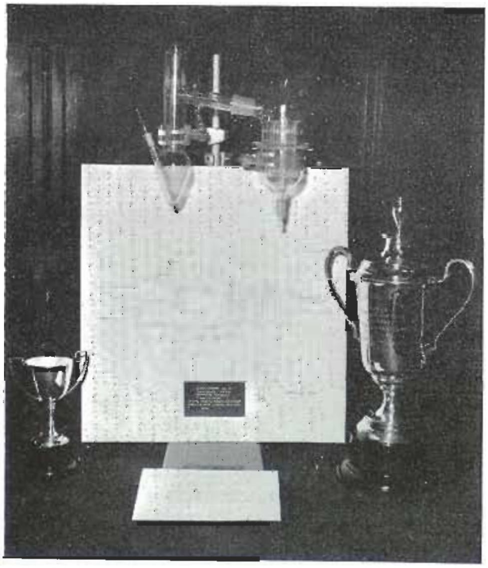
(399) **The fabrication of vacuum-tight, high density polythene cells.**
S. Ashdown, T. F. Crowdy, D. Steele, *Lab. Practice*, 15, 8, 868-9, August 1966.
A simple technique for fabricating cells for infra-red from single sheets of high-density polythene. Sketches. B.R.W.

(400) **Electronic methods of pH Measurement.**
L. W. Price, *Lab. Practice*, 15, 11, 1245-1251, November 1966.
Equipment currently available, electrodes and circuits are discussed together with the possibility of field effect transistors being used as electrometers. B.R.W.

A. D. WOOD CUP AWARD

THIS award is presented for the most outstanding piece of scientific glassware of the year made by a student member with not more than three years' experience in the trade.

Graham Hepburn is 21 years old and has been a member of Fisons Pest Control Research Station for two years.



The Vacuum Jacketed Distillation Apparatus submitted by him was judged to be the best in 1966 and is an excellent example of quality and craftsmanship, demonstrating his natural ability.

Mrs. A. D. Wood presented the cup to Mr. Hepburn at the Leeds Colloquium.

Metal Glass Seals—continued from page 8

types such as platinum, tungsten, molybdenum and Kovar wire and rod seals, Kovar tubular seals, and perhaps an occasional unmatched tubular glass seal. It would be an involved process to give a full survey of the making of all types of seals and the book by J. H. Partridge on *Glass to Metal Seals* is regarded as the standard source of knowledge, and in addition, *Scientific Glassblowing* by E. L. Wheeler, contains much useful information.

However, all scientific glassblowers should be acquainted with the making of tungsten and Kovar alloy seals, in addition to simple platinum and copper coated nickel-iron (Dumet) wire seals which require no special preparation.

Tungsten

Tungsten is available centreless ground, of sealing quality, in wire or rod form in sizes up to 5 mm. To reduce cost short lengths are normally used, to which copper leads are brazed, or units of tungsten welded to braided copper can be purchased ready for use.

The tungsten must be cleaned which is easily done in a D.C. deplating bath with the tungsten as the + ve and nickel — ve using 5 to 40 volts.

The electrolyte is caustic soda of about 10% which is improved by the carbonate which forms on standing. The conditions are not critical and a good polish is easily obtained.

Other methods exist such as boiling in mixed potassium ferricyanide and sodium hydroxide solution, and dipping in fused sodium nitrite the latter now being seldom used.

After cleaning, the tungsten must be washed thoroughly, finishing with distilled water.

It is then oxidised in the oxidising part of the flame and a close fitting sleeve of the chosen sealing glass is melted on, working from one end to the other to avoid trapping gas bubbles.

The oxide before seating must be dark blue in colour (not yellow) and if not enough the resulting seal will be metallic in colour and mechanically weak. If too thick the resulting seal will be black and liable to leak. With a good sealing glass it will be found however. that slight over oxidisation and prolonged heating will form the golden brown required but if grossly over oxidised it is better to discard at this stage. Yellow oxide should be scraped from the tungsten before re-cleaning.

Sleeved wires can be beaded and sealed in singly or jigged in numbers to form a pinch seal, the main condition being that all contours inside and outside must be rounded.

