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Chemical Bonds 1841—1991: 150 Years of the British Chemical Community*

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1 Introduction

The Chemical Society existed for 20 years before one of its members (Edward Frankland) introduced the novel idea of a 'chemical bond'.[1] Although this concept eventually became central to the science of chemistry it was at first received with a mixture of scepticism (by people like Kolbe) and amusement (by leading Chemical Society fellows in the 1870s).[2] The subsequent development of this suggestion led to its adoption as one of the central themes of chemistry. However, it is not with such bonds that I am concerned today. Instead I would like to draw your attention to a different kind of bonding, to those equally intangible, but nevertheless real, bonds of social companionship and common cause that unite the community of chemists, and have united it for 150 years in this country.

Today we celebrate the sesquicentenary of the Chemical Society,[3] and you have given me the great privilege and responsibility of delivering this first plenary lecture. Fifty years ago our mono-centenary passed almost unnoticed during the dark wartime days of 1941. But 100 years ago the Jubilee *was* celebrated, with typically Victorian abandon. A Jubilee Book[4] was compiled to record the great and the good of the first 50 years. Festivities commenced with a eulogy by the President of the Society, W. J. Russell, and concluded with another Victorian custom: a dinner of gargantuan proportions (Figure 1). One feels it is not only the 18th century that can be justly called 'the age of indigestion'.

So 100 years after the last major celebration nothing would be easier for me than to launch into a fulsome, congratulatory account of the Society's remarkable achievements (and they have been truly remarkable) over the last 100 or even 150 years, and leave it at that. Yet such a eulogy would be devoid of analysis, and

* This is a slightly expanded version of the Plenary Lecture delivered on 8th April 1991 at the Opening Session of the 150th Anniversary Annual Chemical Congress of the Royal Society of Chemistry at Imperial College London.

[1] E. Frankland, *J. Chem. Soc.*, 1866, **19**, 377.

[2] C. A. Russell, 'The History of Valency', Leicester University Press, 1971.

[3] General accounts of the history of the Royal Society of Chemistry or its predecessors include: (*a*) T. S. Moore and J. C. Philip, 'The Chemical Society 1841—1941', Chemical Society, London, 1947. (*b*) R. Bud, *Chem. Brit.*, 1991, **27**, 230. (*c*) C. A. Russell, N. G. Coley, and G. K. Roberts, 'Chemists by Profession', Open University Press/Royal Institute of Chemistry, Milton Keynes, 1977. (*d*) D. W. Whiffen, 'The Royal Society of Chemistry: The First 150 Years', Royal Society of Chemistry, London, 1991.

[4] 'The Jubilee of the Chemical Society of London, 1891', Chemical Society, London 1896.

THE DINNER.

MENU.

Huîtres au Citron.

Chablis.

POTAGES.
Consommé à la d'Orléans. Crême d'Orge à l'Allemande.

Dry Sherry.

POISSONS.
Saumon, Sauce Hollandaise. Eperlans Frits, Sauce Tartare.

Niersteiner.

ENTRÉES.
Médaillons de Volaille à la Princesse. Ris de Veau à la Provençale.

G. H. Mumm & Co. Extra Quality, Extra Dry.

RELEVÉS.
Selle de Mouton de Galles. Jambon Braisé au Champagne.

Deutz and Geldermann's Gold Lack.

LÉGUMES.
Haricots Verts Sautés. Pommes de Terre Dauphine.

RÔTI.
Cailles Rôties au Cresson.
Salade.

ENTREMETS.
Pouding à la Rossini. Crême Rubanée.

Fine Champagne Liqueur Brandy.

Canapés Norvégiens.

Bombe à la Vanille. Gâteaux Condé.

DESSERT.

Cantenac. Cockburn's Old Bottled Port.

Café Noir.

Johannis Natural Mineral Water.

Figure 1 *Menu for the Jubilee Dinner, 1891*

therefore unworthy of the occasion, the Society, and this distinguished audience. In the belief that the past has lessons for the future, I want to look first at what actually happened in 1841, to draw some general conclusions, and to see what relevance these may have for the later and possibly future adventures of the Society.

2 Founders of The Chemical Society, 1841

So, what were these Victorian chemists up to 100 years ago? In a word, *they were celebrating the formation of the world's first national chemical society.* True, in Britain there had been a handful of student societies, a few short-lived chemical clubs and one abortive attempt in 1824 to establish a 'London Chemical Society'.[5] But until 1841 the only permanent home for chemists had been beneath the comprehensive umbrella of the Royal Society. There had, it is true, been a gathering of chemists in Section B of the British Association for the Advancement of Science. Much later (1860) this led to the formation of the 'B-Club', an informal, convivial, and light-hearted gathering, often at picnics in the Surrey countryside (chemists have always been sociable creatures). It is possible that the scientific meetings of Section B 'suggested the formation of a formal and central society ten years later'.[6] However that may be, on 23 February 1841, at the Society of Arts in the Adelphi, London, 'a meeting was held of gentlemen desirous of uniting themselves for the purpose of forming a Chemical Society'. But who were these men, and what brought them together?

