Translating Textbooks

Russian, German, and the Language of Chemistry

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ABSTRACT

Using the cases of three Russian chemistry textbooks from the 1860s—authored by Freidrich Beilstein, A. M. Butlerov, and D. I. Mendeleev—this essay analyzes their contemporary translation into German and the implications of their divergent histories for scholars' understanding of the processes of credit accrual and the choices of languages of science.

THERE WAS A TIME, a few decades ago, when historians of science ignored textbooks. Textbooks were not "real" science, since they represented the fossilized conclusions of theories and experiments that were universally accepted, to the point that they could be trusted to the pliant minds of students. If you wanted to find true scientific work, you looked in journal articles, or specialist monographs, or—as many historians of science would now insist—in laboratory notebooks and correspondence deposited in archives. Of course, these historians are right: the work of science in the making can indeed be found in these places. But not only there—and in recognition of this fact the field has ceased ignoring textbooks. Increasingly, there are studies that devote significant attention to textbooks as source material—and even sometimes as the subject of study themselves.[1] This work has been extremely productive, and I concur with the other contributors to this Focus section as to the multiple benefits that have accrued to the field from taking textbooks seriously.

Nevertheless, we tend to use textbooks *as sources* in rather particular ways. The first of these approaches to emerge historically, which still dominates in the literature, focuses on

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Russian dates in the nineteenth century lagged twelve days behind the European new-style Gregorian calendar. All unattributed translations are my own.

[1] See, e.g., Anders Lundgren and Bernadette Bensaude-Vincent, eds., *Communicating Chemistry: Textbooks and Their Audiences, 1789–1939* (Canton, Mass.: Science History Publications, 2000).

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the production of textbooks. This is straightforward enough: we write histories of various scientists or scientific schools; some of our actors wrote textbooks; and we scrutinize these texts to flesh out their worldviews or changing approaches to the subject matter.[2] Such work is absolutely necessary for obtaining a full picture of the writer. Omitting textbooks from our consideration would be as irresponsible as a biographer of Thomas Hardy neglecting his poems on the grounds that he was "really" a novelist. Textbook writing is part of scientific work; and if we as intellectual historians want to understand scientists, we need to come to terms with it.

To this has been added the much trickier subject of consumption, beset by severe difficulties of source base and interpretation. How are we supposed to get at the readers of textbooks? In the modern period—and even in the medieval period, for that matter—we can often determine which texts were used in universities to teach knowledge of the natural world. But how does one deduce what the students did with these texts, how they *used* them? The laudable attention to practices in the history of science has set a high bar, and it is devilishly hard to come up with sources. In a few instances—such as Andrew Warwick's Cantabridgians cramming for the Mathematical Tripos, or Paul Wittich's tutorials on Copernicus's *De revolutionibus*—we actually have scratch paper and readers' notes.[3] Work with sources like these has yielded impressive efforts in social and intellectual history, with a decided emphasis on pedagogy.[4]

My goal here is to explore—in a cursory but, I hope, suggestive manner—how we might expand our approach to textbooks even further, using them to investigate historical questions somewhat orthogonal to production or consumption. Let's forget for a moment that textbooks are textbooks (that is, texts that belong to a particular genre and adhere to certain culturally specific conventions) and instead exploit some other features they possess as texts. Textbooks have several properties that are rare in other scientific texts. For example, some of them are *serial*, and we can read several editions of the same book in order to explore how a certain concept changed over time or to gauge its acceptance.[5] Textbooks are also quite frequently (perhaps more than any other single genre of scientific writing) subjected to translation between languages, and we can examine these highly mobile texts with an eye to capturing the complex dynamics of a scientific discipline in a transnational manner.[6]

[2] Excellent examples include Crosbie Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge: Cambridge Univ. Press, 1989), Ch. 11; and Mary Jo Nye, *From Chemical Philosophy to Theoretical Chemistry: Dynamics of Matter and Dynamics of Disciplines, 1800–1950* (Berkeley: Univ. California Press, 1993). This was also largely my approach to D. I. Mendeleev's writings in Michael D. Gordin, *A Well-Ordered Thing: Dmitrii Mendeleev and the Shadow of the Periodic Table* (New York: Basic, 2004), Ch. 2.

[3] Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics* (Chicago: Univ. Chicago Press, 2003); and Owen Gingerich and Robert S. Westman, *The Wittich Connection: Conflict and Priority in Late Sixteenth-Century Cosmology* (Philadelphia: American Philosophical Society, 1988).

[4] See the essays in David Kaiser, ed., *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives* (Cambridge, Mass.: MIT Press, 2005).

