Salters' Institute

1918 - 2018

Celebrating **100** years

The Salters' Institute *Celebrates*
100 years of support for chemistry & science education

Kathryn Roberts

Foreword

As this account to celebrate its 100th anniversary shows, the Salters' Institute has made a major contribution to science education for the past 100 years. As the flagship charity of the Salters' Company, for the first 50 years the Institute funded postdoctoral fellowships and postgraduate scholarships to encourage chemists and chemical engineers to make their careers in the chemicals and related industries. The success of these awards is indicated by the many Fellows who eventually took senior positions in industry.

Over the past 50 years, the Institute shifted its support in the main to school chemistry, and latterly to all of school science. Not only has it played a major role in the development of a number of innovative and inspirational curricula but, through its Festivals of Chemistry and Chemistry Camps, it has given many thousands of young people the opportunity to experience first-hand the excitement of chemistry not always found in the classroom. At the same time, the Institute has played an important role in supporting science education in a university context, through the funding of successive Salters' professors of chemistry or science education at the University of York.

The Institute now has a substantial impact on the teaching of chemistry and other sciences across the UK and beyond. This has been done in collaboration with industry, with universities and with other scientific professional bodies – associations which the Institute highly values.

The Institute looks forward to drawing on its growing network of alumni – industrialists and educators – to support and shape its future work.

Professor Michael Reiss,
Master of the Salters' Company

The Salters' Company

The Salters' Company is one of the Great 12 Livery Companies of the City of London, and has its origins in the salt trade of medieval London. The importance of salt, especially hundreds of years ago, cannot be overstated – it was used to make food palatable and to preserve it, and was a valuable token of trade. People who could afford to kept lavish salt containers in their homes as a symbol of wealth and status.

1394 The Company was granted its charter from Richard II, a licence to establish a fraternity of Salters. Some of these 'citizens of London' had expertise in using salt, for example to dry fish and meat; others were more interested in its value, and weights and measures for trading purposes. Whatever their business, being part of the Company was an indication that the goods they produced or traded with were of reputable quality. In return for its licence, the Salters' Company, like all the high-ranking livery companies, was expected to support charitable activities.

1894-1911 As part of its charitable giving, the Company awarded research fellowships of between £100 and £150 each to young men to work in various government and hospital laboratories in London. As one of the founding members of the City and Guilds London Institute (1878), the Company gave one of its fellowships to encourage research in applied chemistry in this institution.

The first recipient of the City & Guilds fellowship was Martin Onslow Forster, a demonstrator at the Royal College of Science, London, who later became the first Director of the Salter's Institute of Industrial Chemistry.

The Salters' Company

The Salters' Company is governed by a Master, two Wardens, and a Court of Assistants (Board of Directors) that is responsible for company business and electing the Master and Wardens. The Clerk is a permanent member of staff who runs the day-to-day activities for the Company. The Master is in office for one year.

There are around 300 current Salters, some by inheritance, some through invitation.

The Salters' Institute

Immediately after the First World War, in 1917, the Salters' Company set up a Special Committee to consider 'how best to further the interests of the trades for which it was originally formed'. The Great War had highlighted the strengths of the German chemicals industry compared with Britain's, where relatively few graduate chemists were employed and research lagged behind that of its German competitors. As a result, Germany's production of fertilisers, explosives and dyestuffs was thriving and more advanced than Britain's. Moreover, the value the Germans placed on the technical training of their chemists exposed Britain's lack of regard for this more vocational aspect of science education.

The Salters' Company needed a high-profile charitable purpose. The Committee chose chemical manufacturing as its 'trade', recognising the importance of salt as an input to inorganic chemical manufacture and hence to the country's future prosperity.

Many livery companies gave their support to schools in London, the Haberdashers' Company and the Merchant Taylors' Company for example. The Salters' Company was unique in giving its support to one subject – chemistry education. In the years to come this decision would prove to be tremendously valuable in raising the profile of the Company – the name Salters is known in schools all over the country.

1918 The Salters' Institute of Industrial Chemistry was founded with the overarching objective, under an elected Director, to encourage more graduate chemists and chemical engineers into the chemical and pharmaceutical industries.

The focus of the Institute's support was applied chemistry research and training, not pure research since there were already organisations providing money for this. The Company wanted to do something no other organisation was doing. This strategy of enriching provision rather than replicating what others were doing in support of chemistry education, and later science education, would become a trademark of the Institute.

The Institute's first Director, Dr Martin Onslow Forster, was chosen in part for his achievements as an organic chemist – he was Director of British Dyestuffs in 1916 – and in part because he had been outspoken on the need for high quality science education that also met the needs of industry.

Forster led the Institute for four years, with the next 50 years seeing four more eminent chemists take charge, all of whom were Fellows of the Royal Society – Arthur Smithells (1922–37), Sir Robert Robinson (1937–49), Sir Alfred Egerton (1949–59) and Arthur Ubbelohde (1959–75).

Initially, through postdoctoral fellowships, the Institute helped young men whose chemistry studies had been interrupted by the Great War to complete their education. Subsequently, it set its sights on helping young chemists to get further training in research and encouraging them to enter industry.

Over the next 50 years the Institute would introduce different types of awards to reflect the changing needs of industry. In the early 1930s, small 'grants-in-aid' were given to working young men and women who wanted to attend evening classes to improve their chemical knowledge and their career prospects. Many of these young people went on to do degrees in chemistry and take up positions in the chemicals industry. In the aftermath of the Second World War (1939–45), with the Company's City premises in St Swithin's Lane destroyed and in need of rebuilding, finances were tight. Nevertheless, the Institute found the money to introduce postgraduate scholarships. Later, in the 1960s, the Institute recognised the need to attract future leaders to industry so some of its fellowships were given for achievement 'well above the average'.

From 1918 to 1975: 130 postdoctoral fellowships were awarded; 80 postgraduate scholarships; seven business management fellowships, as well as the 'grants in aid'.[1]

Many Salters' Fellows went on to secure places in industry and government bodies, several becoming CEOs of major scientific institutions. Dr Peter Doyle, who became Director of Research at ICI and at Zeneca, is one example. Like several other Salters' fellows and scholars, he later became Master of the Salters' Company.

A growing need for well-qualified chemists

By the 1960s, the chemicals and pharmaceuticals industries in the UK were competitive and strong, and the demand for well-qualified chemists was high. GCE A-levels were established as the standard entry requirement into Higher Education. To encourage A-level chemistry students to take the subject at university, thus expanding the pool of chemists for industry, the Director of the Institute, Alfred Ubbelohde, Professor of Chemical Engineering at Imperial College London, decided to expand the Institute's support for school chemistry education. He had little difficulty in persuading the Master of the Company in 1961 that this was a good idea – Professor Sir Alexander Todd (later Lord Todd) was

a scientist and an academic. A renowned organic chemist, Todd had been awarded the Nobel Prize in Chemistry in 1957 for his synthesis of nucleotides and nucleotide co-enzymes.

1960 The Institute ran a series of lectures aimed at inspiring A-level chemistry students to study the subject at university. Given by eminent chemists, these lectures were intended to complement the Royal Institution Christmas lectures which had been running successfully for many years but were aimed at younger children.

One Salters' School Lecture was given by inspirational chemist and educator, George Porter, then Professor of Chemistry at the University of Sheffield, on chemical reactions. Porter received the Nobel Prize in Chemistry in 1967, along with Manfred Eigen and Ronald G. W. Norrish, for his part in studying fast chemical reactions triggered by very short pulses of energy. Porter would later play an influential part in the Institute's legacy, driven by his belief in the need to increase the numbers of high-quality physical scientists for the prosperity of the country.

1961 The Institute launched five-day, university-based conferences for school science teachers to give them the opportunity to find out about the latest developments in science and to come together to discuss new teaching techniques. The first Salters' Conference for School Science Teachers was held at the University of Manchester; its success led to the Institute running similar events at different universities annually for many years.

