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Chemie - Kultur - Geschichte

Festschrift für Hans-Werner Schütt anlässlich seines 65. Geburtstages

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Vorwort

Chemie - Kultur - Geschichte signalisiert die Interdependenz dreier im Alltagsverständnis so oft als selbstständig, ja unüberbrückbar fremd wahrgenommener Dimensionen unseres Wissens. Chemie aber ist Kultur. Chemie aber hat Geschichte. Dies sind durchaus intensive, aber auch gespannte Verhältnisse. »Wegen ihrer Entwicklung fort vom Alltagswissen hin zu einer esoterischen Wissenschaft mit esoterischer Fachsprache bei gleichzeitiger Entwicklung hin zu einem Unternehmen, das für unser aller Leben von eminenter Bedeutung ist, trägt auch die Chemie zur Beirrung des Menschen in seiner eigenen Umwelt bei, und gerät so in Gefahr, als eine dunkle Macht gefürchtet und eben deshalb abgelehnt zu werden« (Hans-Werner Schütt). Hier behutsam aufklärend zu wirken, Chemie in ihrer kulturellen und historischen Dimension zu erfassen, als Teil unserer Kulturgeschichte zu begreifen und zu vermitteln, ist das Ziel einer als Chemiekulturgeschichte verstandenen Chemiegeschichtsschreibung.

Chemiegeschichtsschreibung ist auch Bestandteil einer allgemeinen Historiographie der Naturwissenschaften und der Technik und hat daher, als Ort deren kritischer Selbstreflexion, an einer Technischen Universität ihren unverzichtbaren Platz. An der Technischen Universität Berlin wurde deshalb 1969 einer Empfehlung des Wissenschaftsrates folgend der »Lehrstuhl für Geschichte der exakten Wissenschaften und der Technik« errichtet. Diesen Platz im »Institut für Philosophie, Wissenschaftstheorie, Wissenschafts- und Technikgeschichte« seit 1979, also für mehr als zwei Dezennien, ausgefüllt und mit internationaler Ausstrahlung versehen zu haben, ist das Verdienst von Hans-Werner Schütt. Sein 65. Geburtstag im Jahre 2002 ist Anlass zum Feiern und zu dieser Festschrift.

Kolleginnen und Kollegen, Mitarbeiterinnen und Mitarbeiter, Schülerinnen und Schüler sowie Weggefährten von Hans-Werner Schütt haben sich hier zu seinen Ehren mit ihren Beiträgen versammelt, die sich dem Ziel, Interdependenzen von Wissenschaft und Technik, Kultur und Geschichte aufzuzeigen, verpflichtet fühlen. Den Anfang macht Alan Rocke mit seiner Würdigung des wissenschaftlichen Werks von Hans-Werner Schütt, die er auf dem akademischen Festakt am 15. November 2002 vorgetragen hat.

V.I.T.R.I.O.L.

Astrid Schürmann
Burghard Weiss

Telling True Lives: Chemistry, History, and Biography

Alan J. Rocke

The welcome invitation to contribute to this *Festschrift* honoring the career of Hans-Werner Schütt obligated me to the pleasant and stimulating task of reading or re-reading many of Professor Schütt's contributions to the history of science and technology. This exercise taught me many new things, both about my friend and about the field to which we have both devoted our efforts. After offering a commentary on Professor Schütt's career and on the general character of the field of history of chemistry, I wish to focus today on one aspect that characterizes his work, that is, the biographical approach to the history of chemistry, and explore its present state and future possibilities.

1. On the Work of Hans-Werner Schütt

One might reasonably subdivide Professor Schütt's oeuvre into three overlapping phases. The first phase was occasioned by a major study of the nineteenth-century chemist and historian of science Emil Wohlwill (1835-1912). Wohlwill was important both for his innovations in electrochemical refining, and for his pathbreaking biography of Galileo, which has still not been sufficiently appreciated by contemporary Galileo scholars[1]. Schütt's monograph, published under the title »Emil Wohlwill: Galileiforscher, Chemiker, Hamburger Bürger im 19. Jahrhundert«[2], precipitated Schütt's own engagement with Galileo studies, which was evidenced by several contributions published in the late 1960s and early 1970s.

The engagement with Wohlwill's Galileo led Schütt to another, entirely new interest. Wohlwill had studied under the great Prussian chemist Eilhard Mitscherlich, and shortly after the latter's death (1863) he engaged in a historical dispute with Gustav Rose over the nature of Mitscherlich's discovery of isomorphism. Thus was Schütt introduced to problems and issues concerning European chemistry during the nineteenth century. For the next twenty years, roughly 1972 to 1992, Schütt treated his colleagues to a steady shower of papers as well as two more sole-authored books, the large majority of which dealt with chemistry and chemical technology in the nineteenth century. The *leitmotifs* in this body of work were mineralogical chemistry, the complex of issues surrounding isomorphism, and the life and work of Eilhard Mitscherlich. But there was much more there than just that. For one thing, Schütt showed himself to be a sophisticated analyst of issues in the philosophy of science. His »Entdeckung des Isomorphismus«[3] was structured as »eine Fallstudie zur Geschichte der Mineralogie und der Chemie«, and he used the story to provide a

1 Emil Wohlwill, Galilei und sein Kampf für die copernicanische Lehre, 2 vols., Leipzig 1909-26.
2 Hans-Werner Schütt, Emil Wohlwill: Galileiforscher, Chemiker, Hamburger Bürger im 19. Jahrhundert, Hildesheim 1972.
3 Hans-Werner Schütt, Entdeckung des Isomorphismus, Hildesheim 1984.

penetrating assessment of the value of Thomas Kuhn's structure of scientific revolutions in understanding his case.