[5] See, e.g., the analysis of multiple editions of a single textbook in Gordin, *Well-Ordered Thing* (cit. n. 2), pp. 183–185; and Erika Lorraine Milam, *Looking for a Few Good Males: Female Choice in Evolutionary Biology* (Baltimore: Johns Hopkins Univ. Press, 2010), pp. 156–157.

[6] Translation is another topic that has recently received welcome attention. For a particularly appropriate example of translation flows in the modern period from what has classically been seen as "metropole" to "periphery" see Marwa S. Elshakry, "Knowledge in Motion: The Cultural Politics of Modern Science Translations in Arabic," *Isis*, 2008, *99*:701–730. For an introduction to translation studies see Lawrence Venuti, ed., *The Translation Studies Reader* (New York: Routledge, 2000); and David Bellos, *Is That a Fish in Your Ear? Translation and the Meaning of Everything* (New York: Faber & Faber, 2011).

As an experiment in this latter direction, I will explore three different textbooks from the same science, the same decade, and the same language to describe the rather diverse stories of their translations. I have selected chemistry textbooks from the 1860s both because of my own interest in the matter and because the rapid professionalization of chemistry in the nineteenth century and the transition in chemical theories (both organic and inorganic) in its middle decades endowed textbooks with a particular prominence. But the most salient feature of my selection of these textbooks is that they were written in Russian and translated into German. This transition from the ostensibly more "provincial" language to a "metropolitan" language—the reverse of the usual flow—opens up questions about the manner in which textbooks function on a self-defined periphery (in this instance, mostly St. Petersburg, the capital of the Russian Empire). Throughout what follows, we will see a shift in these textbooks away from narrowly defined pedagogical goals, which the books were indeed intended to fulfill in the Russian context, to a more pointed attention to credit and its international distribution. Textbooks, no less than more "standard" scientific sources, had at this moment a role to play in the adjudication and distribution of priority, and the assignment of credit was crucially dependent on the language of publication.

FRIEDRICH KONRAD BEILSTEIN

The first instance of composition and translation came from the pen of one of the most unusual of Russian chemists, and yet it represents perhaps the most "ordinary" case of the three as it was translated—both linguistically and physically—from Russian into German. I place the word "ordinary" in quotation marks not because there was some sort of typical template that one might expect textbooks to follow (there was not), but because the translation was so unremarkable as barely to attract the notice of contemporaries *as a translation*.

The author was Friedrich Konrad Beilstein (1838–1906), and despite the obvious Germanness of that name he was a native St. Petersburger.[7] Born to a German family in the imperial capital and raised bilingually, he first sought his higher education and his career in the German states, where he wandered (as was the custom) among several universities and eventually achieved brilliant and precocious success with a position at the University of Göttingen. After the death of his father in 1866 and at the consequent importuning of his family, however, he returned to the city of his birth to assume a position teaching chemistry at the Technological Institute.

As a pedagogical setting, this was rather a step down. The institute had been created by Tsar Nicholas I before the Crimean War as a way to train much-needed civilian engineers and as a consequence featured high teaching loads and students who were not particularly interested in the pure sciences.[8] Beilstein's predecessor in the post was another young chemist, Dmitrii Mendeleev, who had just assumed the professorship of general chemistry at St. Petersburg University (a job, ironically, that Beilstein had declined a few years earlier). Mendeleev was thus located right next to the Academy of Sciences and across the Neva River from all the major ministries, while Beilstein, at the Technological Institute,

[7] Biographical details are drawn from Michael D. Gordin, "Beilstein Unbound: The Pedagogical Unraveling of a Man and His *Handbuch*," in *Pedagogy and the Practice of Science*, ed. Kaiser (cit. n. 4), pp. 11–39.

[8] On the history of the Technological Institute see *Piatidesiatiletnii iubilei S.-Peterburgskago Prakticheskago Tekhnologicheskago Instituta: 28-go noiabria 1878 g.* (St. Petersburg: A. M. Kotomin, 1879).

resided south of the city center and was marginalized from daily academic interaction. But Beilstein had not been hired to pursue a career in pure science; his job was to teach analytic and organic chemistry. He would remain at the Technological Institute for thirty years, ministering to hordes of budding engineers.

The early years were quite unpleasant, largely because he felt he had walked into a situation that Mendeleev had horribly neglected. We get an excellent sense of the frustrations surrounding Beilstein's initial position at the institute in a revealing letter to Aleksandr Butlerov (then at Kazan University—and the subject of the next section of this essay) dated November 1866:

> Perhaps the tidings have not yet reached you in the far East that I have now decided to move to Petersburg. I am Mendeleev's successor at the *Technological Institute* and am busying myself dealing with my imposed duties. That is no small affair, when I tell you that my predecessor—who, as you know, is not really a practical chemist—never bothered with the work of *Praktikanten* and went at most for a few minutes into the laboratory every 1/4 of the year. He was in such a rush to get Chancel and Gerhardt translated, without bothering to consider progress in analytic chemistry in the least. This book was shoved into the hands of each *Praktikant* and then he was discharged with a blessing. You can easily imagine in what kind of dilapidated circumstances I have encountered almost everything here.

