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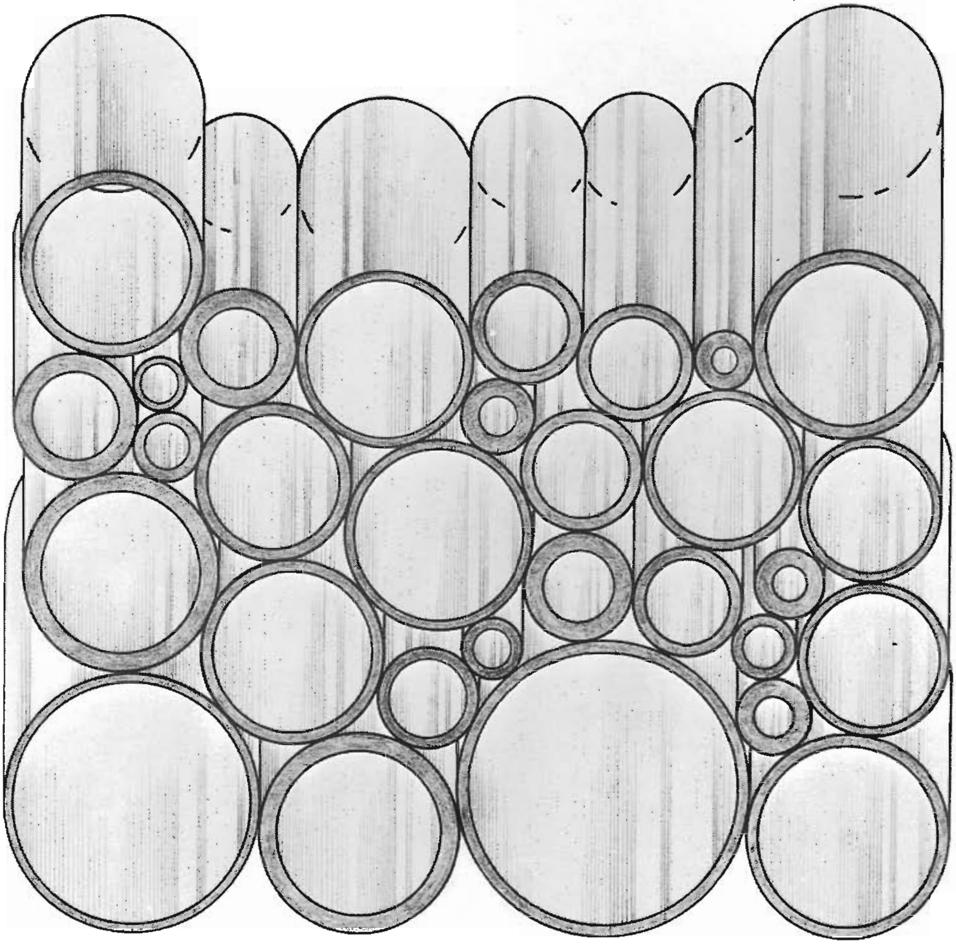

British Society of Scientific Glassblowers

Founded 1960

President: Mr. STAFFORD SCHOLES

Vol. 13 APRIL 1975 No. 2

EDITORIAL STAFF

R.E. Garrard, F.G. Porter. Journal of the B.S.S.G. School of Chemistry, University of Bristol.

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OVERSEAS MEMBERS AND VISITORS

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

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

The Journal is published quarterly by the B.S.S.G. and is available free to members and at £1.00 per copy (or £4.00 per annum, airmail extra charge) to non-members. A limited number of back copies are available.

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TWO CENTURIES OF FLAT GLASS MANUFACTURE

Miss P.A. Pemberton
Group Archivist,
Pilkington Brothers Ltd.

My subject is the last two hundred years in the history of flat glass – on the face of it one of the less fascinating aspects of the history of glass but one that becomes more and more interesting as you look into it. I have chosen the last two hundred years for, while window glass has been known since Roman times and glass mirrors from the sixteenth century, it is just two hundred and one years since the great cast plate glass works was established at Ravenhead near St. Helens, the first cast plate glass works outside France, and crown window glass was at the height of its popularity.

At the end of the eighteenth century there were these two basic types of flat glass, plate and window glass. Plate glass was the luxury product, distortion free, with polished parallel surfaces in sizes up to 5' x 4' in the early days. Its prime use was for mirrors but it was also used for specialised glazing including shop windows towards the end of the nineteenth century and, of course, automobile windscreens in the twentieth. Window glass, on the other hand, was not of as high a quality, it had marked distortion and the metal quality was often far from good. But it had the great advantage that it was cheap. There was a third type of flat glass, cathedral/rolled patterned glass, which appeared in the nineteenth century, a thin, translucent glass at first merely obscured but later patterned, but plate and window glass were by far the most important.

I will first look at the points which plate and window glass had in common before turning to their quite different manufacturing processes. The raw materials were basically the same although quality standards were much higher in the case of plate. To take St. Helens as an example, the Shirdley Hill sand deposit which stretches from St. Helens to Southport is suitable for bottle and window glass but its iron content made it unsuitable for plate. Plate sand was brought from Alum Bay in the Isle of Wight, King's Lynn in Norfolk, Loch Aline in Scotland and the Muckish Mountains in Ireland. Two centuries ago, before the development of artificial soda, the flux was an impure soda ash obtained from kelp seaweed picked by women on the coasts of Ireland and Scotland or, in the case of plate, a rather purer compound obtained from the barilla or salt wort plant imported from Alicante in Spain. Limestone as the source for lime, the stabiliser, has remained unchanged.

These raw materials together with decolourisers and other special additives were melted together in refractory clay pots holding, in the case of plate glass, up to a ton of molten metal. The pots were ranged around a circular coal-fired reverbatory furnace. Openings in the furnace wall allowed the pots to be filled and the founded and refined glass removed for working.

From the reign of James I glassmaking was very much a coal-based industry. A proclamation of 1615 forbade the use of wood fuel for glass furnaces in the interests of providing wood for the British Navy. The glassmakers had to leave their traditional sites and move in search of coal — hence Stourbridge with fireclay and cheap coal; Newcastle with coal, fireclay and coastal shipping which could use the Norfolk sand as a return voyage ballast from London; Bristol with coal and the second largest English port after London; and St. Helens with local coal, sand, and water transport provided by the Sankey Canal opened in 1750.

Once the glass was melted, refined and ready for working, the subsequent manufacture of plate and window glass differed considerably: plate was cast and later flowed, window glass was first blown and later drawn. I will deal with window glass first.

At the end of the eighteenth century and well into the nineteenth most British window glass was produced by the crown process. The glassmakers worked in teams of four. The first was the gatherer who, using a previously warmed pipe 6 feet long, 1¼" in diameter and with a ½" bore, slightly cone shaped at the gathering end, would gather sufficient metal to make an average crown table 52" in diameter, that is to say, 13 to 14 lbs. The metal would be gathered directly from the pot in the furnace. A ring of fireclay floated on the surface of the pot and it was this area only which the skimmer would keep clear of scum and dirt and from which the gather would be made. Often two or more gathers were necessary to obtain sufficient metal. The gatherer would then shape the gather on a marver or flat slab of marble so that it had a conical form, the point ultimately becoming the bullion or bull's eye in the crown table. At the same time a boy blew forcibly down the pipe to create a small air bubble.

The blowing iron was then passed to the blower who reheated it before commencing the blow in earnest. It was always important to keep the bullion point in line with the axis of the pipe and to this end a bullion cup was developed. Resting the iron on a horizontal bar the blower shaped the metal to resemble an enormous decanter with a flat bottom and a large neck. An attendant then attached the punty or solid iron rod to the bullion point in the centre of the flat base and the blowing iron was cracked off. The piece was then subjected to intense reheating before being rotated on the punty at the greatest possible speed opening it into a large disc with the bullion at the centre. When complete the table was carried to an annealing kiln to be stacked on edge, the bullion serving to keep surfaces apart, for an annealing period of 24 to 48 hours. A kiln would hold 350 to 400 tables. Each "journey" or shift lasted 16 hours in which the team of four would make 6–800 tables. There were three journeys a week.