As is well known, Kuhn's landmark 1962 book posited the existence in all mature sciences of intellectual entities called »paradigms« that structure ongoing research; programs of research under reigning paradigms he called »normal science«. Revolutions, in Kuhn's theory, represent the replacement of one paradigm by another. Kuhn's book had an enormous influence in a wide range of disciplines. Over the past forty years, his movement against positivist, Whiggish, and naively progressivist ideas, and in support of a more historicist and relativising approach, has been widely adopted across virtually all humanistic disciplines. Nearly all competent observers consider »Structure of Scientific Revolutions« to be one of the great scholarly works of the twentieth century. Ironically, however, the *specific details* of Kuhn's theory of scientific change have been largely rejected — and even more damning, ignored — by historians of science, especially by those in Kuhn's own Anglophone community.

Schütt's intent was to provide a test case for Kuhn, and he found much of interest. Mitscherlich's discovery of isomorphism, he determined, was simultaneously an example both of normal science within chemistry, and of a revolution-producing anomaly within mineralogy. Kuhn had never considered such cross-disciplinary effects of anomalies. Even within each discipline, Kuhn's theory showed weakness, for Schütt demonstrated that the mineralogical paradigm that had apparently been destroyed by isomorphism lived on, in altered form, for another generation, and the chemical paradigm that had apparently been strengthened had altered considerably in the wake of the discovery.

A broader lesson from all of this is consistent with one of Kuhn's principal convictions: that theories are heuristically useful to scientists, even apart from their truth value. So also did Schütt find Kuhn's historical/philosophical theory heuristically useful for his historical investigation. Indeed, it had never been Schütt's intent to test the truth value of Kuhn's ideas, but only their utility.

After »Die Entdeckung des Isomorphismus« was published, Schütt further broadened his reach, exploring issues in the history of physics, the history of technology, the history of organic chemistry, and the relations between science, technology, and religion; in chronological terms he studied events ranging from the Renaissance to the twentieth century, and in geographical terms his reach was pretty much global. This was an extraordinary range of fine scholarship. But he did not let go of Mitscherlich and isomorphism, for he completed and published his definitive biography of the man only in 1992: »Eilhard Mitscherlich: Baumeister am Fundament der Chemie«[4].

I will return to this important book a little later. Here I would just want to add one further comment, regarding both Schütt's relationship to Kuhn, and his use of scientific biography. Kuhn's analysis was internalist and highly schematic — he always referred to the book as an »essay« — and although he focused on scientific communities, he did not carry out any empirical case studies to support his ideas. In fact, in his only post-»Structure« historical monograph, »Black-Body Theory and the Quantum Discontinuity«[5], Kuhn did not even make use of his own theoretical structure. By contrast, in testing the application of Kuhn's ideas to isomorphism, Schütt carried out what Seymour Mauskopf has called »one of the most systematic and

[4] Hans-Werner Schütt, Eilhard Mitscherlich: Baumeister am Fundament der Chemie, München 1992.

[5] Thomas S. Kuhn, Black-Body Theory and the Quantum Discontinuity, New York 1978.

complete enumerations of a scientific community.« Schütt was to complement and supplement this revealing proposopographical or collective-biographical portion of »Entdeckung des Isomorphismus« by publishing the Mitscherlich biography. As I said, I will return to this biography shortly.

In a sense, Schütt had spent two decades working around Mitscherlich's footprints, and it seems that he had finally gotten the man out of his system. So now, in a third phase of his scholarly career, he turned back to what appears to have been an old interest, the history of alchemy. The next few years saw a number of interesting papers flow from Schütt's pen, until finally, in the millennial year of 2000, there was published a magisterial survey of the subject: »Auf der Suche nach dem Stein der Weisen: Die Geschichte der Alchemie«[6]. This was the first general history of alchemy to appear in about half a century, and it will have a major impact on the study of this subject in the years to come.

