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SGT NEWS

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EARLY NINETEENTH CENTURE GLASS TECHNOLOGY IN AUSTRIA AND GERMANY

The works of Professor B Scholz and Factory Superintendent Kirn 1820–37.

Translated by Michael Cable

THIS volume is the third in a series that shows how advances in science, especially chemistry, influenced the development of glass melting from the middle of the seventeenth century to almost the middle of the nineteenth by making available in English the works of authors of those times. The first, published as *The World's Most Famous Book on Glass Making* in 2001, was Christopher Merrett's *The Art of Glass* (1662), a translation of Antonio Neri's *L'Arte Vetraria* first published in Florence in 1612 and reprinted in 1661. It included an essay by WES Turner explaining the importance of *Neri/Merrett*. In the seventeenth century the classical four element theory of matter (earth, wind, fire, water) still governed thinking about chemistry and there was little understanding of glassmaking.

The second translated the works of Paul Bosc D'Antic, written in France between 1758 and 1780. D'Antic had some experience of glassmaking and his writings show an earnest desire to understand glass melting in terms of the latest scientific ideas. Despite the four element theory, the chemical identities of a wide range of useful elements and compounds had by then been recognised although analytical tools were very few and primitive. The role of heat in melting or solidification and chemical reactions was still confused by the belief in *phlogiston* as a chemical substance. However, that belief was only a few years away from collapse as attempts to interpret chemical phenomena by invoking it became ever more tortuous. That is clearly seen in some of D'Antic's writings. Nevertheless he reports some ingenious experiments and penetrating observations.

The third volume contains translations of articles by two authors, Scholz and Kirn, writing in German between 1820 and 1837. These show great advance and provide the most detailed known first hand accounts of European glass making practices early in the nineteenth century. Both technological and economic factors are discussed at length. They give batch compositions and comment on the melting behaviour of 80 different glass compositions.

BENJAMIN SCHOLZ

Benjamin Scholz MD (1786–1833) had trained as a physician. He mentions in his paper that in 1815 he was chemist to the Imperial and Royal Natural History Collection in Vienna. He then became the first Professor of General and Technical Chemistry at the new Imperial and Royal Polytechnic Institute in Vienna. He began teaching in January 1818 and was confirmed in his position the next month.

The first Director of the Vienna Polytechnic, Johann Joseph Prechtl, was also the publisher and editor of the Institution's *Yearbooks*, the first volume of which appeared in 1819. He was a frequent contributor to the *Yearbooks* and one of his papers, on how a saltworks might use potash to produce an enriched mixture of sodium and potassium sulphates for use as a glassmaking flux, is included in this volume.

Benjamin Scholz had already in 1816 published *A Foundation in Physics as an Introduction to the Study of Chemistry*. A second edition appeared in 1821, a third in 1827, and it eventually ran to a posthumous fifth edition produced by Schrötter in 1837.

Scholz's one contribution on glassmaking is a very lengthy article. Its first part is a knowledgeable review of "what everyone ought to know about glass"; the second a detailed discussion of experiments in Austria to attempt to discover how to use *Glauber's salt* (sodium sulphate) to replace potash as the source of alkali in glass batches. Potash was then expensive and in short supply. This part records information about applications for exclusive licences to exploit claimed inventions and submissions for a prize (never awarded) for a method of making colourless glass without potash.

FACTORY SUPERINTENDENT KIRN

The second author, Factory Superintendent Kirn of the Royal Württemburg Glass-house at Schönmünzach, is a shadowy figure whose first name or initials have yet to be discovered. His works have rarely been referred to by later authors.

By his own account it seems that Kirn had considerable experience of both glass and iron manufacture. He talks of having worked in "many countries" but Germany was at that time a patchwork of independent kingdoms and dukedoms and he might have worked in several of those. However, he also had a detailed knowledge of French glass making in the Vosges.

Kirn published experiments in glassmaking were made while he was employed by the Royal Württemburg Glass-house, which was run to try to show other glassmakers how to improve their operations and thus benefit both their own and the State's economies. That must have played a decisive part in his ability to make so many experiments and publish detailed accounts of their results. He was probably recruited in 1828 and most likely left in 1832 or 1833. Kirn's contributions are unique at that time, partly for their content, also because he wrote to assist practising glassmakers.

Kirn published six papers between 1830 and 1834 and a seventh in 1837. Only the first two identify him as being at Schönmünzach, but the contents of the papers show that all but the last definitely describe investigations undertaken there. The last paper obviously relies on data collected from many sources. The range of topics that he covers and the amount of quantitative information, both technological and economic, that he gives are remarkable.