Kovar type

The starting form will be wire, rod or tubing which can be conveniently sliced into lengths with a water-lubricated carborundum disc saw.

As purchased this material is usually unsuitable for sealing and contains traces of carbon products which give rise to bubbles at the seal. The usual procedure is to heat at about 1,100°C in first wet hydrogen and then dry hydrogen for a time which will vary with the material, an average being about 15 minutes each.

This operation should be carried out or repeated immediately before use and care should be taken that the sealing region is not handled or allowed to rest on other materials as the clean metal surface is easily contaminated.

The sealing procedure is again to oxidise and cover with glass and there must be sufficient oxide to give a green grey seal when finished.

Over oxidation is less serious as during making it will be noticed that the surplus migrates to the end of the seal and appears as a black band. Insufficient oxide will give a metallic looking seal which is mechanically weak.

With tubular seals it is customary to glass inside and outside, in which case all sharp corners must be rounded off and the metal polished with aluminium oxide cloth (not emery or carborundum).

There are a number of cleaning processes for finished Kovar seals.

The heavy oxide scale can be removed by boiling in hydrochloric acid. Final polishing can be done electrolytically in hydrochloric acid and common salt or by dipping in a mixture of acetic and nitric acids plus common salt and immediately followed by washing.

Cleaning oxidised copper

First soak in approximately 8% sulphuric acid until all oxide appears red. Transfer to a bath containing strong chromic acid plus a few per cent sulphuric and follow by washing.

Aluminium can also be cleaned in chromic acid.

Sealing glasses

In the list of glasses which appear on pages 15 and 16 a selection of those suitable for various types of metal-glass seals will be found, together with the source of supply.

These notes cover Item No. 7 of the Board of Examiners Syllabus Articles but have not yet been approved. J.H.B.

GRADUATING GLASSWARE

Talk given to the Western Section
by DERRICK JONES
Biochemistry Department, University of South Wales and Monmouthshire

THIS talk was based on processes which are carried out at E-Mil Works, Treforest, Glamorgan, by Messrs. H. J. Elliott Ltd., who co-operated with information on glassware in various stages of production and photographs of operators in action.

Graduating glassware is the process of marking the surface of glass with permanent regular divisions, patterns, and designs, and the established method is by etching the glass with suitable acids. E-Mil have been using this process since 1914, but in recent years many innovations have been introduced which have advantages over older methods and development continues to maintain the lead the firm has established.

The first stage is to calibrate the article to the accuracy required by the particular specification. Specific tolerances are laid down by various Standards Organisations such as the British Standards Specification, The National Physical Laboratory, The American Society for Testing Materials, and International Standards Organisation. In addition large scale users such as Shell and the National Coal Board have their own standards and marks.

There are two main methods of calibrating each item; Volumetric, which is used for most "B" quality work because it allows speed in repetition, and the Gravimetric which is used for class "A" work, where each item is calibrated by the volumetric standards and then checked by weighing. When required, a certificate of guarantee is issued with each item which is also serially numbered and recorded.

The volumetric method ensures rapid measurement, consistent volumes being transferred from all glass "Standards" to the item being calibrated, when the operator after checking the level of the water meniscus, makes a temporary mark on the item with a fine "Brush" dipped in black ink. This brush is made by the operator, from a single human hair set in a small piece of glass tubing which forms a handle, and enables the operator to make a very fine line on the surface of the glass. The articles are then left to drain, and a quality control check is made by inspectors at this stage to ensure that the standards are correct.

The work is then transferred to the waxing department where it is held over a tank of low-melting-point wax which is poured over the article, the excess draining into the tank.

Each piece of glassware is then placed on wooden trays or racks for storage and ease in handling during subsequent operations. The black calibration marks and "paint" maximum and minimum marks on thermometers are visible through the wax.

The wax used consists of 25% beeswax, 50% paraffin wax and 25% micro crystals.

After "waxing," items are selected for scale lengths, that is the distance between the two calibration marks, and these are kept in their respective scale batches, e.g. "A," "B," "C" and "D," etc., which helps to reduce the operator's machine-setting time.

Where a single ring division is required, e.g. graduated flask or bulb pipette, etc., these can often be cut during the calibrating operation using a diamond, but where a customer specifies an etched ring then this can be performed on a hand operated dividing machine where a very fine needle cuts through the surface of the wax to the glass underneath.