> *As a young chemistry teacher, I remember going to one of the Salters' school teacher conferences, and feeling as if the doors had been thrown open and I could see that there was a whole world out there of researchers using chemistry to improve people's lives – that was a great awakening for me.*
>
> *Sir John Holman, Chairman, the Salters' Institute*

At this time, the Salters' Company's finances were in good shape because of investment in the property market and it was supporting its charitable activities to the tune of some £34,000 per year, most of which went to the Institute. (In today's terms, this would equate

to approximately £700,000 pa.) The institute was already being seen by the Company as its flagship charity.

Other schemes supported in the 1960s by the Salters' Institute

1967, the Institute offered business management fellowships to recent high-quality chemistry and chemical engineering graduates to encourage and fast track them to executive careers in industry.

1967, the Institute started giving grants for books to science libraries in selected schools.

1968, the Institute offered bursaries to school science teachers to spend a sabbatical leave in chemical engineering departments in universities.

From 1968 to 1972, the Institute awarded six £500 bursaries to women who wanted to resume their careers in industry or science education after a career break.

A change in direction

The 1970s were challenging times for school science. A-level numbers in chemistry and physics had been declining since the late 1960s as highlighted in the Dainton report published 1968.

In 1972, a government-commissioned enquiry into teacher training, led by Eric James, Vice Chancellor of the University of York, made the case for in-service training (INSET) of experienced teachers as a way of keeping them up-to-date with their subject knowledge and the latest developments in their subject. This, the report argued, would have a positive, knock-on effect on student numbers.

The University of York, under the leadership of Professor of Chemistry, Richard Norman, was quick to take the lead in implementing this recommendation. Norman was already convinced of the need for universities to have good relationships with schools, not least as a way of attracting students to study chemistry in his department. A longstanding association, over a period of some 10 years, with David Waddington, Head of Science at Wellington College in Windsor, Berks, would turn out to be particularly productive in the coming years.

By 1974, in response to the James' report, and together with colleagues from the departments of chemistry and education, Norman and Waddington had developed a two-part INSET course aimed at experienced chemistry teachers wanting to refresh and update their knowledge.

This project attracted the attention of the Salters' Company, who were looking for a new Director for the Institute. Keen to establish links with the good work being done at the University of York, the Company offered the position to Norman, who accepted.

1975 Professor Richard Norman appointed as Director of the Institute.

Professor Richard Norman

Under the leadership of Norman, the Salters' Institute moved to a whole new level of support for secondary school chemistry education, making this its focus for the foreseeable future. Although chemistry was the initial and major beneficiary, physics and biology would also gain from this commitment in the future.

Norman held the next Salters' Conference for School Science Teachers at the University of York, and set the overall theme as: 'The teaching of chemistry in the context of its role in society'. Ideas about society, especially industrial processes, were beginning to appear in school syllabuses. Since the Salters' Institute was funding the conference, the theme made good sense as it would provide an opportunity to discuss what and how societal issues should be taught through school chemistry.

1975 The Salters' Institute together with ICI and Shell, provided bursaries for the 'less well-off majority' of chemistry teachers to attend the University of York's INSET course.

However, in 1975, coinciding with the start of Norman's Directorship, the Company finances received a blow – the bank called in the loan for the rebuilding of the new Hall in Fore Street.
(The Hall was opened by HRH Duke of Kent in 1976.)

The Institute therefore needed to re-think its expenditure and decided to abolish its postdoctoral fellowships and postgraduate scholarships, reasoning that other organisations and government bodies were funding this sector over and above what the Institute could do. The Institute felt it could do more for chemistry through school science.

In addition, the Institute decided that the Salters' Conferences for School Science Teachers would no longer be held annually but 'at regular intervals', with industry invited to share its views on the subjects covered by these conferences and contribute to the costs. Companies like Reckitt & Colman at Hull, Ciba-Geigy at Grimsby and ICI provided some funding, as well as speakers and tours of their plants for the teachers.

From 1984 to 1993, 965 teachers from 730 different schools and colleges took part in 18 Salters' Conferences for School Science Teachers.[1]

The partnerships with industry would underpin the Institute's strategy for the future – all projects would be supported together with industrial or business partners, or with other professional bodies. This strategy would ensure that any disruptions to the Company's finances would have less impact on the Institute's overarching aim to support chemistry education.

The Graduate Awards

Despite abolishing the postdoctoral fellowships and postgraduate scholarships, the Institute valued its link with young professional chemists and decided to offer annual prizes for academically outstanding graduates in chemistry and chemical engineering. The recipients would have a first-class degree and the potential to make their mark in the chemicals or allied industries.

1980 The Graduate Awards were launched. Initially, three awards were given to chemical engineers and two to chemists. The scheme continues – for the past 10 years, 10 awards of £1000 each have been split between chemists and chemical engineers. The awards are given at a prize-giving ceremony held annually at Salters' Hall.

Candidates are pre-selected by their departmental heads in their final undergraduate year and are then invited to Salters' Hall where they undergo a panel interview made up of professional chemists or chemical engineers, together with a representative of the Salters' Company. In addition to chemical competence, the panel is looking for graduates with some knowledge of the problems and challenges facing UK industry as well as the need for changing technology in the future.

Videos, books and software

The Institute shared the costs with ICI in the making of two video films on the wide range of careers open to students with chemistry qualifications – Why Chemistry (1982) aimed at 13-14-year olds and The Excitement of Chemistry *(1983) aimed at 16-17-year olds.*

In 1983 the Institute funded chemistry teachers Dai Davies and Barbara Page to write a book about industrial chemistry processes. The Essential Chemical Industry *was edited by David Waddington. The 5th edition, published in 2010, was developed with support from the Salters' Institute, the Royal Society of Chemistry (RSC), the Gatsby Charitable Foundation, global chemicals major Arkema, the British Plastics Federation (BPF) and the Chemicals Industries Association (CIA). The book is now out of print but available on the web (essentialchemistry.org).*

The Essential Chemical Industry *receives more than 100,000 hits a month, worldwide.*

In 1983, the Institute funded the development of 'software for school chemistry courses' by John Lazonby and Bob Campbell, both from the department of education at the University of York. The software was aimed at helping teachers interpret mass spectra and diffraction patterns.

Since 1980, 147 chemists and 189 chemical engineers have been presented with Graduate Awards.

1980-2003 The Institute, under Norman's leadership, set up a scheme to distribute chemical laboratory equipment, discarded by companies, to schools as free gifts – basic glassware, thermometers and test tubes. The scheme was run by school teacher Francesca Garforth, who was on secondment at the University of York, as a Leverhulme Fellow, doing curriculum research. So successful was the scheme that the Institute, with support from the Nuffield Foundation, established other distribution centres at several other universities across the country.

Curriculum development at the University of York

By the early 1980s, the number of A-level chemistry and physics candidates had continued to fall. There was growing concern among chemists that the way the subject was being taught in the third year of secondary school was putting students off from choosing the subject at O-level (now GCSE). There was also a gender imbalance in the uptake of the separate science O-levels – given the choice, many girls opted to study biology or no science at all this stage. Overall, the science syllabuses for 11-16-year olds were perceived by too many students as hard, boring and irrelevant.

In 1983, David Waddington was now Professor of Chemical Education at the University of York and leading the University of York Science Education Group (UYSEG), a group of chemists and educationalists working together to develop curriculum materials for schools. He decided to bring together a number of academic chemists, chemical educators and, crucially, chemistry teachers to work on new ideas for teaching materials for 13-14-year olds. The working group included John Lazonby and Francesca Garforth from the University of York, John Raffan from the University of Cambridge, Malcolm Frazer from the University of East Anglia and chemistry teachers, including Peter Nicholson, Sue Adamson and John Holman.