The first paper includes detailed costings for works operating in Bohemia and France, made because wood cost much more in France. That affected the methods of working in the two regions and those differences are described in detail.

His second paper discusses in much greater detail than any other author all the stages of preparing wood for the glass furnace. It includes the results of experiments which show the author to have been most concerned about using the wood efficiently, minimising the amount of work involved, and about conserving the forest and assisting regrowth. Many mainland European glassmakers fired their furnaces with wood until the end of the nineteenth century.

Other papers report investigations of modifications to furnace hearths to establish the best conditions for efficient combustion of the wood and for introducing secondary air; the most efficient ways of drying large quantities of wood; and using sodium chloride as a source of alkali in the batch. A big problem with the chloride is its volatility and Kirn describes consequent changes to furnace design to avoid drips from the crown, caused by volatilisation, falling into the pots and spoiling the glass.

He also describes the flattening of window glass cylinders, the results of extensive trials to find how to make clay slabs sufficiently flat and smooth to avoid the use of glass lagres. His last paper summarises extensive data for various types of furnace and shows how to choose the dimensions of both pots and furnaces for efficient glass melting.

The rarity of reference to any other authorities, which contrasts markedly with the writings of Bosc D'Antic and Scholz, is an interesting feature of Kirn's papers. Kirn indicates that he was widely read about industries and makes one scornful reference to French works on the manufacture of glass which convince him that their authors "can never have seen a glass furnace," which could refer to Blancourt's translation (1697) of Neri/Merrett. Kirn refers to other well-known works on glassmaking very rarely, although he does quote with approval the information about furnace dimensions and construction given in the German translation by Tabor of Loysel's book.

The works of Scholz and Kirn show a great leap forward in the detail of their reports and in understanding, as a result of very rapid advances in chemistry. The only known similarly detailed account of glassmaking researches contemporary with Scholz and Kirn was by Faraday who published his work on making homogeneous glasses suitable for achromatic telescope lenses in 1830 after working part-time on the problem for something more than two years, during which time he considered that he had made as much progress as he could. However, Faraday was not a glassmaker and his specialised small-scale work appears to have had no influence on the glass industry. Fraunhofer, whose interest in making homogeneous glasses was known to Faraday, published a few observations on glass properties but nothing significant on making optical glass. Those include a paper on testing the chemical durability of glasses which appears to include the first reference to the beneficial influence of the *mixed alkali effect*.

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THE EMERGENCE OF MODERN CHEMISTRY

The early years of the nineteenth century saw a true appreciation of combustion, the identification of many new elements and the production and purification of many compounds. Glass apparatus played a vital part in those works. Humphry Davy (1778–1829) was one of the leading chemists of that time and discoverer of several elements. His most farsighted act was to employ the young Michael Faraday (1791–1867) as his assistant in March 1813. By that time the experimental method relying on carefully recorded and interpreted results was firmly established as the way to make progress in science. Glassmaking and other industries were ready to use at least some discoveries when they were publicised.

By 1820, when Scholz wrote his paper, many of the basic ideas of inorganic chemistry that we accept today were in circulation even if not yet generally accepted. Papers published in the period 1820–40 were written by authors who no longer clung to basic postulates that we find difficult to understand today. For the first time extensive and sometimes rather tenuous reinterpretation of their explanations of the phenomena involved are rarely required. The major deficiency of inorganic chemistry was lack of a way of putting the elements and their chemical properties in intelligible order and predicting what elements might remain undiscovered. That crucial discovery had to wait for Mendeleyev's inspiration to yield the *Periodic Table* in 1869. Better understanding of the chemistry of combustion and the possibilities of generating gaseous fuels outside the furnace were not exploited until about 1850 but the patent literature from 1840 shows that ingenious minds were already trying to improve glassmaking. Major developments in refractory materials, essential to improve furnace technology, also lay a century hence.

Early Nineteenth Century Glass Technology in Austria and Germany, A5, ISBN 0-900682-45-0, £25.00 (£20.00 SGT members). Orders can be made through the Society's website. ■

SGT NEWS

GLASS: PAST, PRESENT AND FUTURE

The 2005 Annual Meeting of the Society of Glass Technology moves to September. The meeting will be held in Sheffield and marks the 90th anniversary of the founding of the Department of Glass Technology and coincides with the centenary of the University of Sheffield's Charter. During 7–10 September there will be events celebrating the contributions made by the Society's founder, W E S Turner, the first Professor of Glass Technology, and his continuing influence.

SESSIONS CELEBRATING THE WORK OF PROF M CABLE AND PROF H SCHAEFFER

A key aim of the meeting is to celebrate the contributions over many years of Professors Cable and Schaeffer to glass science and technology. Sessions will be devoted to their research interests, presented principally by speakers they have worked with.

