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The Chemistry of Everyday Life. Popular Chemical Writing in Germany 1780 - 1939

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I. Introduction

The prevailing view of scientific writing affirms quite clear frontiers between scientific papers, textbooks and a more popular writing. Popular scientific writing has traditionally been considered as radically different from other types of scientific texts.[1] Produced for a lay public popular texts are separated from the central core of scientific research and thus from the process of knowledge production. In the best case they summarize and describe results of scientific research, but not the scientific process itself; they transfer knowledge from the scientific sphere to the general public by simplifying complex phenomena and translating them into a common language. Popularization of scientific knowledge is at best a subsidiary scholar's activity, not necessary for reputation and prestige and more often done by non-scientific writers. Because it is assumed that the development of science popularization is a kind of side-effect of the universal process of professionalization, it is viewed as something external, which was somehow helpful for purposes of legitimation and acceptance, but by no means a necessary consequence of the advancement of science.

Seen from this perspective, scientific popularization has no great relevance to the history of science.[2] However, it is a remarkable but yet unexplored fact that a specific kind of popular science printing was set in motion, which even today is still alive and an important part of the publishers business. The history of popular scientific writing in general is poorly documented[3] ; there is scarcely empirical or analytical work which could help to verify the traditional arguments about the character of popular science.

Even if we accept that the rise of popularization enterprises went along with the professionalization and specialization of scientific disciplines since the mid nineteenth century, we do not know how this happened. What could be told about the literary quality of popular lectures on scientific knowledge. How did popular science writers make the reader a participant of the scientific progress? How did they structure reading matters, describe scientific theories, methods and facilities; all these questions are far from being clear. To what extend did popular books differ from other kinds of science lecturing, for example academic textbooks? Moreover, it is not clear which function popular books had in the progress of science proper, or the role they played in building the reputation of their academic writers. On the one hand, one could suggest that simplifying and translating

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1 For a discussion of this position see R. Whitley, "Knowledge Producers and Knowledge Acquirers: Popularisation as a Relation beween Scientific Fields and their Publics" in T. Shinn and R. Whitley (eds.), *Expository Science: Forms and Functions of Popularisation*, (Dordrecht: Reidel 1985), pp. 3 - 28.

2 See R. Cooter, S. Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science popularization and Science in Popular Culture", in *History of Science* (1994) 32, pp. 237-267; B. Bensaude-Vincent, "In the Name of Science", in J. Krige, D. Pestre (eds.), *Science in the twentieth century*, (Harwood Academic Publishers 1997, forthcoming).

3 As an exception in the history of popular chemistry see: E. Homburg, "Van Volksscheikunde tot Technologie: Popularisering van de Chemie in de Negentiende Eeuww" in *Gewina* 18 (1995), pp. 72-101; I. Szász, Frauenchemie - Männerchemie? Aspekte geschlechtsspezifischer Wissensvermittlung in Frauenchemiebüchern des 17. - 19. Jahrhunderts, in Ch. Meinel, M. Renneberg (eds.), *Geschlechterverhältnisse in Naturwissenschaft, Technik und Medizin*, (Stuttgart: GNT-Verlag 1996), pp. 263 - 270.

scientific facts is one of the basic acts of scientist's work, necessary not only in popular books or articles for the daily press, but also for the communication within a broader intra-scientific audience, with students or financiers. Scientists have to present their work to very different types of lay people. But on the other hand, what does the transformation of scientific knowledge into everyday terms really mean for the nature of that knowledge? Popular books are part of a literary and journalistic "way of life" with its own rules regarding what is called the public taste. Thus, popular texts can be expected to be the result of a complex process embracing teaching efforts, different literary styles and political and institutional attachments from inside as well as from outside the sciences.

The following paper gives an overview of the monographic popular chemistry published in the German language between the end of the eighteenth and the first part of the twentieth century. Because the purpose is to describe principal varieties of the genre the approach adopted in this paper is somehow morphological. That means I am less concerned with the question whether the arguments or pictures used to popularize chemical knowledge are efficient instruments to shed light on natural phenomena. Focussing my attention to the motivations, aims, forms and conventions of lecturing chemistry I hope to describe and interpret the term "popular chemistry" with reference to the differences between textbooks and popular books. In so far as this is possible, I also will provide some details on the reception of popular chemical textbooks which may help to clarify the cultural relevance of popular books.

I started with a bibliographical survey which at least included about 250 titles. Among the authors we find a considerable number of academic chemists (Erdmann, Lampadius, Kützing, Lassar-Cohn), some of them quite famous, e.g. Liebig, Ostwald, Arrhenius. Especially the German movement of polytechnical education forced some of the involved professors, like Bertuch, Funke or the Liebig pupil Schoedler, to produce teaching materials not only to be used in schools. But also industrial chemists wrote popular books, like Bolley or Runge, both of them had written about technical chemistry. Other authors had no formal training in chemistry, like for example Wilhelm von Hamm, a landowner who had studied agriculture. Several authors (e.g. Heerwagen, Senner, Franke) had been school teachers. Presumably, some of the included authors and especially those writing for series could have earned their money as popular science writers. However, less became as famous as Hans Dominik.[4]

It was quite difficult to fix any precise definition about what is a popular book on chemistry. At first, I included every book which already in the title promised to explore the usefulness or necessity of chemistry to all lay persons without any formal training in chemistry or professional interests. For publications after 1850 this task was quite easy to fulfill because - as will shown later - at this time a "chemistry of everyday life"as a code for a specific repertoire of chemical knowledge was produced. Before 1850 things were much more complicate. Beside different categories of intended readers, for example medical students, craftsmen, manufacturers or pharmacists authors very often used the term "für das Selbststudium" (training yourself). Being generous at the beginning, I threw out several of these books later, because I found them quite easy to define as a textbook for teaching efforts. That means authors had a reader in mind who wanted to get any kind of professional training.

A second problem was the strong influence of natural history on the popular book market before 1850. Because scientific knowledge wasn't yet bounded in a considerable number of specialized disciplines, popular books were no windows on scientific institutions and disciplines. Of course, I found a few publications on chemistry which can be characterized as popular books in reference to my definition. But beside these few examples I had to

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4 Hans Dominik (1872 - 1945), trained in electrical engineering, wrote numerous bestselling novels about science and technology. See his autobiography H. Dominik, Vom Schraubstock zum Schreibtisch, Lebenserinnerungen, (Berlin 1942).

widen my perspective; the most important theme of popular science before 1850 was the natural history in general. Since the mid eighteenth century natural history and its utilitarian - pragmatical adherent, the so-called "Realienkunde", were regarded to be very effective fields for the distribution of enlightenment knowledge.[5] Particularly in form of a new genre of advising literature and encyclopedias for the household (in a wider economic sense) the application of scientific knowledge in everyday life gained in importance. But also in general treatises on natural history one could get a glance of contemporary chemistry, mostly reflected in the chapters dealing with the kingdom of minerals.

Again, while reflecting the decline of natural history in the first decades of the nineteenth century, I was conducted to another type of literature: since a system of natural objects (like the three kingdoms of nature) as a core of knowledge for all scientists was increasingly replaced by a grewing number of specialized disciplines with specific knowledge systems, popular compendia on different natural sciences took the place of general treatises on natural history.

Finally, a remarkable number of all books included in my bibliographical survey (about 1/4) was adressed to women. I had to treat these books as a special case of popular literature, not only because of that specific target group symbol of lay-persons par excellence. It is surprising, but there are no great differences between content and style of popular books adressed to women and those directed to a general public. Consequently, popular books for women must be seen as a result of changing gender relations in society and their influence on the book market.

II. General characteristics of the genre of chemical popular science

To characterize the genre in general it might be helpful to refer to Thomas Kuhn, who wrote that textbooks as well as popular books always reproduce the standard knowledge of a scientific community.[6] Both have the task of describing the in fact constantly changing knowledge of science as if it is a closed system of theories. Authentic information about the ways of "exploring" knowledge and gaining acceptance is hidden. Especially in textbooks, the development of science is constructed as a linear and a somehow finalized process.

Kuhn characterized popular books as a genre that itself is based on a canon of textbook knowledge. Whereas textbooks fulfil the task to impart the vocabulary and syntax of a scientific language, popular books have to transform textbook knowledge into everyday terms. In reference to this, one could argue that popular books somehow stand at the bottom of the hierarchy of scientific writings. Kuhn himself undertook no detailed and comparative considerations in order to verify his hypothesis, however, his reflections are worth thinking about at the starting point of a study on popular chemical literature.

Of course, most books included in my survey promised to present a knowledge of clear evidence. Most of them and especially those published after mid nineteenth century did not offer a problem-orientated introduction to science. The results of science were placed in the foreground, mostly presented as matters of fact underlined by a gesture of certainty and beyond all shadow of doubt.[7] In fact, some authors declared that the work they had done was based on or shaped by the most influential textbooks of their time.

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5 There was a strong relation to the development of polytechnical education in different types of schools which I do not consider here. For a more detailed discussion, see E. Homburg, *Van beroep 'Chemiker'. De opkomst van de industriele chemicus en het polytechnische onderwijse in Duitsland (1790-1850)*, (Delft 1993).

6 See T. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed., (University of Chicago 1970). I am following the German translation. *Die Struktur wissenschaftlicher Revolutionen*, 12th ed., (Frankfurt a.M.: Suhrkamp 1993), pp.147 -150.