Dividing machine

Where many rings and division marks of various lengths and spacings are required, they are formed on Auto-dividing machines. These machines can divide single items or many of the same items at the same time, providing these come within the scale lengths of the particular setting of the machine.

Main graduations encircle the tube, intermediate graduations are three-quarters of the circumference, and minor graduations are half the circumference.

By choosing various cams the number and pattern of the divisions can be varied to suit items of glassware which require a complete ring, half ring or short line.

The glass component is held horizontally by two clamps attached to a metal bed on the machine, and the divisions are cut in the wax by a fine needle, the needle travelling along the length of the glass for the required number of divisions. The thickness of the line being cut is controlled by the type of needle which is periodically changed.

These metal beds allow the glass component to travel to the left or right and the clamps allow the glass to rotate on the bed for rings which encircle the tube. When the divisions are completed the machines stop automatically and are unloaded by the operator who then replaces each item carefully in the special wooden tray or storage racks. When each batch of work is completed, it is transferred to the next operation, after having again been passed by quality control inspectors.

Pantograph

In the next operation figures, customers design marks, trade marks, figures, and other inscriptions are added to the scale by means of a Pantograph machine where the inscribing needle is connected by adjustable links to a heavy needle which follows a much larger inscription cut in a template. The required figuring or lettering is thus reproduced on the waxed surface and in certain cases where simple scales only are required these can be directly pantographed from a template. The process depends on the speed and skill of the operator.

The next operation is that of "scorching." Here each article is examined for damage to the wax surface due to handling and where the machine clamps are positioned. These are re-covered with wax and on the smaller items the open ends are closed with wax. The larger items, e.g. flasks and cylinders, are stuck on special trays coated with wax and the open ends closed with corks or rubber caps. The smaller items are placed in special acid resisting "pots" which can hold up to fifty pieces at a time, and are of varying heights to accommodate the small thermometers or the long graduated pipettes.

After "scorching" the special trays and pots are taken into the etching room for the final operation, which is of the greatest importance because any mistake made at this stage means complete rejection of the article or expensive rectification. Here there is need for careful handling to avoid serious burns and bad work.

Special clothing is worn on hands and feet, plus aprons, and where bare skin is exposed this is treated with vaseline to protect it from possible splashes during dipping.

First, the work is dipped in a large tank of methylated spirits which helps to remove any dust or loose wax cuttings from the dividings, and also overcomes the surface tension of the wax.

The trays are then dipped in the acid tanks for a specified number of minutes, varying with the size of the object and the strength of the acid which tends to weaken with the number of pieces dipped. Fresh acid is mixed at the beginning of each week and tests are made each day to determine the time of immersion in the acid tanks.

After dipping in the acid tanks each item is immersed in soda water tanks and finally rinsed well in troughs of cold running water. Where the special pots are used these are filled with the acid for the specified time then neutralised and rinsed with water.

The larger or special items of glassware, e.g. 1-litre, 2-litre cylinders, etc., are too large for trays and so these are etched one at a time by applying the acid in a paste form with a brush over the figures and dividings. These are left for much longer periods (15-20 minutes) under a fume chamber, after which the acid paste is washed off with cold water.

The acid used is 70% hydrofluoric, (60%) and 30% sulphuric for Borosilicate work, and 100% hydrofluoric (60%) for the soda and lead glass articles. For the paste, the hydrofluoric is mixed with a white barium sulphate powder and painted on.

These trays and all the waxed items are now passed to the de-greasing plant where the pieces are removed from the trays and placed in large or small wire mesh baskets depending on their size. These baskets are then placed in large heated vapour tanks of trichloro-ethylene. The wax runs off to be collected in large trays and subsequently returned to the waxing department.

While the articles in the baskets are still quite hot they are taken out of the degreasing tanks and fully immersed in steam-heated tanks of sulphuric acid and water where they are kept for several minutes after which they are given a final rinse in a tank of running hot water. The articles are then taken out of the baskets and placed in containers and allowed to dry.

Some small bore items, e.g. blood pipettes, graduated pipettes, etc., are dipped in tanks of clean acetone to speed up the drying.