They were a mixed bunch, and they can be classified in all kinds of ways. *Socially* they were a mixture of fairly well-to-do manufacturers or entrepreneurs, a few poorer chemists struggling to make a living (like the artisans who tried unsuccessfully to unite in 1824), and some of a new and rising class who have been called 'professionals' because they were paid (often quite generously) to act as consultants, expert witnesses, *etc.*[7] Or one can divide them *geographically*, in which case most were in London, though Cumming was Professor at Cambridge and Graham had recently come from Scotland. Moreover, of the first 77 members Scotland had the largest share (14) after London (40). Nevertheless one potential recruit declined to join on the grounds of his distance from London; he lived in Islington!

A better division is *functionally*, according to their occupations. Some were industrialists, like John Mercer, a calico printer, who wrote to the promoters, saying that such a society was 'much wanted'. But most were academics like C. G. B. Daubeny of Oxford or W. H. Miller from Cambridge (both later Presidents). All except a handful are forgotten now. Let us look at the 14 founding committee members, when it will be apparent that many of them did more than one thing in any case (Table 1).

Of these 14 men, eight taught in some capacity. Furthest from the metropolis was the Rev. James Cumming, a relatively little-known professor at Cambridge. Associated with the new University of London were Thomas Graham (since 1837 at University College and to become the Society's first President), and John Daniell (since 1831 at King's College London). Another London teacher was William Brande who worked for 40 years at the Royal Institution; of him it was said that his emphasis on teaching rather than research 'reflected the labours

[5] W. H. Brock, *Ambix*, 1967, **14**, 133; also reference 3(*c*), p. 56.
[6] A. Scott, *J. Chem. Soc.*, 1916, **109**, 342.
[7] R. Bud and G. K. Roberts, 'Science versus Practice: Chemistry in Victorian Britain', Manchester University Press, Manchester, 1984.

Table 1 *Members of the first Committee of The Chemical Society 1841*

A Aikin (1773—1854)	T Graham (1805—1869)
W T Brande (1788—1866)	W R Grove (1811—1896)
H J Brooke (1771—1857)	H Hennell (?—1842)
J T Cooper (1790—1854)	G Lowe (1788—1868)
J Cumming (1777—1861)	R Phillips (1778—1851)
J F Daniell (1790—1845)	R Porrett (1783—1868)
T Everitt (1803—1846)	R Warington (1807—1867) (*Hon Sec*)

necessary to keep a wife and family in style' William Grove taught physics at the London Institution, a kind of poor relation to the Royal Institution Thomas Everitt contrived to be Professor of Chemistry simultaneously at Putney College of Engineering and Middlesex Hospital Others who lectured from time to time were Cooper and Phillips

Four of these chemists were committed to research Daniell and Grove were especially active in electrochemistry (though the latter is alleged to have said that science ceases to be interesting as soon as it becomes applied) Thomas Graham will always be remembered for his researches in gaseous diffusion,[8] while Robert Porrett as chief clerk in the Ordnance Department at the Tower of London worked on explosives, electroendosmosis, and complex iron cyanides

Not all members of this committee shared Grove's dismissive view of applied chemistry At least five of them were engaged in manufactures (usually as employees) Explosives manufacture occupied Porrett, and also (at the more surprising location of Apothecaries' Hall) Henry Hennell, who eventually blew himself up with 3 kilos of mercury fulminate that he was making for the Afghan War George Lowe worked for the Gas Light & Coke Company in the days when engineers like himself were required to engage in all manner of chemical operations connected with the production and purification of coal gas Henry Brooke was a wealthy manufacturer, and the variegated career of John Cooper had included a spell of chemical production

Finally it must be stressed that probably half of the Committee also enjoyed from time to time the new rôle of consultant In addition to Brande and other academics, their numbers included Arthur Aikin of Guy's Hospital, who was also Secretary to the Society of Arts and became Treasurer of the Chemical Society and its second President Cooper and Phillips frequently combined lucrative consultancy work with their other activities, Cooper also selling chemicals and apparatus, as well as giving popular lectures, while Phillips was chemist at the Museum of Economic Geology

The four sets of overlapping activities marked the founding members of the Chemical Society and go some way to offering a first explanation for its formation

[8] R J H Clark *Chem Soc Rev* 1991 **20** 405

3 Strengthening the Bonds

The Chemical Society was thus a coming together of people with widely differing interests. But why did they meet in the first place? A clue is provided by Robert Warington, first Secretary of the Society:

> 'Such a Society was much needed, not only to break down the party spirit and petty jealousies which existed, but to bring Science and practice into closer communication, and to bring the experience of many to bear in discussing the same subject.'[9]

What does that really say? Beneath the rhetoric is the unspoken assumption that unity is a good thing in itself, that bonds between chemists *need* to be forged. But is that not obviously and always true? If so it is necessary to enquire what was special about 1841, and about the London of that time. To examine his words more closely is to peer below the surface of events and to begin to discern something of the underlying forces at work. Warington is in fact suggesting three separate reasons:

—*to break down the party spirit and petty jealousies*: that refers to fragmentation and internal disorder.