In the warehouse the crown table was cut into the most economical sizes determined after careful inspection, for defects. There were 7 classes: best (which was very rare), seconds, thirds, fourths, CC, CCC (or Irish) and Coarse. There were many possible defects — badly melted seedy glass; blisters caused by air bubbles formed during blowing; dust from the blowing iron nose; dust from the marver; dust from the furnace; bad bullions; music line scratches; or the glass could be crizzled, curved, bent, hard, smokey, too small or too light! It is not surprising that tables of the best quality were few and far between.

The nature of crown glass manufacture explains the necessity for the small leaded panes so popular in Georgian and Regency architecture. The process was very wasteful – the central bullion (which has since staged a revival) and the curved segments at the edge, all went for cullet. However, the brilliant fire finished surface was one reason why crown glass remained dominant so long in Britain when another process making much larger, though duller surfaced, sheets of glass was well established on the Continent. The other main reason was the peculiarity of the British glass excise levy which was finally abolished in 1845. Excise duty on glass was levied by weight but the glass was sold by size and quality. It was, therefore, in the glassmakers interest to make the glass as thin as possible, thereby paying the least possible duty. It was much easier to blow a thin crown table than to blow a thin sheet cylinder.

The manufacture of blown cylinder sheet glass was introduced to Britain in 1832 by Lucas Chance at his Crown Glass Works, Spon Lane, Smethwick near Birmingham. The technique, together with several teams of French workmen, was imported from the glassworks at Choisy-le-Roi, near Paris, under the supervision of the French master glassmaker, Georges Bontemps. For the first eight years, it remained very much a Chance product but in 1840, after the development of a polishing technique to improve the surface, the manufacture was taken up by Pilkington in St. Helens and Cooksons on Tyneside.

At the beginning of the blown cylinder process the gather was made much as for crown glass with the weight of metal varying from 8–9 lbs to 35 lbs depending on the final substance required. The blowing iron was shorter and lighter than for crown. The gatherer placed the blowing iron in an iron fork and forced the metal back to the end of the pipe. The "piece" was then laid in the hollow in a block of wood of the shape ultimately needed, partially filled with water. The piece was turned until it took the shape of the block. The water was supplied from a sponge and though it boiled on contact with the glass it did not crack or injure it, serving rather as a lubricant to preserve the surface.

The blower then took over and by a combination of blowing and blocking produced a shape rather like a short and very squat bottle with a thick bottom. The piece was then carried to a blowing furnace, a long narrow reverbatory furnace with round holes 14 inches in diameter on either side, one for each workman. Opposite each hole and at right angles to the furnace, were long, narrow, deep openings in the floor called 'graves' or 'swingholes'. The glassmaker stood at the end of the swinghole, re-heated his piece in the furnace, then swung it like a pendulum in the hole, sometimes blowing, sometimes re-heating, and occasionally rotating it above his head. The piece gradually lengthened into a cylinder of the diameter determined originally by the block.

Having obtained the cylinder the next operation was to open the end. With thinner glass the end of the cylinder was re-heated while at the same time air was blown into the pipe which was then blocked. The end of the cylinder swelled then burst. It was then widened to the diameter of the rest of the cylinder by rotation. In the case of thicker glass, a lump of very hot metal was attached to the end and at the same time pierced by a pair of pointed shears, and the ragged edges cut off.

The cylinder was laid on a wooden horse or chevalet and the pipe detached by the touch of cold iron or steel. The remaining cap was removed by a combination of a hot thread of glass and a cold iron. After cooling the cylinder was split open lengthways by a diamond attached to a long wooden handle and guided by a wooden rule. It was then passed to the flattener who pushed it, by means of a croppie or iron instrument, into the flattening kiln. The kiln was in two parts, a small and very hot chamber connected by a long tunnel to a large rather cooler one. The cylinder, 'slit' uppermost, was placed in the hotter chamber on the stone floor which had been covered by a lagre or large sheet of glass. In the heat, the cylinder softened and unrolled. The sheet was then rubbed down by a piece of wood the size of a brick attached to a long iron rod. When flat, the cylinder and lagre together were pushed down the tunnel to the cooler or annealing chamber where the cylinder was piled and the lagre pushed back into the hot furnace for the next cylinder.

The sheets of cylinder glass were much larger than the panes of crown glass averaging 41" x 31" — but the surface which resulted from flattening could not compare. Here is a description of the difficulties to be encountered, taken from a lecture given by Henry Chance to the Society of Arts in 1856:

"Sheet glass, blown by a less complex process than crown, is liable in the glass-house to a less number of defects, but the after process of flattening often makes up the deficiency; and the manner in which a sheet, spared by one process, is disfigured by another, is sometimes curiously provoking. Standing before the table of the "assorter", your eye lights upon a piece which, blown under an evil star, has imbibed in the glass-house every possible defect. The founder, skimmer, gatherer, and blower, have all stamped their brand upon it. It is seedy — the vesicles, which were in the crown tables rounded by the rotary motion of the piece, here elongated by the extension of the cylinder; it is stony, disfigured with stony droppings from the furnace; stringy, thin threads of glass meandering over its surface; "ambitty", covered with stony speckles, symptoms of incipient devitrification; conspicuous with gatherers' blisters and blisters from the pipe — badly gathered; badly blown — thin here, thick there, and grooved with a row of scratches; and on this abortion the flattener chances to have exerted his most exquisite skill; it has passed through his hands unscathed, flat as a polished mirror, yet, from its previous defects, entirely worthless. Next comes before you a piece whose beginning was miraculous — no seed, no blisters; it prospered under the hands of the gatherer and blower, and left the glass-house a perfect cylinder. But the croppie of the flattener marked it; the fire scalded it; dust fell upon the lagre, and dirtied it; scraps from the edges of the preceeding cylinder stayed upon the lagre, and stuck to it; the stone scratched it; and the heat of the annealing chamber bent it. Such are the difficulties to which every cylinder is subject — those of the glass-house, and those of the flattening kiln. Not all, however, are such as these — there are good as well as bad, but the good are generally in the minority."

The great popularity of sheet in the 1840s followed upon the development by James Chance of a method of polishing thin sheet glass. The excise law stated that sheet glass must be less than 1/9" in thickness otherwise it was taxed at the higher plate rate. Traditional methods of polishing would break the glass as it was so flexible. James Chance used wet leather as the bedding material (rather than plaster of paris) – two sheets of glass so bedded were rubbed one upon the other with emery or burnt copperas between, vastly improving the surface. The resulting improved polished sheet was confusingly known as patent plate.

The larger sheets of glass coincided with the use of iron in the great architectural works of the Victorians. Apart from larger windows with larger sheets of glass, glass-houses and conservatories appeared all over the country. And the greatest glass house of all was the Crystal Palace of 1850. The million square feet of 49" x 10" panes were blown by Chance Brothers over and above normal production.

At the same time James Hartley developed a method of casting twin plates of glass which had an obscured surface after rolling – a process basically similar to cast plate glass but much cheaper. This glass was used wherever transparency was not important or even disadvantageous – for example the great Victorian railway termini. This was rolled glass to which I will return.

The blown cylinder sheet remained the basis of the window glass industry into the twentieth century. Modifications were introduced: the "bicycle" which took the weight of the swinging cylinder and later compressed air. From the 1890s all sheet manufacturers in Britain, on the Continent and in the United States sought improvements if not radical change. In the 1870s tanks had superseded pots, putting the industry on a continuous shift basis but a way was needed to make cheap flat glass flat from the beginning.

In the meantime, Pilkington in England introduced the mechanical drawn cylinder from the United States. The glass was ladled from the tank into a shallow reversible pot – sufficient metal to make one cylinder. A flanged metal disc (or "pipe") on the end of a long blowpipe was lowered into the pot then drawn up between guiding shafts, taking the glass with it. Compressed air, passed through the blowpipe, was blown in at such a rate as to maintain a constant diameter. By this method a cylinder of glass between 25 feet and 40 feet could be drawn, 24" – 30" in diameter. The huge cylinders were detached both from the blowing pipe and the pot and lowered on to chevals to be split, flattened and annealed.