INDUSTRIAL AND SCIENTIFIC SESSIONS

Further sessions will cover wider aspects of glass science and technology including a one day industrial session and the New Researchers Forum on Glass.

TURNER MEMORIAL LECTURE

Dr David Whitehouse, director of Corning Glass Museum and editor of the Journal of Glass Studies, will present the Turner Memorial Lecture on Thursday 8 September.

HISTORY AND HERITAGE OF GLASS

The Special Interest Group will hold another in its series of one day meetings on Saturday 10 September, based at the Turner Glass Museum. A historical theme will also be covered by the Turner Memorial Lecture and some of the contributors to the session celebrating Professor Cable.

The Annual Meeting will be based at Halifax Hall of Residence with the Turner Memorial Lecture and the following conference dinner held in the main University complex.

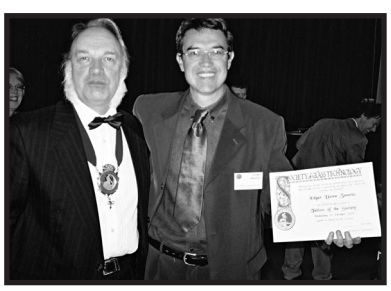
Further details on the conference can be obtained from Christine Brown at the Society. ■

DR L DAVID PYE, HON FSGT

Dr L David Pye, Professor of Glass Science at the School of Ceramic Engineering and Materials Science, Alfred University in the US, has been elected an Honorary Fellow of the Society of Glass Technology. The honour is in recognition of his scholarship in the science and technology of glass and as leader of the Glass Science programme at Alfred University.

Each Honorary Fellowship recognises an individual's unique contribution to the aims of the Society of Glass Technology and to the global glass community.

David Pye has been involved with international educational, research, and industrial programmes for several decades. His research interests include: optical properties of non-crystalline materials; phase transitions in glass forming; glass melt chemistry; natural glasses; and oxynitride glasses. He served as dean of the College of Ceramics at Alfred University, which includes the School of Ceramic Engineering and Materials Science and was founding director of the National Science Foundation's Industry–University Center for Glass Research at Alfred. A former President of the International Commission on Glass, he also has served as a member of the American Ceramics Society Board of Directors, is an honorary member of the Deutsche Glastechnische Gesellschaft, and is a member of the prestigious World Academy of Ceramics.



▲ ***Dr L David Pye, right, receives his Honorary Fellowship from the president of the Society of Glass Technology, Professor Adrian Wright.***

Dr Pye was presented with his Fellowship at the conference dinner on 22 April during the Annual Meeting of the Society of Glass Technology held in Liverpool, 21–23 April 2004.

Dr Pye joins a select group. The rules of the Society of Glass Technology limit the number of Honorary Fellows to twelve at any one time, he is only the 46th Honorary Fellow and is only the sixth American to be so recognised.

The objects of the Society of Glass Technology are to encourage and advance the study of the history, art, science, design, manufacture, after treatment, distribution and end use of glass of any and every kind. These aims are furthered by meetings, publications, a web site, the maintenance of a library and the promotion of association with other interested persons and organisations.

CRYSTALLISATION 2003

The proceedings of the Seventh Symposium on Crystallisation in Glasses and Liquids have been published by the Society of Glass Technology. The meeting was held in July 2003, the submitted papers were peer reviewed and the accepted ones published in the appropriate issues of Glass Technology and Physics and Chemistry of Glasses in April 2004. The proceedings collects the papers into one volume. A4, 200 pages, £30 SGT members (£50 non-members).

LOCAL SECTION CONTACTS
For details of forthcoming local section events in your area, contact the following. All SGT members and non-members welcome.

London
– Mr M Holden,
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– Dr J Mukerji,
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EIGHTH ESG CONFERENCE ON GLASS SCIENCE AND TECHNOLOGY

The Society of Glass Technology has been selected to host the 2006 meeting of the European Society of Glass Science and Technology. The meeting will be held on 10–14 September 2006 at St Peter's Campus, University of Sunderland.

The ESG series of meetings normally feature two or more parallel sessions. One covers purely scientific research while the other covers industrial and technological developments.

The Sunderland meeting will draw some of its influence from the host city and its rich heritage of glassmaking and the strong support of current glassmaking that is provided in the region from the National Glass Centre and the glass based courses at the University of Sunderland.

The ESG Conference is held every two years in a different host country. The scope of this conference is to promote glass science and technology and, in particular, to enhance interaction among experts working on diverse areas such as glass manufacturing, glass archaeology, art and environmental issues, as well as glass science and applications.

