

# **Global Science and National Sovereignty**

Studies in Historical Sociology of Science

**Edited by Grégoire Mallard, Catherine  
Paradeise and Ashveen Peerbaye**

 **Routledge**  
Taylor & Francis Group  
New York London

## 2 Running in Circles

### The Heidelberg *Kruzhok* and the Nationalization of Russian Chemistry<sup>1</sup>

Michael D. Gordin

Science was introduced into Russia twice. The first introduction occurred when Peter the Great (reigned 1689–1725) brought over both the institutions and the practitioners of Enlightenment natural philosophy, but his Academy of Sciences (founded 1725) never managed to train a self-perpetuating cascade of native scientists who saw themselves as part of a national project (Vucinich 1963; Schulze 1985; Gordin 2000). As a result, while significant natural philosophical works were produced in Russia (notably Leonhard Euler's), production by native Russians was sporadic and unexpected (Nikolai Lobachevskii, for example). One might call this period the age of "science in Russia." This chapter is an exploration of the second introduction of science, in the wake of Russia's humiliating defeat in the Crimean War (1854–1856). This time, the strategy was markedly different: Instead of importing all the infrastructure and context of science, so to speak, off the shelf, the Russian state preferred to train Russian subjects abroad in the epicenters of international science and then have them build up the necessary institutions for a self-sufficient scientific establishment at home upon their return. The resultant science began to take on idiosyncratic features that contemporaries and historians since have considered "Russian science."

This strategy of introducing science the second time produced a notable irony: Russian science—both in form and in content—was born in Germany. It was through their experiences in the German states that Russian scholars knew which institutions to copy, how to run a journal, what a professional scientist might look like; at the same time their personal dislike of the Germans who surrounded them during their study abroad gave their Germanocentric Russian chemical community a Germanophobic tinge. One of the central features of Russian science in this second period was its prominent antipathy for what it considered its mirror image: "German science." This was perhaps most prominent among chemists, and their community serves as the focus of this chapter. Chemistry was the dominant science in late Imperial Russia, partially because of its utility to the state in

the areas of mining, oil exploitation, agriculture, and munitions; partially because it was at the time the leading science internationally; and partially because it was simply the first science to cross the horizon of modernity by acquiring a professional society and official government recognition. The chemical community is vital to our historical understanding of the nature of professional organization in Russia because it subsequently served as a model for essentially all communities of scientists (and other technical experts) formed in the spaces of the Russian Empire (Kozlov 1971; Brooks 1989, 1998). Studying chemistry, then, provides a tracer for the evolution of Russian nationalist conceptions precisely at a site where one would least expect it: at the heart of the most international and cosmopolitan physical science.<sup>2</sup> Precisely at a time of increasing international connections among scientists, Russian chemists injected a new urgency in a longstanding cultural antipathy (since at least the seventeenth century) against "Germans"—*nemtsy*, literally "mutes" (Thomas and Wulff 1992; Herrmann and Ospovat 1998).

This transformation of chemistry took place against the background of the political and social transformation of the so-called Great Reforms—the efforts by Tsar Alexander II (reigned 1855–1881) to restructure Russian society towards a greater emphasis on law and citizenship, including emancipation of the serfs (1861), the modern justice system (1864), and the universal military draft (1874)—which served as a necessary part, but only a part, of the model for the development of Russian chemistry (Gordin 2004). This Great-Reforms model of science emphasized general conformity toward laws (whether of nature or society), consensus, and commonalities between Russia and other emerging nation-states (particularly Germany). It thus provides a poor touchstone to explore the simultaneous origins of nationalized thinking in Russian science. The Great Reforms provided some incentive toward professionalization as a goal of modern scientific communities and the specific forms that such institutionalization should take (graduate training, research laboratories, journal production, and so on), but they offered no sense of the *mechanism* by which the community of chemists in Russia should begin to cohere. I argue here that much of this mechanism was provided by the peculiar Russian urban social formation known as the *kruzhok* (pl. *kruzhki*, lit. "circle"). The specific features of the *kruzhok* go a long way toward explaining the rapidity and vehemence of Russian national identification in the sciences, and in chemistry in particular.

It is difficult to formulate a precise definition of the *kruzhok*, which is somewhat of a cross between a focused salon and an intellectual *Stammtisch*. Several features appear to be essential:

1. A relatively focused area of discussion (music, politics, literature, etc.).
2. Small size (roughly under 20 people).
3. Membership was defined; non-members were excluded implicitly and explicitly.

4. Membership was obtained through nomination by a member; other members could blackball a candidacy if the individual was seen as politically unreliable.

The kruzhek became an important institution in the early nineteenth century, building, ironically, on the German discussion circle or *Kreis*, from which the Russian institution takes its name. Although there were reports of earlier kruzhek in the first decades of the century, it was during the 1820s and 1830s, at the beginning of the repressive reign of Tsar Nicholas I (1825–1855), that the kruzhek took on its vital importance as a medium of urban intellectual and cultural organization. Increasing restrictions on free interchange made the kruzhek into an indispensable close network for discussing political issues under a literary or philosophical cover. The forms quickly became standardized: an informal atmosphere of regulated, like-minded, and generally young participants, favoring open discussion and collective tasks on defined topics (Brodskii 1930; Jakobson 1971; Aronson and Reiser 2001). Given the political stakes of a compromised kruzhek—Fedor Dostoevskii was exiled to Siberia for political discussions within the Petrashevskii kruzhek—this insularity and exclusiveness were vital adaptations to a highly controlled political climate. Intellectuals and aristocrats tended to belong to several kruzhek at a time, and would bring concerns from one of them into another, facilitating communication across subject areas.

The historiography of the kruzhek after the Emancipation of 1861 focuses on these institutions as staples of student culture in the demographic boom of Moscow and Petersburg university populations, where they would eventually serve as kernels of Marxist, populist, or terrorist politics (Venturi 1960; Wildman 1960; Miller 1970; Morrissey 1998). Daniel Alexandrov (1994, 1997)—the only historian of science to take the kruzhek seriously as an organizing principle for Russian knowledge-production—draws his genealogical line from these student kruzhek into the Soviet period, and his work gives a picture of the versatility of this institution in Soviet Russia (and abroad, in the case of the famous Kapitza club at Cambridge).<sup>3</sup> I propose that the kruzhek's contributions were richer than just this contribution to radical student culture: It was also a seedbed of establishment professional culture.