Mendeleev and Beilstein did not care for each other—that much is clear—but there is much more to be learned from this excerpt. Note that one of Beilstein's central objections to his predecessor was the latter's choice of a textbook. Mendeleev had organized the translation into Russian of Charles Gerhardt and Gustave Chancel's *Précis d'analyse chimique qualitative*, the most recent edition of which had appeared in 1855—almost a decade earlier.[9] Any useful translation of a book into Russian would have to take account of the passage of time required for the translation to be accomplished, since analytic chemistry was rapidly advancing. Mendeleev had failed to do this.

This brings us to Beilstein's only venture into textbook composition, the *Rukovodstvo k kachestvennomu khimicheskomu analizu* (*Guide to Qualitative Chemical Analysis*), published in 1867 in Russian and simultaneously in German as *Anleitung zur qualitativen chemischen Analyse*.[10] I have been unable to determine whether Beilstein originally wrote in German or in Russian, given his fluency in both tongues and the simultaneity of the volumes' appearance, but it is clear that he produced this slim text as a tool to teach Russian students. The book was an attempt to integrate recent innovations in analytic chemistry in a format that would be useful to laboratory neophytes. The absence of a formal framework made it particularly adaptable across major theoretical and experimental divides, which was especially important for the kinds of engineering students he was teaching and certainly contributed to its broad distribution.

Beilstein organized his book to maximize its classroom utility for students with little preparation. A very slim volume, the *Rukovodstvo/Anleitung* is organized as a set of instructions, not as a conceptual presentation of available techniques and information. The book begins with a preliminary examination section, "Examples of Practice in Analysis,"

[9] Friedrich Konrad Beilstein to Aleksandr Butlerov, 6 Nov. 1868, rpt. in G. W. Bykow and L. M. Bekassowa, "Beiträge zur Geschichte der Chemie der 60-er Jahre des XIX. Jahrhunderts, II: F. Beilsteins Briefe an A. M. Butlerow," *Physis*, 1966, *8*:267–285 (emphasis in original); and Charles Gerhardt and Gustave Chancel, *Précis d'analyse chimique qualitative* (Paris, 1855).

[10] F. F. Beil'shtein, *Rukovodstvo k kachestvennomu khimicheskomu analizu* (St. Petersburg, 1867); and Beilstein, *Anleitung zur qualitativen chemischen Analyse* (Leipzig, 1867; 2nd ed., 1870; 5th ed., 1877; 6th ed., 1887).

designed to give the student a sense of how to calibrate his laboratory. Beilstein walked the student through the basic procedures of titration, heating, carbonization, and so on, so that all the techniques and basic reagents were standardized: you heat something and see what can be evolved and what that substance is; you investigate what happens when you carbonize a substance, moisten it, put it to a flame, dissolve it in sulfuric acid, and so forth. In the second half of the book, entitled "Systematic Course of Analysis," and in even more explicit step-by-step fashion, Beilstein told the student what to do when presented with an unknown substance, assuming the set of skills developed in the first half: first you take a bit of the substance and add water; if it dissolves, then move to step 5; if it does not, try nitric acid, then move to step 7; and so on. By following these steps, the student should be able to identify the substance qualitatively at the end of the series. This is precisely the kind of book you would write if you needed to teach practical skills to novices.

The simultaneous bilingual publication is noteworthy here—the book was created to assist in teaching a very common course, and the fact that it was created in Russia was irrelevant to its utility. The *Rukovodstvo/Anleitung* also appeared in multiple editions in Dutch, English, and French. The English translation stands out largely because of its translator: William Ramsay, later the co-discoverer of noble gases and recipient of the 1904 Nobel Prize in Chemistry. Ramsay translated the book in 1873, and his preface demonstrates the effacement of the book's Russian origin: "The translation of the present work has been undertaken with a view to furnish laboratory students with a manual, which should contain the principal methods of Qualitative Chemical Analysis. It is well known and extensively used in Germany, and the name of its author cannot fail to be a guarantee of its excellence."[11] (All translations were made from a German, not Russian, original.) In this instance, then, the Russian chemist in question did not translate and distribute his book in order to make any broader claim about Russian (or German) science. This was simply, and uncontroversially, a textbook.

