

## A PERSONAL HISTORIOGRAPHY OF THE CHEMICAL INDUSTRY SINCE 1956\*

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Peter J. T. Morris, Science Museum, London

### Introduction

In this paper and its associated bibliography, I will examine what I consider to be key books in the last fifty years (and more) in the historiography of the chemical industry. I am not saying these are the only good books published in this period, as it is impossible to cover every book, but each of these books did make a notable contribution to the historiography of the chemical industry. The last fifty years have not seen a steady and uniform production of books about the development of the chemical industry. There have been bouts of activity, with quiet spells in between, and most of these spurts of publications have been characterized by a certain type of historiographical approach. For each period, I will discuss a book which exemplified and even to some degree shaped the contemporary historiography and several other key books in less detail. It is curious that many of the historiographical "fashions" in the last fifty years had a forerunner which appeared about a decade earlier.

It is important at the outset to make clear the basis of my selection. I have only chosen books in the English language; no papers or foreign language books. To keep this survey within bounds, I have defined the chemical industry narrowly, and I have therefore not covered the soap industry or the production of metals or pharmaceuticals. In general, I have also chosen not to cover plastics manufacture or petroleum refining, but I have been inconsistent here and have included two books I consider to be pioneers in their field. By the same token, I have not tried to survey the growing literature in the history

of chemical engineering, which has been, so far, a very different field. In order to concentrate on what is really worthwhile in this field, I have only considered scholarly works, except for the very earliest period, when the academic study of the history of the chemical industry hardly existed. A personal bias in a process like this is inevitable, and I duly confess to a predilection for the history of the British chemical industry, synthetic dyes, and research and development. As this paper was originally produced for a symposium to mark the fiftieth anniversary of the Dexter/Edelstein Award, I have included all Dexter Award winners in this field. The historiography of the chemical industry is extremely diverse, so much so that one might wonder whether any sustained analysis of it would be possible. There are many possible approaches to the subject, ranging from a straightforward treatment of process development, biography, business history, the broader remit of economic history, and the study of research and development in the industry to the rather different approaches used by geographers, industrial archaeologists, and economists. And the chemical industry can be studied at many different levels, starting at the plant level, and working up via the factory and firm to the level of a region or a nation-state before reaching the final stage of the continent or even taking the relatively rare step of looking at the industry on a worldwide basis. That an analysis of the historiography is feasible in practice is largely a result of a concentration on a limited palette of approaches in any given period.

### The Situation in the Mid-1950s

A number of books on the history of chemical industry were already available to the serious inquirer in the mid-1950s. The British industry was seen as the forerunner and exemplar of the modern industry, beginning with sulfuric acid and the Leblanc soda process, followed by the Solvay process, dyes (where Britain had lost its early lead to Germany), and explosives. The main emphasis was on the creators of this industry, the development of processes, and the evolution of the firms which made up the then-modern industry. Even in the early 1950s, certain issues had come to the fore including the loss of the dye industry to Germany and the relationship between pure chemistry and the chemical industry.

### The Forerunner

Although it had been published in 1931, Stephen Miall's *History of the British Chemical Industry* was ahead of its time and was still influential in the 1950s. It established a schema for the history of the industry which was organized by industrial sectors rather than chronology, which was imitated as recently as 2000. This way of dividing up the historical account was of course made possible by the fact that certain sectors (acids, soda, dyes, and explosives) were important in different periods, but also led to the neglect of other parts of the chemical industry which did not fit into this sequence, for instance wood distillation and solvents. Miall's work concentrated on people and firms, providing very useful "family trees" of firms and several timelines of developments. In many respects, it represents a good family history of an industry which was then only a few generations old (for instance Sir Charles Tennant, the grandson of Charles Tennant, the founder of St Rollox, had died as recently as 1906).