Much larger sheets of glass were produced but it was only fifteen years after its introduction in 1909 that drawn cylinder finally replaced blown cylinder at the quality end of the market. But drawn cylinder was still flat glass made in the round. British sheet manufacturers were under severe competition from the Continentals who had developed the Fourcault process of flat drawing.

Then in 1931 Pilkington adopted the Pittsburgh flat drawn process from the United States and drawn cylinder was gone within two years. In the Pittsburgh process the molten glass is drawn directly from the tank. A bait in the form of an iron grill is lowered into the tank directly below the drawing tower, and, when the metal adheres, it is raised slowly upwards drawing a continuous sheet of glass. The ribbon of glass, when drawn up vertically, has a tendency to "waist". This is overcome by introducing water-cooled knurled rollers just above the level of the glass in the tank. As the ribbon of slowly cooling glass rises it is gripped by a series of these rollers in pairs until it is sufficiently rigid to overcome waisting. The drawing tower, 30 feet in height, acts also as the annealing chamber. At the top of the tower the glass is gripped by vacuum sucker transporters and cut from the ribbon into standard sizes for the warehouse. The average sheet tank holds about 1200 tons of glass and makes about a million square feet of glass per week – the greater part of it for domestic glazing.

I will now leave sheet window glass in 1974 and return to plate. Whereas crown and sheet glass factories were, in the early days, fairly small concerns requiring relatively little capital, plate glass has always been on the grand scale requiring capital for machinery, furnace halls and grinding and polishing engines. In the eighteenth century, cast plate glass used for mirrors was an imported luxury product. The glass was made in France, the greater part of it at the two factories of St. Gobain.

In 1773 a group of English gentlemen put up £40,000 (a vast sum) and petitioned Parliament for authority to form a company and build a cast plate works. The petition became law and the great manufactory was built at Reavenhead in St. Helens and began manufacture in 1776. The cast plate process developed in France in the 1660s was to remain basically unchanged until the 1920s.

The raw materials, of the best quality, were melted in large pots, fritting and refining taking up to 40 hours. When the glass was ready it was transferred by a copper ladle at the end of a long handle into a rectangular cuvette holding the quantity necessary for one plate of glass. After ladling the cuvette was left to stand for some hours to allow air bubbles to rise then removed from the furnace by a crane and placed on a low carriage to be transported to the casting table.

The casting table itself was a considerable engineering feat for its day. It was of solid cast iron, fifteen feet long, nine feet wide and six inches thick, weighing nearly fourteen tons. It was supported on castors and later on rails which allowed it to be moved from one casting site to the next.

After skimming, the cuvette was raised by a crane and the glass poured on to the smooth surface of the casting table. The glass was stopped from running off the table by trangs, or ribs of metal, running along the edge of the table, their height being the required thickness of the glass. When casting was completed the glass was rolled into a plate by a large hollow iron roller resting on the trangs. When the plate was sufficiently cool and rigid it was pushed from the table into one of the annealing kilns behind. As each kiln was filled up with plates it was bricked up and left for fifteen days.

After annealing there was a rough cast glass which needed cutting, polishing, smoothing, grinding and silvering before sale. After being cut into squares using a rough diamond, the plates of glass were bedded on plaster of Paris within a wooden or freestone frame. Another plate, also framed, was then placed above the first and sand, the grinding agent, introduced between. The top plate was then rubbed steadily and evenly over the other with the aid of a steam engine. When one surface was sufficiently ground and even, the plates were turned over and the process repeated. Originally, the grinding alone took three days but this was gradually reduced to a matter of hours.

The plates were then smoothed with emery before polishing. The plate was once again embedded in plaster, and polishing carried out with the aid of a piece of wood wrapped in many layers of woollen cloth and carded wool. The block was wetted and covered in colcothar or red oxide of iron and worked backwards and forwards over the surface of the plate, one section at a time. When the second side had also been polished the glass was washed and removed to the warehouse. Silvering was carried out either by the glass merchant to order or by the Plate Glass Warehouse at Blackfriars Bridge in London. An amalgam of mercury and tin foil was the silvering agent.

As I have mentioned, glass made by this method was very expensive: in 1771 a plate 60" x 40" ground, silvered and polished would bring £81.8.6; by 1832 a similar plate would bring £16.3.5 but one of 160" x 80" £246.15.4. Given the change in the value of money you will appreciate the cost of these plates.

The great casting hall at Ravenhead was one of the largest buildings of its day under one roof. Before later extensions, the hall measured 113 yards by 51, contained three furnaces and 20 annealing kilns. There were also grinding, smoothing and polishing rooms, an engine house, a crucible house, warehouses, a house and stables for the manager and a row of cottages for the workmen.

The British Plate Glass Company remained the sole British manufactory of cast plate glass for fifty years but by 1870 there were six plate works in England, four of them in St. Helens. But the process did not change. In 1920, at Pilkington's Cowley Hill Works, plate glass was still being cast from a pot (rather than a cuvette) on to a table, rolled, annealed, ground and polished.

There had been some changes in grinding and polishing. The plates were no longer laid on benches and ground and polished individually but bedded on large circular discs up to 60 feet in diameter and pushed first under grinding heads, then under polishers, taken up, and relaid to work the other side.

In the 1920s several developments in the manufacture of plate glass happened together. A whole new market for the automobile windscreen opened up, requiring plate quality glass; Pilkington developed a continuous grinding and polishing process; and Pilkington and Henry Ford of T-model fame co-operated to produce the Ford flow process. The first and the last developments are obviously connected.

Henry Ford needed a continuous ribbon of glass 18" wide to put in the windscreens of his cars. He was not interested in the large expensive plates on which most manufacturers concentrated. C.W. Avery, who had been responsible for the introduction of much of the production line at Ford's Detroit factory, was given the task of streamlining the manufacture of plate glass in 1919. Avery's basic ideas were sound but he had had no experience in glassmaking. Other American companies were not interested in helping a possible rival. At this point Pilkington heard of the experiments and visited Ford, returning to England to carry out experiments. The result was a cross licence for the Ford Flow process. The plate glass was flowed directly from the tank between two rollers in a continuous ribbon 100" wide, into the annealing lehr.

I mentioned a third development in the '20s. Pilkington developed a continuous grinder and polisher. The glass was laid onto a series of metal tables covered with a special cloth and fixed with plaster of Paris and wooden pegs. The tables moved forward under grinding and polishing heads. It was not a great step from this to bringing the continuously flowing ribbon and the grinding and polishing line together.

In the 1930s Pilkington developed the "twin" grinder which ground both sides of the ribbon of glass at the same time. The pairs of grinding heads, one above and one below, were fed with a continuous stream of sand and water and kept delicately balanced so as not to exert undue pressure on the glass. Each separate grinder head was so designed that every part of the glass received equal attention.

A twin polisher was never commercially developed but the old grinding and polishing lines were converted into high-speed single-side polishers. In the 1950s the great plate lines at St. Helens, from the beginning of the twin grinder to the end of the high-speed polisher alone, were longer than the *Queen Mary* and housed in a building half as wide.

After the second World War all the plate glass manufacturers were looking for a way to improve the grinding and polishing process which, with all its virtues, had major disadvantages. To produce plate glass a ¼" thick in the warehouse, it had to be ½" thick in the lehr, and the machinery was complicated and expensive to maintain besides covering a huge area. In searching for a way to improve the surface of plate before grinding and polishing, Alastair Pilkington developed the float process which made it unnecessary. In the float process the molten glass is flowed from the tank on to a bath of molten tin where it floats with absolutely flat parallel surfaces. The ribbon of glass emerges from the float bath with a fire polished finish, passes into the lehr, and then to the automatic warehouse.

Float was announced in 1959. Six years later the last plate line was dismantled although some grinding and polishing is still done. At first float had an equilibrium thickness of 6mm similar to standard ¼" plate. It is now made in a range of thicknesses with a variety of body tints and surface treatments.

Having traced the story of sheet and plate and introduced float, I will return briefly to rolled. I mentioned the development of Hartley's casting table which produced a cheap translucent glass. In 1884 Frederick Mason and John Conqueror designed a double rolling machine which was improved by W.E. Chance who added a second pair of rollers, on one of which a pattern was imprinted. The successors of the double rolling machine remained in use until the 1950s for the manufacture of tinted figured cathedral glasses but the basic table rolling process benefitted from the experience of plate glass and the Ford Flow. In the 1920s the rolled process became continuous with the glass flowing from the tank between two rollers, one patterned, into the lehr. The process was adapted for wired glass which is in fact a rolled sandwich, two ribbons of rolled glass with the wire between.