The kruzhek as a sociological formation at the core of Russian professional science also offers insight into the often-fraught question of the public sphere in the Romanov (and later Soviet) Empire. Much literature has recently been devoted to understanding to what extent a public sphere could be understood to exist in Imperial Russia and the Soviet Union—often with the goal of exploring the possibility of effective resistance to state disciplinary power (see especially Clowes, Kassow, and West 1991; for a Foucauldian alternative in terms of legal disciplining, see Engelstein 1994). Yet the *structure* of public life has been left relatively unexplored, and an analysis of the kruzhek is needed to approach the micro-structure of Russian civil

life, and thus an exploration of how a public sphere (however impoverished) was built from the ground up. This feature of the Russian case also allows an inversion of classic models of professionalization. In such Weberian models, individuals looked at the public sphere and built their professional community to mirror certain features of it, and then that institution shaped the individual perspectives within it. This is articulated, among other places, in the “new institutionalism” (DiMaggio and Powell 1991). In the case of Russia, professionals often built their organizations around models appropriated from a variety of sources, and then tried to *export* that notion to *create* a public sphere. That is, there was no suitable preexisting public sphere that could provide a model for organization outside of state formations, as was on occasion the case in Western Europe or North America; much more frequently than their Western counterparts, the Russians needed to develop organizational models out of local *nonprofessional* institutions and then use them to generate professional organizations. These were then the seedbed for developments of a later public sphere. The public sphere, for Russian professionals, would be a kind of society-wide professional organization, where the profession was being a Tsarist subject. It is thus impossible to write the history of late Imperial Russia without looking at the professions, and any history of the professions must give prominent attention to the sciences, some of the earliest and most prolific of these public-sphere exporters.<sup>4</sup>

This chapter explores the nationalization and internationalization of science in the case of one of the most striking chemical communities of nineteenth-century Europe: the Russian, which professionalized and reached maturity rapidly, and disproportionately shaped the foundations of modern chemistry (D. I. Mendeleev's periodic system of chemical elements, A. M. Butlerov's structure theory of organic compounds, V. V. Markovnikov's complex chemistry of petroleum compounds, N. A. Menshutkin's reaction kinetics, and so on). The question here is how this national network of chemists came into being, and why it was that this particular set of chemists, essentially all of whom were trained abroad by mentors they respected, became the center of a vitriolic polemic against Germans and “their” science. I argue that the kruzhek was appropriated as a model for Russian chemists as a seed for professionalization only when the crossing of an international barrier (to Heidelberg University for postdoctoral study) showed them the value of this institution. That is, they exported to Germany a social model from urban Petersburg and Moscow to deal with feelings of exclusion and isolation, where it then hybridized with the nascent German professional models, and then it was re-imported back to Russia as a kernel for what would eventually become the Russian Chemical Society.

This analysis bears much in common with other studies in the sociology of science that look to how national systems of science were standardized, or how “styles” of science can be traced to the movements of scientists in networks (Latour 1987, 1988; Pickering 1995; Czarniawska and Joerges

1996; Rottenburg 1996; Drori et al. 2003). Like Latour's school of thought, I emphasize the amount of labor and contingency that is involved in generating consensus around scientific or sociological truisms, such as the identity of "Russian science." In contrast to "hegemony" narratives, which stress a dominant national group setting a standard which then gets imposed (via brokers) on other national communities abroad, the Russian chemical *kruzhok* provides a historical example of a *domestic* institution that was internationalized and then re-nationalized: The brokers brokered their own culture back to themselves. The Russian chemists would then use their newly created sense of corporate nationalism to argue for the national character of scientific knowledge in at least three different ways: to increase the number of Russians in science; to raise the prominence of Russian as a scientific language; and to guarantee the place of Russian science on the world stage by vigorously advocating, at times, chemical *internationalism*. These styles of nationalism emerged directly out of the model of the *kruzhok* incubated abroad: Only a detailed understanding of the path-dependence of Russian professionalization can reveal why certain inconsistencies in nationalist politicking in the sciences took place.

## CHEMISTRY, FROM PETERSBURG TO HEIDELBERG . . . AND BACK

### Chemistry in Russia: Petersburg in the Wake of the Crimean War

To see this transformation, consider the shape of chemistry in Russia in the late 1850s. In the capital of St. Petersburg, the epicenter of the educational system of Tsarist Russia, there were long-standing places where chemistry could be studied (institutions such as the Technological Institute, St. Petersburg University, or the Academy of Sciences). After the Crimean War, these sites continued to produce a small number of specialists who mostly went into teaching, training a meager number of pharmacists and industrial chemists. From 1857 to 1860 an attempt to provide a forum for chemists to organize emerged; it was designed to be not merely an educational opportunity for further training, but a stepping stone to a fully functioning chemical community: the private laboratory and journal of Nikolai N. Sokolov (1826–1877) and Aleksandr N. Engel'gardt (1832–1893). Both of these chemists were ambitious and talented and undertook strategies that were exactly like those that D. I. Mendeleev and A. M. Butlerov would later employ to such excellent effect—Sokolov in speculative theoretical chemistry like Mendeleev, and Engel'gardt in what would become Butlerov's area of experimental organic chemistry. And yet their professional strategies came to naught. These efforts provide a background of failure to institutionalize and organize that contrasts vividly with the rapid entrenchment of a national chemical community based in Petersburg only a decade later. It is only by reflecting on the contrast between the states before and after that

the importance of the *kruzhok* and postdoctoral study in Heidelberg can be appreciated.

At first, probably using Engel'gardt's funds from his patrimonial estate, the two chemists put together a private laboratory—explicitly modeled on Justus von Liebig's Giessen laboratory<sup>5</sup>—that would be open to chemists in the Petersburg area. The idea was to provide a place for individuals to advance chemical knowledge while waiting for an appointment at an institution that could provide them with more permanent laboratory space, thus generating a chemical network. As a complement to this effort, in 1859 Sokolov and Engel'gardt set up the other *sine qua non* of professionalized mid-century chemistry: a chemical journal. This periodical, *Sokolov and Engel'gardt's Chemical Journal*, came out in only four volumes over two years. The journal intended to offer an outlet for Russian chemical works published in their native language, but besides publishing the dissertations of the editors and a few incidental original pieces, the journal quickly devolved into publishing translated abstracts of important Western articles. As it was unable to sustain itself in this derivative format—most chemists in Russia could read the German, French, and English originals—the journal went under in 1860 (Brooks 1995). The laboratory closed that same year, mostly because Sokolov received a *Privatdozent* post at St. Petersburg University and simply donated the laboratory to the University. Engel'gardt, in turn, was exiled from St. Petersburg in 1869 for his populist agricultural writings and confined to his rural estate, thus terminating his scientific career.<sup>6</sup>

Sokolov and Engel'gardt did not significantly participate in the burgeoning professionalization of Russian chemistry in the 1860s. The fault (not their own) was that they were born and developed too early; when they reached intellectual maturity, the state was not yet willing to encourage science. There are two additional points to make about this brief venture: First, although there was some demand for both the laboratory and the journal, neither had enough demand to make them going ventures financially. Second, when Sokolov obtained a better post, he simply disbanded the laboratory and moved it to the state institution that employed him. There was no sense of loyalty to the project on his part, nor was there enough corporate sensibility among other chemists to resist him. The point of the laboratory may have originally been to focus the network of chemists, but a community had not yet congealed. In contrast, less than ten years later, the Russian Chemical Society was formed, and that organization has (with a few interruptions) survived to the present day, making it one of the oldest professional organizations in Russia.

### Educational Reform in Petersburg and Heidelberg

The biggest political and cultural shock of the 1850s in Russia was the loss of the Crimean War to British and French forces in 1856, the reaction to which in many ways resembled the reactions in Central Europe to the abortive

revolutions of 1848. In many circles, the loss of the Crimean War was interpreted as a failure of Russia to “modernize” adequately vis-à-vis the Western powers. Serfdom was seen as the major emblem of this backwardness, and its abolition was accordingly high on the political agenda. Technical education came second. It was not possible, however, to begin simply churning out chemistry PhDs using the negligible resources then available in Russia. The solution, taken by the Russian state on a limited scale earlier but now expanded to a general policy, was to send talented postdoctoral students to study in Western Europe and then use their expertise to train Russian students.<sup>7</sup> A sizable number of students sent were chemists, and the bulk of these in the early 1860s went to Heidelberg.