—*to bring Science and practice into closer communication*: this implies new external pressures involving industry ('practice') as well as chemistry ('Science').

—*to bring the experience of many to bear in discussing the same subject*: suggesting a new climate of 'togetherness', of sharing experiences, of institutional unity.

In the formation of the Chemical Society, and in all its subsequent history, these considerations seem to be of great importance. Amongst chemists the processes of institutional bond-making (and bond-breaking) are affected by all three elements of their situation:

(1) Internal disorder,
(2) External constraints,
(3) Social and cultural environment.

Somewhat tongue-in-cheek may I suggest an analogy to effects of entropy, temperature, and solvent? There is one other effect which Warington does not mention (and for a very good reason) which we may term catalytic. So we have additionally:

(4) An appropriate catalyst.

We can now see how they contributed to the events of 1841.

A. Internal Disorder.—I refer to the state of chemistry itself. For an understanding of modern chemistry an idea even more fundamental than the concept of a chemical bond is that of an atom. In 1841 Dalton was still alive, yet the atomism of the Cumbrian chemist was still being widely rejected forty years after its birth, for no one had yet seen an atom, and, despite Avogadro, no one knew how to measure its mass. One man, Berzelius, believed in atoms, and clothed them with electric polarities, positive for hydrogen and the metals and negative for all other

[9] Reference 3(*a*), p 117

elements For this he was in deep trouble with the organic substitutions recently discovered in France, for how could a positive hydrogen atom be replaced by chlorine which must be negative? Moreover, if molecules were held together by combination between electrical opposites a diatomic molecule like H_2 was an impossibility [10] At this very time a propaganda war was raging between those who (like Berzelius) believed chemical forces were fundamentally electrical in nature, and the majority of chemists who were not sure about that but were certain that chlorine could replace hydrogen Molecular agnosticism was the order of the day, and remained so for many years to come And with it went a degree of confusion that seems incomprehensible today A classic illustration is the inclusion in his 'Lehrbuch der organischen Chemie' by Kekule of no less than 19 alternative formulae for the simple substance acetic acid [11] That was as late as 1859, just before the value of Avogadro's hypothesis was to be demonstrated by Cannizzaro[12] and a way out of the maze became clear

In 1841 confusion reigned and, not surprisingly, the subject failed to grow Thus Fox Talbot declined to join the new Society on the grounds that chemistry wasn't big enough on its own, why not include electricity as well? As if to prove the point, in 1841 not a single chemical paper graced the pages of the *Philosophical Transactions* of the Royal Society

This malaise in chemistry, this state of internal disorder, might have been expected to fragment the chemical community still further, into sectarian parties and divisions To some extent this was already happening But similar causes can sometimes lead to opposite effects, in those circumstances everything depends on other factors which thus become critical What is quite clear is that while deep ideological divisions remained between (for example) the followers of Berzelius and those of Gerhardt, in Britain the very possibility of deepening divisions caused the chemical community to come together in a quite new way

Those who seek to 'explain' scientific growth or its lack solely in terms of external, often sociological, factors would do well to take a long, hard look at the internal state of chemistry itself At the very heart of chemical theory lay one cogent reason for chemists to unite

B. External Constraints.—Tipping the balance between fragmentation and association were several external influences which led the founders of the Chemical Society to see that a remedy for this internal disorder might lie in a new association between chemists

First, there was the much-publicised visit to this country in 1837 of the German chemist Justus Liebig Founder of the *Annalen* and Professor at the university at Giessen, he already had a European reputation For, despite the smallness of his university, Liebig had created a great school of organic research Moreover his visit coincided with a dawning awareness that English science was

[10] C A Russell *Ann Sci* 1963 **19** 117 127
[11] F A Kekule Lehrbuch der organischen Chemie Erlangen 1861 (circulated in parts from 1859)
[12] J Bradley Cannizzaros Methode der Schlussel zur modernen Chemie Franzbecker Bad Salzdetfurth 1990

a very amateurish affair compared with that in Germany and promoted a wave of general discontent. His theories of agricultural chemistry were of great interest to the more enlightened landowners, and thus to the chemists who would serve them; the example of his research school at Giessen was to bring A. W. Hofmann to direct the new Royal College of Chemistry in London (1845), forerunner of Imperial College, London. Meanwhile Liebig's visit undoubtedly stimulated formation of the Chemical Society. Not surprisingly the first Foreign Member of the Society was Justus Liebig, whose bust to this day stands like a sentinel outside the Council Room at Burlington House.