Here, in nearly 600 pages and close to a hundred short chapters, is an examination of the full range of alchemical lore: beginning »im Schatten der Pyramiden«, Schütt progresses through »fremde Welten« (the Arabic period), then »in Klöstern und andernorts« (the middle ages), and finally »in der neuen Welt Europas«. In an afterword, Schütt notes that it was not his intent to provide a scholarly investigation of the subject that seeks novel understanding. Rather, his aim was to get under the skin and into the minds of the alchemists of various times and places. This included, for Schütt, mining matters »Anekdotisches, Philosophisches, Psychologisches, Politisches, u.s.w.«, in the hope of presenting, as Golo Mann put it, »das ungemein Unterhaltende der Geschichte«. In this way, he concluded, he could steer safely »zwischen der Skylla professoraler Unverständlichkeit« and »der Charybdis effekthaschender Popularität«. Schütt's navigation was up to the task.

In summary, Hans-Werner Schütt's scholarly career is far from over, but during the last thirty-four years he has to his credit four outstanding books and nearly a hundred articles on the most varied subjects. His influence on the field of history of chemistry has been enormous, and it is appropriate to say a few words about the field as a whole.

2. On the History of Chemistry

To start with the obvious, the history of chemistry is a branch of history whose subject is chemistry. To add what might not be so obvious, these two pursuits, history and chemistry, occupy the most fundamental positions in the humanities and in the natural sciences respectively. History enjoys a kind of supremacy among virtually all disciplines of the humanities, and in many of the social sciences, as well. The academic study of musicology, literature, fine arts, religion, classical languages, and philosophy are largely historical in character, and sociology, anthropology, economics, law, and political science have important historical branches. Even some natural sciences, such as geology, evolutionary biology, and astronomy are essentially historical in nature. On the side of the natural sciences, chemistry is surely *the* central science, for it forms the pivot point for physics and its ancillary disciplines in one direction, and biology and its ancillary disciplines in the other. It is also the most

[6] Hans-Werner Schütt, Auf der Suche nach dem Stein der Weisen: Die Geschichte der Alchemie, München 2000.

central of the applied sciences, for chemical knowledge is basic to the manipulation of all of the materials, natural and artificial, which we use in our daily lives. When I teach my course on the history of chemistry, I like to summarize all of this (with a wink and a nod) by asserting that, considering the key positions of both history and chemistry, the history of chemistry must obviously be considered the queen of *all* disciplines.

When I say this to my students, I am not *entirely* in jest, for I, like our honoree, am captivated by the field, and wish others to understand its attractions and its importance. One of the most stimulating discussions of the historiographic goals of history of chemistry came from the pen of Professor Schütt in 1988[7]. Among his suggested »Aufgaben der Chemiegeschichte heute« were »ein Brückenschlag zwischen Natur- und Geisteswissenschaften«, »ein besseres Selbstverständnis der Chemie«, »eine Korrektur des bisherigen einseitig ausgerichteten Geschichtsbildes«, »eine bessere Kenntnis der Abhängigkeit der Chemie auch von ausserwissenschaftlichen Faktoren«, »eine didaktische Hilfe bei der Darstellung naturwissenschaftlicher Probleme«, »ein besseres Verständnis des Wissensstandes und Wissenschaftsbetriebes der Chemie«, and »eine kritische Funktion bei der Diskussion gewisser scheinbar aktueller Probleme«.

The entire essay is well worth study, but let me just dwell on the first two of Schütt's points. The very centrality of history and of chemistry to the humanistic and the scientific disciplines respectively make the history of chemistry outstandingly situated to form a »Brückenschlag zwischen den Disziplinen«. The »science wars« or »culture wars« that have rocked American academia appear to have been less destructive in Europe, but unhealthy symptoms of the »two cultures« phenomenon are clearly in evidence on both sides of the Atlantic. What we need more of is integrative interdisciplinary work that shows connections and relevance between apparently disparate disciplines that utilitize allegedly disparate forms of intelligence. As Schütt put it, »Naturwissenschaftsgeschichte ist zu einer Relativierung dieses gewöhnlich unbefragt hingenommenen Urteils besonders geeignet«.

And heaven knows chemistry needs »ein besseres Selbstverständnis«. The cover of a recent issue of *Nature* bore the declarative (not interrogative) headline, »Chemists: Too shy for their own good.« Inside was an editorial that asserted first that »Chemists and chemistry have never been more vital to science and society than now« and then noted that »the discipline is easily misunderstood, and those working in it are frequently underappreciated. ... Chemists have allowed those from outside the field to characterize it - to define what chemistry is and what it is not. To the public ... chemistry means belching chimneys and poisoned rivers, not life-saving medicines and space-age materials.«[8]

To make the same point in Schütt's more historically-oriented words, »Wegen ihrer Entwicklung fort vom Alltagswissen hin zu einer esoterischen Wissenschaft mit esoterischer Fachsprache bei gleichzeitiger Entwicklung hin zu einem Unternehmen, das für unser aller Leben von eminenter Bedeutung ist, trägt auch die Chemie zur Beirrung des Menschen in seiner eigenen Umwelt bei, und gerät so in Gefahr, als eine dunkle Macht gefürchtet und eben deshalb abgelehnt zu werden. Historische Werke über die Wege, das Wollen und die Absichten der Chemiker können hier, vorausgesetzt sie sind allgemeinverständlich geschrieben, auch den Laien erfahren lassen,

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7 Hans-Werner Schütt, Chemiegeschichtsschreibung — ›Zu welchem Ende?‹, in: Chemie in unserer Zeit 22 (1988), pp. 139-145.