Professor David Waddington

Around this time, the notion of a balanced science curriculum for 11-16-year olds was being mooted among various education and government organisations, particularly the Association for Science Education (ASE). Research on student learning difficulties in chemistry by Garforth had attracted the attention of the Royal Society of Chemistry (RSC), who asked her to write a chemistry syllabus for 11-16-year olds. The RSC wanted a syllabus that would provide a good general education in chemistry for the 90% who would not study the subject further, and at the same time, provide a foundation for the 10% of students who would go on to study A-level chemistry. Her approach was to teach chemistry from the students' own experiences, starting from simple ideas such as cleaning their teeth and drinking fizzy drinks to more sophisticated ideas about medicines, fuels and the environment for older students.

With ideas emerging of what sort of teaching materials were needed to inspire and engage young students of chemistry, Waddington, Garforth and Nicholson brought together another group of 40 teachers to a weekend-long workshop, funded by BP Chemicals, to develop the ideas. So enthusiastic and committed were the teachers that this led to a one-week seminal workshop during which they produced curriculum materials for a chemistry course aimed at 13-14-year olds. The workshop was

funded significantly by the Salters' Institute, the Oxford and Cambridge Schools Examination Board, BP Chemicals and to a lesser amount by the Royal Society of Chemistry (RSC).

Since the project incorporated the innovative ideas of a large a group of teachers and academics from different universities, Waddington approached the Salters' Institute to lend its name to the new course. The Institute, he reasoned, had been generous in its support not only of the initial workshops but also of many other school science projects for many years. The course for 13-14-year olds thus became known as Salters Chemistry.

The project represented a milestone in school science curriculum development – there would be several more Salters' school science courses developed in the future that would build on the ideas discussed at the seminal workshop. **The Salters' Approach** in which science is taught by reference to students' own everyday experiences was born. Its distinctive character comes from being both context- and activities-led, and developed and written by school teachers working with academics and industrialists. Crucially, all Salters' materials are trialled in schools, with feedback and revisions, before being launched nationally.

1984 Following successful trials in 143 schools, Salters Chemistry for 13-14-year olds was published by Heinemann Educational Books.

Any initial concern regarding the uptake of Salters Chemistry because it was too different for teachers to take a risk on were soon squashed. The uptake was higher than expected and the feedback from the teachers involved suggested they would not want to revert to teaching chemistry in the more traditional way, which many perceived as comparatively dull.

By the mid-1980s, however, the landscape of secondary education was changing rapidly. There were two separate discussions going on. One centred on replacing O-levels and the CSE (Certificate of Secondary Education) courses with 'GCSEs'(General Certificates of Secondary Education) that would be taken by all students. The other, led by HMI (Her Majesty's Inspectorate of Schools), called for a double award GCSE as the offering in science. The arguments underpinning both issues were set out in a policy document, *Science 5-16*, published by the government's Department of Education and Science (DES) in March 1985. A significant recommendation from this report for science was that all students should study a balanced science course up to the age of 16, which would take up 20% of curriculum time and comprise equal amounts of biology, chemistry and physics, as well as some aspects of other sciences such as earth science. To

do the three separate sciences in 30% of curriculum time, the report argued, would damage the overall balance of the curriculum, especially since other STEM subjects had to be taught such as maths, design & technology and ICT.

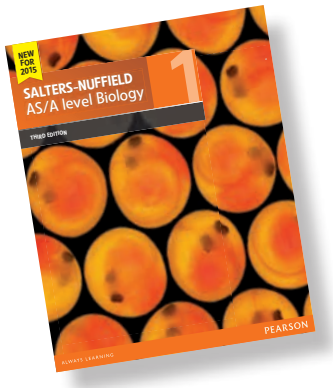
The outcome of these deliberations – the introduction of Double Award GCSE Science in 1986, for first examination in 1988, meant that all three of the main sciences – biology, chemistry and physics – became a part of every child's education. This set the scene for discussions for a National Curriculum, which was eventually launched in 1988. The inevitable question became 'what sort of science course would work for all 15-16-year olds'? The Salters' Approach was a plausible response.

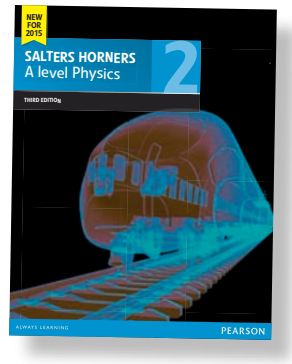
The Salters' GCSE was being developed at the same time as the National Curriculum was coming in, so it represented the latest thinking in how to teach science for all students. I believe that it was influential in forming a new model for what science education should be for that age group.

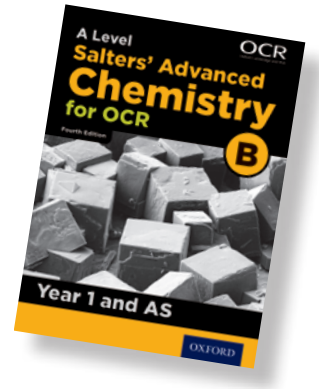
Sir John Holman

Salters GCSE Chemistry, followed by Salters GCSE Science, was developed by Waddington and his growing group of enthusiastic teachers and academics. Salters GCSE Science covered chemistry, physics, biology, with some elements of geology and astronomy, and each science was developed by different groups of teachers and academics.

These courses would ensure that the Salters' Approach would be preserved at this level of education.







1986 Salters GCSE Chemistry launched after successful trials in 135 schools involving 14,000 students, followed in **1990** by Salters GCSE Science.

Uptake of the Salters GCSE grew during the 1990s until over 36,000 candidates annually were taking the national examination offered by OCR – almost 6% of the national cohort.

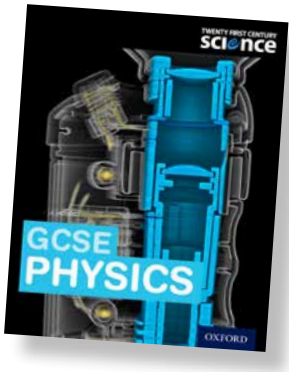
1988 The Institute, along with over 50 chemical companies contributed, and continues to do so, to the cost of the Chemical Industry Education Centre (CIEC) at the University of York.

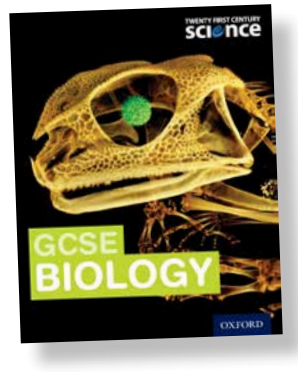
By this time, however, Waddington had already realised that if the GCSE courses were to be truly successful, there would need to be a follow-on Salters A-level Chemistry.

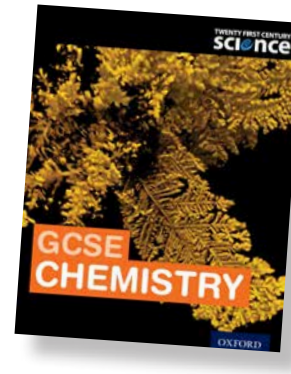
1988 Waddington asked John Holman to direct the Salters A-level chemistry project. Head of Science at Watford Grammar School for Boys, Holman had experience of developing curriculum material, first on the ASE SATIS (Science and Technology in Society) project, working with Andrew Hunt, Director of the Nuffield Curriculum Centre, and on the Salters Chemistry project and the Salters GCSE Chemistry for which he was a lead author.

Holman put together a working group, which over the course of the next two years would involve around 100 chemistry teachers and academics and science educationists. They came up with the idea of starting each of the 13 individual units with a 'story line', from which all the 'chemical ideas' – the relevant chemical concepts – and activities would be developed. The storylines would be about an application of chemistry; the group wanted to include frontier chemistry, so they got their stories by talking to research scientists at the University of York and at other research institutions.