### The Key Work

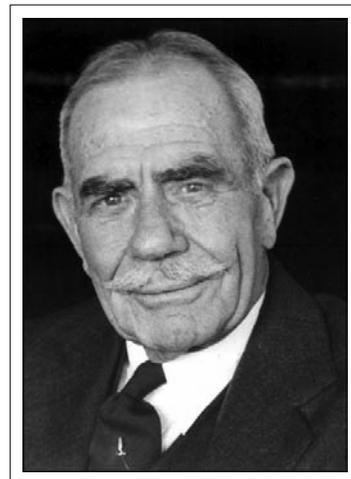
William Haynes's massive six-volume history of the American chemical industry was head and shoulders above any other history of the chemical industry in this period. A project of this size needed sponsorship (even in the 1930s) and was made possible by Haynes's close relationship with the two major boosters of the chemical industry. Francis Garvan of the Chemical Foundation commissioned Charles Herty to write the history in 1934, and when Herty died in 1938, Haynes took over. However, the appeal for funds led by the chemurgist William J. Hale of Dow Chemicals was initially unsuccessful and the project was close to being abandoned when Dow, at

Hale's behest, stepped in and provided enough money to keep it going. Monsanto then agreed to share the financial burden, and Haynes began work on his history in 1940. The first volume dealt with the period up to 1911, the next four volumes with the 1910s to 1930s, and the sixth volume was a compilation of over 200 company histories supplied by the firms and edited by Haynes.

As a journalist, Haynes (Dexter Award, 1957) was of course a superb writer, and the amount of information he assembled was astonishing. His compilation of tariff duties and imports in the 19th century is particularly noteworthy. Above all he was able to keep the technology, economic aspects, and corporate history in a fine balance. Even half a century later, his *American Chemical Industry* withstands comparison with anything published today. It is perhaps not surprising that no one has ever undertaken a similar history of the US industry. His compilation of company histories was later imitated by D. W. F. Hardie and J. Davidson Pratt in their *History of the Modern Chemical Industry*, a rather standard account of the British industry published in 1966.

### Other Important Works

Walter Gardner's *The British Coal-tar Industry* brought together reprints of many papers about the British dye industry, mostly polemical in nature but with some historical value, and thus it was the forerunner of the long-running debate about the British and German dye industries and the "British decline."



William Haynes, courtesy HIST

Gilbert Morgan and David Pratt's *The British Chemical Industry* provided considerable detail about many existing processes and specific technical developments—for example coke production or superphosphate manufacture—but the broader history of the industry is lacking. The most innovative history in this period was the Clows' *Chemical Revolution*. They broke new ground in placing the chemical industry in the context of the Industrial Revolution and the Chemical Revolution. However, the Clows attached too much importance to the

Scottish industry, and it is unfortunate that they adopted Lewis Mumford's classification of technological development which may have appeared relevant at the time but does not add anything to their analysis and only makes their work appear dated to the modern reader.

*The Chemical Industry: Past and Present* by Trevor Williams (Dexter Award, 1976) provided a highly readable history of the industry, which placed its development in the context of the economic boom it was then enjoying. Williams shared Miall's emphasis on alkalis, sulfuric acid, dyes, and explosives, thus taking a retrospective view of the industry from the industrial organization of the 1950s. By contrast, Frank Sherwood Taylor's posthumous *History of Industrial Chemistry* was a curious book that contains a considerable amount of pure chemistry and which hardly ever mentions the name of a chemical company (with the exception of BASF). However, as a historian of alchemy, Taylor did cover a longer period than any other historian of the industry.

One of the few histories of R&D in the industry in the mid-1950s was Frank Miles's *History of Research in the Nobel Division of ICI*, published by ICI. This is a very clear history of Nobel's research since Alfred Nobel's early experiments on nitroglycerin in the 1860s; but, typically for this period, Miles failed to address the corporate or commercial background of the developments he presented. It is instructive to compare his description of the development of Ardil protein fiber with David Hounshell and John K. Smith Jr's account of the development of nylon three decades later (see below).

On the biographical side, there was J. Fenwick Allen's *Some Founders of the Chemical Industry*, which gave sketches of pioneers such as James Muspratt, Peter Spence, and Walter Weldon. J. M. Cohen, *The Life of Ludwig Mond* was one of the few full-length biographies of an industrial chemist in this period. It covered the development of Mond's factories fairly well, especially the early Winnington years, with appendices on Mond's processes. But Mond is not an easy person to uncover; and, as the author admitted to me in a 1989 letter, Cohen's "ignorance of scientific technology was .. total."