8 Nature 411, 24 May 2001, p. 399.

was die Chemikerwelt ›im Innersten zusammenhält‹, und damit aufklärend wirken.« But Wege, Wollen, und Absichten der Chemiker can only best be understood by the selective examination of Wege, Wollen, und Absichten *bestimmter* Chemiker in *bestimmten* historischen Lagen. In other words, in order properly to pursue history of chemistry we need, inter alia, to pursue the histories of chemists, that is to say, biography. Professor Schütt has not neglected this important approach to the field. Two of his four books were biographies, of Wohlwill and Mitscherlich, and many of his other scholarly contributions had constitutive biographical elements, as well—treating, for example, Galileo, Haüy, Klaproth, Berzelius, Schönbein, Körner, and Pasteur. It is time to move to a discussion of the role of biography in the history of chemistry and the history of science.

3. Reflections on Chemical Biography

Mitscherlich was one of the most significant German chemists of the first half of the century; Schütt rightly calls him the »Prince of Prussian chemistry«. After less than a year as Praktikant in the laboratory of the botanist H. F. Link, in 1818 Mitscherlich encountered distinct cases of isomorphism; this discovery came to the attention of the great Jacob Berzelius, who happened to be traveling in Germany at the time. Asked by the Prussian ministry to recommend a successor to the great Heinrich Klaproth at the University of Berlin, Berzelius named the hitherto unknown student. After a period of study with Berzelius, Mitscherlich thus became ordentlicher Professor of chemistry at Berlin. There he remained over forty years, until his death in 1863. Mitscherlich's fame was established by his pathbreaking work on isomorphism, but there was much more to his career than that. He carried out important studies of polymorphism, isomerism, the formation and reactions of benzene and of ether, studies in analytical and inorganic chemistry, and much else besides.

Schütt not only followed Mitscherlich's remarkable scientific career, but also strove throughout his book to come to grips with his subject's difficult personality, for Mitscherlich was famously suspicious, arrogant, hypochondriac, and paranoid. To deal with these issues required, if not psychohistorical techniques, at least some careful contextualization, and here I want to return to something Schütt stated in his historiographic article. At the end of the piece he posed »Zwei Fragen an die Geschichte«, or, other words, »was Geschichtsschreibung ganz allgemein eigentlich will.« His two questions are »Wo stehen wir heute?« and »Was ist der Mensch?« and he points out that the history of chemistry has its own important approaches to these questions. »All das allerdings«, Schütt concludes, »geht der Frage, ›Warum, also zu welchem Ende, entschliesst sich ein Chemiker, Chemiegeschichte zu treiben?‹ noch nicht auf den Grund. Au fond, wird die wichtigste persönliche Rechtfertigung jedes Chemiehistorikers schlicht das Vergnügen sein, das er empfindet, wenn er dem Menschen in seinen historischen Situationen nachspürt.«

Here is where the Stichwörter dieses Festaktes - Chemie, Kultur, and Geschichte - are relevant. In a reflective article published a few years after his biography appeared, Schütt strove to place Mitscherlich in his cultural context, by relating his individual psychic world to that of his society. Mitscherlich's personality, he wrote, seems to have been a »merkwürdige Mischung von Bescheidenheit, Empfindlichkeit und Herrschsucht. ... [Er] war eingebunden in ein Netz von äusseren Abhängigkeiten und inneren Hemmungen«, and he appears never to have been sure of his own convictions.

This uncomfortable temperament led Mitscherlich into many difficulties with his contemporaries, which Schütt entertainingly outlines. More to the point, Schütt paints this personality as in some measure a reflection of the biedermeierliche culture of which he was a part - cautious, conventional, narrowminded, middle-class, and risk-averse. In this sense he was the antithesis of the romantic figure Liebig, with whom he had the worst relations of any[9].

I am well familiar with Schütt's struggle to come to terms with a difficult personality. I, too, wrote a biography of a nineteenth-century German chemist who, besides being extraordinarily important, was suspicious, arrogant, hypochondriac, and paranoid[10]. My man, who was twenty-five years younger than Mitscherlich, was Hermann Kolbe (1818-1884). Also similar to Mitscherlich, Kolbe had profoundly conservative theoretical predilections, and loathed modernist theoretical chemistry, with its structural formulas and benzene rings. His fulminations against »modern« chemistry and against his real and perceived opponents were so violent and extended that many contemporaries thought he was suffering a mental illness. I, too, tried to relate Kolbe's personality to that of his culture, but there was a limit to how far I could carry the point.