ALEKSANDR MIKHAILOVICH BUTLEROV

The same cannot be said of the publication and translation of the textbook of organic chemistry written by Aleksandr M. Butlerov (1828–1886). Butlerov's reputation in Europe was less solid than Beilstein's, even though he was a decade older, for Butlerov had been educated entirely within the confines of the Russian Empire, at the University of Kazan on the Volga River—and, from the perspective of German scientists, unfathomably far from the European border.[12] On the other hand, Butlerov was well established within Russia itself. From being professor of chemistry and rector at Kazan, he moved in 1868 to St. Petersburg University as both professor of organic chemistry (where Mendeleev was his colleague) and holder of the coveted chair of chemistry at the St. Petersburg Academy of Sciences, where he joined his mentor Nikolai N. Zinin, the first noteworthy member of

[11] Preface to F. Beilstein, *A Manual of Qualitative Chemical Analysis*, trans. William Ramsay (New York, 1873), p. 5. For the French version see Beilstein, *Manuel d'analyse chimique qualitative*, trans. A. Busine and P. Busine (Lille, 1882). On the volume's popularity as a teaching text see the later American translations and adaptations: W. S. Christopher, *Chemical Experiments for Medical Students Arranged after Beilstein* (Cincinnati, 1888), p. 3; and Charles O. Curtman, *Dr. F. Beilstein's Lessons in Qualitative Chemical Analysis, Arranged on the Basis of the Fifth German Edition*, 2nd ed. (St. Louis, 1886), p. v. Curtman indicates that Beilstein authorized this adaptation.

[12] For Butlerov's biography see G. V. Bykov, *Aleksandr Mikhailovich Butlerov: Ocherk zhizni i deiatel'nosti* (Moscow: Izd. AN SSSR, 1961). On his career in Kazan see Nathan M. Brooks, "Alexander Butlerov and the Professionalization of Science in Russia," *Russian Review*, 1998, *57*:10–24.

the Kazan school of chemistry. Although he had traveled abroad, and his German-language publications were read and appreciated by European chemists, Butlerov wanted more recognition from the West. The mechanism he chose to deploy was a textbook.

This was an unusual strategy, and its origins lay in Kazan in the 1850s, where Butlerov diligently (and quite successfully) taught organic chemistry to university students at all levels. By just about any other measure Kazan was provincial with respect to St. Petersburg, but in the sciences—and particularly in chemistry—Kazan's university had become in the first decades after its founding in 1804 a major intellectual center. Butlerov had experience with translated textbooks, and in his own classes in the 1850s he used a translation of Carl Gotthelf Lehmann's *Handbuch der physiologischen Chemie*, supplemented by lectures based on Justus von Liebig's organic chemistry text (he used the German version, for it was not translated into Russian). Organic chemical theory was the subject of much debate in this decade, but a new synthesis had not yet emerged and all textbooks would have to be supplemented by careful attention to the current scholarly literature.[13] In the late 1850s Butlerov began diverging from the available textbooks, teaching Charles Gerhardt's "type theory" and developing his own notes into a fuller presentation of organic chemistry with a new set of foundational principles.

We now call this framework, based on the concept of tetravalent carbon and mutually bonded carbon chains, "structure theory," and credit for it is usually assigned to August Kekulé, although there are several other claimants—including Butlerov.[14] The latter began to formulate his theory fully only while on a trip abroad (naturally, he spent most of his time in the German states) in 1861, and he began to test his theories in his lectures in 1861/1862, from which, regrettably, no lecture notes survive. In any event, he could not have given the full course of lectures that year, since Russian universities were closed for the second half of the academic year owing to student unrest and Butlerov himself fell ill. Lecture notes do survive from the 1862/1863 course, and one can observe that he was well on the way to writing a textbook. These notes make it clear that Butlerov thought of his project as the composition of an introductory textbook, but one that would reformulate the fundamental principles of organic chemistry, perhaps in a fashion similar to Lavoisier's textbook at the end of the previous century.[15]

This textbook, entitled *Vvedenie k polnomu izucheniiu organicheskoi khimii* (*Introduction to a Complete Study of Organic Chemistry*) appeared—like much Russian publishing of that day—in several separate fascicles, dated January 1864, May 1865, and October 1866, at which point it was also released as a single bound volume. The first fascicle closely resembled the lecture course from 1862/1863 and addressed the general theoretical picture; the later fascicles discussed empirical data, made predictions of novel compounds,

[13] The volumes Butlerov drew on were C. G. Lehmann, *Handbuch der physiologischen Chemie* (Leipzig, 1854); and Justus von Liebig, *Die organische Chemie in ihrer Anwendung auf Physiologie und Pathologie* (Braunschweig, 1842). On contemporary organic chemical theory see Alan J. Rocke, *The Quiet Revolution: Hermann Kolbe and the Science of Organic Chemistry* (Berkeley: Univ. California Press, 1993); and Rocke, *Image and Reality: Kekulé, Kopp, and the Scientific Imagination* (Chicago: Univ. Chicago Press, 2010).