7 The way of simplifying things in popular chemical books was already criticized by Gaston Bachelard in reference to the example of Justus von Liebigs "*Chemische Briefe"*. Liebig had declared: "*The fiftysix elements all together on a table can be arranged in two classes by a child only according to the material composition."* (J. v. Liebig, *Chemische Briefe*, 4th ed., (Heidelberg 1859), p. 110) Bachelard pointed out: "*This is an assertion without any kind of plausibility; no unprepared mind lead by a naive empirism would arrange sulphur, bromine,*

But what does this mean in detail? Is a popular book scarcely more than a popularized textbook, thus depending on the changing contents of scientific monographs? If a popular book is a kind of summarized textbook, then again the question arises, why do academic writers in particular engage in the hard work of writing a popular book?

A mere glance at the motivations for writing a popular book in the period between the end of eighteenth and the beginning of twentieth century challenges such a view. The further we go back into history the less clear become the differences between a textbook and a popular book. And the authors had multilayered goals in mind than translating an expert knowledge to lay people. Several authors intended moralistic and natural theological contemplations and wanted their readers to admire the miracles of God's creation.[8] In 1804, Carl Schnieder, doctor of philosophy and master of liberal arts, justified his popular book with the amusing and instructive character of chemistry. He wrote that his book would enable the reader to participate in conversations within cultured society, therefore he dedicated it to the generous goodwill of an interested public. But who is "the public" and what's amusing?

Schnieder, as well as other authors found it worth to discuss the boundaries between different ways of studying nature. Therefore, he saw his main task in structuring and describing the chore of chemistry as a very specific and - as he said - very extraordinary kind of natural knowledge. Chemistry seemed to offer new methodological procedures to discuss subjects like, for example, heat, light and electricity, highely discussed topics in the well educated society. For him, the "amusing" thing was to think about different ways of exploring and describing natural phenomena, to draw a line between chemistry and natural history and physics ("Physik" or "Naturlehre") in particular. (I will come back to this point later on.) According to Schnieder, the reader should overcome prejudices and learn to see nature through the eyes of a systematic practice of natural sciences and to use a scientifically correct nomenclature.[9]

"The public" wasn't just a lay-readership. Karl Philip Funke, author of a book on natural history and technology, declared[10] that his book should be an introduction for the newcomer of natural sciences at first. But because systematizing natural phenomena was, in his opinion, one of the main tasks of natural scientists, his book should also be a pleasant lecture for those lovers of nature who know about the internal procedures of science. With such kind of readership in mind, it was not unusual to mention scientific controversies as well. Even in the books intended to a female readership - by definition a non-scientific audience -, one can read about the contemporary controversies. Karl Friedrich Hochheimer, for example, declared to his female readers in 1795 that he mentions both conflicting theories of Stahl and Lavoisier, leaving it to the reader to reach her own opinion.[11]

About fifty years later the style of prefaces had changed. Under the impression of the revolution of 1848, the professor of geology Gustav Bischof revealed the political motivations for popularization. It was so to speak the fulfilment of a bourgois duty, he wrote, to instruct those who are "*unfamiliar with nature*".[12] A well educated person should no longer know only about the well-established sciences of jurisprudence, theology and

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iodine, oxygen in one and the same category. It is impossible to arrive at the categorie of non-metals without a teacher." G. Bachelard, *Epistemologie*, German ed., Frankfurt / BerlinWien 1974, quoted from the new edition, (Frankfurt a.M.: Suhrkamp 1993), p. 105.

8 For a more detailed discussion of these aims, see E. Homburg, *op.cit.* , (3), pp. 74-81.

9 C. Schnieder, Das Gemeinnützige der Chemie. Gemeinfaßlich vorgetragen als Lektüre für Freunde der Natur und als Handbuch für Lehrer in Schulen, vol. 1, (Freyberg 1804), p. VII.

10 K.P. Funke, Naturgeschichte und Technologie für Lehrer in Schulen und für Liebhaber dieser Wissenschaften, 5th renewed and improved ed., (Wien 1812) , p. V.

11 K.F.A. Hochheimer, Chemische Briefe an ein Frauenzimmer, in welchen die vornehmsten Gegenstände der Chemie auf eine faßliche Art vorgetragen, ihre Anwendung in der Oekonomie, in den Künsten und zur Unterhaltung gezeigt, und zugleich Anleitung zum Laboriren gegeben wird, vol. 1, (Leipzig 1795), p. VII.

12 C.G. Bischof, Vol. 2, Unterhaltungen über Gegenstände aus dem Gebiete der Physik, Chemie und Geologie in ihrer Anwendung auf das bürgerliche Leben, Bonn 1849, p. III.

philology, but also about the emerging natural sciences. Ten years later, the chemist Wilhelm Baer[13] already felt that there was a real demand for chemical instruction in all classes of society. In his opinion, chemistry was a knowledge useful for everyone, because all participate in scientific work and expect from science further progress and victories over the forces of nature.

However, making chemistry popular needed much more acceptance for it as an academic discipline. In mid nineteenth century the situation of chemistry at German universities was still unsatisfactory. Insofar, it was a new task of popular writing to reach recognition for a science which already had begun to develop into a profession. Scarcely anyone struggled harder for the institutionalization of academic chemistry than Justus von Liebig.[14] His popular writing was a very succesful work in influencing public opinion about the necessity of an academic chemistry, and his *"Chemische Briefe"* (see below) became famous because of their widely acceptance in scientific and public spheres either. For him like for others establishing a broad chemical education was intended to create better conditions and public support for scientific work at universities and private laboratories.

By mid nineteenth century, thinking in terms of a clear-cut distinction between science and general public became usual. Authors had become aware of the fact that the theoretical and practical framework of chemistry was establishing its territory in academic and industrial laboratories, while the general public was left outside; here the expert, there uninformed lay-people. Popularizing chemistry was now reinterpreted as a kind of social service done by scientists. "*Even the heroes of natural sciences* ", Baer wrote, *"did not find it beneath contempt to take this unusual path (of popular writing, B.O.) and due to this, they changed a dead erudition into a living knowledge"*.[15] This renewed task to inform lay-people forced several authors to raise the question, what kind of chemical knowledge could be of some interest for the public at large. The answer was found in everyday life. It should be the task of an scientific expert to locate himself within the ordinary side of life, the chemist Friedlieb Ferdinand Runge already had written in 1830, because *"the properties of the substances always in view of their usefulness for life, actually only because of their applicability"* really justify the popular character of chemistry.[16]

Drawing up different didactical concepts, authors simultaneously tried to introduce lay readers to the knowledge of an academic chemistry and to present the utility of chemistry to the reqirements of everyday life. Following this line, some of the first significant books, which began to carry out this task, were a kind of advanced textbook, introducing chemistry, its methodology and practise in a so to say theoretical part. In a more practical part, nearly all of the considered sources dealt with questions of nutrition and food technology, drugs, detergents, colours and bleaching agents, heating and lighting. The choice of subjects of applied chemistry was open. Erich Lassar-Cohn, for example, added to his collection oil paintings, glass, ceramics and porcelain, photographs and x-ray technology.[17]

Chemistry for life or*everyday life, modern life* or *in your life, chemistry for all of us* or *everyone* or *all lay people*, since the 1850s titles were quite similar. Authors hoped to attract the interest of potential audiences because of the double function of their books: explaining a scientific

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13 W. Baer, Die Chemie des praktischen Lebens. Populäre Darstellung der Lehren der Chemie in ihrer Anwendung auf die Gewerbe, die Land- und Hauswirthschaft. so wie auf die Vorgänge im menschlichen Körper, nebst einer Anleitung zur Anstellung der einfachsten chemischen Versuche, vol. 1, (Leipzig 1858), preface.

14 On the political activities of Justus von Liebig, see, for instance, R. Zott, E. Heuser, *Die streitbaren Gelehrten, Justus von Liebig und die preußischen Universitäten,* (Berlin: Ers 1992), pp.34 - 42.

15 W. Baer, *op. cit.* (13), preface.

16 F. F. Runge, Grundlehre der Chemie für Jedermann, besonders für Aerzte, Apotheker, Landwirthe, Fabrikanten und Gewerbetreibende und alle Diejenigen, welche in dieser nützlichen Wissenschaft gründliche Kenntnisse sich erwerben wollen, (Breslau 1830), p. IV.

17 See E. Lassar-Cohn, Die Chemie im täglichen Leben. Gemeinverständliche Vorträge, (Hamburg/Leipzig 1895).

knowledge and giving practical advice about how to understand and use it in everyday life. They tried to synthesize two different worlds of knowledge and action. Early books written by chemists like Baer[18] , Zimmermann[19] , Lassar-Cohn[20] or Schoedler[21] carried out this task in a very elaborated manner, future publications shouldn't take a lot of trouble with it.

At the end of the nineteenth century, things changed again. In author's mind the significance of chemistry in science, technology and national economy grew constantly, and so did the popularization of chemistry. Popular science, ordinary education and national economic interests amalgamated, for example, to Svante Arrhenius, director of the Nobel Institut of Physical Chemistry, who presented his *"chemistry and modern life"* to the Swedish public in 1919. Still under the impression of the recently concluded first World War, Arrhenius remarked that German chemistry and chemical industry were still unsurpassed. Even the British nation had to admit to itself, he wrote, that several military failures of the Entente nations were caused by their own delay in chemical research and technology. His conclusion: "*If we desire any success in postwar peaceful competition among the nations, we must accelerate the development of our industry, particularly the chemical industry, in all directions.*"[22] Even three years later, in 1922, the book was translated and sold in Germany.