I will conclude with a description of perhaps the last of the spectacular discontinuous flat glass processes – the Bicheroux. As is so often the way, a streamlined continuous production line leads to standardization. This was so with Ford Flow plate glass, and the twin. But if extra wide, extra thick, tinted opaque or special plate glasses were required they were made on the Bicheroux — installed at St. Helens in 1930 and finally stopped in 1958. The glass was melted in oval pots each holding 25 cwt. When the glass was ready to cast, it was removed from the furnace in a pair of giant mechanical tongs and placed on an electric trolley. The pot was then manoeuvered into the jaws of a specially constructed moving crane which carried it sideways and upwards and finally tilted it to discharge the molten glass into the hopper of a rolling machine. At the moment when the molten glass passed between the two rollers, great metal tables slid out from below and received the ribbon, a giant guillotine cutting off portions onto each table. On the tables the glass passed into the lehr before being ground and polished on the old disc grinders.

With the Bicheroux I will finish the history of flat glass — float has virtually swept all but rolled before it but it is only in the last fifteen years that an industry which dates from Roman times, has been so completely revolutionised.

This paper was presented at the Symposium 1974, held at Lancaster University. Grateful acknowledgement is made to the author and to Pilkington Bros. Ltd.

THERMAL SYNDICATE WINS £4.5 MILLION CONTRACT

Thermal Syndicate Ltd., has been awarded a contract by the German Democratic Republic to supply £4.5m. worth of know-how and plant for the production of fused quartz tubes. The equipment will be installed in a new factory to be erected in the German Democratic Republic. The factory is planned to be in full operation by the summer of 1977 and will produce about 75 tons of fused quartz tubing a year.

Much of the production machinery being supplied will be built at Thermal Syndicate's main factory in Wallsend. It will be installed by the company's own engineers in co-operation with personnel from the German Democratic Republic. Initial training for the German Democratic Republic team will take place in Wallsend. Later a team of British engineers and technicians will work in the German Democratic Republic in setting up the project and getting it under way.

Dr. Gordon Hetherington, managing director of Thermal Syndicate, said that negotiations for the contract had been conducted through VE AHB Industrieanlagen-Import, Berlin, and had been going on for some time. He was delighted at their successful conclusion and this contract, the largest ever received by the company, had come as a great tonic to the start of 1975.

The contract was formally signed in Berlin by Herr Dieter Gaedecke, director for import, and Herr Michael Mieth-Grund, deputy director for import, on behalf of Industrieanlagen-Import, and Dr. Gordon Hetherington and Mr. Frank Moran, finance director, on behalf of Thermal Syndicate.

Two previous orders won by the company in the COMECON area were for know-how and plant for fused quartz tubing supplied to Poland and the USSR. The company has also previously won an order for the supply of a synthetic fused silica plant to the USSR.

SYMPOSIUM 75

SEPTEMBER
11·12·13

UNIVERSITY OF WARWICK

PROVISIONAL PROGRAMME

	THURSDAY		FRIDAY		SATURDAY
10.00 a.m.	Registration Open	8 – 9 a.m.	Breakfast	8 – 9 a.m.	Breakfast
12 – 1.00	Lunch	9.00	Exhibition Open	9.00	Exhibition Open
1.45	Exhibition Opening	10.00	Technical Lecture	9.30	A.G.M.
2.45	Technical Lecture	11.00	Coffee	11.00	Technical Lecture
3.45	Tea	11.30	Technical Lecture	12.30	Lunch
4.15	Technical Lecture	1.00	Lunch	2.00	Technical Lecture
5.30	High Tea	2.30	Technical Lecture	3.15	Technical Lecture
7.30	Reception	3.30	Tea	4.15	Tea
		4.00	Technical Lecture	4.30	Closing Address
		7 p.m.	Annual Dinner		
			Presentation Awards		
			After Dinner Speaker		
		10.45	Smoking Concert		

Keith Holden Symposium Secretary
School of Molecular and Bio Science, University of Warwick, Coventry.

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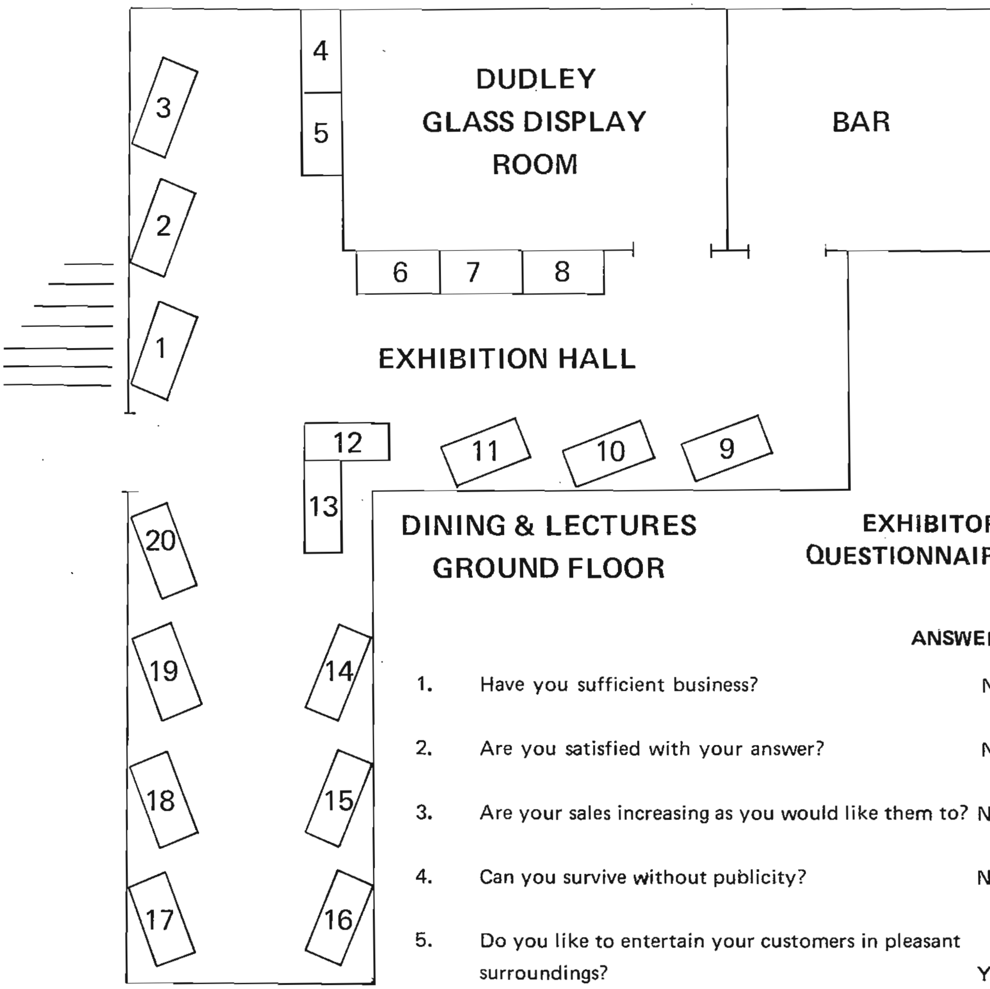

EXHIBITORS QUESTIONNAIRE

		ANSWERS
1.	Have you sufficient business?	NO
2.	Are you satisfied with your answer?	NO
3.	Are your sales increasing as you would like them to?	NO
4.	Can you survive without publicity?	NO
5.	Do you like to entertain your customers in pleasant surroundings?	YES
6.	Can the B.S.S.G. assist you?	YES

If your answers are the same as ours, then the remedy to your problem is:—

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"SYMPOSIUM 75"

Symposium Chairman
JIM HUCKFIELD

SOCIETY DIARY

One of the major topics under discussion at the last Council meeting was, naturally, the economic state of the society and from the Hon. Treasurer's report it became obvious that inflation was causing great difficulties, which although the society might well be able to withstand during 1975 . . . would mean that subscription increases for 1976 would be almost inevitable.