[14] On the issue of credit see Alan J. Rocke, "Kekulé, Butlerov, and the Historiography of the Theory of Chemical Structure," *British Journal for the History of Science*, 1981, *14*:27–57.

[15] Much of this information on the composition of the textbook is derived from the excellent article by G. B. Bykov, "Materialy k istorii trekh pervykh izdanii 'Vvedeniia k polnomu izucheniiu organicheskoi khimii' A. M. Butlerova," *Trudy Instituta Istorii Estestvoznaniia i Tekhniki*, 1955, *6*:243–291. The Russian and German editions of Butlerov's textbook are, respectively, *Vvedenie k pol'nomu izucheniiu organicheskoi khimii* (Kazan, 1864 [1866]), and *Lehrbuch der organischen Chemie: Zur Einführung in das specielle Studium derselben* (Leipzig, 1868).

and discussed applications. The book was an immediate sensation among Russian chemists, and they had substantial difficulties securing copies not only in secondary cities like Kiev and Kharkov but in St. Petersburg itself.

As Russophone chemists came to appreciate what Butlerov had accomplished in his synthesis of organic theory, they implored him to think about a broader audience. For example, Karl Schmidt, a chemist at Dorpat University (in today's Estonia), wrote to Butlerov (in German) with enthusiasm for the idea of a translation:

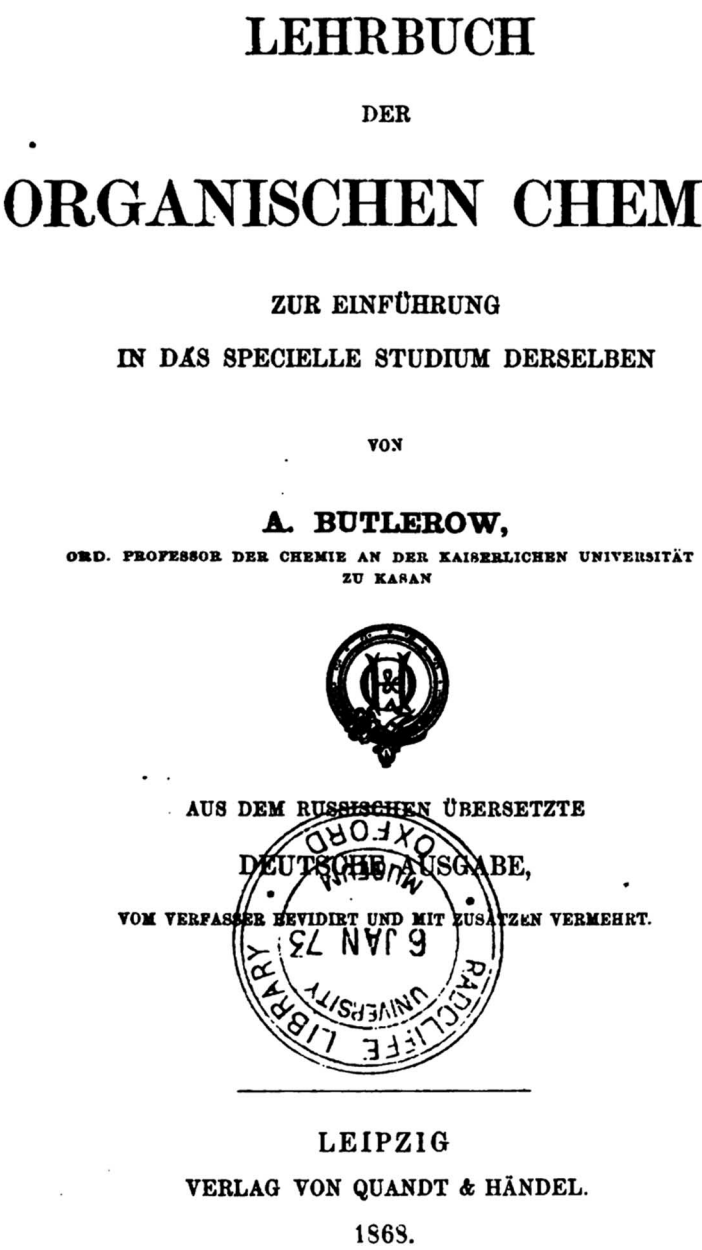
> At present to write a "guide" is a much harder and more thankless task than conducting independent experimental work. Each transitional period in the history of culture brings with itself a certain chaotic order of things, which demands a certain period to stabilize itself in the social and political, as well as in the scientific sphere. . . . With the publication of this book for the *West* in German or French you will earn the thanks of many young chemists. . . . I am convinced that many of our Western colleagues, like me, *would greet* your work *with joy and gratitude*, if they were able to read it freely.