Most authors insisted that the ubiquity of chemical products and processes had lent to the so to speak existential need for everyone to hold an opinion about the chemicals used in everyday life.[23] But whereas a public education seemed to be of greater significance than ever before, paradoxically the contents in popular books dramatically changed into the opposite. C*hemistry of everyday life*, as it was now taught, had more less in common with academic textbooks than ever before, but it differed also from older examples of popular books. Formerly large publications shrunk into small brochures. The space for instruction was reduced and the propagandistic description of the progress of chemical industries and products grew; instead of scientific facts, images of chemistry were projected. Chemical knowledge in everyday life had lost its relevance for writers facing a differentiated chemical industry with numerous consumer goods. On the other hand, the work of describing the emerging output of chemical research as a whole became impossible to them. It was scarcely more than the constantly repeated hymn of progress which remained.

This tendency might also be influenced by the fact that experts slowly withdrew from the business of popularization; instead of school teachers and chemists a new kind of popular science writer came into business, who, like Hans Dominik, sometimes became quite famous literary figures. In the meantime, popularization had become a business by itself. It offered good opportunities to earn money and created the new profession of popular science writer.[24]

Following these different motivations of writing a popular book on chemistry, one can see that popularization apparently interacted with the societal relevance of academic and industrial chemistry. The increasing ability to present themselves as expert mediators between nature and society allowed authors to comment upon the political state of science as well as to create an image of public knowledge. To take popular chemical books in the sense of Kuhn's definition as popularized kinds of textbooks does not do justice to this role.

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18 W. Baer, *op. cit.* (13).

19 See Zimmermann, W.F.A. (Pseudonym of Vollmer, W.F.A.), Chemie für Laien. Eine populäre Belehrung über die Geheimnisse der Chemie, deren Aufschlüsse über das innere Leben der Natur, sowie ihre Bedeutung und praktische Nutzung für das Leben, 8 vols., Berlin 1857-1861.

20 See Lassar-Cohn, *op. cit.* (17).

21 See F. Schoedler, Die Chemie der Gegenwart in ihren Grundzügen und Beziehungen zu Wissenschaft und Kunst, Gewerbe und Ackerbau, Schule und Leben. Für Gebildete aller Stände, (Leipzig 1854).

22 S. Arrhenius, *Die Chemie und das moderne Leben*, tr. B. Finkelstein, (Leipzig 1922), p. VII.

23 H. Römpp, Chemie des Alltags. Praktische Chemie für Jedermann, (Stuttgart 1936), preface.

24 See D. Raichvarg, J. Jacques, *Savants et ignorants. Une histoire de la vulgarisation des sciences*, (Paris: édition du seuil 1991), pp. 57-94.

III. Chemistry and the rise and decline of popular natural history

The development of the literary and textual form of popular chemical writings has to be seen in direct connection with the spread of literacy in broader sections of society. While the book market at the beginning of eighteenth century more or less had been a production from experts for experts, by the end of the eighteenth century things had changed. German and Latin texts listed in the catalogs of the book fairs in Frankfurt and Leipzig show that around 1680 the same amount of books was published in German and Latin, but in 1800 only 4% of all listed books were published in Latin.[25]

The social and political reasons for this change are based in the politics of reformistic absolutism, which declared the social welfare of each and every subject to be the main purpose of state action. The authority of the state was now secular and rational and no longer God-given, the position of the bourgois became more privileged. Influenced by the French Revolution and the economic signals of industrialization in England, bourgois groups became able to influence social norms and ethics. For several decades, the renewed German term 'public' unified all educated persons which had a great deal in common with educational interests, aestethical views and opinions.[26]

The contemporary theory of welfare, which propagated an efficient bureaucracy and technical know-how, and also the bourgois discourse on the right way of living gave way to the Enlightenment perception of nature. We might note that from a perspective of popular science enlightened thoughts were mostly imparted in the form of practical advices from empirical and experimental sciences, published in educational pamphlets to ordinary people.[27] In this context natural history and its utilitarian-pragmatical adherent, the so-called „Realienkunde“, were regarded to be very effective fields for the distribution of enlightenment knowledge, not only in the newly educated bourgoisie but in all classes of society.[28] Other scientific positions of that time like the speculative philosophy of nature (Schelling, Hegel) or the "*Romantic Philosophy of Nature"* (Romantische Naturphilosophie) did not find the same expression in popular writing. Starting my considerations with popular books on natural history and not - as perhaps expected - with books on alchemy has the same reason. Alchemy with its aristocratic tradition did not initiate any kind of popular science.

The role of chemistry in popular natural history has to be considered in reference to the transitional stage which both traditions of scientific thought passed through in the period between 1750 and 1850. Chemistry and natural history had a great deal in common methodologically. Both followed a common goal in describing the diversity of natural phenomena. This description was lead by perceptive-accidental criteria and should end in systems of taxonomy in order to use the scientific knowledge practically. This coincidence was expressed occasionally by the instutional combination of both traditions in one professorship. In 1758, for example, Christian Wilhelm Büttner received a chair for natural history and chemistry at the philosophical faculty of the University of Göttingen.[29]

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25 See E.. Schön, *Der Verlust der Sinnlichkeit oder Die Verwandlungen des Lesers. Mentalitätswandel um 1800,* (Stuttgart: Klett-Cotta 1993): 38.

26 To the changing content of the term 'public' in Germany, see L.. Hölscher, Öffentlichkeit und Geheimnis. Eine begriffsgeschichtliche Untersuchung zur Entstehung der Öffentlichkeit in der frühen Neuzeit, (Stuttgart: Klett 1979).

27 See H. Börning, Gemeinnützig-ökonomische Aufkklärung und Volksaufklärung. Bemerkungen zum Selbstverständnis und zur Wirkung der praktisch-populären Aufklärung im deutschsprachigen Raum, in S. Jüttner, J. Schlobach (eds.), *Europäische Aufklärung(en), Einheit und nationale Vielfalt,* (Studien zum 18. Jahrhundert, vol. 14), (Hamburg: Meiner 1992), 218-248.

28 Bibliographical references are given by H. Börning, R. Siegel: Volksaufklärung: Biobliographisches Handbuch zur Popularisierung aufklärerischen Denkens im deutschen Sprachraum, von den Anfängen bis 1850, Vol. 1, (Stuttgart: Klett-Cotta 1990).

29 See C. Meinel, Reine und angewandte Chemie. Die Entstehung einer neuen Wissenschaftskonzeption in der Chemie der Aufklärung, in *Berichte zur Wissenschaftsgeschichte*, 8 (1985), p. 39.

Natural history discovered gradually the things behind direct perception. However, it was chemistry that gave an idea of invisible elements like molecules and atoms instead of a *prima materia.* All useful knowledge about the kingdom of minerals is basically chemical knowledge, as Georg Adolf Suckow, professor at the Electoral Economical School in Lautern, mentioned. Because of that, chemistry would be one of the most useful disciplines of future natural history. Without chemistry, remarked Suckow, many parts of natural history would be *„so to speak, dead, and partly unusable.“* [30] Today, chemistry has not developed all its skills, but in the future it will play a major role for the state and finance („Kameralwissenschaft“), if it starts to explore the other two kingdoms of nature, namely plants and animals.

In the popular economic texts of "Realienkunde" as well as in general treatises on natural history, exotic curiosities of nature, until this time mostly collected and studied within the aristocratic world, lost their dominating role, replaced by the natural bodies, things and practical problems of everyday life.[31] Writings about the application of scientific knowledge to agriculture and the household gained in importance; here, natural history demonstrated its usefulness not only for naturalists. In contrast to the already existing so-called "Hausväterliteratur" based on informal empirical knowledge of craftsmen and farmers, this new kind of popular science propagated the sciences as an instrument for the systematic and methodical study of nature. It was a popular science open to a wide range of participants who could contribute to and benefit from the production of knowledge. According to Friedrich Justi Bertuch 1799, if the farmer who is working on the fields, in the forest, in nature and who therefore is able to admire thousands of things and natural phenomena, gets some instruction in natural history, then the armchair scholar will also profit from the farmer's countless possible discoveries.

Bertuch, who himself propagated a stronger popularization of natural history, didn't spare his criticism of the contemporary practise. All these countless children's and popular natural histories, botanic and zoological picture books and Orbis picti which *"grow out daily from our book stores like mushrooms"* , did not reach their targets.[32] Often, they were too scholarly, giving German expressions in the kingdom of minerals, Latin expressions in the kingdom of plants and all common languages in the kingdom of animals. On the other hand, most of them were not written in a systematic manner, therefore confusing, and the nomenclature of all described natural bodies and phenomena got tangled up. Last but not least, most books were lacking good illustrations. *"How shall a lay-person come through this babylonian language confusion?"*[33]

This problem remained for the most part unresolved.[34] Popular natural history often had an encyclopedic character. With the help of numerous keywords the reader could find interesting notes or advice, for example, in reference books like *„Berlinische Sammlungen“* (1768-1779) or the *„Hauslexikon“* (1858-1862) published ninety years later, about Guianan bats, feeding of animals and plants, causes of constipation as well as practical tips on keeping milk fresh, making textile colours or caring for a beehive. Following the quantifying work of the eighteenth century, these encyclopedia were a mixture of compilations of practical recipes and, on the contrary, a description of technical innovations and new theoretical explanations. In such works chemistry was not an exclusive body of

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30 Von dem Nutzen der Chymie zum Behuf des bürgerlichen Lebens, und der Oekonomie. Nebst Ankündigung der Lesestunden des Sommers halben Jahres 1775 bei der kurfürstlichen oekonomischen Schule zu Lautern, von G.A. Suckow, der A.D. Professor der theoretischen Wissenschaften, und beständigen Sekretair der Kurfürstlichen oekonomischen Gesellschaft, (Mannheim / Lautern 1775), p.3.