Members can expect a letter from the President (who was in attendance at the Council meeting) dealing with the financial position and explaining the proposed actions to be taken by Council and the membership.

Following on from these discussions on the economic situation, our President, Mr. Stafford Scholes made a strong plea for a truly businesslike attitude to be adopted, particularly in respect of the possible introduction of "corporate membership" by large and small industrial concerns who might well be interested in being involved with the society. Quite apart from the obvious immediate financial return . . . there could well be long-term advantages accrueing to the society by such contacts. Much discussion took place on this subject and it was finally decided that a sub-committee (consisting of the President) should look into the possible interest of various companies, and of getting this form of membership implemented.

From the Board of Examiners the information that the final regulations for the application for "Master Glass blower" qualifications were now complete . . . and any Full Member who feels he can qualify for this can make application in the first instance to the Hon. Secretary of the Board of Examiners for all the details.

Many members will be interested to know that Mr. Ted Evans has parted from his previous company, and is intending to start in business on his own account some time in the future. Ted would like to maintain friendships within the society and contact can be made with him at his home address or telephone Earls Colne 2833.

EDITORIAL SUGGESTION

At the council last time, I made the observation that section workshop sessions were well attended and apparently created great interest and enjoyment.

It occurred to me that it might be an idea for the future section workshop sessions to be extended, possibly under the guidance of an experienced member, with the aim of preparing a paper covering the techniques that had been demonstrated during that session . . . for the preparation of a paper can be achieved by working to a formula which could be explained by the experienced member who has already produced papers of this type.

Should this approach be a success, and I see no reason why it shouldn't be, then it would encourage members to have a shot on their own account . . . for one thing is certain, we have the members who can perform the techniques with glass and ancillary components, it is only necessary that they get the descriptions of these techniques down on paper.

The journal needs papers on "technical glassblowing", who else can I ask to provide them . . . but the "glassblowers of the British Society of Scientific Glassblowers".

McLEOD GAUGES

I. C. P. SMITH

From time to time the need arises to design McLeod gauges for particular performances or ranges; this is an attempt to examine the subject and to get down to simple terms. A table of ranges is worked out, and a simple method given for calibrating. A later article will go into the construction of the gauges, and will include notes on the earlier form, which had the capillary calibrated for volume, and the reference level in millimetres.

Firstly as regards range, and considering the lowest pressure it may be desirable to handle. The gauge depends on the fundamental gas formula $V_1P_1 = V_2P_2$. V_1 is the volume of air at the low pressure that is trapped at its pressure P_1. V_2P_2 is represented by Fig. 1, and is the small volume V_2 at the head of the capillary tube, at the pressure P_2, represented by the mercury height h. So what is the smallest capillary tube one may wish to use, and what is the smallest dimension h one may reliably arrive at and measure? Some users do not like to go below 1mm capillary diameter; some are prepared to go down to 0.8 mm. Possible contamination is a problem; in clean gas conditions, maybe .8 mm; when chemicals are about, 1 mm. 0.88 mm is a size available to choose as a compromise. Then height h: 1.0 mm is rather small, better 1.5 mm on a gauge of this type, and 2 mm on the larger size. Now for volume V_1, and the larger this is, the smaller the ultimate reading P_1, but mercury is both heavy and expensive; 500 cc will weight about 6.8 kg or 15 lb, and is generally considered the economic and practical maximum. 300 cc or 350 cc seem to be popular sizes.

NOTICE TO MEMBERS

On the resignation of Mr. D. Newell from the board, the post of Competitions Secretary has been taken by:–
Mr. R.G. Eustance, 42a Boroughbridge Road, Knaresborough, Yorkshire.
Business:– I.C.I. Fibres Ltd., Hookstone Road, Harrogate, Yorkshire.
Tel: 0423 68021 Ext. 491
To whom all correspondence relating to Competitions should be addressed.

It is desirable at this stage to summarise and expand the formulae employed in determining readings. The fundamental formula is:–

$$V_1P_1 = V_2P_2 \quad \text{.......... (1)}$$

V_1 is the reference volume of the instrument, measured from the cut-off point at the bottom, and is usually expressed in cc.

P_1 is the pressure in the system we wish to determine, requiring the answer in torr or mmHg.

V_2 is here πr^2h, r being the known radius of the capillary, and h measured as in Fig. 1.

P_2 is again h.

To make proper use of the equations it is essential that all dimensions are in the same units, i.e. cm and cc, and the values of P_1, r and h expressed accordingly. P_1 will be converted back to mmHg or torr in reporting or applying the calculated scale.

To expand formula (1):–

$$V_1P_1 = \pi r^2 h \times h$$

or $$V_1P_1 = \pi r^2h^2 \quad \text{-------- (2)}$$

and $$h = \sqrt{\frac{V_1P_1}{\pi r^2}}$$

or $$h = \sqrt{\frac{V_1}{\pi r^2}} \times \sqrt{P_1} \quad \text{---(3)}$$

$$\sqrt{\frac{V_1}{\pi r^2}} = k \quad \text{--------(4)}$$

and $$h = k\sqrt{P_1} \quad \text{--------(5)}$$

from (2)

$$P_1 = \frac{\pi r^2h^2}{V_1} = \frac{h^2}{k^2} \quad \text{---(6)}$$

Capillary diam. mm	Volume cc	Const k	Value of P_1 in torr for:	
			h = 1.5 mm	h = 200 mm
0.80	500	315	2.3×10^{-6}	4.0×10^{-2}
0.88	500	287	2.7×10^{-6}	4.9×10^{-2}
0.88	300	222	4.6×10^{-6}	8.1×10^{-2}
1.0	300	195	6.1×10^{-6}	0.107
1.5	200	107	2.0×10^{-5}	0.35
2.0	100	56.4	7.1×10^{-5}	1.26
3.0	25	18.8	6.4×10^{-4}	11.3

Formula 3 is fundamental to the McLeod gauges described, and its first part is a constant for a particular gauge; this constant k is best worked out, formula 4, and the simple formula 5 employed for purposes of calibration. For working out the table, formula 6 was employed.

The table is intended as a guide when choosing the volumes and capillary diameters required for selected ranges. On the first item a 1mm value of h would indicate the magic '1×10^{-6} torr', but these small readings can be unreliable. At the coarse end of the table the McLeod gauge is brought up into the range of the mercury U tube manometer, but having a much more open scale. In some respects the McLeod gauge is more reliable here than the manometer, as the latter is very liable to contamination. On the other hand errors may be introduced in the McLeod gauge when condensable vapours are present.

It is usual to employ precision-bore capillary tubing, and established sizes are shown; in critical use it may be desirable to search the bore, as described in an earlier article.[1] The bulb is usually blown to a close figure then carefully measured, either using a good burette, or by weight, employing distilled water and making a correction for temperature according to BS 1797. The volume of the capillary should be included, and this may be calculated and added.

Calibration, direct-reading scale

Having now the value of V_1 in cc and of r in cm, the constant k for the gauge is calculated from formula 4, and formula 5 applied for successive values of P_1. It is the writer's preference here to make four columns:

(1) value of P_1 in torr; (2) equivalent in cmHg; (3) calculated value of h in cm, (4) equivalent in mm. This system best looks after the position of the decimal point; it is possible to make short-cuts later. For all calculations, log tables are the most reliable, or if available, one of the new electronic calculators. The short-cut involves the use of a slide-rule, and even if one is not proficient in its use, by following simple directions, an excellent scale may be produced. It is most satisfactory to work out an example, and the fourth item in Table 1 will be taken, volume V_1, 300 cc, capillary diameter 1.0 mm, 0.1 cm, radius 0.05 cm.

First to determine k; from formula 4:

$$k^2 = V_1/\pi r^2 = 300/(\pi \times .05^2)$$

$$= 300/.0078 = 38700$$

and $k = 195$

For successive values of P_1 formula 5 is used, $h = k \sqrt{P_1}$.

To take two specimen readings:

1×10^{-5} torr, 1×10^{-6} cm.