The Heidelberg chemist Emil Erlenmeyer, who did not read Russian, had made the same point to Butlerov in a letter dated 9 July 1864, without ever having set eyes on the yet-unpublished work: "I should say to you that I consider it unwise that you wrote your 'Introduction' only in Russian. Why not also in German?"[16]

Both Erlenmeyer and Beilstein offered to find a publisher for a German translation, but the task proved more difficult than at first anticipated. Butlerov contemplated publishing the translation in France, or even in St. Petersburg, and his student V. V. Markovnikov shuttled around Germany on his behalf. (Interestingly, Markovnikov's spoken German was weak, so he conducted his negotiations in French.) Finally, Beilstein arranged a contract with Quandt & Handel, the publishers of his own journal, the *Zeitschrift für Chemie*, and Butlerov contracted a local teacher in Kazan named Risch to do the translation. Butlerov allowed the publishers to change the title of the book a bit, to *Lehrbuch der organischen Chemie: Zur Einführung in das specielle Studium derselben*, and the complete version appeared in 1868. Somewhat atypically for a translation of this sort, Butlerov insisted that "aus dem russischen übersetzte" ("translated from the Russian") appear prominently on the title page. (See Figure 1.) Although he was going to publish in German, he did not want his readers to forget that the original had been composed in Russian. (Risch, on the other hand, was not credited on the title page.) This was no straightforward translation (assuming that such a thing exists): Butlerov corrected numerous mistakes from the Russian original and expanded both the material and the interpretations, especially about the determination of isomers and metamers.

What can we learn from this brief account of a textbook and its translation? An obvious point is the centrality of credit. Throughout the 1860s Butlerov was actively asserting the validity of his priority claims, and he understood his textbook—as much as the German-language research articles he also published—to be vital in this campaign. This indicates that textbooks, especially the *synthetic* features of introductory surveys, were granted considerable respect by the chemical community. There is a corollary here pertaining to the *languages* in which credit can be granted: Russian counted less than German, which

[16] Karl Schmidt to Butlerov, 1/13 April 1865, reproduced in G. V. Bykov, ed., *Pis'ma russkikh khimikov k A. M. Butlerovu: Nauchnoe Nasledstvo*, Vol. 4 (Moscow: Izd. AN SSSR, 1961), p. 402 (emphasis in original); and Emil Erlenmeyer to Butlerov, 9 July 1864, quoted in Bykov, "Materialy k istorii trekh pervykh izdanii 'Vvedeniia k polnomu izucheniiu organicheskoi khimii' A. M. Butlerova," p. 254.


LEHRBUCH

DER

ORGANISCHEN CHEMIE

ZUR EINFÜHRUNG

IN DAS SPECIELLE STUDIUM DERSELBEN

VON

A. BUTLEROW,

ORD. PROFESSOR DER CHEMIE AN DER KAISERLICHEN UNIVERSITÄT ZU KASAN

AUS DEM RUSSISCHEN ÜBERSETZTE

DEUTSCHE AUSGABE,

VOM VERFASSER REVIDIRT UND MIT ZUSÄTZEN VERMEHRT.

LEIPZIG

VERLAG VON QUANDT & HÄNDEL.

1868.

Figure 1. *Title page of A. M. Butlerov's* Lehrbuch der organischen Chemie *(Leipzig: Quandt & Handel, 1868). Observe the specific declaration of its Russian origins beneath the publisher's crest in the middle of the page.*

was the obvious target language for the translation. Finally, the collaborative process of assembling a translation highlights the corporate features of the chemical community in a way that focusing on textbook composition (or research article composition, for that matter) tends to obscure. In contrast, Mendeleev's effort was more of a solo venture, because for him standing alone was the whole point.

DMITRII IVANOVICH MENDELEEV

Dmitrii I. Mendeleev (1834–1907) remains imperial Russia's most famous chemist, a reputation based on his 1869 formulation of the periodic system of chemical elements. Of course, when he returned to St. Petersburg in February 1861 from two years' postdoctoral study abroad at Heidelberg he had no inkling of that future; instead, he was worried about finding enough money to keep his chemical career afloat in the heady atmosphere of the capital as it entered a phase of vigorous reform, beginning with the emancipation of the serfs two weeks after his arrival. This was the middle of the academic year, which made it all but impossible to find a teaching job, and so he turned to what seemed an obvious strategy: textbook composition. Less than a month after his return, Mendeleev had already contacted the publisher Social Good (Obshchestvennaia Pol'za) about translating J. R. Wagner's German text on chemical technology and to solicit a contract for his own proposed organic chemistry textbook, which was published in 1862 and for which he won the prestigious Demidov Prize of the Academy of Sciences.[17]