31 See N. Jardine, J.A. Secord and E.C. Sparry (eds.), *Cultures of Natural History*, (Cambridge: Cambridge University Press 1996).

32 F.J. Bertuch, Über die Mittel, Naturgeschichte gemeinnützig zu machen und in das praktische Leben einzuführen, (Weimar 1799), p. 9.

33 F. J. Bertuch, *op. cit.* (20), p. 10.

34 To the popularization of natural history in general, see J.-M. Drouin, B. Bensaude-Vincent, Nature for the people, in N. Jardine et. al., (eds.), *op. cit.* (21).

knowledge, it was part of natural history as a universal discipline. Here, chemistry demonstrated its significance for both the mere discovery of nature and for practical application.[35]

Because mineralogy and metallurgy were among the most progressive subjects in chemistry at the end of the eighteenth century, chemical knowledge was therefore reflected most strongly in those parts of popular works on natural history dealing with the kingdom of minerals. Anton Friedrich Büsching, for example, in his chapter on the kingdom of minerals not only provided the different soils and stones, far more, he included the contemporary knowledge about acids, bases and salts, about metals and nonmetals and about flammable bodies.[36]

The nineteenth century transformation of natural history to the new biological and earth sciences changed the representation of natural historical knowledge. The site of natural historical research shifted from the collection to the laboratory, new disciplines, institutions and research resources shaped the literature on natural history. As the sociologist of science, Wolf Lepenies, has pointed out, traditional natural history survived in literature, not in the sciences.[37] In fact, popular books on natural history, yet following the concept of the three kingdoms of nature, could be found in German living rooms even at the end of nineteenth century. But this could not prevent the decline of natural history in the popular literature as well - accompanied by the rise of a specific popular chemistry.

Although new editions of old-fashioned natural history books appeared after the mid nineteenth century, more and more encyclopedic compendia, subdivided into several volumes for each scientific discipline, entered the market place beside those which concentrated only on chemistry. References to a system of natural objects (the three kingdoms of nature) were replaced by a concept referring to the on-going establishment and professionalization of, in some sense, now esoteric academic disciplines. The unity of nature still existed, but was now merely separated in different volumes.

A meaningful example is the seven volume work *„Die Naturwissenschaften und ihre Anwendungen. Eine allgemeine Naturkunde für Jedermann."*[38] Volume 1 deals with physics, volume 2 with chemistry and its applications, followed by astronomy, geophysics and metereology (volume 3), geological history, cristallography and mineralogy (volume 4), biology (volume 5), zoology, anthropology and paleontology (volume 6), finally botanics and palaeobotanics (volume 7).

The structure of the compendium reflected the importance of physics and chemistry as leading methodological and paradigmatic sciences. They were described in the first two volumes. The rest remained in the common structure of natural history. From volume 3 on one can easily recognize the old theory of the three kingdoms, and paleontology redefines the context of natural history. The editor described the aims of this work in the preface: Although there are many excellent, generally comprehensible surveys of the sciences in Germany, most of them illustrate only a small sector of the wide field of scientific engagement. His compendium, he noted, should aim to reconstruct the lost unity of the sciences and explain the complex relations between them. By this, the reader should recognize the deep reciprocal influences between the different sciences, for example, the strong physical and chemical influence on biology and medicine.

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35 The German historian of chemistry, Christoph Meinel pointed out that the significance of this practical literature for the success and prestige of chemistry as an academic discipline has until now been underestimated. See Ch. Meinel, *op. cit.* (29), p. 36.

36 See A. F. Büsching, Unterricht in der Naturgeschichte für Diejenigen, welche wenig oder gar nichts von derselben wissen, (Berlin 1775).

37 W. Lepenies, Das Ende der Naturgeschichte. Wandel kultureller Selbstverständlichkeiten in den Wissenschaften des 18. und 19. Jahrhunderts, (München / Wien: Hanser 1976), p. 122.

38 See C. E. Thesing (ed.), Die Naturwissenschaften und ihre Anwendungen. Eine allgemeine Naturkunde für Jedermann, 7 vols., (Leipzig 1917).

This statement as well as the structure of the work above shows the dilemma of popularisation (and scientific disciplines too). The disciplines are separated and specialized, but somehow not totally. Physics and chemistry are the paradigmatic sciences, but somehow in coalition with the other sciences. The old natural history had disappeared, but yet somehow existed.

IV. Development of an Autonomous Popular Chemical Literature

Whereas the genre of natural history and „Realienkunde“ disappeared from the book market or was superseded by the new type of popular encyclopedic compendia, chemistry more and more was treated as an autonomous scientific discipline.

But even if there were some titles before the mid nineteenth century, as mentioned above, one can say that the actual chemical popularization in Germany began after this time. This can be recognized not only by the date of publishing of most books in my bibliography. We find this thesis confirmed, by a more narrow look at some selected successful books. They show how popular chemistry was established as an original genre on the commercial book market.

In 1841, the editor of *Augsburger Allgemeine Zeitung* asked Justus von Liebig to present chemistry to a wider public by a series of articles in his newspaper. The wellknown chemist took that opportunity: the first of his „*Chemische Briefe* " was published on 13th September 1841, followed by six others in the same year. The articles became so successful that Liebig published them in a monograph in 1844, which he later expanded from edition to edition. While the first edition from 1844 contained 26 „*Letters* ", their number increased up to 50 in the fourth edition from 1859, which was now printed in two volumes.

The public success was so overwhelming that Wilhelm Ostwald - like Liebig a prominent chemist and popular author during his life time - declared in 1909 that Liebig's book was the outstanding prototype of German popular literature on chemistry and named Liebig as the founder of this genre. The genre rapidly reached, in Ostwald's words, *"a remarkable standard in Germany and evoked some excellent books which happily connected both scientific strength and general accessability."* [39]

A second bestseller on the German market was not of German origin. James Finley Weir, chemist at the University of Durham, never experienced the international success of his popular chemical publications, having died in 1855. His "*Chemie des täglichen Lebens*", originally published 1850 in New York and republished in twelve editions up to 1873, was thrown on the German book market between 1854 and 1856 by not less than four publishing houses in separate translations.[40] In 1858, a fifth special edition for women followed, but showed no significant differences to the earlier translations.[41] Still in 1882 there has been a revised translation of Johnston.[42] Finally, I should mention Wilhelm Hamm´s "*Chemische Bilder aus dem täglichen Leben*" from 1854 as an autonomous imitation of Johnston´s bestseller; Hamm explicitly declared Johnston to be an inspiration and reference for his own book.

Both bestsellers show us the differences between publications appearing before and after the mid nineteenth century. Whereas the school teacher Friedrich Kützing wrote in 1838 that only the enthusiasm of his audiences from several public lectures assured him to write

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39 W. Ostwald, *Zur Geschichte der Wissenschaft. Vier Manuskripte aus dem Nachlaß von Wilhelm Ostwald,* introduced by Regine Zott, (Ostwalds Klassiker der exakten Wissenschaften, no. 267), (Leipzig: Akademische Verlagsgesellschaft 1985), p. 228.

40 Duncker in Berlin, E. Balde in Cassel, G. Neuse in Sondershausen, Lorch in Leipzig.

41 See *Chemische Bilder aus dem täglichen Leben*. Für Frauen bearb. von S. Augustin, 2 vols., (Leipzig 1856-1858).

42 See E. Dornblüth, *Johnstons Chemie des täglichen Lebens*, Stuttgart 1882 (2nd ed. 1887).

a book[43], and Friedlieb Ferdinand Runge 1830 still laconicly stated: *"Nothing is more unpopular than the word 'popular'; this to justify the title of my book"* [44], all authors after Liebig never mentioned any kind of problems to find a publisher. More over, publishers initiated popular writings.

Around 1850, an important and stable market for books on popular chemistry was set in motion. In the decades before, popular education mostly meant public lectures and was not yet a fact of printed matters.[45] In the case of Friedrich Kützing, the text is the result of an attempt to fix (or mummify) the fleeting character of the spoken word. As Brian P. Dolan mentioned in this volume, Jane Haldimand Marcet's well-known "*Conversations on chemistry"*, translated into German in 1839, was written because, after attending lectures at the Royal Institution in London, she found it "*almost impossible to derive any clear or satisfactory information from the rapid demonstrations which are usually, and perhaps necessarily, crowded into popular courses of this kind."* [46]

Around 1850, the sudden public interest in chemistry was shaped by general developments on the publishing market, combined with a general booming interest in popular scientific media.[47] A flood of magazines, fiction and non-fictional monographs, series, public lectures, museums, exhibitions, pictures, games and stage plays concerning scientific topics found their public.[48] As a consequence of the liberalization of the press, every serious newspaper took up a scientific-technological feature section into its programm.

National commercial success was complemented by translations into foreign languages. Erich Lassar-Cohn remarked on the occasion of the fourth edition of his *„Chemie im täglichen Leben* ", that his book has already been translated into English, Russian and Italian. Translations into Serbian, Portuguese, Czech, Swedish and Polish were forthcoming.[49] And a lot of titles were written as commission works for popular scientific series.[50] Finally, it should be added that the high number of copies and the low-cost lay-out of popular chemical books made them much cheaper from the start than scientific textbooks. Emil Postel complained that an extraordinary textbook like Stöckhardt´s *„Schule der Chemie"* nearly never would reach a wider public, *„because only a few assiduous teachers and knowledge thirsty tradesmen are willing to spend two Reichsthaler for a book in our hard times."* [51]

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43 F. T. Kützing, Die Chemie und ihre Anwendung auf das Leben. Ein nothwendiges Hand- und Hülfsbuch zur Belehrung und Unterhaltung für alle Stände, (Nordhausen 1838), preface.