### Germany and Economics: 1958-1971

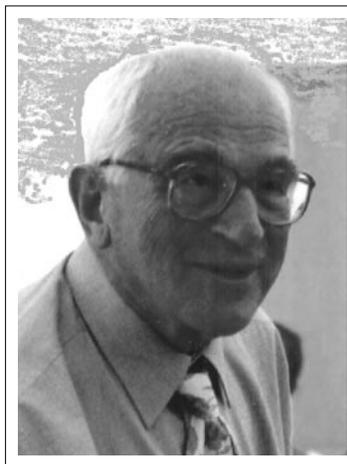
The late 1950s and the 1960s saw a complete shift of emphasis from Britain (and America) to Germany and Europe as a whole, and from technical and corporate developments to the study of the economic evolution of the chemical industry and its growing importance to

the nation-state, above all the new nation of Germany in the late nineteenth century. This shift essentially set the terms for any subsequent history of the industry up to the present. We might emphasise different factors in the industry's development or point out that the impact of the industry on the environment has been overlooked, but the framework in which we make these observations was established by L. F. (Lutz) Haber (Dexter Award, 1988) in 1958.

### The Forerunner

The crucial aspect of Haber's work is that he had no forerunner. He had Williams Haynes's history as a general model, but there was nothing comparable to Haynes for the European chemical industry. Nearly all British volumes on the chemical industry up to that time focussed on Britain. Sherwood Taylor's book, published only a year before Haber's *Chemical Industry during the Nineteenth Century*, covered the worldwide industry but it pales into insignificance alongside Haber's volume.

### The Key Works



L. F. Haber, courtesy HIST

This period opens and ends with a pioneering book by Haber. His *Chemical Industry during the Nineteenth Century* introduced a new kind of historiography with a greater emphasis on economic history. This approach had been pioneered by Haynes, but had not been hitherto applied to the more important case of Europe nor had it been used by a

trained economist. With his German background (he was the son of Fritz Haber), Lutz Haber also wrote about Germany and France and not just Britain and used a much wider range of sources than his predecessors. Given the revolutionary nature of his book, Haber began rather cautiously. He was clearly uncomfortable at this stage dealing with the history of the chemical industry as this was then very much the province of "boosters," among whom we have to include Haynes and Morgan, and in Germany, even Nazi propagandists such as Walter Greiling and Claus Ungewitter, who was in some respects

Haber's closest predecessor as a historian of the German chemical industry. Like Sherwood Taylor and John Beer (see below), Haber thus approached the subject in terms of applied chemistry. Indeed this is very much a history of applied chemistry, for the chemical industry is presented in terms of the economic development of specific regions and the technological development of processes rather than the corporate history of firms (although this volume is an excellent source for the history of small companies). What is revolutionary, however, is the other half of Haber's subtitle: *A Study of the Economic Aspects of Applied Chemistry*. For the first time, the evolution of industrial chemistry was subjected to the scrutiny of a trained economist. But Haber's genius was to use his training as an economist to write a general history of the chemical industry, which was accessible to historians of chemistry, rather than a dense econometric analysis of the kind that was later developed by John Enos, Paul Hohenberg, and Peter Murmann.

Haber's *Chemical Industry, 1900-1930* shares with his earlier volume its coverage of European developments and a focus on economic history. Yet it is a very different book, with emphasis on the large corporations and technical change rather than applied chemistry. This style reflects the difference between the 19<sup>th</sup> and early 20<sup>th</sup> century—the latter period was dominated by the formation of IG Farben in 1925—but Haber was also influenced by Bill Reader's history of ICI; he read the typescript of the first volume before it was published in 1970. Haber knew much more than he ever published, and it is frustrating that he never covered the period after 1930 or wrote much about technical developments. His reluctance to cover the late 1930s and 1940s was clearly connected to his own family's fate in this period; and as an economist (and as the son of a famous chemist), he may have been unwilling to risk his reputation by writing about the chemical side of the industry. From personal experience, I know he was very anxious about making mistakes and took every effort to correct them. This perfectionism may have inhibited Haber from writing any further volumes. It is also unfortunate that he did not train any successors while he was at the University of Surrey; as far as I am aware, I was the only young historian who benefited from his advice.

### Other Important Works

Haber's focus on the German industry was shared by another German émigré, John Joseph Beer in his *Emergence of the German Dye Industry*. Beer was always

surprised by the success of his book and told me that he was simply repeating what had been well known in his native Germany. He concluded that the development of dyes had been driven by fashion, and the German industry was successful because of its influence on university education and the patent law system, the same conclusions reached in 2003 by Peter Murmann, who used a much more elaborate method (see below).