Even more important than Liebig's coming was a new British phenomenon. This was the emergence of two groups who were already represented on that first Committee. For these men chemical knowledge was not a luxury but a necessity: the people Warington implied by his reference to 'practice'. First were those oddly assorted individuals who earned their living as consultants to a variety of enterprises, like Richard Phillips, who undertook soil analysis for landowners, W. T. Brande who fought against pollution of air and water, and J. T. Cooper who advised gas companies on the disposal of noxious by-products. Even at this time chemists were being called upon as expert witnesses in litigation, Michael Faraday being one of the most successful at this form of consultancy, earning several hundred pounds a year in this way.

Secondly there were manufacturers of pharmaceuticals, metals, and heavy chemicals. The early membership included several well-known names in this field. Among these was Hugh Lee Pattinson, the lead manufacturer who had in that very year discovered his method for extracting magnesia from dolomite and was about to found the famous Washington Chemical Company. Other manufacturers who were founder members are included in Table 2. All these men needed a wide

Table 2 *Some founder members engaged in chemical manufacture*

William J. Cock: London, platinum manufacture
Walter Crum: Glasgow, calico-printing, dyeing, and bleaching
John Joseph Griffin: Glasgow, chemical apparatus
John Mercer: Oakenshaw, calico-printing
Hugh Lee Pattinson; Gateshead, lead, alkali, and acid manufacture
Robert Porrett: London, explosives manufacture
Thomas Richardson: Newcastle-upon-Tyne, chemical manure manufacture
James Thomson: Clitheroe, calico-printing

acquaintance with chemistry, but how were they to get it? University training was not appropriate to men in mid-career, and even if it had been there was little undergraduate teaching in chemistry available in England, despite the recent advance of King's and University Colleges in London. In Scotland the situation was relieved by the presence in Glasgow of that renowned 'chemist breeder' Thomas Thomson.[13] Otherwise a would-be chemist had to go abroad, probably to Germany, and the visit of Liebig to Britain would certainly have given valuable ammunition to advocates of British chemical training. The need was urgent, the

[13] J. B. Morrell, *Ambix*, 1972, **19**, 1.

heat was on Bond-making was becoming an economic as well as a cultural necessity The same driving-forces led to the creation four years later of the Royal College of Chemistry in London But in 1841 the Chemical Society was to become the embodiment of these hopes and of an academic tradition that was distinctively Scottish

C. Social Context.—No organic chemist can underestimate the role of solvent in bond-breaking and bond-making processes In a very similar way the bonding processes that led to the formation of the Chemical Society were sensitive to the social environment

Imagine yourself in the London of the early 1840s The Napoleonic Wars were over, the post-war depressions all too familiar and the whole country was in the throes of the Industrial Revolution (which, incidentally, would have been impossible without chemistry) And now a new voice was being heard, the voice of organized labour Trade Unionism, once suppressed under the Combination Acts, was now legitimate and workers all over the country were *getting together*, if manual workers, why not chemists? One may profitably scan the list of other scientific groups founded near this time (Table 3) All these were in London and

Table 3 *Some scientific societies formed in London before* 1841

Spitalfields Mathematical Society	1788
Linnean Society	1788
Mineralogical Society	1799
Chalcographic Society	1803
Geological Society	1807
Astronomical Society	1820
Meteorological Society	1823
Zoological Society	1826
Entomological Society	1833
Botanical Society	1836
Microscopical Society	1839

must have constituted a powerful incentive for chemists to do the same Nothing, however, concentrated the mind so much as the regrouping of those other people called chemists into what became on 15 April, 1841, the Pharmaceutical Society of Great Britain Their action was a response to a newly perceived threat to their profession from some impending legislation This was a reasonable move to protect the public by insisting on a proper registration of all who practised medicine and pharmacy The problem lay in the proposed certificating body, where pharmaceutical chemists would be always outnumbered by the doctors So a Pharmaceutical Society was formed 'for the purpose of protecting the permanent interests and increasing the respectability of Chemists and Druggists' For the other chemists this was to prove a stimulating example Only in the distant future was it to constitute a mild threat, and that arose from a clause in its Charter permitting only members of the Pharmaceutical Society to be called 'chemists'

For now, however, its formation was typical of the era. Gone were the days when apologists for the Royal Society could complain of 'separatists who, under the plea of cultivating with more intensity and attention animal chemistry, tore themselves off from the bosom of their mother society and yet adhered still to its mangled remains'.[14] This was the hour for newly mature specialisms to have their own organizations.