When the batches of items are dry they are passed to operators for colouring with the specified colour according to the type of glassware or the customers specification. These colours are made from special powders and mixed to a thick paste by the operators and then applied to the etched surfaces of the glass with small pads. After a short period the operator cleans off the surplus with clean tissues and the figures and dividings remain filled. For some items of glassware a ceramic filling can be used in the same way, but after removing the surplus paste the articles can be fired in an oven when the colour then becomes a permanent part of the glass. These colours have been thoroughly tested and will stand repeated sterilisation.

Only a strict final inspection remains to check all graduations and pantographing, or any other physical defect which can interfere with the performance of the article; if these defects are small, in some cases they can be "touched up" but this is kept to a minimum, and where large numbers are found to be defective, the fault is traced and rectified. This helps to maintain the high standard and quality of this type of product.

SECTION ACTIVITIES

Southern Section

The Section Annual General Meeting was held on 18th January, 1967 and although the attendance was disappointing (20), it was an improvement on the previous year.

It was reported that the system of sending out ballot forms had produced no response from members other than the Section Chairman and Chairman of Council, and during the discussion which followed some interesting points were raised by younger members. It is hoped that they will continue to support meetings and bring their colleagues. The Chairman thanked the 1966 committee and special votes of thanks were given to Miss Firth of Fisons Ltd., and Mrs. Lenton of Queen Elizabeth's College for their invaluable assistance during the past year.

The following officers and committee were re-elected for 1967 :

Chairman : T. Parsell
Secretary : E. White
Treasurer : L. Benge
Auditor : W. Brench
Councillor : D. Smith
Committee : Messrs. F. Branfield, E. Evans, A. Price, G. Zambit, I. C. P. Smith, R. Reader, D. Smith.

Following the meeting Mr. I. C. P. Smith gave a very enlightening talk on "Flanges" and in consequence the meeting continued till after 10 p.m. He covered the principles of good design in flange making both by hand and using carbon formers, and a method of testing the fit by using a conventional flow meter was of particular interest. He has promised to make this paper available for publication in the Journal in the near future. The talk was well received and we would once again like to record our appreciation of Mr. Smith's service to the Society. The formation of the East Anglian Section by Ted Evans will take away some very active members from the Southern Section, including Miss Firth, but nevertheless we wish them every success.

Future section meetings will continue as in the published programme. A. PRICE

Thames Valley Section

The 1967 Symposium Committee has held six meetings and the progress to date was reported to the section at the general meeting held at Oxford on 6th December, 1966.

It is hoped that every member of the Valley Section will contribute something to the symposium; particularly welcome will be the reading of a paper or giving a demonstration of a glassblowing technique.

On 5th January, the section held its A.G.M. at which the following officers were elected:

Chairman: J. S. Macdonald
Secretary: M. Noad
Treasurer: D. Henson
Councillor: J. Price
Representatives on Council: Messrs. J. S. Macdonald, M. Noad
Committee: Messrs. D. Saxton, T. Davies, P. Brook.

The A.G.M. was a brief one and immediately following it, Mr. B. Brown of A.W.R.E. gave a lecture, "Optics and Cameras". He described methods of using light from an object to get an image, starting with a pinhole camera, then a camera fitted with a simple meniscus lens, through to modern multi-lens miniature cameras. Included in the talk was a description of many types of viewfinders and rangefinders, together with a discussion of the various aberrations which the lens designer must attempt to eliminate.

This interesting lecture certainly helped the audience to understand a great deal more of what happens when the camera shutter clicks. IMP.

Western Section

At a well attended meeting on 25th November, 1966 Mr. F. Porter of the Chemistry Dept., Bristol University, gave demonstrations of three test pieces listed in the Examination syllabus. In the first the sealing of sintered discs into "Pyrex" tubes was shown, both by hand for the smaller sizes and using the lathe for larger ones. He mentioned the need for careful preparation of the edges and speed during the sealing to avoid closure of the pores.