The team ensured that the A-level course was underpinned by up-to-date applications of chemistry, which set it apart from the traditional A-level. The learning activities included practical experiments, discussions, data-handling exercises, simulations and an individual investigation lasting three to four weeks. The chemical ideas were delivered in a 'drip feed' fashion throughout the course. This gave students the opportunity to revisit ideas several times before the end of the course. The lead editor, former chemistry teacher Gwen Pilling, made sure the chemistry was accurate and accessible. The project team produced two separate books for the course – Storylines, and Chemical Ideas – both written largely by schoolteachers.







Again, it was the Salters' Institute which put up the necessary funding to get the A-level project started. In addition, Waddington was keen to get industry on board at the development stage and secured funding from several companies, including BP Chemicals, British Steel, Esso UK, Shell UK, and Zeneca Agricultural Products as well as from the Association of the British Pharmaceutical Industry (ABPI) and the RSC.

Significantly, however, the Salters' Institute, by being the first to provide funding for such projects, became recognised as an organisation prepared to take risks for the benefit of school chemistry. Once projects were underway, the Institute would often provide more funding to improve and revise the projects to meet the changing requirements of government regulators.

Once you have money from one funder, it makes it a lot easier to raise more money from other sources. But this does mean that the Institute was always taking the risk, and this has been a huge value to the curriculum development we have done at York; it wouldn't have happened without the Salters' Institute being the first mover.

Sir John Holman

The Institute was prepared to continue supporting development projects after the first edition had been published and was in use in schools – so much research funding dries up when you get to the end of the initial funding stage; to have this continuing support makes a huge difference to what you can achieve.

Robin Millar, Salters' Professor of Science Education (2006-14)

1990 Salters A-level chemistry course trialled in 24 schools, and in **1992** 354 students took the first A-level examination (run by the Oxford and Cambridge Schools Examination Board) in the new course.

One of the key elements of the Salters A-level Chemistry was the month-long practical individual investigation. This unique way of assessing student practical skills allowed students to get a taste of what it is really like to be a scientist. For many students, and their teachers, this was the highlight of their A-level studies and often had a direct influence on their decision to read chemistry at university.

Derek Denby, former chemistry teacher at John Leggott College, Scunthorpe

Over the past 30 years the Salters' courses have been developed and revised, made possible by continuing funding from the Salters' Institute. In 2002, the GCSE courses underwent a major revision resulting in Twenty First Century Science and between 2012 and 2016, the A-level courses were revised in time for the new curricula, based on government guidelines, in 2016.

By 2000, more than 5000 students in over 320 schools were taking Salters A-level Chemistry each year.[2]

The Salters' publications have been translated or adapted in many countries around the world – in several European countries, Russia and the US; the Salters A-level Chemistry course was also adapted for use in Scotland to fit the Higher syllabus. The Salters' Approach has been used in Germany, Sweden and Belgium to develop new courses for secondary school science.

The total number of students who have taken our courses so far is in excess of 1 million. This is remarkable. The only other group of curriculum projects in the UK to have had such a success were the Nuffield courses, written in the 1960s and 1970s.[2]

David Waddington

The Institute takes stock

1989 The Master of the Salters' Company, Sir Michael Palmer, called for a review of all its activities, including those of the Institute, the first of its kind. He asked Richard Homan, a member of the Institute's committee to explore the options. Homan had recently retired as Industrial Director of the UK government's National Economic Development Office (NEDO) after a long career with ICI.

Homan decided to 'test the market' by inviting a group of 120 professionals from the worlds of education and industry, as well as representatives from the scientific professional bodies and government education agencies, to a seminar at Salters' Hall. Two questions were on the agenda: what did the participants think of what the Institute was doing to support secondary chemistry education; and what did they think it should do next. Robert Jackson, MP, Minister of State for Education, and Lord Porter, a Salter and President of the Royal Society, were among the invited guests.

The Institute's support for secondary school chemistry and curriculum development was endorsed by the group, and in addition there was agreement that the Institute's activities should be broadened. Over 40 suggestions were made, two of which were selected by the Director and Homan for the Institute to concentrate on.

First, the Institute would develop activities that would encourage pre-GCSE students to study chemistry at A-level. The outcome of these discussions saw the launch of Salters' Chemistry Clubs and Festivals of Chemistry in 1991, followed by Salters' Chemistry Camps in 1998 (see **Boxes on pages 22 & 23 and pages 28 & 29**).

Secondly, the Chemical Education Group (CEG) was established in 1991 to provide a 'collective voice' for the chemistry education community on matters of major importance to science education policy. Lord Porter, the CEG's first Chairman, recognised that the new science curriculum with its dual mandate required a close watch on policy and, importantly, the ability to influence it.

The CEG was made up of representatives from the nine professional and industrial bodies that had an interest and part to play in chemistry education – the

Royal Society (RS), the Royal Institution (RI), the Chemical Industries Association (CIA), the Association of the British Pharmaceutical Industry (ABPI), the Royal Society of Chemistry (RSC), Institution of Chemical Engineers (IChemE), the Society of Chemical Industry (SCI), the Association for Science Education (ASE), and the Salters' Institute. The Group worked at two, but synergistic, levels: one, chaired by Lord Porter, involved the presidents of the eight institutions; the other, chaired by Homan, brought together the executive directors of the same institutions.

Lord George Porter

You cannot underestimate the convening power of people like George Porter and of the Salters' Institute in bringing key people and institutions together, which was innovative at the time. The CEG was a precursor to SCORE (the Science Community Representing Education), which was formed in 2006 and which continued to present the case for science education to policy-makers for the next decade.

Sir John Holman

Initially, the CEG commissioned the Chemical Industries Education Centre (CIEC), based at the University of York and managed by Miranda Stephenson, to build a database for school teachers that would hold all the activities and resources produced by institutions and companies in support of chemical education. On completion of the database in 1993, the Institute held a workshop for teachers to find out which resources they thought were the most useful. The collective opinion was that many resources did not match their requirements nor those of the National Curriculum, so the CEG commissioned the CIEC to produce guidelines to assist companies which wanted to contribute to this field in the future.

In 1992, the CEG invited John Holman to investigate the major challenges facing school chemistry. His ensuing report, *Chemistry: a view from the*

schools, would underpin the focus of the CEG. For the next two years, the CEG concentrated on a topic close to Lord Porter's heart – the broadening of post-16 education – and made several submissions to the Department for Education and Employment on this matter. Following Sir Ron Dearing's report, *The Dearing review of qualifications for 16-19-year olds*, published in 1997, it became possible for students to take a combination of arts and science at A-level, and the CEG can take some credit for this significant change to secondary school education.

After this, in 1996, under Homan's chairmanship, the CEG moved to having annual seminars on specific issues of concern in science education, most of which had been brought to the Group's attention by Holman's report (see **Table 1**). The main driver for these seminars was to bring together teachers, academics, industrialists, the relevant institutions and government representatives to identify best practice and disseminate this to teachers across the country.

The 2000 CEG seminar resulted in the publication ICT and Science Education*, which had some influence on how the subject was taught in secondary schools when introduced in the early 2000s.*

Table 1
Topics covered in the CEG seminars 1996-2010

1996	Primary science education
1997	Chemistry in the curriculum
1998	Mathematics for science education
1999	Chemistry teaching in schools
2000	ICT and science education
2001	Future skill needs of the process industry
2003	Undergraduate chemistry
2004	14-19 curriculum and qualifications reform
2006	The changing nature of university chemistry courses
2007	Sustaining chemistry in Higher Education
2008	Science for the 21st century
2009	The teaching and learning of chemistry at Key Stage 3 (11-14-year olds)
2010	How can assessment promote effective science teaching and learning

1991 Salters' Chemistry Clubs and Festivals launched – some 170 schools took part in the first competition in 1991 (see **Box on pages 22 & 23**).

1993 The Institute funds the development of a Salters AS-level Chemistry to meet the demand for a shorter advanced-level course.