If one wanted to educate chemists, Heidelberg was a natural destination. In the 1830s and 1840s, the obvious German chemical center for laboratory-based education was at Giessen with the inventor of such education: Justus von Liebig. After the revolutions of 1848–1849 in Germany, however, chemistry was seen in agricultural states such as Baden as a crucial way to avert future famines and thus mitigate future revolutions, and attempts were made to bring Liebig to Heidelberg, but he went to Munich instead. On a second round of bidding, Heidelberg in 1852 persuaded chemical star Robert Wilhelm Bunsen to leave Breslau, on the condition that a large teaching/research laboratory would be built for him. With the opening of Bunsen’s laboratory, Heidelberg became a magnet for students from across Europe. This was heightened after Bunsen engineered the hires of physicists Gustav Kirchhoff and Hermann von Helmholtz (Borscheid, 1976; Tuchman 1993).<sup>8</sup> This particular constellation of scientific luminaries, the access to a substantial teaching laboratory, and the fact that previous Russians had already to some degree colonized the town as tourists all formed reasons why Russians chose to go there. Part of the reason for the centrality of Heidelberg was also structural: As the grants for study abroad became increasingly formalized, students were required to report to the state’s designated foreign chaperone, famed physician Nikolai Pirogov. For reasons of geography and personal inclination, Pirogov chose to set up camp in Heidelberg, and so all students after 1862 had to at least meet in Heidelberg once during a two- to three-year stay.<sup>9</sup>

### The Heidelberg Chemical Kruzhok

By tracing the paths of a sample of these Russian students—such as D. I. Mendeleev, A. P. Borodin, Nikolai Zhitinskii, and Ladislav Olevinsky (who was, strictly speaking, Polish)—one can begin a reconstruction of their world to explore just what it meant to study and do chemistry in Heidelberg, as well as what it meant to be “Russian” in this context. Mendeleev is well known as one of the leaders of the Russian chemical community in the nineteenth century—a reputation that developed after his return to Petersburg and his work on the periodic system, but that was in evidence also in

Heidelberg. Borodin is more widely known today as a musical composer. While in Heidelberg, Borodin was considered by his peers, his teachers in Russia, and his local mentors to be the rising star of Russian organic chemistry, a reputation not borne out by later developments. He also used his time in Heidelberg to indulge his musical interests, showing the multilayered traffic between Russian and German culture.<sup>10</sup> Zhitinskii was a mild-mannered chemist who completely dropped out of sight after returning to Russia, pursuing no public or scientific career at all, typical of the vast majority of Russian émigré students in this period. And, lastly, Olevinsky—Mendeleev’s closest friend while abroad—entered a series of public disputes with Russian chemists and finally committed suicide in late 1861.

Olevinsky’s case is rather more dramatic than most, but it is clear that almost all the Russian postdocs found their experience profoundly alienating on at least some level. The Russian chemists who arrived in Heidelberg generally came with a good knowledge of the language, but they were often not comfortable around Germans culturally. This was particularly pronounced in Heidelberg, where much of the student life was organized around *Burschenschaften* (regional or dueling societies), which by definition excluded foreign students.<sup>11</sup> They were broadly considered a peculiarity of the German university that one would have to deal with, and in Heidelberg—a small town consumed by its university—they were quite active. The *Burschenschaften* were simply the most prominent of what the Russians perceived as a series of petty insults to their country, their culture, and themselves. Russians refused to interact socially with Germans, and vice versa. As Dmitrii Mendeleev noted in his diary in February 1861: “I was forced to talk to Germans. Boredom” (Mendeleev 1951: 123). Mendeleev was not an antisocial introvert, and he had plenty of society—he just found it elsewhere. He wrote to friends in 1860: “And there was nothing really to write—I sat the entire time at home, worked, lived, like in Russia, all surrounded by Russians.”<sup>12</sup>

The Russians he engaged with here were members of a Heidelberg-centered *kruzhok*, who tended to circle around the basic institutions of Hofmann’s *pension* (run by a German-Russian couple), the Badischer Hof restaurant, and a reading room, where they would exchange the latest journals from abroad. The Russians fairly quickly assorted into separate groupings, as Aleksandr Borodin wrote to his mother in November 1859: “The society of foreigners here forms its own *kruzhki* and do not acquaint themselves with Germans. There are a lot of Russians here [. . .] The Russians divide into two groups: those who do nothing, i.e., aristocrats [. . .] and those who do something, i.e., students; these all hang out together and go to meals and parties.”<sup>13</sup> It is not enough to have Russians essentially “hanging out” together in order to have a *kruzhok*: The membership must also be exclusive. This is clearly the case for the Mendeleev/Borodin circle. The crucial members of the group, besides these two, were Olevinsky, Aleksei Manov, Valerian Savich, and the more transitory involvement of

Petr Alekseev, Aleksandr Butlerov, and other chemists who traveled through town. The topic of conversation was primarily chemistry and secondarily politics—mostly, as far as I can detect from correspondence, academic politics in Petersburg centering around who would get which job when they returned. The essential elements of a kruzok outlined in the introduction to this chapter were all present:

1. The topic was focused: chemistry (both the science and the career).
2. The size was small (never more than 15).
3. The membership was definite.
4. The only way into the group was to be inducted by an existing member.

The term the Russian chemists used for their grouping was the obvious one: kruzok. The turn to the kruzok as a social buttress in a hostile environment would have been reflexive for Russians in this period. Almost every intellectually ambitious student at the major universities in Russia had spent some time either as a participant or as a guest in one or several kruzki, and its particular features seemed just as well adapted to scientific discussion in the 1850s as it had been to literary and philosophical discussion in the 1830s.

The crucial feature that differentiated a kruzok from a simple social gathering or salon was like-minded ideological conformity. If the Heidelberg chemical kruzok's intention was to preserve Russian cultural autonomy in a hegemonic German atmosphere, then the inclusion of one German, *Privatdozent* Emil Erlenmeyer, was the exception that proved the rule. The case of Erlenmeyer proves illustrative of the nature of Russian social organization in Heidelberg. Robert Bunsen was the most famous chemist in Heidelberg, and one would consider it surprising if the Russian students did not exploit the opportunity to work with him. But that is precisely what did happen. Despite their original intention, Russians shied away from Bunsen—both because he had no interest in working with the Russians and because their interests (along with most chemists of the time) lay in organic chemistry and Bunsen farmed out anyone interested in that field to his *Privatdozenten*. Thus, the Russians worked with Erlenmeyer, and corresponded with him after their return to Russia; he was the dominant German figure of their Heidelberg years. The model of chemical practice and particularly what it meant to do *theoretical chemistry* among Russian scientists derived from Erlenmeyer's idiosyncratic approach. While Erlenmeyer is well known today for his eponymous flask, at the time he was a marginal figure who was considered by the mainstream of German chemistry to be unrigorous and too polemical (Krätz 1972). Yet Erlenmeyer left a towering impact on the Russians, both because they liked his personality and because he was the editor of a German chemical journal, the *Zeitschrift für Chemie und Pharmacie* (Journal of Chemistry and Pharmacy), which under Erlenmeyer made a

point of giving Russians an outlet to publish their work in the lingua franca of chemistry: German (Bykov and Sheptunova 1960).

The Russian chemical kruzok survived long after the founding members had left; new Russian postdocs would fill the spots of those who returned to Russia, a return often quite heavily colored with nostalgia, as noted by Borodin in a letter to his mother: "I admit I was a little sad to say goodbye to Heidelberg, where I so peacefully and well lived for a whole year; true besides Erlenmeyer I almost didn't meet any Germans [. . .]. But our Russian kruzok lived here truly as equals [. . .]. Such a close and friendly kruzok you probably won't find in another place."<sup>14</sup> He was more right than he knew.