This was followed by the sealing of ground and polished windows to the ends of tubes, the operation being carried out horizontally in a glassworking lathe using a sprung carbon point to hold the window in position. Mr. Porter described stages in polishing and their method for checking optical flatness together with the need for careful trueing of the tube end and cleaning the window before sealing. Mr. K. Tindall of the Physics Department recorded the operation on 16 mm. colour film.

In the third demonstration the requirements for making satisfactory bellows were outlined following which a series of six convolutions were tooled in a piece of thin walled tubing.

On 2nd January, 1967 the Section A.G.M. was held at the H. H. Wills's Physics Laboratory. The attendance was poor (8) but reports were read from the Chairman, Mr. Garrard; the Secretary, Mr. Spear; the Treasurer, Mr. Jones; and Mr. Porter, Council member and Editor of *Revue*. For 1967 the officers are:

Chairman: R. Garrard
Secretary: R. C. Perkins
Treasurer: D. A. Jones
Committee: Messrs. F. Porter, K. Lyons, E. Spear; a fourth is to be co-opted later.

A resolution was passed that any two full members of the section be elected as Council representatives and a request has been sent out for nominations.

A short discussion took place on entry to the Society by examination but as little information was available and the subject was to be covered by a Society questionnaire, no conclusions were recorded.

The Jobling Evening took place on 30th January and is reported on page 3. J.H.B.

North-Western Section

The A.G.M. took place at the Training Centre of Joseph Crossfield & Sons Ltd., on Friday, 18th November, and the following officers for 1967 were elected:

Chairman: L. Elson
Secretary: J. Stockton
Treasurer: C. Blackburn
Asst. Treasurer: J. Kay
Committee: Messrs. J. Edkins, E. Mears, J. Kember, E. Burgess, Van de Bospoort.
Representatives to Council: Messrs. J. Stockton and J. Edkins.

On Friday, 16th December following a business meeting of the Section two descriptive films relating to the manufacture of glass were shown. Messrs. Pilkington are thanked for the trays and so these are etched one at a time by applying the acid in a paste form with a brush over the figures and dividings. These are left for much longer periods (15-20 minutes) under a fume chamber, after which the acid paste is washed off with cold water.

The acid used is 70% hydrofluoric, (60%) and 30% sulphuric for Borosilicate work, and 100% hydrofluoric (60%) for the soda and lead glass articles. For the paste, the hydrofluoric is mixed with a white barium sulphate powder and painted on.

These trays and all the waxed items are now passed to the de-greasing plant where the pieces are removed from the trays and placed in large or small wire mesh baskets depending on their size. These baskets are then placed in large heated vapour tanks of trichloro-ethylene. The wax runs off to be collected in large trays and subsequently returned to the waxing department.

While the articles in the baskets are still quite hot they are taken out of the degreasing tanks and fully immersed in steam-heated tanks of sulphuric acid and water where they are kept for several minutes after which they are given a final rinse in a tank of running hot water. The articles are then taken out of the baskets and placed in containers and allowed to dry.

Some small bore items, e.g. blood pipettes, graduated pipettes, etc., are dipped in tanks of clean acetone to speed up the drying.

When the batches of items are dry they are passed to operators for colouring with the specified colour according to the type of glassware or the customers specification. These colours are made from special powders and mixed to a thick paste by the operators and then applied to the etched surfaces of the glass with small pads. After a short period the operator cleans off the surplus with clean tissues and the figures and dividings remain filled. For some items of glassware a ceramic filling can be used in the same way, but after removing the surplus paste the articles can be fired in an oven when the colour then becomes a permanent part of the glass. These colours have been thoroughly tested and will stand repeated sterilisation.

Only a strict final inspection remains to check all graduations and pantographing, or any other physical defect which can interfere with the performance of the article; if these defects are small, in some cases they can be "touched up" but this is kept to a minimum, and where large numbers are found to be defective, the fault is traced and rectified. This helps to maintain the high standard and quality of this type of product.

SECTION ACTIVITIES

Southern Section

The Section Annual General Meeting was held on 18th January, 1967 and although the attendance was disappointing (20), it was an improvement on the previous year.

It was reported that the system of sending out ballot forms had produced no response from members other than the Section Chairman and Chairman of Council, and during the discussion which followed some interesting points were raised by younger members. It is hoped that they will continue to support meetings and bring their colleagues. The Chairman thanked the 1966 committee and special votes of thanks were given to Miss Firth of Fisons Ltd., and Mrs. Lenton of Queen Elizabeth's College for their invaluable assistance during the past year.