Even that does not exhaust what might be said about the solvent effect, or social environment. Not only was *combination* the order of the day; so also was *communication*. London was poised on the brink of the railway revolution. 1841 saw the opening of both the Great Western and the London & Brighton Railways, while Euston's primitive shed was the point of departure for a journey to Glasgow that from 1841 could be reached within 24 hours (though admittedly a steamship voyage was necessary to get you from Lancashire to Scotland). And only in 1840 had the Penny Post been launched, making scientific and other communication immeasurably easier than before.

It is not hard to see how all these circumstances facilitated the establishment of bonds between chemists. But, as we all know, bond-formation can often be promoted in yet another way, by the right catalyst.

D. The Right Catalyst.—The catalyst for the Chemical Society was Robert Warington, which doubtless explains why he omitted to mention the fact. Robert Warington (1807—1867) had received an apprenticeship in the chemical industry and from 1831 to 1839 had served as chemist to a brewery. Shortly afterwards he became chemist to the Apothecaries' Society of London. However in the early 1840s he confessed that he had time on his hands, being in between jobs, and he became available at just the right moment to become honorary secretary to the committee setting up the new society, and then to its successors for twenty more years. No great chemist himself, he had, as all who knew him acknowledged, an extraordinary capacity for hard, detailed work, and a more than usual gift of patience. As W. J. Russell observed, 'Obviously some special force was required to build up this complicated molecule; that special force was embodied in and exercised by Robert Warington.'[15] We are all in his debt.

4 Crises to Come

And so, for all these reasons, the world's first national Chemical Society was born. It immediately instituted regular meetings, chiefly for reading and discussing papers, held at a variety of venues. It began collecting books and journals for a library, and in 1842 bought a bookcase. Its one short-lived enterprise was a chemical museum, with many curious exhibits, such as 'a specimen of butter, supposed to be 300 years old, discovered in a bog near Downpatrick'. Most importantly it created a new journal: *Memoirs & Proceedings* from 1841 to 1848, then 14 years of a *Quarterly Journal*, and from 1862 the

[14] Reference 3(*a*), p. 12.
[15] W. J. Russell, reference 4, p. 6.

Journal of The Chemical Society The Faraday Lectureship was instituted in 1869, with its splendid Medal For the Society's first 30 years membership increased apace and by 1870 was a healthy 551

In the 150 years since its birth there have been four major crises (landmarks if you prefer) in which bond-making and, sadly, bond-breaking were prominent In every case the same four principles apply, though in different combinations The first major challenge arrived in the 1870s

A. The Challenge of Professionalism.—Despite growth, from the late 1860s internal strains began to appear This time they were not within chemical theory itself, for (despite lingering doubts about atomism[16]) the science was at last acquiring a new unity through the concepts of valency and structure Instead the tensions were within the Society itself

The troubles started as a challenge to the Council which had hitherto regarded as absolute its prerogative to nominate its successors Now some impudent upstarts in the membership were prepared to exert their constitutional rights and propose alternatives Worse still, the election of Fellows was being hindered by the process of 'black-balling', whereby a small minority at a meeting could deprive nominees of the necessary 75% majority to secure their election

To us it all seems a storm in a teacup, a rather squalid power struggle best consigned to the dustbin of history In fact the rise of the Institute was also a response to genuinely external constraints It sprang from a growing recognition that membership of the Society was no guarantee of chemical competence, and the letters FCS much used by the Victorians were no indicator of professional status Jumping on the bandwagon of chemical analysis were all manner of unqualified persons, quacks in fact, whose activities put in peril the jobs of competent analysts Horror stories abounded Much analysis of food, water, and air was also being undertaken by medical men whose training, though possibly excellent for its purpose, did not include chemical analysis Chemical indignation knew no bounds when testing of water supplies and manufacture of gas were entrusted not to chemists but to engineers Many chemists were now experiencing an uncomfortable rise in temperature and were endeavouring to bring it down, le Chatelier would have been pleased! The result was not a coming together in unity, but a fragmentation and the emergence of a new institution out of and alongside the Chemical Society, the Institute of Chemistry (1877), whose designatory letters would imply genuine chemical achievement This was another 'first' for British chemists the first professional *scientific* institute in the world

There is another reason why, this time, internal strains led to fission rather than fusion Partly this was because the leadership of the Chemical Society was unable or unwilling to tackle the problem The days when manufacturing interests were seen to be served by the Society were long over, for now its emphasis was largely academic It must be added that people with such sympathies are not always likely to be most aware of the pressures on grass-roots

[16] The Atomic Debates ed W H Brock Leicester University Press Leicester 1967

chemists who work in a strongly competitive environment. A further difficulty lay in the very metropolitan character of the Society, with meetings always in London, and out of touch with the great centres of manufacturing chemistry on the banks of the Mersey and Tyne. An unheard-of precedent occurred in 1868 with the formation of the Society's first provincial rival: the Newcastle Chemical Society.[17]

It held its own meetings, published its own *Journal*, and 14 years later became a founding constituent of the Society of Chemical Industry. It was a provincial manifestation of the same professionalizing tendencies that led to the Institute of Chemistry; it was much in sympathy with the latter and sought to serve and encourage the professional chemists concerned as employers or employees in the great chemical works springing up on both banks of the Tyne. One of the Newcastle leaders, A. F. Marreco, complained of 'that excessive centralisation with which we meet at every turn, and which would aim at concentrating the whole of art, science and literature in one corner of London, for that is what we are fast drifting into'.[18] The whole situation demanded imaginative and flexible leadership from London that was unfortunately not forthcoming.