#### PHANTOM LIMBS: THE RETURN TO PETERSBURG AND THE BIRTH OF THE RUSSIAN CHEMICAL SOCIETY

The postdoctoral students eventually had to return to Russia, and many returned to the place of the original studies, St. Petersburg, to search for employment. Objectively speaking—in terms of number of teaching positions available, average salaries, opportunities for lab space and research, and so on—the situation in Petersburg was actually rather better after the return from Heidelberg than it was before they left. True, they had no domestic chemical journal to publish in, but they could publish (as before) in the *Mining Journal*, which had a chemistry section, as well as the *Bulletin* of the Petersburg Academy of Sciences, and they now had new opportunities to publish in German in Erlenmeyer's *Zeitschrift für Chemie und Pharmacie*.

But the chemists *felt* that things were worse than before. Repeatedly in their diaries and correspondence, there persisted a lament for the bygone days of Heidelberg. Like a phantom limb, the lack of something previously taken for granted—in this case, the kruzok—proved impossible to ignore. Striking is the omnipresent complaint about the lack of companionship of like-minded chemists, that is, a chemical community. Consider, as one rather graphic example, a letter from Aleksandr Borodin to Emil Erlenmeyer about two years after his return, upon assuming a post as chemical professor at the Medico-Surgical Institute in Petersburg, an institution devoted to training military physicians:

Since I have openly devoted myself to scientific prostitution, I am often pregnant. My sad position has however never allowed me to give birth to a healthy, living child. As is the case with all other whores, I always end my pregnancy with an abortion in the first months or even weeks after a coupling with chemistry science. The reason for this lies in the lack of rest (exactly as with the other whores) and in the different miscarriage of the natural reproductive material, an unnatural material to satisfy scientific lust. This unnatural material is the fruit of scientific



demoralization, and is to be expected from the impotents of science. To this belongs the pederasty of chemistry in its applications to agriculture, the collected physiologico-pathologico-forensico-chemical researches of ash-bone-mineral water-excrement-and piss-analysis, the last raised to an autonomous science via the Greek name uroscopy. This *Abusus veneris* can bring one to a true *Tabes dorsalis*, upon which death follows. Further, one must also tally up to this also the seemingly inoffensive onanism, which by the name of theoretical lectures sets the air of auditoriums in fruitless motion[. . .]. The onanism can, however, also lead to a *Tabes dorsalis ex abusu veneris*—which is also life-threatening.<sup>15</sup>

Amidst self-pity, Borodin missed the kruzhek atmosphere that existed earlier. And so the *very same* set of people who were involved in the Heidelberg kruzhek began to agitate for the formation of a Russian Chemical Society—a professional group that could replicate in Russia the social roles cemented by the kruzhek that had been exported to Germany. Mendeleev, for example, began to organize chemical “evenings” around himself and his friends almost immediately after his return from Heidelberg (Volkova 1950). This small-scale kruzhek soon proved to be inadequate for the desires of the Petersburg chemists, because they also yearned after the possibilities for publication—a post-Emancipation innovation on the insular kruzhek.

The first rumblings for a chemical society began in the capital’s daily newspapers. An anonymous note in the *Russian Invalid* on 17 August 1861, almost certainly written by Mendeleev—just months after his return from Heidelberg—stated the case:

A chemical society, in our opinion, is entirely possible in Petersburg. There live our most famous chemists, Messrs. Voskresenskii, Zinin, Mendeleev, Sokolov, Shishkov, Khodnev, and Engel’gardt—and in general in Petersburg many young people occupy themselves by studying chemistry. Why shouldn’t our scientists gather around themselves an entire society?

We consider it unnecessary to discuss the utility of such a society. Under the society there could be a public laboratory, which there isn’t in Petersburg at this time. The University laboratory is too small and serves only for University students. . . . It is too hard to get access to the Academy [of Sciences] laboratory. . . . The establishment of a physico-chemical society could enable the publication of a “Chemical Journal” . . .<sup>16</sup>

In January 1868, at the first Russian Congress of Natural Scientists and Physicians in St. Petersburg, part of a government effort to increase communication among Russian naturalists, the Chemical Division turned the event into a plea for a Chemical Society, a plea which was approved on 26 October of that year.<sup>17</sup> The Society financed itself through subscriptions and

was administered autonomously under its first president, Nikolai N. Zinin. The Chemical Society, in the spirit of the Great Reforms of the 1860s, was a government attempt to let scholars manage their own affairs. But it was also created in the spirit of the kruzhek from Heidelberg, and this spirit would infuse the organization with noticeable consequences.

I am not claiming that this formalized (and professionalized) Chemical Society was the same thing as a large-scale kruzhek. I mean instead to point to two items: First, that the *demand* for a professionalized group of chemists in part was drawn from the experience of kruzhek sociability in its exported form in Heidelberg. This showed chemists some of what could be gained from a particular kind of discipline-oriented sociability. In that sense, Heidelberg’s kruzhek succeeded where Sokolov and Engel’gardt failed, by showing the young Russian chemists the benefits of the structures of professionalized science. The second is that several of the distinctive features by which Russians (and foreigners) at the time defined the so-called “Russian chemistry” also stemmed from this kruzhek origin story.

First, the tradition of having an exclusive membership carried over into the Russian Chemical Society. As opposed to many other contemporary professional associations, where an advanced degree in the subject and/or employment in the relevant industry was enough for access, the Russian Chemical Society required a proposal for membership endorsed by *three* members of the Society (initially they all had to be founding members), and candidates had to “be occupied with the teaching of chemistry or present a printed or manuscript chemical work.”<sup>18</sup> This meant that the overwhelming Petersburg dominance of the Russian Chemical Society was perpetuated until the nomination restriction was removed a while later. Second, the kinds of topics investigated by Russian chemists began to congeal into a few major areas: the chemistry of oil, structure theory, reaction kinetics, etc. The diversity of topics investigated in, say, the Berlin Chemical Society was not present during the first decade of its Russian counterpart—a carry-over from the smaller, local scale of the Heidelberg kruzhek. Third, the explicitly nationalist anti-German features of Russian priority disputes in the 1860s and 1870s (as opposed to equally credible disputes against the French or the British) were a product of the sort of alienation the Russians experienced while abroad.

### THREE STYLES OF RUSSIAN CHEMICAL NATIONALISM

#### Knowledge, Membership, and “Styles” of Nationalist Argumentation

The experiences of adopting German forms for their discipline—the journals, the laboratories, the professional structures—while at the same time resenting their isolation and marginalization while abroad left their mark. For example, the experience of publishing in the *Zeitschrift für Chemie*

und Pharmacie, even under so congenial an editor as Erlenmeyer, generated resentment, as the Russians felt that both their contributions and their language were slighted. As has been noted by several historians, the Russian chemical community was frequently shaken by polarized and acrimonious scientific debates, usually in the pages of the *Journal of the Russian Physico-Chemical Society*, and its editor, Nikolai Menshutkin, managed the periodical à la Erlenmeyer: very interventionist editing practices, a penchant for the theoretical, and a deep enjoyment of scientific conflict. For many of these chemists, the experience of working with Erlenmeyer, perhaps more than publishing in his journal, transformed their vision of chemistry from a collegial enterprise of empirical data-gathering to a vituperative display of theoretical prowess. During the first fifteen years of the Russian Chemical Society's functioning, one can easily identify multiple instances where what were fairly standard scientific disputes quickly escalated into nationalist diatribes. Although there are more disputes than I can discuss at length here, many of them fall within three different "styles" of nationalist argumentation: the representative, the linguistic, and the internationalist.