1993 Lord Porter appointed as Master of the Salters' Company.

By this time, there was a general feeling that one of the best ways to support schools and school science was through teachers. Lord Porter wanted something for chemistry that would raise its public profile. So, as part of the Salters' Company's 600th anniversary celebrations, the Company decided to set up an annual prize worth £10,000 for a chemistry teacher in either a primary or secondary school in the UK. The intention was to emphasise the role of good chemistry education by identifying good practice.

1993 The first Salters' Chemistry Teacher Prize awarded to Anne Hubbard, Head of Chemistry at Reigate Sixth Form College, Surrey.

This was a big occasion for me. I was very surprised to be given the award, and I had to give some TV and radio interviews as a result, as well as receiving invitations from the US, Finland and New Zealand to give a lecture. But the big thrill for me was being given the award by Lord Porter because I used to go his lectures at the Royal Institution, which I found hugely inspirational. At the interview he asked me 'What is the most important thing in your laboratory?' I replied 'test tubes' – whether this had any influence, I cannot say.

Anne Hubbard

With Lord Porter's backing, the chemistry teacher prize was awarded for the next eight years. In 1998, however, the format changed to encourage more schools to nominate a teacher – the prize was split equally between the winning teacher and his or her school, with the runners-up receiving medals. By 2002, the number of nominations for these awards had fallen; it was becoming clear that schools were finding it hard to nominate just one person from its science team. The award itself had its own challenges, not least because it was difficult to distinguish one teacher from a pool of around 60 coming from widely different school environments. So, the Institute changed the focus of these awards giving, from 2002-4, four awards, annually, of £2500 to outstanding chemistry teachers new to the profession.

In 2004, because of too few nominations, the chemistry teacher prize came to an end.

There has been a tremendous amount of good will generated by these and indeed all our awards. As a result, we have built up a multitude of very impressive alumni, who are extremely useful and fundamental to the Institute's work.

Richard Homan CBE

1993 Dr David Harrison appointed as Director of the Salters' Institute.

In 1993, with the tragically unexpected death of Sir Richard Norman, the Company needed a new Director. With no provision in place, the Master – Lord Porter – turned to Cambridge colleague and physical chemist Dr David Harrison to take charge of the Institute. Harrison had the right credentials for the job. He had served as admissions tutor for Selwyn College, Cambridge from 1963-79, so had a good knowledge of the secondary–tertiary interface. He was a Fellow of the Royal Society of Chemistry and of the Royal Academy of Engineering, and had previous experience of heading up other professional organisations: he was President of the Institution of Chemical Engineers from 1991-92; and Chairman of the UK Committee of Vice Chancellors and Principals in 1991.

The Salters' Chemistry

Former chemistry teacher and ICI schools' liaison officer Bob Finch came up with the idea of running Chemistry Clubs for 11-14-year olds as a way of making chemistry more visible within the school curriculum. Chemists were concerned that the introduction of a balanced science curriculum meant that the distinctions between chemistry and the other sciences were not fully appreciated by students, especially since chemistry was not always taught by chemistry teachers. The Chemistry Clubs, Finch reasoned, would allow students to do chemistry that they wouldn't otherwise do in the classroom and experience 'some of the magical sights, sounds and smells, the colour changes and effects which are unique to this subject'. The enjoyment they would get, he reasoned, would inspire them to study the subject further.

Schools were given a sum of money by the Salters' Institute to set up Chemistry Clubs and work on a set practical project. The Institute funded two part-time staff, including Finch, to run the Clubs from an office at Homerton College Cambridge; and many companies provided start-up grants for schools. The schools were then invited to regional events at universities and polytechnics, where the projects were judged by academic chemists and the winners invited to a national Festival of Chemistry final.

In 1994, the management of the Chemistry Clubs moved to Salters' Hall and from 1996, under the institute Manager, Audrey Strong's leadership went from strength to strength, with up to 200 schools and 4000 students across the country taking part. By the mid-1990s they were being called Festivals of Chemistry to celebrate the enthusiasm of the students taking part.

By the late 1990s, however, interest in the Festivals was waning – the same good and well-resourced schools always tended to reach the national finals and so the student experience for the majority was called into question. In response, in 2000, the Institute sent out questionnaires to teachers to find out what they valued from these events and to make them more inclusive.

The feedback suggested teachers liked the idea of the Festivals, but would prefer a one-off event, which gave 11-13-year olds an opportunity to experience a 'great day of chemistry' outside the classroom, preferably in a university

Clubs and Festivals

environment. There was also some agreement that the regional finals could be soul-destroying for those students who didn't win.

The feedback provided a template for Festivals of Chemistry that are still running now in collaboration with the RSC. These one-day events, where students work in teams to solve a range of problems, are run at universities across the UK and Ireland. Where there is no local university, as is the case in some rural areas, Further Education Colleges are approached to host a Festival. The day ends with an exciting demonstration lecture of pops and bangs, followed by a short prize-giving ceremony.

With additional funding from industry, the Salters' Institute produced the Salters' Chemistry Club Handbook (volumes 1&2), which provides ideas and experiments for enhancement studies for this age group. The Handbook is available at http://resources.schoolscience.co.uk/Salters/Index.html. In addition, the Salters' Institute has allowed experiments from the Handbook to be put on the RSC website (http://www.rsc.org/learnchemistry/collections/experimentation/practicalchemistry).

Prior to 2000, around 20 regional Festivals were held each year with a maximum of 200 schools taking part in the Chemistry Clubs. Since then, around 40 universities/colleges host an average of 50 Festivals each year, with the number of schools reaching 890 in 2012.

Salters' Festivals enthuse students not only because of interesting activities carried out in a spirit of friendly competition and the opportunity to meet people from different schools but also because it gives the students the opportunity to experience the university environment.

Colin Osborne, RSC education manager, schools and colleges 1996-2008

Future expansion of Festivals is planned for 2018 onwards – the intention is to increase the number of students taking part as well as develop Festivals for 14-year olds.

Dick Norman had done a marvellous job in chemistry education at the University of York through the various curriculum development projects with David Waddington, but there was a strong sense that more needed to be done. A lot of schools were finding it hard to recruit specialist science teachers, and there had been a gradual decline in practical work being done in schools.

Sir David Harrison

For the next 22 years Sir David Harrison supported the staff at York and in London, through many projects and activities, which were continuously evolving. As all Directors did, he also played a part in meetings with government agencies on matters to do with the school curriculum. His diplomatic approach saved the Salters Chemistry A-level on at least one occasion in the mid-1990s when successive governments wanted to change or reduce the number of specifications on offer.

Harrison's links with other livery companies, notably the Horners' Company, and with the Nuffield Foundation would prove invaluable as the Salters' Institute later looked to supporting curriculum development projects in physics and biology respectively.

1994 Richard Homan CBE appointed as Master of the Salters' Company.

A change in governance

This was a time of much activity for the Institute, which called on its committee members to be more involved in helping to set up and oversea its projects. Indeed, so big an operation had this become that the Company, under Homan's lead, decided that it would be in the best interests of the Institute if it were controlled by a more formal Board. The Chairman of the Board would be someone who was actively involved with

the Institute and would remain in office for as long as suited both parties. The Chairman and the Director would lead the Institute, and ex officio members of the Board would include the Master and two Wardens of the Salters' Company, members of the Salters' Court and non-Court members of the Company who could contribute to the Board's work. The Board would be responsible to the Salters' Court for overseeing all the activities of the Institute.

After serving as Master, Homan became the first Chairman of the Board in 1995 and remained in post until 2003/4, when Dr Peter Doyle took over. In 2013, Doyle retired to be replaced by the current Chairman, Sir John Holman.

Richard Homan CBE

1995 Salters A-level Chemistry Prizes launched.

These awards are made to the students who have achieved the highest marks in the Salters A-level Chemistry examinations. Between three and six awards are made each year.

1995 Salters' City & Guilds Prize launched.

As one of the founders of the City & Guilds London Institute, the Salters' Company was particularly keen that the link between the two institutions was maintained, so established the Salters' City & Guilds Prize. These awards, of which up to three are given each year, are aimed at students, or industry employees, who gain the top marks in Chemical Process Level 3 of the Process Technology Scheme.