Topics will include, but will not be limited to, the following:

- Furnace technologies and refractories
- Glass melting and forming
- Water and sulphur in glass
- Energy and environmental issues
- Glass products and quality control
- Glass structure and properties
- Sol-gel processing
- Glass surfaces
- Nucleation and crystallisation
- Glassy and glass-ceramic nanomaterials
- Glasses in optics and photonics
- Novel glasses and applications in medicine, dentistry, biotechnology
- Glass art
- History and Heritage of Glass

Further information can be obtained from Christine Brown at the Society. ■

HOW GREEN IS YOUR FACTORY?

The Glass Batch Furnace and Refractories Committee is organising a clinic discussion meeting on Integrated Pollution Prevention and Control – the environmental issues, at Pilkington Technology Centre, Lathom on Wednesday 24th November. The IPPC legislation is an all-embracing piece of law, which encompasses emissions to air and water, waste generation, noise and the visual impact of the site. An important aspect of the permit is the minimisation of all kinds of environmental impacts, not forgetting the monitoring of them.

Despite an application cut off date of 31st July 2003, very few permits have been granted and those that have are of varying content. Judging by the amounts of paper, tree conservation sometimes doesn't seem to come in to it!

Alan Norris of Pilkington will chair this talk about the issues that concern glassmakers and their suppliers, and perhaps come up with some solutions. Put the date in your diary now and come along on the 24th.

STANDARD SAMPLES – LIMESTONE AND DOLOMITE

The Analysis & Properties Committee of the Society of Glass Technology are at the mid point in their analysis of two new certified reference materials for limestone and dolomite. There have been 13 contributing laboratories to the analysis so far and progress is very encouraging.

The committee is working on a revision of the BSI standard on the sampling and analysis of glassmaking sands. The first part has finished public consultation and so will be published very soon.

A subcommittee of the Analysis and Properties Committee has a survey of cullet quality and analysis due for publication in Glass Technology and for distribution to the cullet supply chain.

CURRENT STANDARD SAMPLES

The current certified reference materials include amber and green soda–lime–silica glasses, these are available in the form of glass pieces and also as 40mm diameter discs.

They are intended for the verification of analytical methods, for the calibration of analytical instruments in cases where the calibration of primary substances (pure stoichiometric compounds) is not possible and for establishing secondary reference materials.

The traceability of this certified reference material is ensured by the use of either stoichiometric analytical techniques or methods that are calibrated against pure compounds.

SGT10 Amber soda–lime–silica container glass (mass%)

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	BaO	Na_2O	K_2O	TiO_2	SO_3	Cr_2O_3
72.8	1.62	0.325	10.6-	1.82	0.02	12.2	0.35	0.09	0.05	0.020

SGT11 Green soda–lime–silica container glass (mass%)

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	BaO	Na_2O	K_2O	TiO_2	SO_3	Cr_2O_3
70.7	1.83	0.342	10.3	2.14	0.031	13.6	0.69	0.068	0.06	0.205

There are also values for ZrO2 and Mn3O4.

These add to the existing range of standard sand and glass samples for analysis and calibration purposes.

GLASSES

Standard Glass No. 4. Fluoride Opal Glass
Also available as 6 mm thick sheets to special order, price on application.
Standard Glass No. 5. Soda–Lime–Magnesia–Silica Glass
Standard Glass No. 6. Soda–Lime–Silica Glass
Standard Glass No. 7. Soda–Lime–Silica Glass
Two lead glasses were received by the Analysis & Properties Committee but because of time limitations Glass No. 9 was not analysed by all of the collaborating laboratories. This glass has a lower lead oxide content, about 28% PbO, than Glass No. 8 and although it cannot be offered as a certified material, it could be useful as a subsidiary calibration check.
Standard Glass No. 8. Lead oxide–potassium oxide–silica glass (30·59 wt% PbO)
Standard Glass No. 9. Probable composition available.

SANDS

Standard Sand No. 1. 200 g packs at £20.00 plus postage (Al_2O_3 0·061, Fe_2O_3 0·014, TiO_2 0·026).
Standard Sand No. 6. (Al_2O_3 0·06, Fe_2O_3 0·032, TiO_2 0·024)
Standard Sand No. 8. (Al_2O_3 2·07, Fe_2O_3 0·26, TiO_2 0·073, K_2O 1·06)
Standard Sand No. 9. (Al_2O_3 1·35, Fe_2O_3 0·103, TiO_2 0·044, K_2O 0·82)

Orders can be made through the SGT website: www.sgt.org

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