In 1962 there appeared a very unusual book, which aimed to analyze development of processes (specifically in petroleum refining) in terms of their technical and economic performance. Most unusually, John Enos's *Petroleum, Progress and Profits* is also an excellent history of an important period in petroleum refining and deserves to be better known. His analysis is both accurate and thought provoking. It is a great pity that it has never been emulated to any extent, and that Enos himself left the field for many years, until he published a sequel, *Technical Progress and Profits*, in 2002. In a conversation in 1981, he appeared to consider writing the history of the chemical industry to be a waste of time, assuring me that (pure) economics was the only proper way to study technical innovation.

Beer's book is easy to read, which, sadly, was not the case with Paul Hohenberg's *Chemicals in Western Europe, 1850-1914*. This was, however, the first book to try to explain the growth of the soda and dye industries in the 19<sup>th</sup> century using a higher level of economic analysis than Haber's approach. Like most economists (but unlike Enos or Haber), Hohenberg had little to say about the technical developments themselves. Described by its author as an "interpretive essay," *Chemicals in Western Europe* was a strange combination of snippets of information and economic theorizing. Hohenberg reached the rather unsurprising and fairly vague conclusion that economic growth depended on "sustained technical effort."

*Petroleum, Progress and Profits* raised the possibility of studying the development of one chemical (or plastic) in depth in order to shed light on industrial development. Morris Kaufman's *History of Polyvinyl Chloride* was an unique case study of a single plastic. He looked at the individual stages of PVC manufacture, showing how they evolved to create a cheap stable material, drawing on patent literature and postwar intelligence reports. Kaufman did not cover the economics of PVC production. He was good, however, at comparing the relative progress of the German and American industries and showed that the Americans often did better than their German counterparts.

## History of Localities: 1971-1980

Although Haynes and Haber had been very much aware of the regional nature of the chemical industry, their analysis had been on the national and continental level. As the result of the development of regional geography—in particular the study of why certain industries were located in specific regions—in universities and perhaps also a growing popular interest in local history, the 1970s saw a new emphasis on localities in the history of the chemical industry.

### The Forerunner

D. W. F. Hardie essentially established this approach in his *History of the Chemical Industry in Widnes* back in 1950; but, stemming from a career in industry rather than academia, his work was not emulated for many years. In a highly readable presentation, he demonstrated a real feel for the interaction between the geography of a region, the local entrepreneurs, and developments in the chemical industry. The appendices are particularly interesting for the historian of the industry.

### The Key Work

By 1980 several authors (including Reader) had covered the development of the soda industry in Britain, but a real sense of how the industry evolved in economic and geographical terms was lacking. As a geographer, Kenneth Warren was able to bring a new perspective to the subject and did so brilliantly in his *Chemical Foundations* (1980), which examined the industry region by region (and with maps). Just as earlier historians had benefited from the coincidence that each sector of the chemical industry appeared in a historical sequence, Warren was able to capitalize on the shift of the British alkali industry from Glasgow to Newcastle, then to Widnes, and finally Winnington. Taking each area in turn, he was able to show that the location of the industry there was not a historical accident but the result of specific geographical and economic factors, especially the availability of raw materials (as the raw materials for the soda industry are heavy) and transport links. Warren had not realized the general significance of his work for the history of the chemical industry (as opposed to locational geography) until I met him in 1981, and sadly—like Hardie before him—his approach has not been used by other historians to any extent.

## Other Important Works

Alec Campbell's *Chemical Industry* may have notionally been a book about industrial archeology, but it was the result of his work on the industry on Tyneside. His book is remarkable for the clarity of the description of how the processes that underpin the chemical industry were developed and the locales in which these developments occurred.

John Graham Smith's *Heavy Chemical Industry in France* was similar to Campbell's work in many ways, although it was more detailed and scholarly. Despite the "national" title, it was very much about regions; and it is a pity there were no maps. Nonetheless, Smith shows how a new industry grew up during the revolutionary and Napoleonic periods in certain regions of France, the role played by chemists and governments, and the impact of the industry on the region. As the technology was new and the times were unsettled, the industry was only transient in some regions and longer lasting in others.