Russian education was at this moment still largely dependent on translations of foreign textbooks. Earlier in the century this had posed less of a problem, since chemical knowledge remained comparatively static in its basics. By the early 1860s, however, in part thanks to the innovations developed by fellow Russians like Butlerov, chemistry was undergoing such rapid changes that any textbook would be outdated by the time a translation appeared in print. In addition, translations like those of A. Cahours's chemical textbook (1859–1862), which Mendeleev participated in, were pedagogically handicapped by their lack of a coherent structure for introducing inorganic chemistry.[18] There was great demand for a textbook that synthesized inorganic chemistry in a pedagogically useful format, promising sizable profits both from university sales and from adaptations for lower-level students.

Thus when Mendeleev composed his *Principles of Chemistry* (*Osnovy khimii*; 1st ed., 1869–1871) it was quickly modified for use by chemistry students at any level. Mendeleev started writing his textbook of inorganic chemistry in 1868 with the goal of suiting it to the freshman chemistry course he had taken over in October 1867 along with his mentor Aleksandr A. Voskresenskii's chair at St. Petersburg University (leaving the Technological Institute post to Beilstein). This was a large year-long lecture course, and he needed a textbook. The *Principles* was divided into two volumes, each with two parts. The two parts of Volume 1 were largely written in 1868 and completed in the first month of 1869. I have described elsewhere the crucial importance that this text—and especially the transition between Volumes 1 and 2—played in the formation of his periodic system.[19]

However local and pedagogical Mendeleev's motivations for beginning the textbook, the function of the *Principles*, like that of Butlerov's *Introduction*, changed rather sharply when it was rendered into German. The *Principles* was written in part with the same goal as Beilstein's guide to analytic chemistry: to provide an up-to-date textbook suited to

[17] Johannes Rudolf Wagner, *Die chemische Technologie*, 2nd ed. (Leipzig, 1853). Mendeleev's organic chemistry textbook is *Organicheskaia khimiia* (St. Petersburg, 1861). On his negotiations with publishers see Nathan Marc Brooks, "The Formation of a Community of Chemists in Russia: 1700–1870" (Ph.D. diss., Columbia Univ., 1989), p. 402.

[18] A. Kagur [Cahours], *Kurs elementarnoi khimii*, trans. I. Il'in and D. Dverkiev, 2 vols. (St. Petersburg, 1859–1862).

[19] Gordin, *Well-Ordered Thing* (cit. n. 2), Ch. 2. On the impact of Mendeleev's (and Butlerov's) textbooks on chemistry education in the empire see K. Ia. Parmenov, *Khimiia kak uchebnyi predmet v dorevoliutsionnoi i sovetskoi shkole* (Moscow: Akademiia pedagogicheskikh nauk RSFSR, 1963), Ch. 3, esp. pp. 65–71.

Russian teaching conditions. As Mendeleev revised his textbook over the years, however, it also became a focus for something more like Butlerov's desire to establish credit—first at home, and then abroad. After the completion of the first edition in 1871, Mendeleev revised the text in 1873 to update information; he did so a second time in 1877, when he began to integrate the periodic law more tightly into the text. He did little to change the fourth edition in 1881—which appeared when it did largely to finance Mendeleev's divorce—but the fifth edition, published in 1889, represented a thorough overhaul. He altered the introductory matter to emphasize the central role of the periodic system in pedagogy and chemical theory and added new information on the three newly discovered elements (gallium, scandium, and germanium) that he had predicted in 1871. He hoped that this edition would establish firmly that he was the author of the system of elements, and one way of accomplishing that was to assert that the true test of that system was its prediction of yet-undiscovered elements.[20]

This fifth edition was the one most widely translated into foreign languages, including German.[21] Mendeleev's reasons for having the *Principles* translated are significant. By the early 1890s his book was hardly cutting-edge, and its idiosyncratic structure of providing new information in extremely long footnotes was not likely to be popular. The context that had demanded production of the book in the first place—the dearth of adequate textbooks in the Russian language—surely did not apply in Western Europe, which had a surfeit of excellent books already on the market. The crucial factor here was the *edition* that was translated: the fifth, the one designed to document Mendeleev's priority in discovering the periodic law and the centrality of prediction to the discovery. As such, from Mendeleev's point of view, the need for a translation was not, as was the case for Beilstein, to cement pedagogical innovations but, rather, to drive the final nail in the coffin of his priority dispute with the Tübingen chemist Julius Lothar Meyer (1830–1895), which had raged during the 1870s and had just about petered out by the early 1890s.[22] The purpose was thus to stake a claim for credit to a discovery, as Butlerov had; in this case, however, this was not a salvo in an ongoing battle, but a venture to secure the verdict of history when the fight was already at an end. Mendeleev could not guarantee his claims to priority in Russian, only in German—and the best weapon was the textbook that had served as the starting point of his own path to the periodic system.