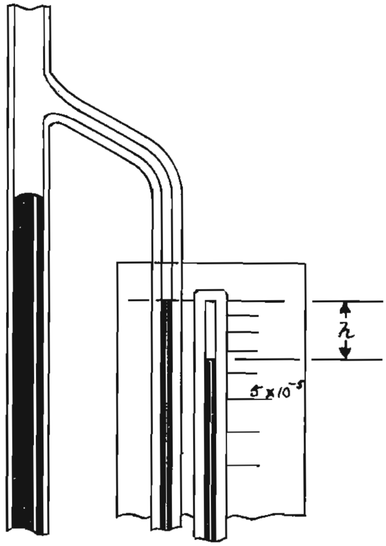
$h = k \sqrt{P_1} = 195 \times \sqrt{(1 \times 10^{-6})} = 195 \times 10^{-3}$

$= 0.195$ cm $= 1.95$ mm

2.0×10^{-5} torr, 2×10^{-6} cm.

$h = 195 \times \sqrt{(2 \times 10^{-6})} = 195 \times 1.41 \times 10^{-3}$

$= 276 \times 10^{-3} = .276$ cm $= 2.76$ mm



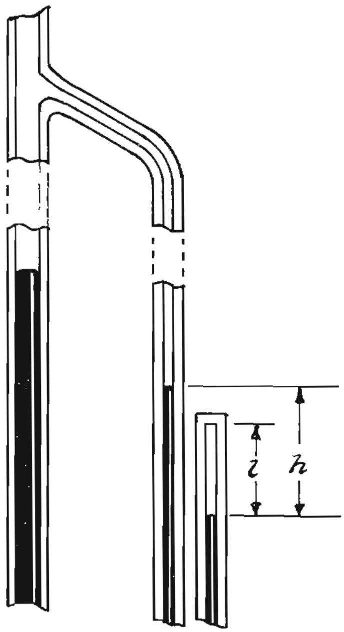
To put this on the slide-rule, and calling the four scales respectively A, B, C, D from top to bottom,

(1) Place the cursor line on the value of k on scale D, 1.95,

(2) Place the 1 of scale C under the line of the cursor,

(3) Move the cursor to successive values of P_1 on scale B, and read off the cursor on scale D.

The cursor starts on the 1 on scale B, in this case 1.0×10^{-5} torr; the reading on scale D is 1.95, i.e. 1.95 mm as above; move the cursor to 2 on scale B; the reading on scale D is 2.76, i.e. 2.76 mm as above; then carry on:



P_1, torr x 10^{-5}:	1.0	2.0	3.0	4.0	5.0
	8.0	9.0	10.0		
h, mm :	1.95	2.76	3.38	3.91	4.36
	5.52	5.85	6.16		

the last entry is of course equally 1×10^{-4} torr, so carry on:

P_1, torr x 10^{-4}:	1.0	2.0	2.5
h, mm :	6.16	8.72	9.75

At this point we run out of scale, so the cursor is moved back to its original position on the 1.0 of scales B and C (1.95 on scale D), and the slide is moved to the left so that 10 on the scale B comes under the cursor line. Now move the cursor to 3 on scale B – move to the left to 3, not to the right to 30 – take the reading on scale D 1.07, clearly for our scale 10.7, and carry on:

P_1, torr x 10^{-4}:	3.0	3.5	4.0	4.5	5.0
	9.0	9.5	1 x 10^{-3}		
h, mm :	10.7	11.55	12.35	13.1	13.8
	18.5	19.0	19.5		

Here we see that the numbers start to repeat themselves:

1 x 10^{-5} torr = 1.95 mm; 1 x 10^{-3} torr = 19.5 mm; 1 x 10^{-1} or 0.1 torr = 195 mm

but while the torr figure is multiplied by 100, the mm figure is multiplied by 10. This pattern is followed right through, and its use is helpful in working out the remainder of the scale. This however may be given smaller decimal fractions as the scale becomes more open.

Readings of the McLeod gauge to close limits.

If it is desirable for a particular experiment to obtain the best available pressure reading, and a cathetometer or similar instrument is on hand; assuming also that the volume and the capillary diameter are known to close limits, then the following alternative procedure may be adopted for taking individual readings. Referring to Fig. 2, the mercury is brought up in the reference limb to a position close to the reference line, without trying tediously to obtain exact register; it may be above or below it. Then the two measurements, 1 of the bulb capillary, and h of the pressure reading P_2 are taken, using the cathetometer. Now in the formula $P_1V_1 = P_2V_2$, P_2 is the value of h, and V_2 is $\Pi r^2 1$; thus $P_1 = (h \times \Pi r^2 1)/V_1$

The same method of using the McLeod gauge may be employed without a cathetometer, if a millimetre scale, or a strip of millimetre graph paper is attached, so that it may read both mercury columns. Maximum sensitivity on small readings is obtained when h is equal to or slightly greater than 1. If in the construction of the gauge the reference capillary can be extended to a length of 200 mm upwards before it rejoins the vapour tube, the value of h can be increased accordingly, and the range of an instrument thus doubled.

1) This J. Vol. 3. p16.

SOCIETY TIES

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REPORT ON DUTCH GLASS TECHNOLOGY DAY

On Saturday, 9th November, 1974, the "Stichting Glastechnik" held its glass technology day in "Transitonium 3 de Uithof" of the "Rijks Universiteit te Utrecht".

Taking part were 12 glassblowers from BAYER Leverhusen, 3 from BAYER Donagen and a number of people of the KFA Jülich with their Managing Director. One glassblower was represented from BAYER Antwerp. Altogether 19 exhibitors were announced, amongst them, the technical colleges of Delft and Gindhoven as well as the imperial universities of Utrecht, Leiden and Gromingen.

As usual, several German firms exhibited there in the stands of their dutch agencies. One would see, amongst other things, original blowing apparatus in separated and mixed gas performance. The part automatic production of polished kernels was demonstrated on a machine.

Fine administrating fancets with wide seat-beds were shown in various performances separated for gas and liquids, an indication that development in this field is still not a "closed shop".

One could see pieces of glass of the highest precision which were produced by means of ultra-sound-borers and laser treatment. The separating of glass tubes by a laser beam was shown both on a monitor and in the film room. In the film room they showed several films at various intervals during the day. One of the films had as its theme "the meaning of light". It began with the formation of protoplasm and ended with the activity of a sun-furnace as a heating source for power stations.

The production of plane-polished-lids from glass sheets by means of a suction and rolling process – which was at hand in picture presentations and in sample pieces – aroused the attention of many participants.

Various producers of diamond tools and machines were represented as exhibitors. This time they offered, amongst other things, diamond whetting and polishing pastes as well.

Displayed on the stand of the Dutch association were, amongst other things, tension apparatus for plane-polished-lids made of a fire proof material, as yet unknown to us. On inquiry you can obtain sketches for the production of such holders (these will be charged for).

The Dutch colleagues exhibited glass instruments which they had produced, and which no doubt found ungrudging admiration amongst all the visitors. Some of our colleagues were disappointed that this time there were no large glass-working-machines on show.

On consultation with colleagues on the executive committee of the Dutch association, we learned the following: Because this year's exhibition was taking place in the first floor of the Transitonium 3, and the lifts were inadequate both in their size and in their bearing power for the transportation of such machines, they had had to abandon the idea of an exhibition of such parts this time.

These kinds of vocationally orientated exhibitions offer a wealth of new things in the smallest of spaces, and it is to be hoped that they also offer new stimuli in the field of glass instrument technology.

HANS MULLER

SYMPOSIUM 1974 REPORT

LANCASTER UNIVERSITY

The Symposium held at Lancaster from Thursday 29th to 31st August, 1974, was from the point of view of the Organisers something of a nightmare. Considering the state of the nation, with three day weeks, industrial recession, and threats of a £1 a gallon petrol, and considering that on the 7th June, 1974, the Symposium had collected £31.99 – the estimated cost of the Symposium being in the region of £1,500; up to the time of the Symposium £927.05 was taken in for the Symposium; there was a great deal of concern.

On the day of the Symposium £637.79 was received from late bookings, which enabled the Symposium to flourish, but caused a great deal of confusion regarding accommodation and meals from the University. This was expected and found to be so, as the numbers for meals had to be continually revised.