Each of these three styles shared a set of beliefs about the relationship of the character of natural knowledge to membership in a specific group. In the same way that the *kruzhok* in Heidelberg wedded specific Erlenmeyer-inflected approaches to chemistry with the insularity and inwardness of the small circle, each of these three styles inverted the process: they pointed to membership first, and then judged the quality and character of the knowledge accordingly. In this sense, what was produced was similar to a Latourian network, where the status of the knowledge is intimately tied to its position in a network. The feature that I would like to point to here is how the knowledge was seen as being *national*, much like the membership was. In the representative case, the knowledge was seen to be national because it inhered in the person of a member of the network; in the linguistic case, the knowledge was national because it inhered in the network of language users; and in the internationalist case, the knowledge was national in the sense of being safeguarded by members of the network of Russian chemists from predations by other nationalities. None of the three can be understood without the background of how that network was built in the first instance in Heidelberg.

### The Representative Style of Nationalism

First, to the representative. I do not mean "representative" in the sense of "typical," but in the sense of a nationalism about which *national* members should be considered representative in scientific institutions. In American terms, this representative nationalism would be a question of affirmative action. This style of nationalism is best exemplified by the explosion of nationalist controversy around the failure of the Imperial Academy of Sciences in St. Petersburg to elect noted chemist D. I. Mendeleev to the chair

in technology on 11 November, 1880 (for a full treatment of this dispute, see Gordin 2004, chapter 5; Gordin 2005; for another interpretation, see Dmitriev 2002).

This rejection sparked a massive outcry from Russian chemists and from newspaper reporters and editorialists. In each of the main dailies, telegrams appeared from chemists spread all over the Empire (and even abroad) full of respect for Mendeleev and scorn for the Academy's rejection. The telegrams usually originated from individual scientific societies or universities, the small corporate centers that comprised the Russian scientific community.

Nationalism came soon afterwards, invoking two dominant discourses of nationalism: the outward emphasis of Pan-Slavism and the inward emphasis on Russification. Mendeleev's rejection was occasionally invoked as a symbol of Pan-Slavism—the movement to unify the Slavic peoples in a loose federation led by Russia—as an editorialist for the *New Times* noted when the Czech and South Slavic Academies elected Mendeleev as an honorary member: "Now one can say that the scholarly representatives of the entire Slavic world have expressed their reproof to the spirit which reigns in our Academy; only Polish scholars have yet to join the Slavic protest."<sup>19</sup> As was the case with much of Pan-Slavism, this expansionist view of Russian culture was encouraged by smaller Slavic nations, which in turn used it as a cudgel against perceived (typically Germanic) aggressors at home (Hunczak 1974).

The Russification case was more dramatic, more common, and better exemplifies the "representative" trope of the scientific politics of nationalism. Newspapers blamed the Academy's behavior on the pernicious influence of "Germans" on the institutions of Russian culture.<sup>20</sup> Honoring Mendeleev became a litmus test for patriotism. There were almost daily articles on Mendeleev in the major Petersburg newspapers from the day after his rejection until the end of the year, and the supposed bias of the Academy would appear in headlines until the assassination of Tsar Alexander II in March 1881 finally displaced it completely.

The real reasons why Mendeleev did not obtain the chair probably had very little to do with national identity. Contrary to contemporary perception, it was not the case that all academicians who voted against him were of German origin, or that all who supported him were Russian. Instead, Mendeleev seemed to be a riskier choice than Friedrich Konrad Beilstein, the Petersburg-born chemist who eventually got the position. First of all, Beilstein's contributions to chemistry, although not as widely known today outside chemistry, were substantial and already well authenticated by 1880, while Mendeleev's periodic system was still under some discussion. In addition, Mendeleev was cantankerous, belligerent, and mired in an adultery scandal that jeopardized the prestige of the institution. Most saliently, however, Mendeleev's loyalties lay with St. Petersburg University, which was a competing institution. Despite these available alternative explanations, the dispute was discussed at the time exclusively in nationalist terms.



Two features of this episode bear remark: First, the use of nationalist political rhetoric to push Mendeleev began first within the scientific community and then was exported out into the world of public pundits, showing an instance of how ostensibly apolitical scientists used politics for their own purposes; second, there was at no point any discussion of Mendeleev's science being Russian, only of his *person*.

### The Linguistic Style of Nationalism

The linguistic nationalist case is more complicated. In the first place, this was a case where nationalist politics failed to mobilize outside of the specific scientific community—perhaps because the content was too specialized—and, second, this was a case of arguing for the *content* of science being defined by “Russianness,” importing a rhetoric that had already permeated debates over, say, Russian music. A specialized nomenclature is one of the distinguishing features of modern chemistry. Historically speaking, modern chemistry was born with Antoine Lavoisier's interpretation of combustion and respiration as combination with oxygen (as opposed to the release of phlogiston), and he accompanied his reform of conceptual content with a concomitant nomenclature program, where compounds would be designated not by evocative names (“fixed air,” “flowers of vitriol”) but by names that reflected their composition from simple substances (“carbon dioxide,” “sulfuric acid”).<sup>21</sup> That is to say, the extent to which chemistry has been seen as a unified science has from the late eighteenth century been treated as intimately bound up with agreement about the way things are named.

Chemists working in Russia in the immediate post-Lavoisier period—who were predominantly of German background—understood the importance of modifying nomenclature. In a sense, the Russian language was fortunate in that the paucity of traditions antedating the importation of modern chemistry meant there was little historical inertia resisting the new chemistry. The main principles of naming the elements and compounds were established by German Gess (1802–1850) in 1835/6, when he named the fifty-four elements then known. His reform of inorganic chemical naming remained basically untouched until 1912 (Savchenkov 1870; Kritsman 1994). Its distinctive features were using traditional Russian words for well-known elements such as gold (*zoloto*), and providing linguistic calques for newly coined terms, such as oxygen (literally “acid-maker,” hence *kislorod*; the Czech *kyslík* represents a similar contemporary trajectory in naming). This reform was characterized by minimal disturbance of traditional words and a determination to use European models.

The problems that emerged in the 1860s and 1870s came as a consequence of the formation of the Russian Chemical Society in 1868. One of the first tasks set by the Chemical Society was to appoint Fedor Savchenkov to examine the origins of Russian chemical nomenclature. Implicit in his report to the Society was the double bind of all nationalist investigations

of nomenclature: If one wanted one's chemistry to be read and understood abroad, one needed a functionally isomorphic nomenclature that replaced Western nomenclature word for word. On the other hand, such a nomenclature was, by definition, Western European, and hence not reflective of features of either the Russian language or Russian culture—as contrasted with the actual proposal that nomenclature follow the patronymic structure of Russian naming (so that water would be, for example, “hydrogen oxygenovich”). Savchenkov resolved this double bind by sidestepping: He created a fictional opposition—one that wanted simply to impose French or German words as the only ones used in chemistry—and declared that this would be inappropriate: “One should not transpose a nomenclature. The German language has a great deal in common with the Russian in terms of phrasing, but there is no good nomenclature yet in German. The best was written in French, and we cannot transpose from French, because that language allows the easy construction of nouns, of which there are many in French nomenclature, but in the Russian language it is hard to make nouns” (Savchenkov 1870: 210). What he meant was that there were lots of ways in Russian to make a nominal form—*kislik*, *kislets*, etc.—and standardization would be difficult (although not impossible) to enforce in a case language without definite articles like Russian. So he generated a solution by deferring it, saying they should keep the “Russian” nomenclature (a direct calque from the French) in opposition to an importation of French words directly (which no one had advocated).