CONCLUSION

This essay has sought to make a simple point: that in addition to their very rich uses as sources in the sense of production (largely in intellectual history) and consumption (mostly in the social history of pedagogy), textbooks play supplementary roles in the culture of science that merit further exploration. The reason for juxtaposing the issue of

[20] The sixth, seventh, and eighth editions appeared in 1895, 1903, and 1906, respectively. On the publication history of the eight editions of the *Principles* published by Mendeleev in his lifetime see I. Kablukov, "Obzor izdanii 'Osnov khimii' D. I. Mendeleeva," in D. I. Mendeleev, *Osnovy khimii*, 9th ed., Vol. 1 (Moscow: Gos. izd., 1927), pp. xli–xlvi.

[21] D. Mendelejeff, *Grundlagen der Chemie*, trans. L. Jawein and A. Thillot (St. Petersburg, 1890). There were also English and French translations of this edition: Mendeléef, *The Principles of Chemistry*, trans. George Kamensky, 2 vols. (London, 1891); and Mendéléeff, *Principes de chimie*, trans. E. Achkinaski and H. Carrion (Paris, 1895–1896).

[22] On this dispute see Michael D. Gordin, "The Textbook Case of a Priority Dispute: D. I. Mendeleev, Lothar Meyer, and the Periodic System," in *Nature Engaged: Science in Practice from the Renaissance to the Present*, ed. Jessica Riskin and Mario Biagioli (New York: Palgrave Macmillan, forthcoming).

textbooks as sources with that of translation (in this instance, from Russian to German) was to suggest some of the issues we might explore further by treating textbooks as the polyvalent texts they so demonstrably are.

One of the things we learn from the specific cases discussed here is a layered appreciation for the *function* of any particular textbook. Only one of my three case studies involved a book whose German edition was used (or was even intended to be used) as a tool in pedagogical settings—regardless of the incontrovertible pedagogical origins all three exhibited in their Russian incarnation. So what were these translations for? In the two most significant cases, the translations were produced to guarantee credit—and credit for a particular form of highly synthetic chemical theorizing. In this regard, textbooks are different from articles, and we can see the same impulse to synthesis in German chemical textbooks of the same period (and doubtless in other languages as well).[23] I certainly do not want to imply that *only* translated textbooks are deployed to secure this form of credit accrual; however, the high hurdles for translation—from reworking the language to finding a publisher—make the issue more salient in such cases. In this sense, textbooks in Russia in the late nineteenth century had a function *and* status quite distinct from the function and status of textbooks today.

Likewise, I do not wish to restrict the observations about translation and credit just to textbooks. Nineteenth-century scientific monographs were also widely translated—with the caveat that since they were directed to specialists, who often were competent in English, French, and German, translation among these three languages was not always essential for recognition. Since textbooks target students, some of the same stakes we can find in the case of monographs are merely thrown into sharper relief. The longer shelf life of textbooks through multiple editions also made them more lucrative for publishers. The divergent functions of textbooks for authors, readers, and publishers merely underscore the heterogeneity that inheres in all scientific texts, and professional credit is not the least of these factors.

The point about credit prompts two final observations. The first concerns the rather different status of the authors of textbooks in the mid-nineteenth century and at present. With some important exceptions, most textbook authors today, whatever their expository and analytic gifts, are not typically at the forefront of their research fields—and this is perhaps what prompted the disdain for textbooks found among an earlier generation of historians of science. For the generation of chemists examined here, however, the leaders of the field wrote textbooks in an effort to promote their particular theoretical and practical approaches. Textbooks had not yet been relegated to an "inferior" genre. The process by which such revaluation of status happened is ripe for further investigation.[24] The second observation is that the languages in which science is conducted are not neutral objects but are themselves active fields of contestation. The fact that claims for credit in these textbooks were initially made in Russian and then had to be *translated*—both linguistically and spatially—into German raises broad questions about the diversity of the texts we use in our research and mandates a sensitivity as to who was reading those texts and in which form.

[23] This is especially true of the theoretical ambitions of the first edition of Lothar Meyer's textbook, *Die modernen Theorien der Chemie und ihre Bedeutung für die chemische Statik* (Breslau, 1864).

[24] The point here is similar to the recent revaluation of "popular science" as an important genre in its own right and one whose position with respect to mainstream science is specifically situated in each historical context. Among many exemplary studies see Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: Univ. Chicago Press, 2007).