Robert Multhauf's *Neptune's Gift* (1978) illustrates the problem of trying to cover several different aspects of the chemical industry in the same volume. Multhauf (Dexter Award, 1985) used his wide knowledge of the history of the industry to produce a very technical account—which thus lacks the popular appeal or breadth of Mark Kurlansky's later work, *Salt: A World History*—but which almost paradoxically does not have much to say about the role of salt in the chemical industry. *Neptune's Gift* is very much a book of its time in paying considerable attention to localities and geography.

## Large-scale History: 1987-1990

In a remarkably short period in the late 1980s, there was an explosion of books about the chemical industry, which shared an interest with large corporations or projects. This was partly a result of scholarly and political interest in the effectiveness of large-scale government programs and large firms, but it also stemmed from the series of corporate histories in the 1960s and early 1970s, which celebrated the centenaries of the major German chemical firms followed by Reader's history of ICI and Joseph Borkin's contentious history of IG Farben.

### The Forerunner

The forerunner of these studies was W. J. Reader's official history of Imperial Chemical Industries, the first volume of which dealt with the forerunners to ICI, published in

1970. The second volume, which covered the first twenty-five years of the British firm, followed in 1975. Reader's volumes owed much to Haynes and Haber, but in essence formed a sequel to Sir Charles Wilson's magisterial history of Unilever, which appeared in 1954. Reader had been a student of Wilson at Cambridge and had worked as a research assistant on the Unilever history. Reader emulated Wilson in his concern for the broad sweep of corporate history, which essentially treated business history as an offshoot of diplomatic history. He differed from his teacher, however, in a liking for human drama; and in the second volume, he brought out "the interplay between men and events" in the development of ICI. I remember Reader giving a paper on the tragic fall and suicide of Roscoe Brunner in 1981 (he intended to write a novel based on these events), and it was clear he relished the dramatic and human elements of this prelude to the creation of ICI. In his history of ICI, Reader covered the technical side adequately, but without the same brio. Nonetheless, it was the first serious scholarly history of a major chemical company.

### The Key Work

The publication of *Science and Corporate Strategy* in 1988 was a major milestone. Written by David Hounshell and John K. Smith, it was the first major study of R&D in a chemical firm that drew on the scholarly literature about R&D and corporate development, especially the work of Alfred D. Chandler. They showed how R&D moved in the period between the wars from being simply important to completely crucial to the firm's future. Unlike Reader, Hounshell and Smith were able to take the story almost up to the present. After World War II, DuPont searched for another nylon with limited success. In the inevitable retrenchment, the basic research that had produced nylon lost out to clearly defined, directed research. While drawing lessons about the role of R&D in the modern chemical firm, Hounshell and Smith were also able to describe the important technological developments—neoprene, nylon, and Mylar among others—in considerable detail.

### Other Important Works

Peter Hayes's *Industry and Ideology: IG Farben in the Nazi Period* shared Reader's concern with politics, but was shaped by the debate about the role played by German firms just before and during the Third Reich. Hayes covered technical developments well—in fact better than Reader—but they were clearly not his main concern.

Ray Stokes's *Divide and Prosper* (1988) analyzed the breakup of IG Farben in depth and showed how it was largely a matter of international and German politics. Hayes and Stokes thus introduced a new kind of history of the chemical industry, which showed how it was shaped by politics.

Peter Spitz's *Petrochemicals* (1988) opens in Germany in 1945, like *Divide and Prosper*, but that is where the similarity ends. There is hardly any technology in *Divide and Prosper*, but *Petrochemicals* gives an insider's view of technology development while retaining the broader picture, a rare achievement. The interplay between economics, engineering, and chemistry is described clearly; and Spitz's choice of case studies was excellent. Above all, Spitz recognized that the history of the organic chemical industry is essentially shaped by its feedstocks, an insight he had gained from Carl Heinrich Krauch of Hüls.

Alfred Chandler's *Scale and Scope* (1990) was a comparison of managerial capitalism in the USA, UK, and Germany. IG Farben, ICI, and DuPont were crucial to this comparison. But it was not a history of the chemical industry, nor did it add much to that history. However, it did perform the valuable service of putting the major firms into their economic context (e.g. the importance of wood distiller HIAG compared with the other chemical firms before its *raison d'être* was destroyed by the Pier synthetic methanol process).