The following officers and committee were re-elected for 1967 :

Chairman : T. Parsell
Secretary : E. White
Treasurer : L. Bengo
Auditor : W. Brench
Councillor : D. Smith
Committee : Messrs. F. Branfield, E. Evans, A. Price, G. Zambit, I. C. P. Smith, R. Reader, D. Smith.

Following the meeting Mr. I. C. P. Smith gave a very enlightening talk on "Flanges" and in consequence the meeting continued till after 10 p.m. He covered the principles of good design in flange making both by hand and using carbon formers, and a method of testing the fit by using a conventional flow meter was of particular interest. He has promised to make this paper available for publication in the Journal in the near future. The talk was well received and we would once again like to record our appreciation of Mr. Smith's service to the Society. The formation of the East Anglian Section by Ted Evans will take away some very active members from the Southern Section, including Miss Firth, but nevertheless we wish them every success.

Future section meetings will continue as in the published programme. A. PRICE

Thames Valley Section

The 1967 Symposium Committee has held six meetings and the progress to date was reported to the section at the general meeting held at Oxford on 6th December, 1966.

It is hoped that every member of the Valley Section will contribute something to the symposium; particularly welcome will be the reading of a paper or giving a demonstration of a glassblowing technique.

On 5th January, the section held its A.G.M. at which the following officers were elected :

Chairman : J. S. Macdonald
Secretary : M. Noad
Treasurer : D. Henson
Councillor : J. Price
Representatives on Council : Messrs. J. S. Macdonald, M. Noad
Committee : Messrs. D. Saxton, T. Davies, P. Brook.

The A.G.M. was a brief one and immediately following it, Mr. B. Brown of A.W.R.E. gave a lecture, "Optics and Cameras". He described methods of using light from an object to get an image, starting with a pinhole camera, then a camera fitted with a simple meniscus lens, through to modern multi-lens miniature cameras. Included in the talk was a description of many types of viewfinders and rangefinders, together with a discussion of the various aberrations which the lens designer must attempt to eliminate.

This interesting lecture certainly helped the audience to understand a great deal more of what happens when the camera shutter clicks. IMP.

Western Section

At a well attended meeting on 25th November, 1966 Mr. F. Porter of the Chemistry Dept., Bristol University, gave demonstrations of three test pieces listed in the Examination syllabus. In the first the sealing of sintered discs into "Pyrex" tubes was shown, both by hand for the smaller sizes and using the lathe for larger ones. He mentioned the need for careful preparation of the edges and speed during the sealing to avoid closure of the pores.

This was followed by the sealing of ground and polished windows to the ends of tubes, the operation being carried out horizontally in a glassworking lathe using a sprung carbon point to hold the window in position. Mr. Porter described stages in polishing and their method for checking optical flatness together with the need for careful trueing of the tube end and cleaning the window before sealing. Mr. K. Tindall of the Physics Department recorded the operation on 16 mm. colour film.

In the third demonstration the requirements for making satisfactory bellows were outlined following which a series of six convolutions were tooled in a piece of thin walled tubing.

On 2nd January, 1967 the Section A.G.M. was held at the H. H. Wills's Physics Laboratory. The attendance was poor (8) but reports were read from the Chairman, Mr. Garrard; the Secretary, Mr. Spear; the Treasurer, Mr. Jones; and Mr. Porter, Council member and Editor of *Revue*. For 1967 the officers are:

Chairman : R. Garrard
Secretary : R. C. Perkins
Treasurer : D. A. Jones
Committee : Messrs. F. Porter, K. Lyons, E. Spear; a fourth is to be co-opted later.

A resolution was passed that any two full members of the section be elected as Council representatives and a request has been sent out for nominations.

A short discussion took place on entry to the Society by examination but as little information was available and the subject was to be covered by a Society questionnaire, no conclusions were recorded.

The Jobling Evening took place on 30th January and is reported on page 3. J.H.B.