The tensions within the Chemical Society were also a manifestation of a new phenomenon that was now evident in middle-class British society. As one historian put it, 'the very Victorians who condemned trade unions as vicious, restrictive, futile and unwarrantable interferences with individual liberty, flocked to join professional combinations'.[19] Everyone was doing it, so why not chemists? Here is a classic case of response by chemists to the cultural climate, the 'solvent effect'. And to hand was another and powerful catalyst, this time in the person of Edward Frankland, first President of the Institute. A restless man, peculiarly sensitive to recognition,[20] recently retired from active research he proved to be a master at social engineering. No doubt he had learned the techniques from his fellow agitators in the semi-secret pressure group calling itself the X-Club.[21]

The social reaction induced by these tensions was a concomitant process of bond breaking *and* bond making. True, some forsook the Chemical Society for the new Institute which first appeared in 1877. The interesting thing is that, for all its failure to adjust, the Chemical Society seems to have survived rather well. Of the 54 founding members of the Institute all but two were fellows of the Chemical Society, and many had held or were to hold high office in the parent body. And if Chemical Society membership figures are examined, it seems that formation of the Institute, far from inhibiting further growth may actually have stimulated it (Figure 2). From which I conclude that solidarity amongst chemists may transcend institutional barriers.

[17] W. A. Campbell, *Chem. Ind.*, 1968, 1463.
[18] A. F. Marreco, *Trans. Newcastle Chem. Soc.*, 1874 7, **3**, 233.
[19] F. M. L. Thompson, 'The Chartered Surveyors: The Growth of a Profession', Routledge, London, 1968, p. 149.
[20] C. A. Russell, 'Lancastrian Chemist: The Early Years of Sir Edward Frankland', Open University Press, Milton Keynes, 1986.
[21] R. Barton, *Brit. J. Hist. Sci.*, 1990, **23**, 53.

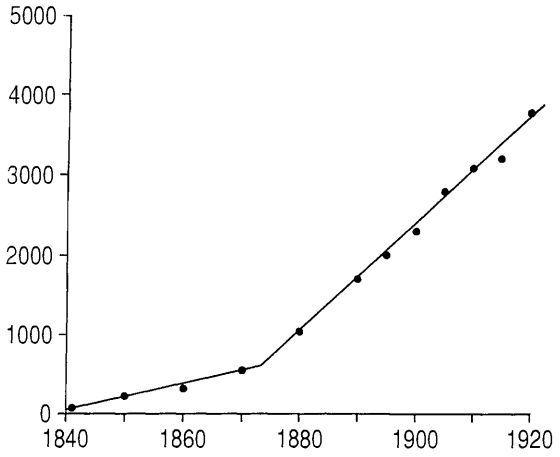

Figure 2 *Chemical Society membership,* 1841—1920

B. The Challenge of Inter-war Decline.—For another half century the Society prospered, its *Journal* increased its international reputation, and the Longstaff Medal joined the Faraday in 1881. From 1857 to 1873 the Society had been lodged (under rather cramped conditions) in the Old Burlington House. In 1874 the House was enlarged and the Society moved into the new East wing, with better accommodation for meeting-room (which some may recall) and the growing library. It successfully weathered the difficulties of World War I, its war memorial being prominently displayed at the foot of the stairs. Some of its members played distinguished advisory and research rôles in the conduct of 'the chemists' war'. Then, suddenly in the mid-twenties, disaster struck. Membership statistics, for the first time in its history, began to fall. Between 1926 and 1932 there was a decline of 12%. Bonds were being broken and (from 1930) not remade (Figure 3). What had happened?

It is clear that Victorian values had long dominated the Society's leadership which was out of touch with modern needs. Thus it was increasingly being criticized for adhering to the old established form of specialist scientific meeting. Only in 1920 did it begin to admit women to its Fellowship.[22] Above all it was still fiercely metropolitan; not till 1926 did it hold its first AGM outside London, and Local Sections were only formed as a response to the crisis. Internal strains were beginning to show strongly. The bond-breaking processes owed much to these.

We need also to glance at its sister establishment, the Institute of Chemistry. The truth seems to be that World War I marked a watershed for chemistry as it did for much else in Britain. But it took some years for the effects to be fully felt.