The continual revision of numbers was accepted by the University management who were prepared to be flexible in this respect but on the day it was necessary to convince the catering staff. Considering the changing numbers requested by the Symposium Committee the service and quality of the meals was of the highest standard.

1,500 members of the General Public visited the exhibition on Friday and a further 1,000 on Saturday afternoon between 1.00 – 6.00 p.m.

Facilities for the Exhibition were ample. The combination of two Exhibitions in one, being novel and judging from the reaction from Press, T.V. and General Public, a success.

The Exhibitions had no lack of space, enabling easy access to all stands and all credit must go to Alan Thompson for arranging the Exhibition.

One cause for concern regarding Trade Stands arose from the need to use natural gas and oxygen. Oxygen was readily available from the University, but gas was not quite so forthcoming. The various suppliers of compressed gases were eventually ruled out because of prohibitive rental cost. Our final supply came from a gas conversion unit operating at Liverpool University the cylinders being transported from Liverpool to Lancaster by Mr. P. Halliwell and Mr. B. Chapple.

The opening speech was made by Mr. Harvey (Chairman of BSSG) as the person who was due to open the proceedings was unable to do so at the last minute.

The lectures and lecturers were:

Thursday 29th 3.00 p.m.	Mr. W.R. Povey – Production Executive, Blythe Colours Ltd. "Decoration of Glass by Ceramic Enamels". Raw Materials method of manufacture and application, together with examples of decoration and marking of laboratory glassware.
Thursday 29th 4.30 p.m.	Miss P.A. Pemberton – Group Archivist, Pilkington Brothers Ltd. "The Development of Glass". Historical development of glass together with a film of some of the more recent events.
Friday 30th 10.00 a.m.	Mr. L.W. Bell – Asst. Research Manager, Thermal Syndicate Ltd. "Recent Development within the Fused Silica Industry". A general talk on vitreous silica relating it to other glasses, description of different forms available and their properties, applications and uses in industry and research.
Friday 30th 11.30 a.m.	Mr. Stafford Scholes – President of the B.S.S.G. "A Superficial look at Glass". Beauty, they say, is skin-deep: so are many properties of glasses. But although the surface determines the behaviour of glass in many of its applications, comparatively little attention is paid to it. However, recent work has revealed some surprising things about the surface which, in many ways, is completely different from the bulk of the glass. This talk describes some of our modern ideas about the surface.
Friday 30th 2.30 p.m.	Mr. W.E. Stuart of Stuart Crystal & Sons Ltd. "How English Crystal has developed".
Friday 30th 4.00 p.m.	Dr. Geoffrey Beard. Department of Visual Arts, University of Lancaster. "Glass, Science and Art".

The Trade Stands consisted of the following:

Thermal Syndicate
James A. Jobling
Nordsea Gas Appliance
T.W. Wingents

On the industrial side the Q.V.F. 20 ft. working H_2SO_4 column.

The Artistic Exhibits consisted of:

The Cinzano Collection with over 90 distinctive pieces of antique glass.
Work from the "Glass House".
Bertil and Ulrica Valliens.

Mr. S. Daniels performing at the lamp, and the Jobling, Thermal and Flack Awards.

The Trade Stands dismantled on Saturday at 1.00 p.m. leaving the Artistic Side open to the public and press. Two members of the Symposium Committee erected a glass-blowing bench and for the remainder of the afternoon gave demonstrations of glassblowing. Over 1,000 members of the General Public passed through the Exhibition Hall.

Because of the layout of the buildings slight difficulty in getting 102 people from Lecture Hall to tea and coffee was experienced. This is understandable, half an hour was allowed for these breaks and was found to be just sufficient. Perhaps 40 minutes might be considered for future Symposia.

On Friday 30th the A.G.M. Dinner was attended by 101 guests.

Mr. Stafford Scholes made the Presidential Speech and also introduced the presentation of Awards. The presentations were as follows:

Jobling Cup presented by Mr. Clarke to Michael Holmes.
Thermal Trophy was presented to John Burns.
Mr. Flack gave the Flack Award to Andrew Thompson.
The Thames Valley Award was presented by Mr. Rodwell to Mr. K. Holden.
Mr. Scholes presented Mr. Cescotti with the Presidents Cup.

The former President, Dr. L. Oldfield, was presented on Thursday at 4.00 p.m. by Mr. Stafford Scholes with a piece of work by Mr. Harvey on the Society's behalf for the work she has done for the Society.

The Symposium concluded on Saturday, 31st with the A.G.M. 51 members were present.

Only one thing marred the proceedings, and that was the fact that Alan Thompson, who had done so much for the exhibition,found that a Cinzano book valued at £5.50 had been taken away without payment. As the books were on a sale or return basis the cost of the book has had to be paid for from the Symposium funds.

P. Le Pinnet

LETTER FROM BRITISH GLASS INDUSTRY RESEARCH ASSOCIATION

I was interested to read the article by R.C. Reader in your January 1975 issue in which reference was made to the standard strain discs that were originally developed by the Glass Container Association of America in the 1930's.

I think it may be useful to point out that these discs are now manufactured by the British Glass Industry Research Association as BGIRA Standard Strain Discs to the ASTM specification and none is now produced by either the GCA or the Department of Ceramics, Glasses and Polymers (formerly Department of Glass Technology) in the University of Sheffield which were the only organisations mentioned in this article.

Incidentally, this has been the position for the last twenty years.

P.J. Doyle
Information Officer

STICHTING GLASTECHNIEK

'Glastechnische Mededelingen', no. 5, December 1974

Abstracts

- Vacuum technique, part 1 (C.J. van Klink, Leiden, 2½p., 3 fig.)

  After an introduction a review of various pumps is given, followed by the description of the water jet pump. The art. will be continued in consecutive issues of G.T.M.

- Workshop aid (B.A. van Gijzel, Amsterdam, ½p., 2 fig.)

  A set of 'Sindanyo'-discs is described for the use of closing glass tubes instead of the conventional plugs. A hose connection allows blowing on the glass lathe.

- Safety glasses (W. van Hoppe, Eindhoven, 10p., 12 fig.)

  Attention is drawn to the necessity of using various types of safety glasses, depending on the work carried out, when blowing glass and to the risks of eye damage. The requirements of good safety glasses are mentioned with the type of glass for specific activities. For the latter graphs on transparency are given together with a visibility curve of the eye. A short mention is made of polarisation of light and the use of polarizing filters in glasses.

- A method to check pumping velocities (J.M.M. Tesselaar, Amsterdam, 2p., 2 fig.)

  A system of the measurement of small quantities of liquid in a pumping array is described, using a burette as a percentage-indicator.

- Transparent heating tumblers and ovens (J.P.M. van Hoof and J. Zondag, 3p., 5 fig.)

  A description is given of heated glass tumblers and ovens, using a layer of applied tin oxide, including details as electrical connections and guarding outer envelopes.

- Glass Technical Day 1974, address of the President (2p.)
- Examination 1974: practical and theoretical (7½p., 9 fig.)
- Information:

  Electronic alarm apparatus for harmful gasses; improved gas discharge lamps; Klebstoffe und Klebververfahren für Kunststoffe (review on a German book on adhesives for thermoplastic materials); change of the president of Messrs. Edelstaal, Amsterdam; catalogue 'Duran' -glass (Schott); SI-units (Systéme Internationale); tantalium condensor encapsulated in glass (ITT).

P.J. van der Burgh,
secretary.

NEWS

FROM

JAPAN

The Sendai section of the Japanese Society of Scientific Glassblowing held its session on October 4 at the Semiconductor Laboratory of Tohoku University.

The session was opened by Chairman's address at 1.00 p.m. and a lecture on the semiconductor was given by Dr. J. Nishizaki, President of the Laboratory. The lecture was not only on the semiconductor but also on the recent development items in relation to the optical transmission of glasses. The lecture was received very well by the 58 attendants.

Following the lecture, the attendants were split into small groups and a tour of the laboratory was conducted by the research staff. Many questions were asked by the attendants and the staff were kept busy answering them during the course of the tour. Adjourned at 4.30 p.m.

On October 30, the National Society held its last meeting in 1974 at one of the municipal facilities, Kinro Fukushi Kaikan, in down-town Tokyo.