Peter Morris's *American Synthetic Rubber Research Program* (1989) was different from the other volumes mentioned here. Concerned with a project involving many firms—rather than internal R&D—and its impact on the development of polymer science in the USA, Morris (Edelstein Award, 2006) sought to draw lessons about cooperative research programs. Influenced by the "evolutionary economics" of Richard Nelson and Sidney Winter, the author argued that radical innovation was best promoted by free competition and that cooperative programs only generate incremental improvements (which can be important nonetheless).

### The "Konferenzzeit": 1991-2000

After this flurry of activity, the 1990s was characterized by a series of conferences that were subsequently published—hence the German title of *Konferenzzeit* ("conference period") on the basis of such periods as the *Gründerzeit*. As conference proceedings, the quality of these books was inevitably uneven, but they contained

important material and were generally of a higher standard than earlier books in this genre. The 1990s also saw the publications of books that were to some extent a revisiting of earlier publications. Anthony Travis revised Beer's classic, and Stokes questioned the standard historiography of the postwar period presented by Spitz.

### The Forerunners

The Brent Schools and Industry Project in northwest London strove in the period 1980-1985 to interest school pupils in the industrial history of their local area. As Perkin's dyestuffs factory at Greenford Green was within the London Borough of Brent, the dye industry was an obvious topic for this project. One of the chemistry teachers involved with the project, Anthony Travis, developed the topic into a series of three educational books, which appeared between 1983 and 1984 but were never formally published. The first, *The Colour Chemists*, dealt with Perkin and the rise of the synthetic dye industry. Its sequel, *The High Pressure Chemists*, covered the development of the Haber-Bosch and Bergius processes in Germany. The final volume, *Farbenindustrie*, described the IG Farben. These books were written without any knowledge of the contemporary academic work being done in these fields by Peter Hayes, Peter Morris, Willem Hornix, and Ernst Homburg; but they were pioneering in their use of the history of the chemical industry for educational purposes. This approach, taken up by the Salters' Chemistry Course developed at the University of York, is integral to the 21<sup>st</sup> Century Science curriculum which has just been introduced in England. It also was the starting point for Travis's later work on the history of the dye industry and the Haber-Bosch process.

### The Key Work

Travis's *Rainbow Makers* replaced all earlier histories of the 19<sup>th</sup> century dye industry. He wove the science, technology, legal issues, and corporate developments into a finely written and accurate narrative, which placed Perkin's discovery and later work into its scientific, economic, and social context. Above all, he showed that alizarin, rather than mauve or fuchsine, was the crucial synthetic dye in the development of the industry. But Travis did not stop there: in a series of first-rate papers he fleshed out the account given in the *Rainbow Makers* in several directions, including the development of aniline black, dyes in postage stamps, and (with Peter Morris) a broader history of the synthetic dye industry which took it up to the late twentieth century.

### Other Important Works

The first of the conference volumes—published in 1992—was a special issue of the *British Journal for the History of Science* covering the history of the dye industry. It contained Ernst Homburg's seminal paper on research laboratories. This was supplemented by Carsten Reinhardt's paper on the BASF research laboratory in *Chemical Industry in Europe, 1850-1914*. This conference volume was noteworthy for its papers on the chemical industry and pollution and Travis and Schröter's paper on different approaches by Britain and Germany in this period. The concentration of these two volumes on the synthetic dye industry was counterbalanced by *Natural Dyestuffs and Industrial Culture in Europe, 1750-1880* (1999), which covered the scientific and geographical aspects of natural dyes, the role of the factory in the natural dyestuffs industry, and the shift from natural dyes to synthetic dyestuffs.

*Determinants in the Evolution of the European Chemical Industry, 1900-1939* (1998) suffered from a polarization between the IG Farben scholars and those studying the chemical industry on the European periphery. Travis published an acclaimed paper on the Haber-Bosch process, and Morris presented his work on synthetic rubber in IG Farben. The latter was also the focus of the final conference volume, *German Chemical Industry in the Twentieth Century* (2000). This was the summing up by some of the key players in the field of two decades of research on the German chemical industry.

In *Opting for Oil* (1994), Stokes wrote the history of the postwar West German chemical industry from the political perspective of *Divide and Prosper*. As a result, he reached the controversial conclusion that the replacement of coal by oil in the West German chemical industry was not inevitable. This went against the viewpoint of all previous historians: that cheap oil had driven the development of the postwar chemical industry. Recently, however, his analysis has received sympathetic attention from academics working on the development of sustainable manufacture of chemicals.