Savchenkov's arguments, weak as they were, almost proved insufficient. Debate continued, largely because the status quo had changed. By the late 1860s the vast majority of chemists were working in the field of organic chemistry, which had undergone conceptual, empirical, and industrial transformations in the preceding decades. As Kazan (later Moscow) chemist Vladimir Markovnikov noted in February 1871, the lack of a unified chemical nomenclature in organic chemistry was proving disastrous for pedagogy. Markovnikov was worried about consistency, not content, and advocated selecting one of the various nomenclatures available; the endorsement by the Chemical Society would, he hoped, make it almost “obligatory,” and thus also shore up the authority of the Society (Markovnikov 1871).<sup>22</sup> The nomenclature would become “national” in the sense of being endorsed by the corporate body of Russian chemists. Linguistic patriotism and nationalism pointed to a paradox for nationalism in the sciences: The scientific project encompassed a variety of language groups, and while each side could theoretically express itself however it wanted, each also craved outside recognition.

### The Internationalist Style of Nationalism

This raises the oddity of *internationalist* nationalism. In this example, the same nationalist politicking that made Russian scientists so quick to adopt

hostile rhetoric led to the counterintuitive case of Russian chemists inserting themselves in a nationalist polemic between French and German chemists to argue for the *absence* of nationalist content in science. In this rôle as peacemaker, the Russians were following the same nationalist script, but they reversed its polarities.

The issue hinged on a conflict between two Doppelgänger: Adolphe Wurtz and Hermann Kolbe. The reason people speak of these two men in the same breath today is not that they were both seminal figures in mid-century organic chemistry (although they were), but that they were the main interlocutors in *the* central nationalist debate in the sciences, over the question “Does chemistry belong to any one country?”

In 1868, modeling himself on a German encyclopedia of pure and applied chemistry published thirty years earlier, Wurtz published his *Dictionnaire de chimie pure et appliquée* (Dictionary of Pure and Applied Chemistry), which soon became very influential for French chemists at all levels. It is more accurate to consider this volume a series of monographic articles deliberately composed with the goal of reforming chemistry in the direction of standardized atomic weights, concepts of valency and structure, and other innovations that had been sweeping Europe from the German states since the mid-1850s (Rocke 2001). However, the entire debate about the text had little to do with Wurtz’s reform program, but with his opening lines: “Chemistry is a French science. . . .”

German attacks on French science for its arrogance, self-obsession, and provincialism date at least as far back as 1832, when Justus von Liebig attacked them in precisely these terms (Rocke 2001: 70). The primary difference in 1870 was that, as Hermann Kolbe saw it, there was increasingly less to justify French chemical arrogance. In a post-Liebig age, German chemistry was the world’s center (Rocke 1993: 341). In his own scientific periodical, the *Journal für praktische Chemie* Journal for Practical Chemistry, Kolbe published a series of broadsides that lambasted Wurtz for exaggerating the role of French chemistry and its derivative development of purer German concepts. Historically speaking, Kolbe was accurate. His tone, however, was seen by many as beyond the pale.

This is where the Russians came in. On 9 (21) October, 1870, in the *St.-Petersburger Zeitung* St. Petersburg Newspaper, the Russian capital’s German language daily, four Russian chemists—Nikolai Zinin, Aleksandr Butlerov, Dmitrii Mendeleev, and Aleksandr Engel’gardt—published a response to the polemic propagated by Kolbe’s *Journal*.<sup>23</sup> They began, “With the words, ‘chemistry is a French science,’ Mr. Adam [sic] Wurtz, professor of chemistry at the Ecole de médecine in Paris and member of the Paris Institute, began his ‘History of chemical doctrines’ which appeared about two years ago. We, Russian chemists, read these words with a certain astonishment. Now, however, we stand with the same astonishment and a most deep bewilderment before two articles that recently appeared in a German journal specially devoted to chemistry.” These articles were Kolbe’s “On the State of

Chemistry in France” and Jakob Volhard’s refutation of Lavoisier’s priority in the discovery of oxygen (Kolbe 1870; Volhard 1870). In particular, the Russians objected to the dedication of the separate offprint, “To all the friends of German science.” As they saw it, Kolbe responded to Wurtz by an equal transgression. The obvious context, as the Russians pointed out, was that France and Germany were at the moment engaged in “bloody battle with each other” in the Franco-Prussian War, and the Russians worried that “the treasures of civilization, science and art—the legacy of centuries—will be annihilated in a few days.” The Russians chose to interpose themselves to speak in favor of internationalism. Chemistry belonged to no one, and they would be its spokesmen.

## CONCLUSION

It is striking that the very same Russians—almost to a man—who were trying to canonize a Russian nomenclature were also claiming to be the only impartial speakers for *internationalism*. When one strips away the surface differences, however, one finds that the three modes of nationalism—representative, linguistic, and international—all derived from the same sets of concerns of the Russian (and specifically Petersburg) chemical community. The fundamental roots stemmed, quite directly, from the kruzhok atmosphere created in Heidelberg, re-imported to Petersburg as chemical evenings, and then enshrined in the Russian Chemical Society, and it is with drawing these connections that I conclude.

The fundamental feature of the Russian chemical community was that it grew very quickly, and that it grew abroad. These Heidelberg students had learned what it meant to be professional chemists by supporting themselves in an environment that they saw as hostile to expressions of non-German sentiment, and so they reflexively began to adopt oppositional positions whenever German nationalism seemed to raise its head. In the cases of representative and linguistic nationalism, German language and citizenship became lightning rods for mobilization, but in the internationalist case as well, it was the *German* response to the French provocation that made the Russians sit up and take notice; they had not objected to Wurtz initially. Since they could not very well decry German nationalism without also decrying the French, they adopted an internationalist stance by default, a position that was an anti-German reflex hardwired into the kruzhok-turned-Chemical-Society. In multiple other cases—publication venues, priority disputes (especially between Mendeleev and Lothar Meyer over the creation of the periodic system)—one can track the way the overtures of Germans structured the Russian response, as opposed to French or British moves. Occasionally, indeed, it made Russians defenders of international science. More often, it went the other way, as internal scientific dynamics started to resonate with cultural nationalist politics developing in late Tsarism.