The meeting was opened by President's remark at 10.00 a.m. and three lectures were given by guest speakers on the following titles:

"Lamps for the atomic adsorption analysis"
Dr. S. Tamura, The University of Tokyo

"On the law and incorporation of the JSSG"
Mr. M. Ejima, Jurist and the JSSG counsellor

"Glass beads and its application"
Mr. T. Asai, Glass Dept., Toshiba Electric Co. Ltd.

Following the lecture, films on glass fiber and glassblowing machine were shown. The latter film was offered from a German works through a representative in this country.

The final remark was given by Dr. K. Mukai of the Tokyo Metropolitan Industrial Technology Center. The meeting was adjourned at 5.00 p.m.

The Japanese Society of Scientific Glassblowing carried out every plan very smoothly and many thanks go to those who offered good co-operation to the Society.

COE GOTOH

TYNE WEAR

The last 3 meetings of the section have been:

1. 21st October when Mr. L.C. Evetts lectured on the Stained Glass Window Art. 14 members and guests received an excellent lecture by Mr. Evetts whose work can be seen in a multitude of churches and chapels throughout the U.K.

2. 18th November when our President Mr. Stafford Scholes gave an interesting lecture on the 'History of Glass' with a pre-Christian bias. This unusual approach was particularly well received by the 12 members present.

3. 10th December when the Section held a joint meeting with the Society of Glass Technology. The subject was appropriately 'Scientific Glassblowing' and B.S.S.G. members demonstrated Soda, Borosilicate and fused silica working to a mixed company of thirty.

The A.G.M. was held 21st January in J.A. Jobling, Social Club, Sunderland.

S O U T H

The Southern Section held a meeting at E.M.I., Hayes on November 13th. The following report of this meeting is from our Section Chairman, Mr. Luadaka:

There was a very encouraging number in attendance, 14 in all. We were first shown the technique for the manufacture of the glass to metal seals for the photomultipliers and after the two ends are made the centre sections are welded by E.C.H. to complete the tube. The party then moved on to the shop where the 21" scanners are made for aircraft traffic control and for shipping. The main body is manufactured from mild steel with 17% chrome and spun into conical shape. A glass suspension is sprayed on the smaller end of the cone, this is then fired to glaze, and a prepared lead glass neck is brought into contact and sealed to glaze. Then the reverse end is glazed as before, then placed in the oven on a travelling base with 5/8" soda glass x 21" diameter plate to warm up. At this point it becomes a two man operation. The travelling base of the oven is removed and the two operators, with a huge pair of tongs, lift the assembly on to an adjacent jig. Using ring burners with 108 micro jets, the metal cone and soda glass base is heated and it flows to make a seal. Along came the two men clamps and the completed assembly is returned to the annealing oven. This sounds a rather simple operation as described, but the skill and experience required to accomplish this must be seen.

The soda glass base is cut from rectangular sheets, ground and polished and heated on a mould to give a convex face.

As a visit by mostly University or Research Lab glassblowers, this was certainly an eye opener and our thanks should go to Charlie Bradley and some of his staff for their demonstration of great skill involved, I feel all of us left feeling very impressed.

Further thanks should go to Mrs. Bradley who supplied some excellent coffee and sandwiches after the demonstration and to the management of E.M.I. for permission to make this most interesting evening possible.

The December meeting was held on 11th December at 8.00 p.m. at the Red Lion, North London. Six persons were present, 5 members and one guest. It was a pleasant, informal get-together in which glassblowing matters of interest to all were discussed. We welcomed Dave and Jim Young, from the Young Glassblowing Company in Acton. Ron Mason gave details on Vitta tape and Cool Heat products. The evening was most pleasant, where we were able to have a chat and a drink. Unfortunately, we did not see too much of Bob Reader, but we thank him for an enjoyable time.

Finally, a point of interest – Derek Newall and a colleague recently went to Heatherwood Hospital, Ascot, to give a demonstration of glass-blowing at a Fete. Bruce Forsyth opened this Fete, and was presented with a "Bambi" made by Derek. The whole occasion was most successful, and over £1,000 was raised for the Hospital Charity Fund.

The January meeting was the Section A.G.M. held at G.M.F., Portland Street. This was another meeting which was poorly attended, with only 11 members present. The evening was opened with the Chairman's Report:

The Chairman said that so far the attempt at Regional meetings had not proved successful and that in view of the present national situation the section may have to reduce its activities. This would mean a meeting every 6 weeks instead of monthly. Mr. Brench then gave his report on finance.

Thanks were given to the auditors.

The Secretary then reported:

It is becoming very difficult to attract lecturers into London. This is because of the present situation and expenses etc., and they also get to know of the poor attendances. Some of the lecturers approached have been very abrupt – not a pleasant situation for your committee.

The two workshop evenings were quite successful. The next 3 meetings will be at Q.E. Kensington, the first of these being on Wednesday 12th February. The question of section officers then arose and in the absence of any other nominations the present committee will continue.

The Chairman gave a short report on the last Council meeting. The main finances of the main Society are very poor, and measures will have to be taken to improve them. A discussion followed with Society Chairman Mr. Ron Harvey answering questions on some of the problems facing the Society. A request for an extra Council Meeting was withdrawn.

Any Other Business

Mr. Newell has had to give up his B.O.E. membership for domestic reasons, so a volunteer is required.

The question of a different section day came up once more. Mr. Brench proposed that a possible lecturer should choose his own day i.e. an open date. Although this would not be easy to arrange the motion was seconded. The meeting was closed at 8.30 p.m.

R. NEWMAN

THAMES VALLEY

After a slow start to the 74/75 season of meetings, the members who attended the session at Reading University on the 2nd January were rewarded with an entertaining and informative talk presented by Mr. W. Zuber of W.G. Flaig and Sons Ltd. Mr. Zuber heads the company's distribution depot for the Jena-Schott Glassware in this country, located at Telford, Shropshire.

The talk predominantly about the illustrious history of Jena-Schott glassworks and the collaboration between its principals. Otto Schott the glassmaker's son, Prof. Ernst Abbe director of the Jena observatory and Carl Zeiss, optician at the University.

Professor Abbe recognised the need to search for new types of optical glasses that were achromic (producing no spectra in lens form). Schott was the first chemist to re-examine the ingredients of glass that had stayed so constant for thousands of years. An early trial melt of his that contained Lithium oxide was sent in May, 1879, to Abbe for testing. Though unsuitable, Abbe was sufficiently impressed to encourage Schott to embark on a research programme of 130 test melts. When lenses made from melts 77 and 93 were combined the secondary spectrum almost disappeared.

A set-back occurred when melt 93 was found too unstable and became opaque, but a few months of experimentation produced a new melt that was acceptable optically and stable chemically.

Schott moved to Jena in 1882 to continue research in improved facilities provided by Prof. Abbe and Zeiss, the founder of the famous optical instrument company.

The fascinating story retraced events right through the trauma of the Second World War which prompted the Americans to resettle 41 key personnel from Jena in the Soviet zone into West Germany where the story has a successful end with the present company producing its products range from factories in Mainz on the Rhine.

G.R. REED

T H E W E S T

A technical meeting was held at the Bristol Polytechnic on the 25th November, when Mr. M. Locke from Bath University gave a demonstration of "Flanging techniques".

At a short business meeting members discussed various points that needed to be considered for reference to Council.

The Annual Dinner/Dance was held this year, early in December at the Cadbury Country Club when once again an enjoyable evening was experienced.

The A.G.M. was held in January at the Medical School of the University of Bristol.

After a vote of thanks for the efforts of the Officers of the section, all Officers were re-elected.

Chairman	–	P. Houlden
Secretary	–	M. Lock
Treasurer	–	D. Jones
Councillor	–	A. Leeson-Maigret
Council Rep.	–	M. Lock

The October meeting was at the University of Bath, Glassworkshop, an establishment being visited for the first time by many of our members.

Mike Lock was our host for the evening, he having had his workshop converted to natural gas, but very recently. We were shown the results of this exercise, which he considered had gone quite satisfactorily. After a general talk by Mr. Lock, on the various types of burners involved, we were able to try them for ourselves . . . thus enabling us to make up our own minds on requirements we should have at a later date.

A thoroughly enjoyable evening and an informative one also.