44 F. F. Runge, *op. cit.* (9), preface.

45 As Robert Fox pointed out, after 1815 until the 1850s a new style of "*declamatory science"* arose in France. To become an attractive lecturer and to win large audiences, was of great importance for the success of scientists in general. See R. Fox, Scientific enterprise and the patronage of Research in France 1800-70, in R.Fox et.. al. (eds.), The patronage of science in the nineteenth century, (Leyden: Noordhoff 1976), pp. 19 - 24.

46 J. H. Marcet, Conversation on chemistry, in which the elements of that science are familiarly explained and illustrated by experiments, vol. 1, (London 1806), p. V.

47 See, for instance, B. Béguet, La Vulgarisation Scientific en France de 1850 à 1914: Contexte, Conceptions et Procédés, in Bibliotheque du CNAM (ed.), *La Science pour Tous. Sur la Vulgarisation Scientifique en France de 1850 à 1914*, (Paris: Bibliotheque du CNAM 1990), pp. 6 - 27.

48 The specific German development is considered by Andreas Daum, Wissenschaftspopularisierung in Deutschland 1848 - 1914. Eine Geschichte der öffentlichen Vermittlung naturwissenschaftler Bildung in der bürgerlichen Gesellschaft, (forthcoming).

49 E. Lassar-Cohn, *op. cit.*, (17), preface.

50 See in my bibliography of primary sources esp. Rudolphi 1910, Nagel 1914, Holle 1921.

51 E. Postel, Laien-Chemie, oder leichtfassliche, am einfachen Versuche geknüpfte Darstellung der Hauptlehren der Chemie für Gebildete aller Stände, insbes. für Lehrer, Oeconomen und Gewerbetreibende, 4th ed., (Langensalza 1871), p. IV.

V. Different approaches to popular chemistry

My analysis has led me to distinguish three different approaches for the period of time I have considered. These approaches flourish more or less throughout the whole genre; I term them a perceptive, a more systematic and a practically- orientated approach.[52]

The first, and one could say, oldest I've called the perceptive approach, because the author typically opens his presentation of chemistry with the perception of natural phenomena, in order to develop the questions and methods of scientific chemistry. To make teaching chemistry come alive, they often started with the description of air or water and then move on to the different substances, elements and compounds, their properties, reactivity and regularity. To give an example of this approach, I quote Johnston[53]:

"The earth we live on is surrounded by an atmosphere of which one knows that it is at least 10, probably more than 30 miles high. (...) We breath this atmospheric air and without it we could not exist for a moment. It surges around the earth in constant motion, as a smooth breath, as a fast wind, or as a horrible hurricane. We take it for granted so that we normally don't take notice of it; however, its spirit and usefulness is very wonderful, and having a feel for the important role it is playing in the whole nature, the ancients counted it, despite their insufficient knowledge, among the four elements or simple components of nature. (...) But, obviously clear and simple, the air is by no means a simple or unmixed substance. It consists, rather of several different substances of great importance for the life of animals and plants."

With such an introduction, the author built himself a bridge enabling him to explain the elements and compounds of air, its quantitative atmospheric distribution and its properties. In the same chapter the reader was informed about current thinking on photosynthesis, the proportions of water in different organisms, about the power of heat and electricity.

Because of the link between this perceptive strategy and classical natural history, it was the dominant style in earlier publications. Carl Schnieder, for example, went further by offering a so-called "*theory of substances* " (Substanzenlehre), followed by, in the next chapter "*a chemical description of nature, that is to say, an examination of the question, from which substances of the previous chapter the examined bodies of the kingdom of minerals, plants and animals consist."* [54] But for him it was not enough to just explain the air in general, Schnieder took his readers from the top of the atmosphere back down to earth and explained the air in the mountains, the sea air, the marsh air, the air in big cities, the house air, the cellar air and the air in mines.

Because of the long during influence of traditional natural history in popular literature, this approach did not disappear during nineteenth century; in fact, it was a very common style, used in popular chemical books until the first decades of the twentieth century. Within this tradition, a rudimentary natural history could stay alive as well as the ancient four-elements-theory, which chemistry claimed to have superseded. Yet 1921, Hermann Holle used this style in a very rigid way to structure his *"Chemie des häuslichen Lebens"*. He offers an appeasing fusion between ancient and modern natural history with the following book structure: *1. On fire and the transformation of substances, 2. Water as a catalyst of chemical transformations, 3. The kingdom of earth as the chemical store room, 4. The air as a substancial primary source of life.*[55]

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52 Of course, there are some books with an unconventional structure that makes it difficult to allocate them to a certain group. For example Arrhenius (1922) mixed up the three approaches. Others went too far because of a concentration on only one aspect of applied chemistry, mostly food chemistry, however they give a general introduction to scientific chemistry as a whole. (e.g. Langbein 1869; Doebereiner 1857; Moleschott 1855; Weitz 1892; Hünseler 1912).

53 Johnston, James F.W., *Die Chemie des täglichen Lebens,* tr. Th. G. Wolff, (Naturwissenschaftliche Volksbücherei, vol. IV-IX), 2nd ed., (Berlin 1869), pp. 1-2.

54 C. Schnieder, *op. cit.* (5), p. VII.

55 See H. G. Holle, *Die Chemie des häuslichen Lebens,* (Bücherei der Volkshochschule, vol.17), (Bielefeld / Leipzig 1921).

The second approach was based on the systematic knowledge produced within scientific chemistry. The core of chemical knowledge is mostly described in three areas. The first section includes a definition of what chemistry is as a science, its methodology and practice, sometimes combined with an excursion into the history of chemistry. In the second section the author explores chemical theory, that is basic notions, substances, elements, reactivity, laws and so on. Finally, in the third section, applications of chemistry in different trades and products of chemical research are presented.

Typically enough, Liebig, the most famous doyen of academic chemistry in Germany, used this concept in his "*Chemische Briefe* ". In the first sentences of the first letter, he already expressed his hope to persuade the public of the need for an autonomous academic chemistry, not only because of its industrial usefulness but also "*because it allows us to look at the miracles of creation*."[56] Accordingly, he first discussed the place of chemistry among the other natural sciences, its separation from physics since the eighteenth century, the influence of Lavoisier to produce a new image of chemistry, a critical review on former methods of studying natural phenomena. It followed letters on chemical forces, compounds, elements, chemical affinity, atomistic theories. The "*Chemische Briefe"* give an impression of how Justus von Liebig judged the different parts of chemistry, and perhaps this is the reason why this popular book was mentioned in the scientific community itself, much more than any other popular book.

Because the main focus of Liebig's research lay in organic chemistry, he preferred agricultural chemistry, dietetics and food chemistry as research areas to explain the application of chemistry in everyday life. Like him, Moleschott, who as a physiologist discussed Liebig's agricultural chemistry, concentrated on organic chemistry[57], while others gave preference to the inorganic chemistry.[58] Wilhelm Ostwald very consciously chose examples from inorganic chemistry, because he was of the opinion that after some decades of pivileged carbon chemistry, time had come to explore inorganic chemistry in a popular manner.[59]

However, most authors endeavoured to give an overview of both parts of chemistry.[60] Two voluminous illustrations of this type of publication were W.F.A. Zimmermanns "*Chemie für Laien* " (1857-61), which consists of eight volumes, and Wilhelm Baers "*Chemie des praktischen Lebens*" (1859), containing an imposing 2000 pages in two volumes.

Popular books that primarily aimed to provide advice for everyday life took the other way around and chose what I call a practical approach. This approach, I would say, is the youngest of the three approaches, because it is very much related to the progress of chemical industries. Here the applications of chemistry, chemical processes, and products were the main focus of the treatise. Since the publications were not adressed to a specific target group, the authors logically chose subjects close to the necessities of everyday life.

They mostly included chapters on nutrition and food, drugs, detergents, colours and bleaching agents, heating and lighting. A very typical example of this kind of literature was the "*Chemie des täglichen Lebens* " published as the fifth volume in a series called "*Das Buch der Erfindungen, Gewerbe und Industrien* " (the Book of Inventions, Trades and Industries) edited by a Professor of technology, Franz Reuleaux.[61] The book began with an introductory chapter about the following subjects: cristals and cells, elements of the organic

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56 J. v. Liebig, *op. cit.* (7), p. 1.

57 See J. Moleschott, Der Kreislauf des Lebens. Physiologische Antworten auf Liebig's Chemische Briefe, 2nd ed., (Mainz 1855).

58 See in my bibliography of primary sources esp. Gleitner 1805, Runge 1836, Emery 1923.

59 See W. Ostwald, Die Schule der Chemie. Erste Einführung in die Chemie für Jedermann, 2 vols., (Braunschweig 1903-1904).