## NOTES

- All Russian terms are transliterated using a modification of the Library of Congress standard, except for the names of Russian Tsars. All dates that occur in Russia or in Russian correspondence follow the old-style Julian calendar, which lagged twelve days behind the new-style Gregorian calendar in the nineteenth century. All German dates are in new style. All unattributed translations are mine. Abbreviation: *ZhRFKhO*—*Zhurnal Russkogo Fiziko-Khimicheskogo Obshchestva* (Journal of the Russian Physico-Chemical Society). I thank Edyta Bojanowska, Karl Hall, Grégoire Mallard, Catherine Paradeise, Ashveen Peerbaye, and Dan Todes for helpful suggestions on earlier versions of this manuscript.
- The counterpart would be a chauvinistic social science or discipline of the humanities. For these, more intuitive, cases, see for example Vucinich (1976).
- For a more sociological approach to the role of “circles” in Soviet science, but which does not attempt the cultural connection to *kruzhki*, see Lubrano (1993). It is important to be careful not to confuse the *kruzhok*, a culturally specific Russian institution, with the more generalized sociological concept of “social circle,” which has been somewhat fruitful in analyzing scientific change (on “social circle” theory, see Kadushin 1968; Griffith and Mullins 1972). There is obviously a relation between the two, but they are not identical.
- For some literature on professionalization in Russia and its divergence from the classic Anglo-American models, see, for example, Ruane (1994) and Balzer (1996). Helpful criticisms of the traditional models of professionalization for the history of science are Holt (1970), Goldstein (1984), and Broman (1995).
- On the importance of Liebig for the transformation of chemical pedagogy via laboratory instruction, see Morrell (1972) and Brock (1997).
- The writings in question are translated in Frierson (1993).
- One could think of this as an attempt to prime the pump of a “postdoc cascade,” as David Kaiser analyzed for the spread of Feynman diagrams (Kaiser 2005).
- This hegemony over the natural sciences was short-lived, however. After German unification, Helmholtz and the rest of natural-scientific elite migrated to Berlin; Bunsen alone remained in Heidelberg (Riese 1977).
- For a general survey of the Russian experience at Heidelberg, with a few references to the scientific culture, see Birkenmaier (1995). For a comprehensive sociological breakdown of the Russian student body, see Bock (1991).
- On Borodin’s life, see Figurovskii and Solov’ev (1988).
- Derisive comments about the *Burschenschaften* were not specific to the Russians. Mark Twain’s account of them on a visit to Heidelberg in the early 1870s is hilarious (Twain 1880/1997).
- Mendelev to Mar’ia Fedorovna and Vladimir Aleksandrovich, 26 September, 1860, Alb. 1/12, D. I. Mendelev Museum-Archive, St. Petersburg, Russia, reproduced in Mendeleva 1951: 87.
- Borodin to his mother, 25/13 November, 1859, in Dianin 1927–1928: 36–37.
- Letter of 28/16 October, 1860, in Dianin 1927–1928: 52–53.
- Borodin to Erlenmeyer, 12 May, 1864, ll 1-2ob., Hugo-Dingler-Stiftung, Hofbibliothek Aschaffenburg, Germany. Ellipses added.
- “Vnutrennie izvestiia Internal News” section of the 17 August, 1861, issue of *Russkii invalid* Russian Invalid, #17, p. 733. Ellipses added.
- See the petition of 4 January, 1868, quoted in Kozlov and Lazarev 1947: 128.
- From the charter, “Ustav Russkago khimicheskago obshchestva Charter of the Russian Chemical Society,” *ZhRFKhO* 1 (1869): 2–3, on 2.

- Novoe Vremia* New Times, 26 November (8 December), 1880, #1706: 1. The Polish silence was due to the Russian occupation of Poland and contemporaneous forced Russification.
- Strana* Country, 13 November, 1880, #89: 1. See also F. Petrushevskii, “Postupok Akademii nauk. (Pis'mo k redaktsii) The Conduct of the Academy of Sciences. (Letter to the Editor).” *Golos*, 31 December, 1880 (12 January, 1881): 1. Newspapers were seminal in constructing a national consciousness during the Great Reforms. See McReynolds 1991: 44–46.
- The literature on Lavoisier and language is tremendous. For an introduction to these topics, see Crosland (1962), Anderson (1984), Bensaude-Vincent and Abbri (1995), and Riskin (1998).
- On the eventual acceptance of the Geneva Nomenclature compromise in the 1890s, albeit begrudgingly, see Menshutkin (1893).
- N. Zinin, A. Butlerow, D. Mendelejev, and A. Engelhardt, “[Letter to the editor],” *St.-Petersburger Zeitung* St. Petersburg Newspaper, 9 (21) October, 1870, #271: 4.

## WORKS CITED

- Alexandrov, D. A. (1994) “Istoricheskaia antropologija nauki v Rossii.” *Historical Anthropology of Science in Russia Voprosy istorii estestvoznaniia i tekhniki* Questions of the History of Science and Technology 4:3–22.
- . (1997) “The Politics of Scientific ‘Kruzhok’: Study Circles in Russian Science and Their Transformation in the 1920s.” In *Na perelome: Sovetskaja biologija v 20–30'kh godakh* At the Break: Soviet Biology in the '20s–'30s, edited by E. I. Kolchinskii. St. Petersburg: Sankt-Peterburgskii Filial Instituta Istorii Estestvoznaniia i Tekhniki RAN.
- Anderson, W. C. (1984) *Between the Library and the Laboratory: The Language of Chemistry in Eighteenth-Century France*. Baltimore: Johns Hopkins University Press.
- Aronson, M., and S. Reiser. (2001) *Literaturnye kruzhki i salony*. St. Petersburg: Akademicheskii proekt Literary Circles and Salons.
- Balzer, H. D. (ed.) (1996) *Russia's Missing Middle Class: The Professions in Russian History*. New York: M. E. Sharpe.
- Bensaude-Vincent, B., and F. Abbri. (eds.) (1995) *Lavoisier in European Context: Negotiating a New Language for Chemistry*. Canton, MA: Science History Publications.
- Birkenmaier, W. (1995) *Das russische Heidelberg: Zur Geschichte der deutsch-russischen Beziehungen im 19. Jahrhundert*. Russian Heidelberg: Toward the History of German-Russian Relations in the 19th Century. Heidelberg: Wunderhorn.
- Bock, G. (1991) “Studenten des russischen Reichs an der Universität Heidelberg (1862/63–1914).” *Students of the Russian Empire at Heidelberg University (1862/63–1914) Diplomarbeit, Institut für Übersetzen und Dolmetschen*.
- Borscheid, P. (1976) *Naturwissenschaft, Staat und Industrie in Baden, 1848–1914* Natural Science, State, and Industry in Baden, 1848–1914. Stuttgart: Klett.
- Brock, W. H. (1997) *Justus von Liebig: The Chemical Gatekeeper*. Cambridge: Cambridge University Press.
- Brodskii, N. L. (ed.) (1930) *Literaturnye salony i kruzhki* Literary Salons and Circles. Moscow: Academia.
- Broman, T. (1995) “Rethinking Professionalization: Theory, Practice, and Professional Ideology in Eighteenth-Century German Medicine.” *Journal of Modern History* 67:835–872.