Across the Rhine in France, there lived an exact contemporary of Kolbe who exhibited interesting comparisons and contrasts[11]. Adolphe Wurtz was born a few months earlier than Kolbe, but both died in 1884 at the age of 66. Both were leaders in the chemical communities of their respective countries; both were among the world's finest organic chemists; both were strongly theoretically oriented. However, there was an intriguing mirror-image dualism, too: Kolbe found himself outside the mainstream of German chemistry in his opposition to atomic and structural ideas; Wurtz found himself outside the mainstream of *French* chemistry in his *commitment* to the same ideas. Kolbe fought an unsuccessful rear-guard action against structural chemistry in Germany; Wurtz fought an unsuccessful rear-guard action in favor of structuralism in France. Kolbe despised Wurtz with white-hot intensity; Wurtz had little use for Kolbe.

Kolbe also disliked Mitscherlich, and despised Prussia and the Prussians. When the Empire, and the chemical profession, was established under Prussian dominance, and when German chemistry went ever more strongly for structural theory, Kolbe was appalled. »[I]ch verhehle mir nicht«, he wrote to Karl Volhard, »dass wenn Preussen so fortfährt, die Chemie zu ruiniren ... so wird bald die Zeit wiederkehren, wo, wie im zweiten Jahrzehnt dieses Jahrhunderts, die deutschen Chemiker, um sich in der Chemie auszubilden, nach Paris gehen.«[12]

Having completed full-scale biographies of both of these interesting and important chemists, I was struck by certain commonalities and differences in the two experiences. In both cases I sought to make the fullest possible use of unpublished manuscript sources, especially letters. This was much easier in the case of Kolbe, than in the case of Wurtz. For Kolbe, I was able to locate over a thousand letters either to him or from him in various German archives. Wurtz was a tougher challenge. Despite assiduous efforts, I was able to find only about a hundred surviving letters from Wurtz's

9 Hans-Werner Schütt, Eilhard Mitscherlich als ›Erster Chemiker Preussens‹, in: Dahlemer Archivgespräche 2 (1997), pp. 101-14, on pp. 107-9.

10 Alan Rocke, The Quiet Revolution: Hermann Kolbe and the Science of Organic Chemistry, University of California Press 1993.

11 Alan Rocke, Nationalizing Science: Adolphe Wurtz and the Battle for French Chemistry, MIT Press 2001.

12 Kolbe to Volhard, 9 June 1876, Sondersammlungen des Deutschen Museums (Munich), no. 3681.

pen, and about fifty others that were sent to Wurtz. There were several reasons for this scarcity of letters. A single correspondent and a single archive can make an enormous difference, and there is no single such case for Wurtz. For another thing, much of the Wurtz Nachlass had been destroyed during a bombardment in the First World War. And finally, Wurtz resided in the center-point of French science, Paris, along with most of his other principal colleagues. He had less need to write letters than Germans in the decentralized *Deutscher Bund* did.

Professor Schütt clearly faced some of the same issues in writing his biography of Mitscherlich. The case of Mitscherlich is somewhat similar to the case of Wurtz, for if there was any center point to German science and politics, Berlin could make the best case. Moreover, the nineteenth-century Berlin scholars themselves clearly regarded their community as the center-point, despite the disconcerting fact that, during the lifetime of Mitscherlich, such leading figures in the German chemical community as Liebig, Wöhler, Bunsen, Kekulé, Hofmann, and Kolbe all lived outside of Prussia (and in the cases of Kekulé and Hofmann, outside of Germany). Also working to limit the extent and availability of Mitscherlich's surviving letters was his insecure, introverted, and suspicious personality. And added to all of this is the fact that the relatively small number of surviving letters are written in the most excruciatingly difficult German hand I have ever seen—with the possible exception of some of Liebig's later scrawls.

In the face of such difficulties, Schütt's persistence and resourcefulness are all the more to be admired. But in most cases, sources exist in profusion, waiting for future biographers. Heinrich Vieweg carried on extensive correspondence with many German chemists, and Vieweg Verlag has 50,000 letters from the nineteenth century, few of which have been read by historians. Collections such as the Liebigiana in the Bayerische Staatsbibliothek, the Wöhler Nachlass in Göttingen, the Liebig Nachlass in Giessen, the extraordinary treasures in the Deutsches Museum, and many others have been little explored. The same is true for Parisian archives. Just to name a single example, the Fonds Dumas in the Archives de l'Académie des Sciences is an extraordinary treasure trove that has barely been scratched by historians. There are also new collections still surfacing, and surely others that have not yet come to light. One such example is the important Edward Frankland Archive, which Colin Russell has gathered and used with such good effect. Another is an extensive Nachlass for Adolf von Baeyer that has recently surfaced.

There has been no attempt at a Baeyer biography for fifty years, and none has ever been written based on letters and other private documents. A similar situation subsists for most of the great German chemists: we would love to have serious modern biographies of such giants as Hofmann, Kekulé, Kopp, Will, Erlenmeyer, Wallach, Fischer, Willstätter, and many others. The situation for French chemists is just as bad, if not worse. Thenard, Chevreul, Balard, Deville, Pelouze, Frémy, Cahours, and Regnault have never been the objects of modern monographic studies, and Dumas, for his great importance, has only begun to be carefully mined.