### New Waves: 1998-2006

After another (relative) lull, the period after 1998 saw a huge explosion of books about the history of the chemical industry. This time, however, they fell into several distinct categories and thus there is no single key work. One group of books shared Paul Hohenberg's interest in the relationship between economic growth and industrial

chemicals. Another group was concerned with developing an environmental history of the chemical industry. There were also—perhaps coincidentally—several books about the history of German companies, and finally there was a revival in the writing of biographies.

### Economics

This revived interest in the economics of the chemical industry largely stemmed from Ralph Landau's entry into this field in the mid-1990s and his concern about America's leadership of the chemical industry with its implications for US economic growth. He drew on the work of historian Nathan Rosenberg, economist Richard Nelson, and, of course, the work of Alfred Chandler. The first product of this new wave was *Chemicals and Long-term Economic Growth* (1998) by Ashish Arora, Ralph Landau, and Nathan Rosenberg. The most useful chapters for historians of the chemical industry were Landau's study—as a former practitioner—of innovation in the industry, which complements Spitz's work, and Murrman and Landau's comparative study of the German and British industries, a preoccupation that goes back as far as Gardner and even earlier.

Peter Murmann published *Knowledge and Competitive Advantage* in 2003, which largely repeated the exercise carried out by Hohenberg but using Nelson and Winter's evolutionary economics. Murmann concluded that a complex interplay between firms, technology, and national institutions gave German firms dominance of the industry because of Germany's patent laws, educational system, and a strong alliance between the industry and academic centers of excellence in organic chemistry. This conclusion is not surprising—it was foreshadowed by Beer in 1959—but the detailed argument was difficult for noneconomists to follow (in keeping with Murmann's other predecessor, Hohenberg).

Following on from his study of electronics—and energized by his interaction with Ralph Landau—Alfred Chandler finally published a history of the chemical and pharmaceutical industry, *Shaping the Industrial Century*, in 2005. In a mainly narrative history, Chandler argued that chemicals had run out of steam in the 1970s, were supplanted by pharmaceuticals and now were being displaced in turn by biotechnology.

### Environmental History

The other group of historians could hardly be different. With no social connections between them and largely

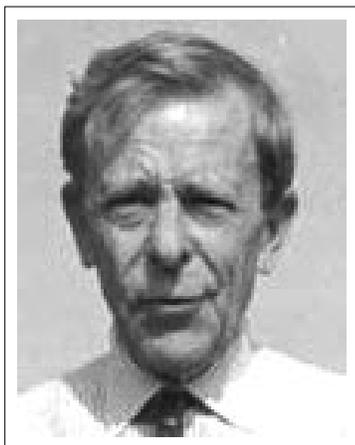
uninterested in economics, they sought to bring environmental issues into the field. It is remarkable how histories of industrial chemistry have largely ignored the environment completely until recently. Of course, this did not apply to the effects of the Leblanc soda industry in the 19th century, but more recent environmental effects were only notable by their absence.

A team of historians led by Colin Russell (Dexter Award, 1990) at the Open University made the first conscious attempt to write a history of the chemical industry that covered the environment. *Chemistry, Society and Environment* (2000) was a successor in other respects to D. W. F. Hardie and J. Davidson Pratt's *History of the Modern Chemical Industry*, a standard history published in 1966 (noteworthy mainly for its potted company histories along the lines of Haynes's final volume). Russell and his coauthors were determined that the environment should be at the heart of their narrative. Based on a well tried structure of industrial sectors combined with periods, the book is a clear history of the British industry very much along the lines of Campbell's earlier book and an Open University course unit on the chemical industry. As the authors intended, the environment does appear in the book, but the reader gets the feeling that it has been tacked on rather than underpinning the whole narrative. The idea was commendably bold, but the resulting execution of it was disappointing.

Travis was more successful with his history of the Calco works in New Jersey, *Dyes Made in America, 1815-1980*. He set out to show why the factory was initially successful but eventually closed. He demonstrated the importance of environmental factors and pointed out the irony that the environmental problems were finally solved just before the factory was shut down. It is, however, a pity that the long environmental section is separate from the operational history of the factory.