60 See in my bibliography of primary sources esp. Kützing 1838, Schoedler 1854, Postel 1850, Koller 1870.

61 See Hamm, Wilhelm von, Schwartze, Theodor, Wagner, Hermann, Zöllner, I., *Die Chemie des täglichen Lebens*, (Das Buch der Erfindungen, Gewerbe und Industrien, vol. V) ed. by Franz Reuleaux, 7th increased and improved ed., (Leipzig/Berlin 1878).

world, causes of the structure of substances, organic compounds, acids and bases, substances for nutrition. Then, it was subdivided in the following chapters:

- grinding and baking
- sugar
- coffee and tea
- tobacco and other narcotics
- fermented beverages
- wine
- beer and brewery
- spices, drugs, cures and poisons
- meat and its use
- soap and candle fabrication
- ethereal oils and perfumery
- lighting, especially by gas and the related industries
- heating and ventilation
- rubber, resin, varnish and lacquer
- india rubber and guttapercha
- tanning and glue fabrication
- bleachery
- dyestuffs and printing fabric
- wallpapers and oilcloth fabrication
- adulteration of food and basic consumer goods

This kind of structure almost favoured encyclopedic tendencies. Hermann Römpp, for example, subdivided his book like a lexicon, in alphabetical order, sometimes resulting in strange word listings, for example *"Kochsalz"* (salt for cooking), *"Limonade"* (lemonade), *"Löten"* (to solder), *"Maggi-Erzeugnisse"* (products of a German food firm), *"Marmelade"* (marmelade), *"Metallätzung"* (corroding metals).[62]

VI. Chemistry for women

"Times have passed when it was usual to withhold chemical knowledge from the beautiful sex. Today one is very much engaged in lecturing women", these words, written by Karl Friedrich August Hochheimer in 1795, could have been published in the 1930s as well.[63] It is remarkable, and therefore worth of attention, that through the whole period of consideration popular books directly adressed to women were being published. However, a specific chemistry for women was not caused by knowledge reasons, particularly because of the fact that all popular books discussed in this paper dealt with subjects which according to the ideas of the time were considered part of women's responsibility. Insofar, it wasn't necessary to produce a chemistry for women. Above this, it was a declared aim of the natural sciences to produce a sex-independant and strongly objective knowledge. Of course, the findings about fermentation processes were not different when taught to women.

In general, it is quite impossible to find differences between popular books adressed to a general public and those for women. Not only the contents were close - air was treated as well as water, food, cooking and conservation, heating, light, detergents, bleachery, colours, tanning and glue -, but also the literary style and even the language did not change.

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62 See Römpp, *op. cit.* (12).

63 K. F. A., Hochheimer, *op. cit.*, (7), p. IV. Chemical books adressed to women seem to belong to the eldest popular science literature in general. Following Ildikó Szász the first chemical book for women was Marie Meurdracs "*La chymie charitable et facile en faveur des Dames"*, published in Paris in 1667 and translated into German in 1673. Until 1738 five editions appeared on the German book market. See I. Szàsz, *op. cit.*, (3), p. 263. See also Nathalie Pigeard in this volume.

Only in one respect chemical books for women differed from general popular literature: women's books more clearly were intended to serve as advisers, quite similar to the common household-advisers. Even the oldest examples of this literature, dedicated to aristocratic women and adressed to those female "amateurs" who cultivated a salon-science or attended public lectures as well-educated wives, daughters or sisters, had in some aspects the character of an adviser. Karl Friedrich August Hochheimer[64], Wilhelm August Lampadius, Ernst August Geitner (all of whom also produced textbooks), thought it important to establish, beside general introductions into chemistry, a practical appliance of chemical knowledge for household affairs. *"Therefore, in the kitchen, the cellar, the laundry, the bleachery, chemistry will be useful for you"*, Lampadius wrote in 1808.[65]

During the nineteenth century popular books for women perfected the style of household-advisers much more than those books adressed to a general public. Thus, chemistry for women sometimes became an adviser in questions of household technology, including advertising for special goods and firms. In the chapter about oxygen the elementary school teacher, Anton Senner, first explained the processes of burning and decay as a form of slow oxidation. Then, he suddenly described the apparatus for sterilization produced by the German firm "Weck". This apparatus should be used for conservation of food.[66]

The main task was to take the female readers through the science. Thus, the recipes and advices are considered as a by-product of the academic chemistry. For example, in the chapter on metals and their compounds the story of the wife of a privy councillor ("Frau Geheimrätin") is told whose problem are spots of rust on her linen. Whereas she learns about the oxidation of iron, she also is instructed how to treat spots of rust with nitric acid.[67] Occasionally authors used examples taken from the female sphere to illustrate chemical processes. After a description of the fact that carbonic acid is heavier than air and therefore is found mostly at the bottom of a room, Anton Senner gave the following advice: "*One shouldn't put a baby basket on the floor of a well lighted, heavily inhabited and heated room, as it is often done.* "[68]

Although most authors aimed to give advices for household affairs, the domestic knowledge on chemistry itself was not at all a prominent part of the presented chemical knowledge in general. A remarkable exception is the book of Friedlieb Ferdinand Runge including 36 letters presumably written long before the publishing year of the book in 1866. Runge who worked for most of his lifetime as technical director of the "Chemischen Produkten Fabrik" in Oranienburg, did not only give his readership some advice, but discussed the old traditions of household affairs too. Obviously, he treated the experiences of women from his immediate neighbourhood; some of them commented letters before publishing or did the proof-reading. In several chapters Runge described conversations in detail and experiments performed by women in their households. Unfortunately we know nothing about the number of copies and the circulation the letters had attained. But there are grounds for the assumption that Runge wrote the letters especially for people which he knew personally. There is every reason to believe that, because his biographer found a handwritten poem in his unpublished works which he had received from women of

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64 Hochheimer took as his inspiration Leonhard Eulers "*Briefe an eine deutsche Prinzessin über verschiedene Gegenstände aus der Physik und der Philosophie"* (3 vols., Bern 1769-1773), which were dedicated to the Princess of Nassau-Anhalt.

65 quoted from I. Szàsz, *op. cit.* (3), p. 265.

66 A. Senner, Naturkunde auf Grundlage von Haus und Herd. Experimentelle hauswirtschaftlich gerichtete Chemie für Volks-, Mittel-, Fortbildungs-, Haushaltungs-, Frauenschulen u. dgl., (Frankfurt 1922), p. 36 / 37.

67 See Zimmermann, W.F.A., *op. cit.* (19), vol. 1, p. 26.

68 A. Senner, *op. cit.*, (50), p. 90.

Oranienburg. In this poem Runge is praised as a popular adviser of housewifes, cooks and washerwomen.[69]

Altogether, the existence of a chemistry for women cannot be explained by the at least small differences in the issues. In contrast to other parts of scientific knowledge, the creation of a everyday life chemistry could have served a female as well as a male public. In fact, some authors seemed to be confused. Bischof, for example, gave the first volume of his publication the title "popular letters dedicated to a well-educated lady...." and the second volume is called "conversations about ...." In the preface of volume II he apologizes for that, explaining that his work can be read by the whole family.

But although female literature was not caused by knowledge reasons, the book market itself shared strongly the culture of separated spheres for women and men, as it was popularized since the mid of the eighteenth century.[70] Whereas early publications were part of the social structure of pre-industrial society, during the nineteenth century, the purpose of chemistry for women, even in school affairs, became more distinctly an education of bourgois (and proletarian) housewifes. No longer should an enjoyable knowledge be served to women leading a life of idleness. However, in the emerging consumer's society, housework itself gained new meaning. Until this time, the family was a community cooperating on relations with its own traditions and rationality. The new family ideal was an intimate, non-public companionship with the wife, mother and housewife in its centre. Here, women should follow their natural destiny, while men increasingly became externally orientated.

Perhaps this changing family tradition explains why, in spite of a flourishing market of popular chemical books for everyday life and in spite of overlapping contents, the existence of a specific chemistry for women should not be seen as a contradiction. Men could but did not necessarily have to be informed about questions of the chemistry of everyday life. Therefore popular books in general were a kind of literature for leisure. Furthermore, men had to take note of the different chemical books adressed to professionals. The position of women was completely different. Women and girls had to be taught chemistry in order to fulfill their destiny - this is explained in the preface of a popular book published in 1860.[71] For them, popular science was a substitute for school lectures and university training. Universities were closed male-orientated institutions until the end of the nineteenth century. At school too, girls were introduced to chemistry much later than boys. It was not until 1908 that mathematics and science became an obligatory part of the education in Prussian girl schools.[72]

Certainly, the housewife as mentioned in popular chemical books is scarcely more than an artificial figure, and also the extensive household which is described in the chemical books was in decline. Not particularly emphazised but insinuated was the model of middle class housewives; these "*ladies* ", who demonstrate "*that they are not only the head of a home but also a good housewife, a fact, which is not meaningless in a time with a lot of difficulties to find good domestic servants.*"[73] But in general, popular books did not reflect the different living conditions in a socially heterogenious society. Chemical knowledge was of universal validity.

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69 See H.H. Bussemas, G. Harsch, *Nachwort zu Runges Hauswirthschaftlichen Briefen*, in F.F. Runge, *Hauswirthschaftliche Briefe:* 1.-3. Dutzend, Berlin 1866 (Reprint Weinheim: VCH-Verlagsgemeinschaft 1988), p. 22.

70 To the philosophy of separate spheres see, for instance, U. Frevert, Bürgerliche Meisterdenker und das Geschlechterverhältnis. Konzepte, Erfahrungen, Visionen an der Wende vom 18. zum 19. Jahrhundert, in U. Frevert (ed.), *Bürgerinnen und Bürger, Geschlechterverhältnisse im 19. Jahrhundert,* (Göttingen: Vandenhoek & Ruprecht 1988), pp. 17 - 48.

71 E. Franke, Chemie der Küche für Töchterschulen, sowie zum Selbstunterrichte, (Eisleben 1860).

72 See E. Küpper, Die höheren Mädchenschulen, in *Handbuch der Bildungsgeschichte, vol. III 1800-1870, Von der Neuordnung Deutschlands bis zur Gründung des Deutschen Reiches,* ed. by K.-E. Jeismann and P. Lundgreen, (München: Beck 1987), pp. 188 - 195.