To be sure, we do now have a few full-scale modern chemical biographies: for example, Crosland on Gay-Lussac, Geison and Debré on Pasteur, Smeaton on Fourcroy, Knight on Davy, Morselli on Avogadro, and Jacques on Berthelot[13]. In

[13] Maurice Crosland, Gay-Lussac: Scientist and Bourgeois, Cambridge University Press 1978; Gerald Geison, The Private Science of Louis Pasteur, Princeton University Press 1995; Patrice Debré, Louis Pasteur, Paris 1994; W. A. Smeaton, Fourcroy: Chemist and Revolutionary,

addition, there are a few older biographies that were done seriously and properly, including the use of manuscript letters, such as Anschütz on Kekulé, Cohen on van't Hoff, Richard Meyer on Victor Meyer, Söderbaum on Berzelius, and Hoesch on Emil Fischer, for example[14].

Indeed, there are signs that science biography is starting to come into its own. Limiting the category to *recent biographies of German chemists*, we can cite Klaus Hoffmann on Otto Hahn (1993), Dietrich Stoltzenberg on Fritz Haber (1994), Kostas Gavroglu on Fritz London (1995), William Brock on Justus Liebig (1997), Wilhelm Strube also on Liebig (1998), Ursula Pohl on Friedrich Otto (1998), Margit Szöllösi-Janze on Fritz Haber (1998), Peter Nolte on Christian Friedrich Schönbein (1999), Georg Schwedt on Friedrich Wöhler (2000), Carsten Reinhardt and Anthony Travis on Heinrich Caro (2000), as well as the Schütt and Rocke biographies I discussed earlier[15]. Since of these dozen modern chemical biographies Professor Schütt's is the earliest, it is reasonable to suggest that his book played an important role in initiating this trend.

But the fact remains that historians of science are still far behind the curve when it comes to biography. In a world in which there are 250 biographical studies of Samuel Johnson, 60 of Charles Dickens, 75 of James Joyce, and God knows how many of Victor Hugo, Jules Verne, and Goethe, it is not unreasonable to ask for full-scale modern biographies of (e.g.) Baeyer, Kekulé, and Hofmann.

4. Verity and Verisimilitude in the Telling of Lives

Or *is* it unreasonable? What is the value of biography, after all? Many have expressed serious doubts, but I would like to offer a defense. Two justifications are both obvious and ready to hand. One is that, for as much as the overriding goal of historians is to analyze the past, it is also true that historians tell stories. An appreciation for the narrative function of history, sanctioned from time immemorial but much derided by shortsighted historians a generation ago, appears fortunately to be in the ascendancy once more. Indeed, if historians wish to have any substantial impact on their societies, they must be more sensitive to the accessibility and appeal of their writings. As

Cambridge 1962; David Knight, Humphry Davy: Science and Power, Oxford 1992; Mario Morselli, Amedeo Avogadro, Boston 1984.

14 Richard Anschütz, August Kekulé, 2 vols., Berlin 1929; Ernst Cohen, Jacobus Henricus van't Hoff: Sein Leben und Wirken, Leipzig 1912; Richard Meyer, Victor Meyer: Leben und Wirken eines deutschen Chemikers und Naturforschers, Leipzig 1917; H. G. Söderbaum, Jac. Berzelius Levnadstecking, 3 vols., Uppsala 1929-31; Kurt Hoesch, Emil Fischer: Sein Leben und sein Werk, Berlin 1921.

15 Klaus Hoffmann, Schuld und Verantwortung: Otto Hahn, Konflikte eines Wissenschaftlers, Berlin 1993; Dietrich Stoltzenberg, Fritz Haber — Chemiker, Nobelpreisträger, Deutscher, Jude: Eine Biographie, Weinheim 1994; Kostas Gavroglu, Fritz London: A Scientific Biography, Cambridge University Press 1995; William Brock, Justus von Liebig: The Chemical Gatekeeper, Cambridge University Press 1997; Wilhelm Strube, Justus Liebig: Eine Biographie, Beucha 1998; Ursula Pohl, Friedrich Julius Otto (1809-1870): Pharmazeut, Technologe, Gesundheitsbeamter, Stuttgart 1998; Margit Szöllösi-Janze, Fritz Haber, 1868-1934: Eine Biographie, Munich 1998; Peter Nolte, Christian Friedrich Schönbein: Ein Leben für die Chemie, Stadt Metzingen 1999; Georg Schwedt, Der Chemiker Friedrich Wöhler (1800-1882): Eine biographische Spurensuche, Seesen 2000; Carsten Reinhardt, Anthony Travis, Heinrich Caro and the Creation of Modern Chemical Industry, Boston 2000.

historical narrative gives opportunity for accessibility, so biography gives opportunity for storytelling; every life has a beginning, development, and conclusion, and most prominent lives can be seen as having been lived for an important purpose, providing a morals for our stories.