Just as Warren brought a new perspective to the history of localities, his fellow geographer Vaclav Smil's *Enriching the Earth* has recently brought a new approach to the history of high-pressure chemistry and the environmental history of food production and the chemical industry. In admirably clear and forthright prose, Smil presents an excellent argument for the importance of the Haber-Bosch process, but the result is strangely un-historical, except for his excellent account of the actual development of the process at BASF.

Despite all these efforts, we still lack a history of the industry that completely integrates the environmental factors into the main narrative. In some cases, the



C. A. Russell, by his permission.

divergence from the standard model will be small as the environmental aspects were minor. In other cases, however—perhaps even the majority—taking into account the environmental aspects in describing the introduction of a new process or the financial history of a chemical firm will make a striking difference in the way

we understand the history of the industry's development. This is the same way that the consideration of the role of R&D has transformed our view of the chemical industry since the 1950s.

### History of German Companies

It is striking how many books about the German chemical industry have been published in the last three years. There have been three major waves of German corporate histories if one includes those written in German. The first was in the 1960s, to mark the centenary of the major firms. On the whole these were not scholarly works. The second wave was in the late 1980s and early 1990s. This third wave perhaps reflects a willingness on the part of German chemical firms to confront their history, as the Third Reich recedes into history and anyone associated with that period even in a junior role has now retired. The history of BASF was the most ambitious but suffered from having several authors with different styles. Peter Hayes's history of Degussa is magisterial and Hans-Liudger Dienel's history of Linde may be the best of the group.

### Biography

Twenty-five years ago, biographies were considered to be old-fashioned, and there were never many of chemical industrialists (at least in English in contrast to German). But biographies have now returned to the history of science. Reinhardt and Travis's *Heinrich Caro and the Creation of the Modern Chemical Industry* illustrates how a good biography can show the connections and movements of people and ideas, which are impossible

to convey in a history of the chemical industry or even a firm. We now need biographies of the key figures who mediated between academia and industry.

### Now for Something Completely Different

In the course of writing the original version of this paper for a conference presentation in September 2006, I found a completely new kind of history of the chemical industry on the new books shelf in the Science Museum Library. Esther Leslie, *Synthetic Worlds* is very different from anything else covered here. It opens with a quotation from *Gravity's Rainbow* and is closer in approach to Pynchon than Haber, Travis, or even Hayes. Written by the Reader of Political Aesthetics at Birkbeck University of London, it is a complex wide-ranging book which links the development of synthetic dyes (and Ferdinand Runge) to changes in aesthetics and also the rise of the Nazis: "the poetics of carbon," as she puts it. Leslie's analysis is avowedly Marxist and when she presents the history of the chemical industry—surprisingly infrequently—her style is similar to that of the histories of IG Farben produced in the former GDR or by Joseph Borkin. One might have hoped she would have woven the literature I have covered into a wholly new tapestry. Strikingly, however, her "select [but long] bibliography" does not list any of these books, which illustrates the pressing need for historians of industrial chemistry to engage with scholars outside that field.

### Conclusions

Writing the history of industrial chemistry is clearly a complex operation involving a number of different approaches and different levels of analysis. Several parts of the industry have failed to interest historians for one reason or another, or have died out, such as wood distillation. Similarly the historiography of the industry has been dominated by large firms and the forerunners of companies which still exist, what one might call the "history of the survivors." There are histories of May & Bayer, but not of Thomas Tyrer's chemical works. As historians, we are still struggling to incorporate several features of this history, in particular the environmental and social factors. Is there a way of bringing the technology and the corporate aspects into harmony? Can we engage fruitfully with scholars in other fields who have a very different approach to the history of the chemical industry? We have clearly failed in the case of *Synthetic Worlds*, but at the same time, I am currently collaborating with a chemist working on the issue of new sustainable feedstocks for

the chemical industry, who is familiar with much of the literature presented here. I would argue that the ideal history of the chemical industry (of any period) has still to be written. For a variety of reasons, perhaps it cannot be written; indeed, given the lack of success of *Neptune's Gift*, is there any point in producing a comprehensive account? Rather, we should perhaps aim to integrate the history of the industry into broader perspectives. It is after all one industry among many and with links to other industries, rather than an unique phenomenon to be studied on its own, which has been the standpoint of many historians in the period reviewed here.

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