73 G. Abel, *Chemie in Küche und Haus,* (Leipzig 1905), p. 4.

VII. Textbooks, popular books and scientific approach

At the end of this overview a comparative approach might provide a more general discussion about the relations between textbooks, popular books, and scientific progress. As mentioned above, in the opinion of Thomas Kuhn textbooks and popular books are important media which obscure the processes of scientific revolution in order to "normalize" the knowledge. Textbooks in particular have the purpose to condense specific methods, results and theories into a closed system of thought, which is accepted by the majority of specialists at a given period, whereas it's said that popular books shall translate the textbook-knowledge into everyday terms.

If so, the question raises how the different categories of publications reflect the scientific progress of their time. But whatever the answer will be in particular, it should be noticed that popularizers of chemistry made an endeavour to take the current state of chemical research into account. Nearly all authors of the considered sources and different periods complained about the conflict to give a profound introduction into chemistry on the one hand (whatever that meant to them), and not to expect too much from the reader on the other hand. Of course, some authors had presumptions about the intellectual capacity of laypersons in mind and noted that only a small amount of expert knowledge could be acceptable for laypersons. Kützing wrote for example that it is impossible to explain all facts with the same scientific accuracy. Lecturing the complicate language of chemistry seemed too difficult for him.[74] Otto Linné Erdmann remarked that he aimed at a general level of science "*without injuring the dignity of science*."[75] But these were problems of lecturing or methods of performing; being up-to-date was in contrast a prerequisite underlying the whole enterprise of popularization

In the here considered period of time chemistry had developed into a science, which, in contrast to its alchemistical roots, not only wanted to produce new substances from well-known ones. Until 1800 it was widely accepted that chemistry could prove its potential utility if it presents a classification scheme for organizing all of the known organic substances. Chemists studied the atomic character of elements and the forces by which they were arranged. During the nineteenth century the searching for and classification of elements became an urgent problem. In order to balance the relationship between chemistry and practical arts, between scientific activities and different technical fields like pharmacy, metallurgy, bleaching or agriculture, chemical theory tried to rule the "demographic explosion" of elements, which number had doubled since the end of the eighteenth century (at this time 33 elements were known), because of better analysis techniques.[76] The rapid development of organic chemistry since the 1840s aggravated these problems of classification because now a mass of new organic compounds had been found which also had to be classified if the transmission of chemical knowledge shouldn't soon become impossible. In conclusion, the classification of elements and the analytical definition of substances had been one of the most important problems within nineteenth century chemistry.

Whereas scientific textbooks of the second half of the nineteenth century shaped this development and presented chemical knowledge in a condensed style, using a symbolic language or stochiometric equations, popular books preferred a narrative language which would have been strictly forbidden in scientific texts. Since the 1830/40s, when teaching laboratories of Liebig in Giessen (1828), Wöhler in Göttingen (1830s), Bunsen in Marburg (1840) or Erdmann in Leipzig (1843) were established and helped students to take a degree in chemistry, teaching materials had to change. Chemistry became intensively

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74 F. Kützing, *op. cit.*, (27), preface.

75 O.L. Erdmann, Populäre Darstellung der neueren Chemie. Mit Berücksichtigung ihrer technischen Anwendung, (Leipzig 1828), preface.

76 See, for instance, B. Bensaude-Vincent, Mendeleev: Die Geschichte einer Entdeckung, in M. Serres (ed.), *Elemente einer Geschichte der Wissenschaften*, (Frankfurt a.M.: Suhrkamp 1994), pp. 796 - 800.

professionalized, a new generation of chemists grew up with the need for specialized textbooks. While it got part of the textbook character to reduce narrative elements as much as possible, popular writings were allowed to use all kinds of literary styles. They were influenced by the scientific sphere as well as by a literary culture which required subjectivity, fiction, and metaphors.

Insofar, the far-reaching absence of the symbolic language is perhaps the most significant difference between text- and popular books since the second half of nineteenth century. The fundamental problems of scientific chemistry in nineteenth century - the search for analytical definitions, the classification of elements in a perfect symbolic manner - were not presented in popular books. To write for a general public, in the words of Theodor Gerding, means "*to ignore the formal apparatus of chemical textbooks which is annoying for laypeople*".[77] Nearly all examined popular books did mostly without symbolic language or stochiometric equations. While a more formal textbook like the one of J.R. Wagner, professor of chemistry at the university of Würzburg, included a table of elements with their relative weights of atoms, the more popular treatise of Lassar-Cohn just mentioned the existence of elements and atoms. "By using them nature created among the most complex things, namely living things."[78]

However, if I raise the question, did the authors of popular books really want to teach scientific knowledge of chemistry to a wider public, I have to say, yes and no. Looking at the table of contents of the extensive examples of this genre, we have to mention that the authors demanded the same effort from the lay-reader which was expected from a student of chemistry studying a scientific textbook. The layperson too, often had to pass through hundreds of pages describing the important metals and non-metals, their deposits and properties. He had to learn about the current known number of elements, as well as their compounds.

But on the other hand, the attempt to synthezise scientific knowledge and the experience of everyday life somehow counteracted the scientific style of popular texts. Apart from the distinct phases in the production of popular chemistry with their changing motivations to study chemistry, most authors wanted to force the comprehension of chemical phenomena in everyday life. For them, the act of perceiving objects and substances was a key element to understand what chemistry is alike whilst applying chemical knowledge to practice showed the usefulness of chemical research. The aspects of the science described were those which could help to understand the invisible parts of nature, the elements of a natural body. But above this, a variety of chemical technologies should help to prove the results of analysis and give way to countless innovations useful in everyday life.

Because more theoretical issues and the practical value of chemistry deeply were combined, the question of how to use chemical experiments was of some importance even in those books given to people who were never going to practice chemistry. The experiment was the methodological basis of chemistry, but more than this it was a very important didactic aid in chemical lectures. However, how to explain a chemical experiment to persons, who had no professional qualification in mind, who had no lab, no necessary apparatus?

There was no single solution of this problem. Some of the authors restricted themselves to describe a lab, instruments and raw material. Others described the rules of the experiment without giving advice on how to manage them. And of course, some authors explained little experiments for the kitchen, quite similar to those one can find today.

Textbooks of the second half of the nineteenth century developped their formal character with the broadening space needed for the desription of experimental works, improved instruments and other aids necessary for a grewing and specializing number of chemical

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77 Th. Gerding, Illustrierte Chemie der Hauswirthschaft und der Gewerbe. Für Hausfrauen und Gewerbsleute allgemein verständlich dargestellt, (Frankfurt 1869), p. III.

78 E. Lassar-Cohn, *op. cit.* (17), p. 23.

operations.[79] In contrary, customs of using the above mentioned types of experiment instructions in popular books were'nt clearly established. There was no consensus on the role they had to play in the popular scientific pedagogy. As schoolteacher Hans Konwiczka emphazized, in no other teaching of technical subjects popular books have "*done more damage, caused more amateurism, experimental foolishness (...) like in chemistry*." [80] Experiments at home normally prove nothing, he pointed out, and because the reader can't help himself for lack of a laboratory, he remains a helpless victim of the author. His opinion about the method of describing the inventory and equipment of a lab was equally negative. Descriptions of equipment and rules of experiment seemed to him senseless because a chemical newcomer could only learn about the subject by practicing.

In his book the readership got a very detailed list of instruments and raw materials, its costs, and where to buy them, or how to produce them at home. Step by step, he described the different stages of an experiment, possible mistakes and expected results. We cannot ascertain whether the readership of Konwiczka was more successful in getting in touch with chemical methods, however this kind of literature is close to the development of another very important medium of popularization, namely, the chemistry experiment-kit. The history of this media started in the nineteenth century, but they weren't produced, as one perhaps can expect, by schools and teachers, but by mail order firms specialized in luxury goods and toys. They were the first who pushed complete experiments ready for use into the market.[81]

VIII. Rhetoric of popular chemistry

Until the mid nineteenth century the indistinct boundaries between more formal textbooks and popular books make it hard to classify different rhetoric styles. Each author represented scientific knowledge in a particular way using well-known literary styles like the dialogue or letter. These old literary forms, very much used in the eighteenth century, didn't disappear during nineteenth century. In popular scientific writing these styles were still alive at the beginning of twentieth century, because authors regarded them as instructive as well as elegant. In 1903, Wilhelm Ostwald chose the dialogue for his "*Schule der Chemie* " because, as he mentioned, dialogs are a fresh and vivid literary form, much like seminars at university.

Even the Platonic dialogue found its poularizers, like for example Heribert Rau's "*Evangelium der Natur* ".[82] He placed dialogues about different sciences, among them chemistry, in a story which formed the framework. But, in contrast to the old examples of Plato and Galileo, there are no controversies between the master and his disciples. One day, an unknown man settles down in a village in one of the most beautiful regions of Germany. This man - mild, serious, good-hearted and full of wisdom and profound scientific knowledge - gathered a group of young men around himself with whom he undertook regular walks into nature. On these occasions, the "disciples" ask their "master" about every aspect of his scientific knowledge: What is alchemy? What did the ancients do with mercury? What is chemistry as opposed to alchemy? What does the phlogiston-theory tell us? And so on.

What I have said about the style goes for the language of popular books too. It is sometimes factual and sometimes enthusiastic. In one case, the author uses the lecturing language of a teacher, in another case, he is an enthusiastic user of the splendid rhetoric of

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79 To the history of laboratory equipping and its influence on chemistry education, see E. von Meyer, *Geschichte der Chemie*, 4th ed. (Leipzig 1914), pp. 578-586.

80 Konwiczka, Hans, Der praktische Chemiker. Chemie für Jedermann. Unterrichtsbriefe zum Selbstunterricht in der Experimentalchemie für Jung und Alt, (Leipzig 1907), p. 1.