The second obvious justification is that history is made from the efforts of human beings, and unless we know some reasonable details about the individual actors, we are left in the dark regarding the sum of their actions. To be sure, much can be learned from prosopographical, sociological, statistical, or communological studies, just as much can be learned about the behavior of a large collection of gas molecules from the study of their statistical mechanical and thermodynamic behavior. However, unless thermodynamics is complemented and supplemented by molecular physics and chemistry, our investigation is limited. To draw my analogy one step further, it is increasingly possible for scientists in the twenty-first century to follow the actions of individual atoms and molecules, significantly advancing our understanding of nature. Historians ought to follow a similar strategy.

Beyond the obvious issues, those who question the worth of scientific biography tend to do so for one or more of three reasons: first, biographies all too quickly tend to descend into hagiography or cheap popularity; second, science biography allegedly fails to focus on what is essential to the history of science, that is, the increasing objective understanding of nature; or third, science biography allegedly fails to focus on what is essential to the history of science, namely a demonstration of the social constructedness of science. I hold to none of these reservations, and neither, I think, does Professor Schütt.

In fact, the value of science biography can be seen by inverting the very objections I just named. Let us take the danger of hagiography, for example. It is true that a biographer ought not to be uncritical in admiration. (Choosing an unhappy personality like that of Mitscherlich or Kolbe provides one kind of inoculation against this danger.) But what, exactly, is the danger in writing in a *critically* admiring fashion? Some historians, reacting against the real dangers of hagiography, apparently feel that the only legitimate critical approach is one taken with a scowl, a wink, or a skeptical smirk. But other authorial poses ought to be possible. I agree with Thomas Söderqvist in his appeal for a kind of science biography that can provide a variety of exemplars of existential projects of individual scientists, an approach that can transform biography into a truly edifying genre. Söderqvist would like to free biographers to show, without apology, their subject's struggle for existential authenticity, even sometimes in direct conflict with socio-political constraints[16].

This sort of approach also obviates the other two objections frequently raised - namely, that biography concerns itself with merely personal aspects of a scientist's life, when what is important is the objective new knowledge that he created; or that biography concerns itself with mere individual agency, when what is important is the social context that determines the course of his life and the content of his thought. My point is that the right kind of science biography can show, by example, the insufficiencies of an objectivist/positivist viewpoint on the one hand, or of a radical social constructivist view on the other. Against positivism, we can understand, through such

[16] Thomas Söderqvist, Existential Projects and Existential Choice in Science: Science Biography as an Edifying Genre, in: M. Shortland, R. Yeo (eds.), Telling Lives in Science: Essays on Scientific Biography, Cambridge University Press 1996, pp. 45-84; see also the editors' outstanding introduction to this volume, pp. 1-44.

biography, that science is a social, collective, and culturally-grounded activity; against social construction, we can also find examples, in Söderqvist's phrase, of how »authenticity can be won in struggling out of an everyday condition.« In other words, the right kind of biography can fulfill Schütt's two goals for history of chemistry, a bridge between disciplines, and a better understanding of science itself.

But there are many different routes to »the right kind of biography«. One tactic that places the details of a personal research program in the foreground has been fruitfully pursued by Frederic L. Holmes; he calls it the »fine structure of investigative pathways«. He first adopted this approach forty years ago, when he encountered at the Collège de France eighteen large laboratory notebooks comprising the bulk of Claude Bernard's original laboratory record. It occurred to Holmes that such records would enable him to examine an example of scientific activity at a finer level of resolution than historians of science had yet achieved. In 1974 he published an award-winning monograph on the early history of Bernard's animal chemistry[17].

For his next project Holmes selected the work of Hans Krebs (1900-1981), one of the most important biochemists of the century. Using detailed laboratory records and live interviews, the Krebs project took more than fifteen years to complete, and culminated in the publication of two large volumes — close to 1000 pages in toto — covering only the first half of Krebs's long career[18]. Since then, Holmes has successfully tackled Lavoisier in the eighteenth century, and Matthew Meselson and Fanklin Stahl in the twentieth, by the same approach[19]. Fine structure investigations of this type, if done well (and Holmes is the undisputed master of the technique), offer a hitherto unequalled access to the details of evolution of the ideas, and thus of the creative process itself, in the minds of the greatest scientists.

The potential disadvantage of this kind of high intellectual history is that it appears to become a rather bloodless affair; we learn little about the conditions of the protagonist's life or the relationships with his or her community. Other biographers, on the other hand, have gone quite far in the opposite direction, though historians of chemistry have seemed not be very susceptible to this temptation. One outstanding example of a biography that is more attuned to socio-psychological relations than to the details of science is Adrian Desmond and James Moore's treatment of Darwin. This was a massive, captivating, and best-selling effort, and part of its appeal was its very personal tone. It is fiery in its language, politically oriented in its action, and lurid in its details[20]. But some readers missed the science.

Both the Holmes approach and the Desmond/Moore approach to biography, as opposite as they may appear, have something essential in common, something that was well noted by a reviewer of the Desmond/Moore biography. The main point of biography is »not to be definitive, but to try to understand ... [T]he skill is in the biographer's capacity for split vision«, in that the author must view the subject as a biographer, while also attempting to view the world as the subject does. »The best biographical writing is the distillation of two minds, one of which sympathizes with,

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17 F.L. Holmes, Claude Bernard and Animal Chemistry: The Emergence of a Scientist, Harvard University Press 1974.