1997 Jerwood Prizes launched.

A social encounter between the Master of the Salters' Company Sir Michael Palmer and Edward Paul, Advisory Board member of the Jerwood Charitable Foundation, led to the Jerwood Prizes. Impressed by the work of the Salters' Institute in science education, Paul was keen to collaborate with the Institute.

The Jerwood Prizes, which ran for nine years, were given to former Graduate Award winners who were mid-career and making their mark in the chemicals industry. The winner received £10,000

and one or two runners up received £500 and a medal; the Salters' Institute administered the prize at its own cost.

In 2000 and 2001 the Jerwood Foundation again partnered with the Salters' Institute to award the Jerwood Environmental Prize given to a researcher doing 'green' environmental chemistry research.

1997-2001 Development of Salters Horners Advanced Physics (SHAP).

With the Salters GCSE Science and Salters A-level Chemistry established, there was some pressure from teachers and students to develop advanced courses in physics and biology based on similar principles. However, by this time funding from industry was becoming difficult to find.

Homan decided to approach another livery company, the Horners' Company, which had an interest in physics. Originally Horners worked and moulded animal horn, made of the natural polymer keratin, into products such as combs and shoe horns. The Company now focuses its charitable activities on science education and modern design and technology since these underpin the plastics industry, the natural successor to the horn industry and its main interest. At that time, the Horners' Company had been bequeathed a large sum of money, of around £1m, and was so impressed by what the Salters' Company was doing for UK science education that it decided to support the advanced physics project.

Elizabeth Swinbank, Salters' Fellow in Science Education at UYSEG, a physics teacher and curriculum developer, led this project. Like its chemistry counterpart, Salters Horners Advanced Physics (SHAP) is context-led but designed to provide progression in both the physics content and the mathematics relevant to physics. Students learn to apply their knowledge and understanding of physics in a wide variety of contexts, including ones that are unfamiliar to them.

The team produced two student books, one for the first (AS-level) year, one for the second (A2-level) year. Maths Notes are given at the end of each book, which summarise the maths required in the course. Swinbank and her team wanted to emphasise that the 'context-led' approach did not imply 'non-mathematical'.

> *In the first few years, most SHAP students went on to take a STEM course in Higher Education; a substantial fraction of these chose some type of engineering; the fraction choosing to study for a physics degree was higher than the national average of all A-level physics, about 12% of SHAP students went on to read physics, whereas nationally the figure was a slightly less than 10%.*
>
> *Elizabeth Swinbank*

SHAP has to some extent influenced physics teaching both in the UK – it is

now commonplace for exam questions to be set in context – and overseas. The SHAP team has made many contacts with teachers and curriculum developers in Europe, notably the Czech Republic, Germany and Sweden. Further afield they have been invited to conferences and seminars in Japan, Mexico and New Zealand to explore how context-led physics courses might be developed to suit local interests.

1998-2000 SHAP on trial in 50 schools across the UK.

1998 Salters' Chemistry Camps launched at the University of Birmingham (see **Box on pages 28 & 29**).

2000 David Waddington retired as Professor of Chemical Education at the University of York.

As a university appointment, usual policy would dictate that this chair would be replaced with a lectureship in chemistry.

However, Waddington was keen that the work of the science education group should continue and had already approached the Salters' Institute to ask if it would provide the additional funding required by the university to appoint his replacement at professorial level.

Sir David Harrison and Richard Homan needed little persuading that this was a good idea. The fast approaching millennium would provide an ideal opportunity to establish a Salters' Professor of Chemical Education at the University of York; it would be a way of celebrating not only the work of the University's by now internationally renowned science education group but also the Salters' Institute's long-standing commitment to supporting chemical education.

The Institute agreed to fund the chair equally with the University of York on a five-year rolling commitment.

The Salters'

During the mid-late 1990s, student numbers in university chemistry departments were falling, and several departments were under threat of closure – many did close, including prestigious ones at King's College London and at the University of Exeter. Sir John Cadogan, the Royal Society representative on the CEG and a member of the Salters' Company, was passionate that something needed to be done to reverse this dangerous trend. A heavyweight industrial research chemist – he was Chief Scientist at BP from 1979 to 1981, and Director of Research until 1992 – he had always taken time out to give lecture demonstrations to school students.

Cadogan felt not enough was being done to switch on youngsters to the exciting career opportunities that a degree in chemistry would give them and came up with the idea of running Chemistry Camps for 14-15-year olds – similar in principle to the American summer camps but with the aim of giving the youngsters an opportunity to experience life as a chemistry student in a university environment.

Fifty students took part in the first Chemistry Camp at the University of Birmingham, which was funded by the Salters' Institute together with the Department of Trade and Industry (DTI) and underwritten by the Royal Society of Chemistry (RSC). Over five days, the students took part in a variety of activities, including challenging and fun hands-on experimental work, lecture demonstrations, and a careers forum

Chemistry Camps

given by young industrialists. Social activities were put on in the evenings to encourage the students to get to know each other. The Camps were managed by Salters' Institute Manager Audrey Strong, and run in collaboration with some very dedicated school teachers.

The Chemistry Camps ran for the 18 years, with around 9500 students taking part in 185 Camps at universities across the UK.

During this time, the format of the Camps was changed to two two-day events running back to back in the participating university, and were moved from the school holidays to the school term. The changes were made in part for financial reasons but mainly as a way of encouraging more students from disadvantaged backgrounds to take part.

The students who attend Chemistry Camps are not only learning about chemistry, but they are learning about themselves through chemistry. It is amazing how they all look as if they are from the same school even though they have known each other for only a few days. The Camps seemed to break down many barriers between the students.

Derek Denby, supervising teacher

In 2016, the Camps were stopped temporarily. Against a background of escalating costs and a reduced grant from the Company, the Institute needed to consider which project – the Festivals or the Camps – had the greater impact on chemistry education. They decided the Festivals reached more students.

However, this was not the end of the road for the Chemistry Camps.

In 2014, the Institute was approached by Dr Yusuf Hamied, an ex-student of Lord Todd at the University of Cambridge, former Chairman of Indian pharmaceuticals major Cipla and a leading Indian philanthropist, to partner the Royal Society of Chemistry (RSC) in a five-year Inspirational Chemistry programme for teachers and students. Whilst the RSC is working with teachers across India, the Institute is running a programme of Chemistry Camps using the model developed in UK. Thirty Salters' Chemistry Camps are planned for the next few years in around 25 locations across India; reaching some 1650 disadvantaged 14-year old students.

By mid-2017, 16 Chemistry Camps had been run in India with around 1000 students taking part.

The post would be filled by someone of high standing in the science education community who, on the one hand, could continue Waddington's pioneering science curriculum development work and, on the other hand, could teach degree-level chemistry.

The new chair was a particularly appropriate way of celebrating the millennium. It was the best way to carry forward our long and successful collaboration with the University of York on science curriculum development and to support further the outstanding work in teaching and research in the department of chemistry.

Richard Homan CBE

2000-05 John Holman appointed as the first Salters' Professor of Chemical Education at the University of York.

John Holman, Headmaster at Watford Grammar School for Boys, was the ideal replacement for Waddington. As a chemistry teacher, he had also worked on several curriculum development projects and, despite being headmaster, Holman also made time to teach A-level chemistry. He found the transition to undergraduate teaching stimulating after 33 years of teaching in schools, concentrating on physical chemistry and thermodynamics in particular.

The Salters' chair made sure that David Waddington's legacy was carried forward. As far as the curriculum work of the Institute is concerned you can't overestimate the importance of David Waddington because he started it, led it and it was important that that momentum was continued, especially since by 2000 we were in the process of developing A-level courses in physics and biology, and there were new editions of earlier courses to be produced. I don't think we would have been able to continue the curriculum work as energetically as we did, had it not been for the Salters' chair.