81 See I. Weller, Entwicklung eines weitgehend unstrukturierten Chemie-Experimentierangebotes für die Freizeit, (Diss. rer. nat., Univ. Bremen 1988), pp. 2-7.

82 See H. Rau, Das Evangelium der Natur. Ein Buch für jedes Haus, (St. Louis 1857).

the nineteenth century bourgois culture. One can find every style, from rational, syntacticly simple lecturing, to highly imaginative prose literature. In any case, it was a flexible language for liberal education.

To give an impression of the different rhetoric, I want to quote three examples without further commentary. Every text explains the subject of chemical science. I regret that translation may destroy some of the beautiful phrases.

In the "*faßlich dargestellten Chemie* ", a textbook adressed to students of the natural sciences, medicine, pharmacy and, as the author declared in the preface, to well educated lay persons, is written: "*Chemistry is the theory of laws from which all bodies are constructed, and which all changes in these bodies follow. The term chemistry is of oriental origin, and was defined in ancient times as the art of deriving gold and silver from common metals."* [83]

Friedrich Schoedler formulated it in his popular book like this: *"Of all the different sciences whose cult has captured the human mind, chemistry is the preferable ward, the pride and hope of the present. For centuries, she was the maid in service of various disciplines, now she has achieved her independance; with the full self-awareness to function as an end unto herself, breaking her chains, chemistry suddenly makes her debut with all the glory and power which a true science spreads around herself in a stimulating and animating manner. The transition from servetitude to freedom, from the darkness of confused terminology and imperfectly observed facts to a clear methodology, to clear well-founded laws has taken place quickly and successfully due to many great steps in the course of the last half century so that modern chemistry appears equivalent to an armed Minerva springing from the head of Jupiter."* [84]

From the agricultural scientist Wilhelm Hamm, adressing the *"beloved housewife"* , we read: "*Science, earlier a sullen master in powdered whig, meets us today like a heavily goddess offering us the drink of life from a golden chalice. She has descended from the clowdy pedestal, on which she stood centuries long unapproachable as a pedestal saint. (...) She gained control over small and large, she measures the orbits of invisible celestial bodies and is custodian of the domestic fire. (...) The invariant order of nature, the macrocosmos, must be mirrored in the order of the microcosmos, of which the smallest domain is the human body. The order of life is to follow the laws of nature; only then may we live the good life. (...) This is hard to reach with naive empirism, but easy and safe when holding the hand of science."* [85]

IX. Conclusion

In conclusion three distinct phases in the development of popular chemistry books since the last quarter of 18th century can be distinguished. Until the 1840s Enlightenment notions of science as an acticity in the public realm were perceptible in different ways. Chemical knowledge was at first a practical knowledge about *prima materia,* useful for the state economy and the welfare of all citizen. Although this opinion didn't help very much to establish chemistry at universities and secondary schools[86] , it found expression in the flourishing popular natural history as well as in a few popular chemistry books adressed to a wider public, mainly produced after 1798. The boundaries between these kinds of popular knowledge and the "*Realienkunde*" as a core of applied sciences mostly to be used in the education of public servants (*"Kameralwissenschaften")* and later on in the polytechnical schools (built up since about 1800) are hazy. In these contexts chemistry was considered as a field of applied sciences, useful for different purposes.

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83 Wagner, J.R., Die Chemie fasslich dargestellt nach dem neuesten Standpunkt der Wissenschaften, 4th ed., (Leipzig 1858), p. 1.

84 F. Schoedler, *op. cit.*, (21), p.1.

85 W. Hamm, Ordnung und Schönheit am häuslichen Herd. Haushaltungskunst und Gesundheitspflege auf wissenschaftlichen Unterlagen. Den Deutschen Frauen gewidmet, (Jena 1866), pp. 6/7.

86 For the reasons see Gunter Lind in this volume.

In this period, there somehow existed a commitment between the instruction of different public audiences and the necessities of a scientific community. All the problems concerning the classification and organization of chemical knowledge, new methods and elaborated experimental standards already were present, however it was not an easy task to construct a homogeneous rhetoric of a specialized discipline. On the one hand chemistry books contained moralistic, theological or Enlightenment contemplations; they were intended to be useful for very different audiences, among them young ladies, children or middle-class families. On the other hand, even more popular books emphasized the contested connection between physics and chemistry or discussed the influence of the discoveries done by Priestley, Lavoisier and others on the definition of a new discipline. On one side books should serve all friends of nature, but on the other side several authors hoped to clearify the modes of chemical discourse for experts. Thus, a clear distinction between textbooks and popular books was by no means established before 1840.

A debate on the role of popular science never took place, however the appearance of some successful popular works of Liebig et. al. along with the liberalization and rapid growth of the publishing market after 1848 resulted in a remarkable number of new popular chemistry books. As a result of developments in book printing for the first time a mass-production of different kinds of printed publications placed chemistry within everyone's accessibility. At the same time the professionalization of an academic chemistry made good progress and chemistry became slowly but irrevocable a school subject on different levels of education. The second half of the nineteenth century made it possible that a really large audience could be served with chemical knowledge.

One consequence was that the contrast between popular books and textbooks became clearer although never encapsulated in a definite image of popular chemistry. At first, popular science writers wanted to demonstrate the ubiquity of chemical knowledge for life referring to the fact that scientific practice became increasingly associated with specific sites from which "the public" was excluded. While the work on analytical definitions of substances and stringent experimental standards became a powerful tool to produce a scientific community, story-telling about the results of this work and its application in everyday life reconstructed the means of popular chemistry. Chemical knowledge as presented in the era of natural history was in some extent an open knowledge. The experiences of farmers, artisans or housewifes were worth to be contributed or discussed, while the work done by chemists or naturalists not yet required to be exclusive knowledge. The moral, theological or political purposes of the knowledge production concerned everyone.

Now, it was regarded as a kind of public service done by scientists to describe discoveries, instruments and modes of chemical discourse. Experiments, instruments and a formal language shaped the disciplinary structure of chemistry. By viewing these scientific practises in the perspective of the public, they were becoming exclusive and indeed esoteric. The instruction of the public seemed to need its own contents, its own experiments, its own language. Insofar, the new role of the public was not only to be passive and grateful admirers of scientific progress, the development of this role created new standards of public instruction either.

By viewing this situation in the perspective of the history of popularization, one can grasp the active parts of this transformation. Popular chemistry writers after 1850 worked very hard on a concept of chemistry of everyday life which meant that the contents and the structure of the work, according to the authors, had to take requirements of everyday life into account. Thus, the chemistry of everyday life delt with questions of nutrition, clothing, heating etc.. Important parts of popular books presented chemistry as an applied science and a precondition of technological and industrial progress. They presented it in a widely used rhetoric and a varied language, thus the third elements that differentiated a textbook from a popular book.

It was the presentation of technological progress that increased considerably in books printed around the turn of the century. Leaving some exceptions out of consideration, one can perceive that the instruction in theories and methods of scientific chemistry had to loose its relevance once and for all. By 1900 the literary style had changed and later publications mostly presented chemical industries and products, celebrating the technological progress. The quantity of books increased, while the space for instruction of the advancing chemical knowledge diminished. Popular science writers still claimed that scientific knowledge should be indispensable in everyday life. But in opposite to this claim nearly all attention went to the results and products of chemistry while the evolution of the theoretical and practical knowledge of academic chemistry no longer was taken into account. In the foreground stood scarcely more than the hymn of the progress of applied chemistry.

Due to this, popular books and especially those published after the mid nineteenth century were, all in all, not vulgarized scientific textbooks. They have not been simple translations of scientific knowledge, but a genre with very different meanings, intentions and even contents. Much more than a necessary explanation of the advancing sciences to a lay audience, they represented a cultural value depending on a general willingness of the public to gain more scientific education than necessary in everyday life. The core of what one could sign as "public knowledge" in opposite to "professional knowledge" changed and scientific chemistry slowly became part of it. A market of popular science expanded combining very different hopes like the economic interests of publishers and writers or the scientists' demand for public support or the great importance of one's general education throughout the whole society. Thus, popular books on chemistry reacted on the demand of a society trusting and believing in the social progress brought by educational activities.

In some aspects this study confirms the prevailing view that affirms quite clear frontiers between scientific and popular writings. The development of popular chemistry books differed from that of other types of scientific texts. Even though one cannot confirm the assumptions about a clear distinction between public and science. The first argument against this position is that practices of popular writing play an active role in the knowledge production process. Especially those books published before 1850 do not allow to sign a clear distinction between science and public, neither in questions of content and messages nor with regard to intended audiences. But even later publications could help their authors to clearify the structure of the ongoing scientific work or in the words of Justus von Liebig, *"to recognize the hidden threads"* of all new knowledge in science and life. But anyway, academic interests always played an important role for the motivation of scientists to engage in popular science, for example were reflections about the value of scientific work part of the claim for public support. Above this, one should not forget that it was (and still is) a prerequisite of the popular science enterprise to make all actors believe that they all together participate in the scientific world. As mentioned above, the main task of what is called "chemistry of everyday life" was to synthesize an expert knowledge with the experience of everyday life. Although, over time, production and consumption became ever more sharply delineated spheres, the scientific knowledge popular books delt with had to be an up-to-date knowledge. In sum, there is nothing like a clear frontier, however, the distinction itself has a history. Therefore, viewed from a historiographical perspective, it is by no means a matter of fact but a simplified description or "model"useful in science policies. In fact, popular science must be seen as one specific way to model the place of science in culture meant as the entirety of a particular way of life.

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