18 F.L. Holmes, Hans Krebs: The Formation of a Scientific Life, 1900-1933, Oxford University Press 1991-93.

19 F.L. Holmes, Lavoisier and the Chemistry of Life: An Exploration of Scientific Creativity, University of Wisconsin Press 1985; Meselson, Stahl, and the Replicatin of DNA: A History of The Most Beautiful Experiment in Biology, Yale University Press 2001.

20 Adrian Desmond, James Moore, Darwin: The Life of a Tormented Evolutionist, New York 1991.

judges, and displays the other.«[21] As different as their approaches may seem, Holmes as well as Desmond and Moore attempt to do just this — the difference comes from the fact that they focused on different essential aspects of their protagonist's life.

To borrow Söderqvist's language, the biographer, no less than his subject, strives for authenticity, in his life and in his work as a historian. For the writing of narrative history, of which biography is a type, this means capturing a full slice of the past, in all its complexity and detail. But anyone who has tried to write serious history knows that this ideal is really impossible. The historian picks and chooses which detail to mention, which to emphasize, which to ignore, and how to assemble the various elements into a coherent story. At every point, the choices are ruled by critical judgment, and a measure of esthetic instinct also obtrudes.

The dirty secret is that a biographer cannot rely solely on documents and demonstrated historical facts - or, at least, he ought not, if he wants to write a worthwhile biography. This is because the documents at his disposal, even in the fortunate cases where there is much raw material, simply never suffice to supply the answers to all possible questions, including and especially many of the most important ones. It is for this reason that the biographer must often resort to extrapolation, triangulation, or informed conjecture to get a bead on the details of his subject's action. I would even want to add that historical imagination is a vital ingredient. Epistemic verity is not possible. Only verisimilitude can be achieved.

Dominique Pestre recently compared historical films with historical articles, noting that the former is, in a sense, much more difficult to do well. The writer of an article or book chooses his details, and has the freedom to ignore that which is unknown, insecure, or irrelevant. Not so in a film. Movies show the action »in the round«, as it were - portraying not just the typical elements of plot, but everything, down to the smallest, most insignificant, even most irrelevant details of language, gesture, clothing, streetscapes, and so on[22].

In the biography which I recently published, I was not able to penetrate to the details of daily life as much as I would have liked. Why was I so eager to get to that level? It was not just for »local color«, authenticity, and storytelling appeal, although that was certainly a part of it. It was also because I was convinced that only by considering such details could one really motivate and explain some of the major elements of the story. Let me give one example. A prominent and much criticized custom of French academic life was the practice known as »cumul«, the cumulation of multiple simultaneous academic posts by individual scholars in Paris. But until we know what *cumul* meant for scientists who indulged in this practice, even down to the level of daily life, we can't know what its effects were. The bottom line is that we make the best estimates we can, given the available data.

To be sure, there is an alternative approach, which is radically to embrace the narrative ideal. Those who choose to do this give themselves the freedom to create a fictionalized »screenplay« of a life, endowed with an omniscient vision and encumbered by no pretensions of writing conventional history at all. Russell McCormmach did this many years ago, with his »Night Thoughts of a Classical Physicist«, which

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21 Cited in James Moore, Metabiographical Reflections on Charles Darwin, in: Shortland, Yeo, Telling Lives (see n. 16), pp. 269-70.

22 D. Pestre, La pratique de reconstitution des expériences historiques, une toute première réflection, in: C. Blondel, M. Dörries (eds.), Restaging Coulomb: Usages, controverses et réplications autour de la balance de torsion, Florence 1994, pp. 17-30.

was loosely based on the life of the German physicist Paul Drude. More recently the technique has been used brilliantly in Tracy Chevalier's »Girl with a Pearl Earring« to illuminate the life of Jan Vermeer (about whom very little is really known). One also is reminded of Edmund Morris's recent controversial biography of Ronald Reagan, in which fictional characters are introduced as narrative aids. These extreme examples only highlight the point I have been at pains to make: that verisimilitude is the highest goal of biography, and that this goal requires a good measure of biographical art as well as science.

And one of the best practitioners of the art and science of biography, as of history, is Professor Schütt. In his »Notwendiges Nachwort« to his most recent book, he disclaims any intent to have shown »wie es eigentlich gewesen ist«, adding that such a goal is even in principle impossible to achieve, for the very reason that historians know both less and more about the events that they describe than their historical protagonists do. His preceding book, the biography of Mitscherlich, likewise combines the best of the various biographical approaches, mixing as it does chapters that focus on personal details of life with other chapters that build context. In both works, indeed in his entire oeuvre, his principal intent was always to get under the skin - into the hearts as well as the minds of his protagonists - not to be definitive, but to approach understanding, in the deepest sense of that word. And he has been remarkably successful in that noble undertaking.