North-Western Section

The A.G.M. took place at the Training Centre of Joseph Crossfield & Sons Ltd., on Friday, 18th November, and the following officers for 1967 were elected :

Chairman : L. Elson
Secretary : J. Stockton
Treasurer : C. Blackburn
Asst. Treasurer : J. Kay
Committee : Messrs. J. Edkins, E. Mears, J. Kember, E. Burgess, Van de Bospoort.
Representatives to Council : Messrs. J. Stockton and J. Edkins.

On Friday, 16th December following a business meeting of the Section two descriptive films relating to the manufacture of glass were shown. Messrs. Pilkington are thanked for the loan of these, questions on which were answered by Mr. P. Atkinson.

Other meetings have been arranged as follows:

20th January. Gadgets and Gimmicks.

4th April. Visit to Pilkington Bros., St. Helens.

7th April. Burners and Flame Technology: R. Cescotti, W.S.A. Ltd.

21st April. Job Costing: Mr. H. Stuart.

27th April. Visit to Glass Tubes and Components Ltd.

8th June. Visit to Wedgewood Ltd., Stoke-on-Trent.

J. STOCKTON

East Anglian Section

Over fifty applications have now been received with regard to the formation of this section. An inaugural meeting for this purpose will be held on Friday, 21st April, 1967, at 7.30 p.m. at the Clubhouse of Fisons Pest Control Ltd., three miles south of Cambridge.

E. G. EVANS

LETTER TO THE EDITOR

Dear Sir

I feel that I must write to you and put the other side of the education dispute as I understand that a few members are trying to stampede the society into changing the educational policy through groundless fears and a reluctance to accept any kind of change, even if it is for the better. If the Society is to fulfil its aims as stated in the rules under objects of the Society, rules 2.1, 2.2, 2.5 and 2.6 are especially relevant.

I am a member of the Board of Examiners and can assure you that a lot of diligent thought and time has been given to the instigation of these tests, which after all were voted on at the last A.G.M. I would be the last one to continue with something that was proved to be useless or harmful to the Society, but this has not been proved, and six months is not long enough for us to form an opinion. It is not too difficult for armchair statisticians to juggle with the figures and make them come out any way they want, but if the society is to mean anything in the future the members must stick to their guns now, and retain this certificate, for although this is a very simple test it is our reference point, from here we can go on to higher qualifications. We must start somewhere and I do not think that it is a great hardship to ask a man who wants to join us to take a simple test even if he has been glassblowing for 20 years, with that much experience he should be able to do the test with the greatest of ease.

At this point I would like to clarify a remark made by a previous correspondent on this subject. The Board of Examiners have been delegated a very important task to perform, they have carried out this task to the best of their ability and in a correct manner, taking their orders from and reporting back to Council.

Never before has there been any inference that all is not well, or that a close watch should be kept upon them in the event of their behaviour being detrimental to the Society's policy.

Finally, I should like to point out that these are my personal views and like your previous correspondent on this subject, do not necessarily represent those of my section.

J. S. MACDONALD

BOARD OF EXAMINERS

THE Board of Examiners held a meeting at the University of Aston in Birmingham on Saturday, 19th November, 1966.

Final drawings for the Certificate of Competence practical test were accepted. A basis for standardisation in marking was agreed and a marking sheet was also drawn up.

Similar work was done for the "Introduction to Elementary Scientific Glassblowing" course.

A short time before this meeting was held arrangements were made to conduct the first examination for the Certificate of Competence.

A. D. Wood and Jobling Cup

Arrangements are in hand to have the replica cups engraved with the names of the winning candidates and the year in which they were won. A small strip or shield engraved with the winner's name will be affixed to each of the annual cups.

In case the previous notice was not adequate it is pointed out that these competitions will take place annually and it is hoped that more student members will receive encouragement from their senior colleagues to make up entry pieces.

N. H. COLLINS

Hon. Secretary to the Board of Examiners

27th November 1966

GLASSES

THE following survey of glasses, mainly of British origin, is intended to be a guide to scientific glassblowers of the range available and sources of purchase.

It will be found that each particular glass has its own merits and it would be unwise to draw comparisons between glasses of a particular type.

For example, no two tungsten sealing glasses are identical in their working properties and the choice will vary according to conditions of use.