Sir John Holman

2000 SHAP launched across the UK.

2000 Salters Horners A-level Physics Prizes launched for students.

The student awards, of between £150 and £250, are made to the students who have achieved the highest marks in the Salters Horners A-level Physics examinations. Between three and six awards are made each year.

2000 The Millennium Lectures launched.

Suggested by Institute Board member Dr Bill Wilkinson and supported by Dr Sandy Todd, Master of the Company, a series of lectures were given to mark both the millennium and the bicentenary of the RI. The lectures were given by eminent scientists.

Twenty First Century Science

By the late 1990s, there was a growing awareness among teachers and the Qualifications and Curriculum Authority (QCA), the government body at that time responsible for the National Curriculum and its assessment, that Double Award GCSE Science was not well suited to the needs or interests of many 15-16-year olds. There was a sense that the strains within schools of coping with the disaffected group of students was diluting the science programme for those who did aspire to more advanced science courses and STEM careers.

2000 QCA set up a review to explore ways of developing and modernising National Curriculum Science.

The science community had already done the intellectual groundwork for the way forward. In 1996 Robin Millar had explored why and what science should be taught to all school students, and highlighted the aim of 'scientific literacy' for all students. Independently, in 1997, Rosalind Driver and Jonathan Osborne – science educationalists at King's College London – had obtained funding from the Nuffield Foundation to run a series of seminars on the future of the school science curriculum, which led to the seminal publication *Beyond 2000* by Millar and Osborne in 1998.

Beyond 2000 argued that the current specifications for 11-16-year olds had their roots in the mid-20th century and were largely aimed at the small percentage of pupils who went on to study science post-16 (*ca* 6% in the case of chemistry). The report recommended that the curriculum should be designed to address the tension between the aims, on the one hand, of promoting scientific literacy for all students, and on the other hand of providing the first stage of scientific training for those students who would go on to study science A-levels.

A key outcome of the QCA review was that the Authority commissioned the University of York Science Education Group (UYSEG) to develop and consult on a curriculum model that would increase the 'flexibility' of provision of science at Key Stage 4 (GCSE). This work, directed by John Holman and Robin Millar at the University of York, and Michael Reiss at the University of Cambridge resulted in the recommendation to QCA that the Double Award GCSE Science should be replaced by a Core Science GCSE course – with an emphasis on scientific literacy – and an Additional Science GCSE course. There could be two types of Additional Science, one that would prepare students to progress on to science A-levels and the other aimed at students who wanted to follow a more applied vocational route post-16.

QCA developed new national criteria for GCSE Science based on the UYSEG model, which would apply to all specifications created by the Awarding Organisations (Examination Boards). The UYSEG in equal partnership with the Nuffield Curriculum Centre, then approached OCR (Oxford Cambridge and RSA Examinations) to develop a suite of specifications for what became known as Twenty First Century Science.

2001 The UYSEG and the Nuffield Curriculum Centre collaboration received substantial grants from the Salters' Institute, the Nuffield Foundation and the Wellcome Trust, and a smaller grant from the Gatsby Charitable Foundation, totalling some £1.3m, to develop teaching schemes and materials for Twenty First Century Science. This work was led by Holman, Hunt and Millar.

2003 Twenty First Century Science goes on trial in 78 pilot schools across the UK.

In Twenty First Century Science, the students could do either single award Core Science, taking up 10% curriculum time over two years, or single award Core Science plus single award Additional Science or Additional Applied Science, which would take 20% curriculum time over two years. The nine core modules, taken by all students, were aimed at helping students become more scientifically-literate citizens.

By the end of 2013, over 700, 000 students had taken Twenty First Century Science.[2]

2000-2004 Development of Salters-Nuffield Advanced Biology.

The Salters' Institute asked Michael Reiss to be the Director of its proposed advanced biology course. The Institute provided the initial funding, with the Nuffield Foundation and the Wellcome Trust giving significant amounts to develop the course. Waddington also managed to secure small amounts of funding from other sources, including pharmacy retailer Boots UK.

For Michael Reiss, who started his career as a biology teacher but was now reader in education and bioethics at Homerton College, Cambridge, this was his first involvement with the Salters' Company. Seventeen years later, having held various prestigious roles in science education, including Director of Education at the Royal Society, a senior advisor to government bodies on bioethics and a member of the Salters' Institute Board for 10 years, he was elected Master of the Salters' Company in 2017.

The biology project team made up of biology teachers, academics and educationalists developed two books, one for the AS-level and one for the A2 course. Each chapter started with a biology-related real-life scenario - for example someone having a heart attack – from which the fundamental aspects of biology were drawn. With school teachers on board from the beginning, this ensured that the course materials were suitable for students across a wide ability range.

The advanced biology course drew on Nuffield's long-standing tradition, which fitted with the Salters' Approach, of encouraging top quality, authentic student investigative work. Like all A-level biology students, these students had to do a number of core practicals. However, Salters-Nuffield Advanced biology (SNAB) students also had to do a lab- or field-based investigation, which they devised and got credit for original ideas.

In 2011, 9017 students took Salters-Nuffield A-level Biology, representing 14.5% of the national biology A-level cohort.

With the biology A-level in place, the Salters' Company could claim to be doing all three major sciences at A-level and together with Twenty First Century Science at GCSE level, this meant that for well over a decade the Salters' Institute with the UYSEG was leading curriculum development in all the sciences nationwide. With these projects running for at least the next five years, it will mean that the Salters' Institute has continued to support this work for some 20 years, which is in my view a phenomenal achievement for a livery company. In most countries, it is something governments do.

Michael Reiss, Master of the Salters' Company

2002-04 Salters-Nuffield A-level Biology on trial in 50 schools across the UK.

2003 Dr Peter Doyle CBE appointed as Master of the Salters' Company and Chairman of the Institute Board.

2005 Salters-Nuffield A-level Biology launched.

2005 Salters-Nuffield A-level Biology Prizes launched.

These awards, of around £250, are made to the students who have achieved the highest marks in the Salters-Nuffield A-level Biology examinations. Between three and six awards are made each year.

Technicians – the unsung heroes of science education

2002 Salters' National Awards for Science Technicians launched.

In 2002 David Waddington was keen to highlight the valuable role science technicians play in enabling high quality practical work to take place in schools. He approached John Holman, member of the Institute's Board and suggested that the Institute should set up an award

to recognise these 'unsung heroes' of school science education. The Institute was keen to support the infrastructure for practical work in schools, and set up a committee, comprising representatives from the Association for Science Education (ASE), the Institute of Biology (IOB), the Institute of Physics (IOP), and the Royal Society of Chemistry (RSC), to take forward the idea. The awards are ongoing.

Initially, up to four awards of £250 each were given every two years to individual technicians in a school. However, like all Salters' projects, the technician awards are continuously evolving, and in 2016 the committee decided to change the format to a 'team award' to reflect more how technicians work in a school. The committee found that in examples of good practice rarely does a technician work as an individual; even if they are the only technician in a school they are still part of a team in the science department.

The selection process also changed, making it easier for a school to apply for an award. In 2016, one major award of £2500 was given and four awards of £500. In 2016, the Institute invited CLEAPSS and SSERC, the equivalent to CLEAPSS in Scotland, to become funding partners and members of the awards committee. In 2017, four equal awards of £1000 will be given, reflecting the fact that it is very difficult to differentiate between teams working at such high levels of good practice.

The outstanding technicians have a real empathy with what doing science is all about; they understand what the teacher is trying to get out of doing a practical. It's not just about labelling everything that moves but a good technician will think for the teacher and know, for example, what is missing from a request. They are excellent problem-solvers – even in the most challenging of circumstances they will come up with a way around most problems affecting a practical.

Kay Stephenson, Chair of the Technician Awards Committee

2005 John Holman stood down as Salters' Professor of Chemical Education to become the Director of the newly formed National Science Learning Centre (NSLC) based in the University of York. Funded by the Wellcome Trust and located at the University of York, the NSLC was the hub for nine regional centres, which aimed to improve the way science was taught in schools by providing career-long subject-specific programmes of continuing professional development (CPD) for science teachers and technicians.