[22] J. Mason, *Chem. Brit.*, 1991, **27**, 233.

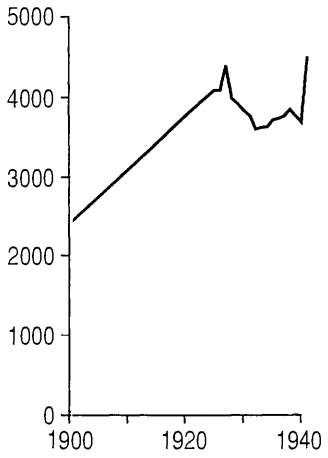

Figure 3 *Chemical Society membership*, 1900—1940

One of these had been predicted as far back as 1919 by William Pope[23]—the severe competition from the German chemical industry. Many German chemical plants, escaping the war unscathed, were poised to flood the market with dyes, fertilizers, and much else, while British wartime over-production of acids and explosives left factories with plant that was redundant as well as obsolescent. The UK industry needed more than the rhetoric of encouragement. In the hope of encouraging the Institute of Chemistry to cater for the needs of industrial members a British Association of Chemists was set up in 1918. It called for wider qualifications for entry, establishment of Local Sections on the lines of those of the SCI, creation of a Benevolent Fund, and more open government with better communication with the membership. The Institute responded positively, with the result that its membership dramatically increased[24] (Figure 4). One reason was the more favourable attitude of its academic leadership who now saw its value for a wider range of chemist than the consultants and analysts who had hitherto formed the backbone of its membership. This was evidently one lesson the war had taught them.

While it does not seem that the Institute's prosperity was at the expense of the Society's, there was a curious connection. For at the very moment of the Institute's reforms other chemical bodies, including the Chemical Society, were beginning to lose their isolationism. In April 1918 the Society's President, W. J. Pope, called for a closer alignment between societies representing pure and applied chemistry. When in the following year the Federal Council for Pure and Applied Chemistry was established, Pope became its first Chairman. It was a

[23] W. J. Pope, *Chem. News*, 1919, **119**, 179.
[24] Reference 3(*c*), p. 330.

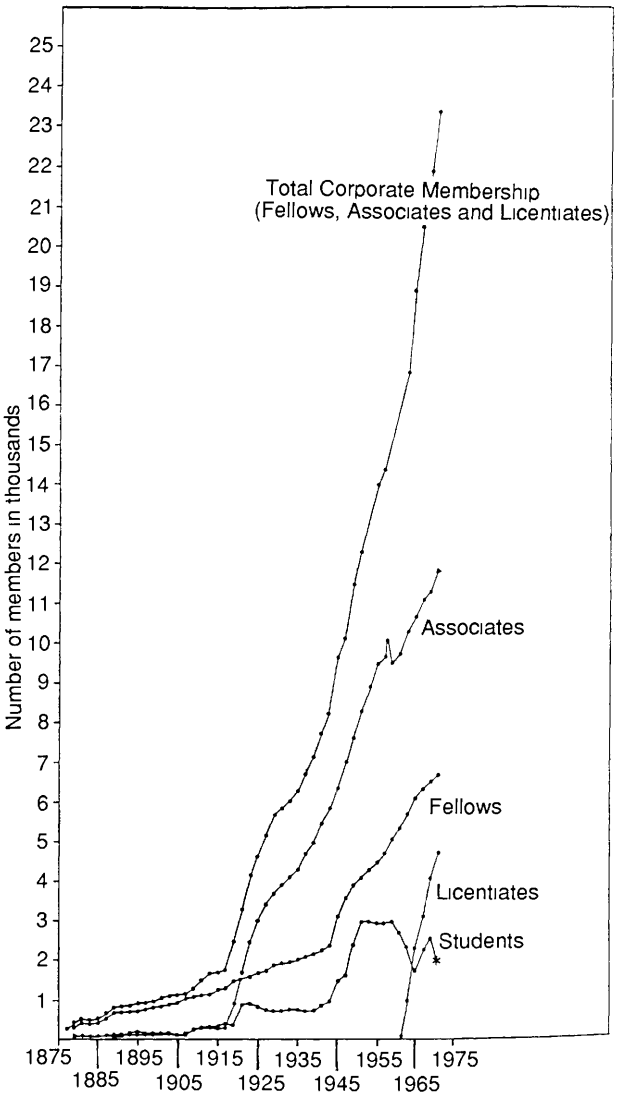

Figure 4 *Institute of Chemistry membership*, 1878—1971

federation of the Chemical Society, the Society of Chemical Industry, and the Association of British Chemical Manufacturers (three seats each), with several smaller bodies each represented by one seat This was an attempt at creating new bonds between chemists on a wholly new scale The Institute of Chemistry declined to join, fearing its position as a professional body might be compromised by any loss of independence

Ironically these very open gestures to the rest of the chemical community led to some of its troubles. The Chemical Society had granted access to its Library to members of other chemical institutions, so the consumer benefits of individual membership were thereby diminished. It was thus the victim of its own generosity. As its *Journal* was now being taken by increasing numbers of company libraries, it was also a victim of its own success, for again individuals saw less reason to subscribe.