It must also be appreciated that glass manufacturers in many countries throughout the world make similar ranges of glasses with almost identical compositions and most are dealt with in the book *Technical Glasses by S. M. Volf*, published by Isaac Pitman.

A few well-known Corning glasses are also included in the list though these are not readily available in England.

Glass	*Use*	*Expansion Coefficients* $\times 10^{-7}$	*Annealing Temp.* °*C*	*Softening Temp.* °*C*	*Forms*
Thermal Syndicate Ltd., Wallsend, Northumberland					
Fused silica ...	High temperature optical, u.v. and i.r. transmission	5.4	1,150 approx.	1,590 approx.	B T R P C M
J. A. Jobling, Wear Glass Works					
Pyrex	General	32	560	820	B T R P
British Heat Resisting Glass Co., Bilston, Staffs					
Phoenix	General	32.4	520	820	B T R C P
Plowden and Thompson Ltd., Stourbridge					
Dial 444 soda ...	General lamp	88	510 upper		T R
Kodial	Fe, Ni, Co, sealing ...	49	540 upper	700	B T P R
Dial 43	Int. Kodial-Bluesil ...	42	560 upper	—	T R
Bluesil	Tungsten sealing ...	37.5	570 upper	—	T R
L1	Platinum sealing ...	91	430	—	T
John Moncrieff Ltd., Perth, Scotland					
Monax	General	44	—	—	B T R
M.V.J.	Combustion	36	—	760	Tubing
Corning Glass Works, Corning, N.Y.					
Pyrex 7740 ...	General	32.5	565	820	All forms including sheet
Vycor 7900 ...	General high temperature	8	910	1,500	B T R P M
Nonex 7720 ...	Tungsten sealing ...	36	525	755	B T P R
Uranium 3320 ...	Tungsten sealing ...	40	540	780	T R

Whitefriars Glass Ltd.

Thermometer tubing, full lead crystal, soda lime and borosilicate tubing.

Wood Bros. Glass Co.

Firmasil borosilicate, hard flint petri dishes, etc.

"Bishops Adamant," St. Helens

Borosilicate gauge glass, plain and red stripe.

Glass	*Use*	*Expansion Coefficients* $\times 10^{-7}$	*Annealing Temp.* °*C*	*Softening Temp.* °*C*	*Forms*
Glass Tubes and Components Ltd., Chesterfield					
Q5 Silica	Lamp and general ...	5	—	—	T
B 37	Tungsten sealing ...	37.5	525	775	B T R P S G
A 43	Mercury vapour lamps	430	750	950	B T P S
B 47	Iron nickel cobalt sealing	48.5	490	715	B T P G
B 53	Iron nickel cobalt sealing	51	530	740	B T P
L 92 Lead ...	Lamp tubing	90	435	630	B T R
S 96		92	530	710	Machine made bulbs
S 97	Hand working	96	520	710	B T R P
X 115	Compression seal with iron	112	480	660	Windows
X 128	Matching seal to iron ...	120	450	625	B T P
X 150	Copper sealing ...	148	450	570	G T S
GS 10	Sealing silica to GS 20	10	750	1,210	R
GS 20	GS 10 to GS 25 ...	20	730	1,190	R
GS 25	GS 20 to GS 30 ...	25	690	1,150	R
GS 30	GS 25 to B 37 or Pyrex	30	640	1,075	R
GS 44	B 37 or Pyrex to GS 50	42.5	550	790	T
GS 50	GS 44 to GS 65 ...	49	520	770	T
GS 65	GS 50 to GS 77 ...	64.5	535	745	T
GS 77	GS 65 to GS 85 ...	75	550	720	T
GS 85	GS 77 to S 96 ...	83	540	710	T
X 49 Bk	Solder seals to B 47 ...	48	500	—	G
X 76	Solder seals	76	—	—	G
X 88	Solder seals to Mica ...	88	—	—	G

G.E.C., Osram Glass Works, Wembley

Range now replaced by G.T.C. glasses.

Key

B = Bulbs	M = Multiform	P = Pressings
C = Castings	S = Sinters	R = Rod
G = Granular	T = Tubes	

This list will be amended as additional information is available. J.H.B.