The Salters' Institute decided to re-advertise the position as a chair in science education, opening it up to professionals other than chemical educators. The Institute agreed that the post would be re-located in the education department. Robin Millar, already with a chair in the education

department at the University of York, applied and was appointed in 2006.

2006 Robin Millar appointed as Salters' Professor of Science Education at the University of York.

2007 First examination of Twenty First Century Science.

In 2008, a national survey of students' post-16 subject choices found a 30% rise in students beginning AS-level biology, chemistry and physics in Twenty First Century Science schools.

2009 The Salters' Institute supports the Royal Society of Chemistry's Industry Study Tours for secondary school chemistry teachers.

Working with the Salters' Institute brought complementarity and added value to both the RSC's and Salters' activities. Salters' curriculum projects complemented the RSC's more general support for the chemistry curriculum.

Colin Osborne, RSC education manager, school and colleges 1996-2008

2012 Sir John Holman appointed as Master of the Salters' Company.

2013 Refurbishment of the Salters' Company Fore Street premises.

2014 Judith Bennett appointed as Salters' Professor of Science Education at the University of York.

Judith Bennett, then Professor of Education at the University of York, had 25 years' experience in chemical education research, during which she focused on young people's attitudes to science and science teaching as well as curriculum development. She was a member of the management and writing teams, and a lead author for the Salters GCSE Science project. She is now leading the development of a research-informed curriculum project aimed at 11-14-year olds. The BEST (Best Evidence Science Teaching) project, which received a start-up grant from the Salters' Institute of £75,000 in 2016, draws on the earlier research and development work by Robin Millar under the York Science project, also funded by the Institute.

The BEST project aims to address the poor impact of educational research on classroom practice, which was highlighted in the booklet, *Inside the Black Box*, by Paul Black and Dylan Wiliam published in 1998:

Teachers will not take up attractive sounding ideas albeit based on extensive research if these are presented as general principles, their classroom lives are too busy for that to be possible. What they need is a variety of living examples of implementation.

At the time of writing, the BEST project, under the leadership of Bennett and Alistair Moore, is using relevant, robust research to develop teaching resources for science teachers. So far, the project

team has developed three teaching units in each of the three main sciences, and these are currently being trialled in schools in England. The units are outcome-led, i.e. observable indicators of successful learning are defined before teaching activities are developed, in order that the activities are fit-for-purpose.

2015 Sir David Harrison retires as Director to be replaced by Anthony Tomei CBE.

Anthony Tomei had spent the previous 20 years as Director of the Nuffield Foundation, leading and promoting science curriculum development work. Inevitably, this work brought him into contact with the Salters' Institute, especially since the Nuffield Foundation co-funded many projects with the Institute. In 2014, two years after his retirement from Nuffield, Sir John Holman asked Tomei to review the Institute's activities, at the same time inviting him onto the Board.

Tomei chaired a working party, producing a report nine months later. The report acknowledged the reduction in the Company's funding to the Institute and the need for the Company to make provision for the on-going work of the Institute in science education. The report identified five areas for the Institute to concentrate on in the coming years. These were:

- to increase the number and expand its Festivals;
- to support the BEST project;
- to develop the Institute's alumni network;
- to introduce special seminars of interest to the science education community; and
- to develop support for technician education.

The report was accepted by the Institute's Board and by the Salters' Company; shortly after Tomei took over as Director from Sir David Harrison on his retirement.

With the Institute's sights set on its forthcoming centenary, Tomei was the natural choice for the job – he would take the Institute forward by implementing the recommendations of the report.

2016 Salters' Hall re-opened by HRH Duke of Kent – now facing London Wall Place.

2016 Completion of revisions of Salters Advanced Chemistry, Salters Horners

Advanced Physics, and Salters-Nuffield Advanced Biology projects, as well as Twenty First Century Science.

2017 The Salters' Institute announces a follow-up grant of £300,000 for the BEST project for three years.

Launch of the Centenary Awards.

These awards, suggested by Sir David Harrison, will be given to graduates in their final year of their PhD or who are two to three years into an industrial career.

2017 Michael Reiss, Professor of Science Education at UCL Institute of Education, appointed as Master of the Salters' Company.

The Salters' Institute prepares for the next century

The Institute has already made progress in expanding the Festivals to more regions, including rural areas, across the UK. As well as significantly increasing the number of Festivals, the Institute is developing new Festivals for 14-year olds.

In addition, as the Institute moves forward, it wants to build new links with industry through the development of its alumni network. The Salters' Graduate Award winners, and the new Centenary Award winners, represent a huge resource of industrial know-how for the Institute – these people are expected to play an important role in shaping the future programme of the Institute.

With increasing government influence on the curriculum, along with reduced inclination of schools to experiment with new ideas – they are now strongly driven by exam results – come consequences for curriculum development work in the future. This work is likely to be further affected by having just three major Awarding Organisations and the changes going on in the world of publishing, with more material going online. To explore these issues and crucially to be prepared for any future government intervention, the Institute will be running seminars next year on the future of the science curriculum.

The Institute also recognises the crucial role of technician education for the future of the UK chemicals industry. It is currently liaising with the Gatsby Charitable Foundation and the Royal Society of Chemistry to work out what can be done to help FE Colleges deliver industry-based work experience for their students, in-line with the current government Industrial Strategy.

The Salters' Legacy

The Salters' Institute has been a major positive influence on the teaching of chemistry, and science education in general, in the UK and worldwide over several decades. The Institute has promoted excitement, innovation and creativity in the teaching of chemistry. This is not surprising because at the heart of all their projects are the people who understand teaching and learning most – high quality teachers and educators. The introduction of the Salters' Approach was not just important for students who followed these specifications but for every student in the UK because all other specifications became more context-aware under the Salters' influence.

Throughout its history, the Institute has been recognised as one which is prepared to take risks, providing pump-priming funding before other organisations and government bodies. At the same time, it has been astute with its funding – ready to commit to a project for as many years as is needed but also ready to re-direct its funding to new projects where the need is greater.

The Institute has forged partnerships with industry and the other professional scientific bodies so that large curriculum projects can not only get started but can continue to develop in response to changing government policy. Indeed, the Institute has always kept a close watch on government education policy at all levels and has been instrumental in bringing together the key people so that a collective voice can not only influence policy but also help science teachers and academics deal with the changes.

The Institute has also played an important role in supporting science education as a university discipline, not least at the University of York where it continues to fund the Salters' professorship. This is especially important because it came at a time when some other universities were losing senior posts in the subject.

Through its many Awards, the Institute has recognised and supported the talent of school students, undergraduates, postgraduates, postdoctorates, school technicians and chemistry teachers. Together with its various curriculum projects and activities, such as its Camps and Festivals, the Salters' Institute's name is now recognised, not just across the UK, but worldwide.

Sources of information / Acknowledgements:

This 100-year timeline of the Salters' Institute's contribution to chemistry and science education has been written in the main through interviews and feedback from: Judith Bennett; Sir David Harrison; Andrew Hunt; Richard Homan; Sir John Holman; Robin Millar; Colin Osborne; Michael Reiss; Kay Stephenson; Audrey Strong; Elizabeth Swinbank; Anthony Tomei; and David Waddington. My sincere thanks to all.

References

1. The Salters' Institute of Industrial Chemistry: a century of support for chemistry education, Hugh Barty-King, 1994.

2. David Waddington in 50 years of Chemistry at York, pages 76-86, 2015.

3. John Holman, Chemistry: a view from the Schools, 1996.

Author

Kathryn Roberts BSc CChem FRSC is a science writer and editor based in London, UK.

Illustrations by Rachael Hare

4 London Wall Place
London EC2Y 5DE

Email: institute@salters.co.uk
www.saltersinstitute.co.uk