By a number of shrewd administrative measures the Society weathered the storm. Having previously tried in vain to set up Local Sections in conjunction with the Institute and SCI, the Society succeeded in doing so independently in 1938, and created a territorial base for its own government. Moreover it accepted an initiative from the Institute for an alternative federation, the Chemical Council, with three representatives each for the Society, the Institute, SCI, and ABCM. This was formed in 1935 and raised considerable sums from industry, one effect of which was to finance the Library, hitherto the sole responsibility of the Chemical Society. The Chemical Council continued until 1966.

Such, in very brief detail, were the complex processes of bond-formation and rearrangement within the British chemical community between the wars.

C. The Challenge of Isolationism.—The Chemical Society survived both the inter-war crisis and the Second World War. But its third major challenge was round the corner. Although the Chemical Council had worked well, Sir Harry Melville, President in 1967, pointed to a series of danger signals that suggested a much closer unity within the chemical community should be sought and achieved. As in 1841 there was some internal disorder within the subject itself. This came about from the fragmentation of chemistry into narrow specialist sub-disciplines, often with their own language and specialist journals. The traditional divisions of chemistry (organic, inorganic, physical) no longer served to meet the needs of people whose interests could be described as physical organic or organometallic, to mention only two of the largest groups. A real danger existed of the chemical community disintegrating.

There were external constraints as well. Since the late 1960s the 'brain drain' of chemists to the USA had caused mounting concern, as did the decline in numbers of school children electing to study chemistry. With the rise of instrumental techniques there came a huge increase in costs and an even greater need to seek support from industry and government. Just as Hofmann 120 years earlier had proclaimed the unity of chemistry, organic and inorganic,[25] in his efforts to gain support for the infant Royal College of Chemistry, so now it was imperative for the world to see a further institutional expression of that kind of creed. So Melville proposed some kind of merger between the three chartered bodies (Chemical Society, SCI, and RIC).[26] Although the SCI eventually declined to join, as we all know this led eventually to amalgamation of the

[25] A. W. Hofmann, *Medical Times & Gazette*, 1853, **6**, 131.
[26] H. Melville, *Chem. Brit.*, 1967, **3**, 212.

Chemical Society with the RIC in 1980, and the emergence of the Royal Society of Chemistry [27] An entirely new type of bonding came into being, a result of a painstakingly careful response to yet another combination of internal and external pressures As for the catalysts for this process it would be invidious to mention names for some of the most effective are happily still with us today

D. The Challenge of Public Approval.—We have come a long way since the simple seal of the 'Chemical Society' was affixed to its documents Now, at the end of the 20th century, the chemical community throughout the world is beset by further crises, not least among them being a fourth which I would define as the diminishing public image of science and of chemistry in particular The challenge today is not merely that of pollution and the 'green' response to it It is a ground-shift in the whole world-view that includes science as an appropriate human activity and nature as an appropriate object of disinterested enquiry So serious is the threat that the Royal Society set up a standing committee to deal with 'the public understanding of science' [28] For the anti-science movement generally, chemistry has always been prominently in the front line because of its potential for environmental destruction

Public approval is invariably important for science, as our Victorian predecessors knew all too well But now there is public disenchantment with science and the scientific method on a scale unheard of since the Scientific Revolution External constraints, such as government attitudes, are not favourable, and for the first time the 'solvent effect', the influence of cultural climate ('post-modernism'), is really against us This reflects changing world-views in an increasingly pagan society, and much of it is beyond our control But not all

The need for chemists to present a united front is more obvious than ever This time it is to engage in another kind of bond-making process to establish strong links with the world outside This is not new, of course, but it needs to be addressed with renewed vigour And the requirement is not a half-hearted apologetic bleat that chemistry is not quite as bad as painted It is rather, a well-documented denial of historical half-truths about industry and the environment, a scrupulously fair assertion of the positive rôle of chemistry in the past, and a full-throated affirmation of the benefits that a responsible chemistry can provide in the future An alliance must be forged with the wider scientific community, for this battle is not only for the chemist

It is surely here that the Royal Society of Chemistry comes into its own In the tradition of the old RIC, but on a greater scale, it has already initiated bonding processes of the utmost importance with sectors of the world outside To mention but two the Sesquicentenary initiative for chemical education and the Parliamentary Links Scheme Perhaps today offers the greatest challenge yet faced in its 150 years by the RSC May it learn from the past and face the future with confidence

[27] Reference 3(*d*) p 56
[28] Report The Public Understanding of Science Royal Society London 1985