- Brooks, N. M. (1989) "The Formation of a Community of Chemists in Russia: 1700–1870." PhD Dissertation, Columbia University.
- . (1995) "Russian Chemistry in the 1850s: A Failed Attempt at Institutionalization." *Annals of Science* 52:577–589.
- . (1998) "The Evolution of Chemistry in Russia During the Eighteenth and Nineteenth Centuries." In *The Making of the Chemist: The Social History of Chemistry in Europe, 1789–1914*, edited by D. Knight and H. Kragh. Cambridge: Cambridge University Press.
- Bykov, G. V., and Z. I. Sheptunova. (1960) "Nemetskii 'Zhurnal Khimii' (1858–1871) i russkie khimiki. (K istorii khimicheskoi periodiki). The German 'Journal of Chemistry' (1858–1871) and Russian Chemists. (Toward a History of Chemical Periodicals)." *Trudy Instituta istorii estestvoznaniia i tekhniki* Works of the Institute of the History of Science and Technology 30:97–110.
- Clowes, E. W., S. D. Kassow, and J. L. West. (eds.) (1991) *Between Tsar and People: Educated Society and the Quest for Public Identity in Late Imperial Russia*. Princeton: Princeton University Press.
- Crosland, M. P. (1962) *Historical Studies in the Language of Chemistry*. Cambridge, MA: Harvard University Press.
- Czarniawska, B., and B. Joerges. (1996) "Travels of Ideas." In *Translating Organizational Change*, edited by B. Czarniawska and G. Sevón. Berlin: Walter de Gruyter. pp. 13–48.
- Dianin, S. A. (ed.) (1927–1928) *Pis'ma: Polnoe sobranie, kriticheski sverennoe s podlinnymi tekstami, v. 1 (1857–1871)*. Letters: Complete Collection, Critically compared with the Original Texts, v. 1 (1857–1871) Moscow: Gos. izd. muzykal'nyi sektor.
- DiMaggio, P. J., and W. W. Powell. (1991) "Introduction." In *The New Institutionalism in Organizational Analysis*, edited by W. W. Powell and P. J. DiMaggio. Chicago: University of Chicago Press. pp. 1–40.
- Dmitriev, I. S. (2002) "Skuchnaia istoriia (o neizbranii D. I. Mendeleeva v Imperatorskuiu akademiiu nauk v 1880 g.). A Boring Story (On the Nonelection of D.I. Mendeleev to the Imperial Academy of Sciences in 1880" *Voprosy istorii estestvoznaniia i tekhniki* [Translated above under Alexandrov.] 2:231–280.
- Drori, G. S., J. W. Meyer, F. O. Ramirez, and E. Schofer. (2003) *Science in the Modern World Polity: Institutionalization and Globalization*. Stanford: Stanford University Press.
- Engelstein, L. (1994) "Combined Underdevelopment: Discipline and Law in Imperial and Soviet Russia." In *Foucault and the Writing of History*, edited by J. Goldstein. Oxford: Blackwell. pp. 220–236.
- Figurovskii, N. A., and Y. I. Solov'ev. (1988) *Aleksandr Porfir'evich Borodin: A Chemist's Biography*. New York: Springer Verlag.
- Frierson, C. A. (tr. and ed.) (1993) *Aleksandr Nikolaevich Engelgardt's Letters from the Country, 1872–1887*. New York: Oxford University Press.
- Goldstein, J. (1984) "Foucault among the Sociologists: The 'Disciplines' and the History of the Professions." *History and Theory* 23:170–192.
- Gordin, M. D. (2000) "The Importation of Being Earnest: The Early St. Petersburg Academy of Sciences." *Isis* 91:1–31.
- . (2004) *A Well-Ordered Thing: Dmitrii Mendeleev and the Shadow of the Periodic Table*. New York: Basic Books.
- . (2005) "Beilstein Unbound: The Pedagogical Unraveling of a Man and His Handbuch." In *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, edited by D. Kaiser. Cambridge, MA: MIT Press. pp. 11–39.
- Griffith, B. C., and N. C. Mullins. (1972) "Coherent Social Groups in Scientific Change." *Science* 4053(177): 959–964.

- Herrmann, D., and A. L. Ospovat. (eds.) (1998) *Deutsche und Deutschland aus russischer Sicht: 19. Jahrhundert: Von der Jahrhundertwende bis zu den Reformen Alexanders II* Germans and Germany in Russian Eyes: From the Turn of the Century to the Reforms of Alexander II. Munich: Wilhelm Fink.
- Holt, B. W. G. (1970) "Social Aspects in the Emergence of Chemistry as an Exact Science: The British Chemical Profession." *British Journal of Sociology* 21:181–199.
- Hunczak, T. (1974) "Pan-Slavism or Pan-Russianism." In *Russian Imperialism From Ivan the Great to the Revolution*, edited by T. Hunczak. New Brunswick, NJ: Rutgers University Press. pp. 82–105.
- Jakobson, R. (1971) "An Example of Migratory Terms and Institutional Models (On the Fiftieth Anniversary of the Moscow Linguistic Circle)." In *Selected Writings, v. 2*, edited by R. Jakobson. The Hague: Mouton.
- Kadushin, C. (1968) "Power, Influence, and Social Circles: A New Methodology for Studying Opinion Makers." *American Sociological Review* 33:685–699.
- Kaiser, D. (2005) *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics*. Chicago: University of Chicago Press.
- Kolbe, H. (1870) "Ueber den Zustand der Chemie in Frankreich On the State of Chemistry in France." *Journal für praktische Chemie* Journal for Practical Chemistry, 110, N.F. 2: 173–183, reprinted as idem (1870) 'Ueber den Zustand der Chemie in Frankreich.' Leipzig: Johann Ambrosius Barth.
- Kozlov, V. V. (1971) *Vsesoiuznoe khimicheskoe obshchestvo imeni D. I. Mendeleeva, 1868–1968* The D.I. Mendeleev All-Union Chemical Society, 1868–1968. Moscow: Nauka.
- Kozlov, V. V., and A. I. Lazarev. (1947) "Tri chetverti veka Russkogo khimicheskogo obshchestva. Three Quarters of a Century of the Russian Chemical Society" In *75 let periodicheskogo zakona D. I. Mendeleeva i Russkogo khimicheskogo obshchestva* 75 Years of D.I. Mendeleevs Periodic Law and the Russian Chemical Society, edited by S. I. Vol'fkovich and V. S. Kiselev. Moscow: Izd. AN SSSR.
- Krätz, O. (1972) "Emil Erlenmeyer, 1825–1909." *Chemie in unserer Zeit* Chemistry in Our Time, 6: 52–58.
- Kritsan, V. A. (1994) "Die Entstehung der russischen chemischen Nomenklatur im europäischen Kontext: Die Frühgeschichte The Establishment of the Russian Chemical Nomenclature in the European Context." In *Cosmographica et Geographica: Festschrift für Heribert M. Nobis zum 70. Geburtstag, v. 2* Cosmographica et Geographica: Festschrift for Heribert M. Nobis on his 70th Birthday. v. 2., edited by B. Fritscher and G. Brey. Munich: Institut für Geschichte der Naturwissenschaften.
- Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, MA: Harvard University Press.
- . (1988) *The Pasteurization of France*. Cambridge, MA: Harvard University Press.
- Lubrano, L. L. (1993) "The Hidden Structure of Soviet Science." *Science, Technology & Human Values* 18:147–175.
- Markovnikov, V. (1871) "Po voprosu o russkoi khimicheskoi nomenklature. On the Question of a Russian Nomenclature" *ZhRfKhO* 3:65–69.
- McReynolds, L. (1991) *The News under Russia's Old Regime: The Development of a Mass Circulation Press*. Princeton, NJ: Princeton University Press.
- Mendeleev, D. I. (1951) "Dnevnik 1861 g. 1861 Diary" *Nauchnoe Nasledstvo* Scientific Heritage 2:111–212.
- Mendeleeva, M. D. (1951) "Novye materialy o zhizni i tvorchestve D. I. Mendeleeva v nachale 60-kh godov. New Materials on the Life and Work of D.I. Mendeleev at the Beginning of the 1860s" *Nauchnoe Nasledstvo* Scientific Heritage 2:85–94.
- Menshutkin, N. (1893) "K voprosu o khimicheskoi nomenklature: Sostavlenie nazvanii organicheskikh kislot. On the Question of Chemical Nomenclature: The Establishment of Names of Organic Acids" *ZhRfKhO* 25:10.

- Miller, M. A. (1970) "Ideological Conflicts in Russian Populism: The Revolutionary Manifestoes of the Chaikovsky Circle, 1869-1874." *Slavic Review* 29:1-21.
- Morrell, J. B. (1972) "The Chemist Breeders: The Research Schools of Liebig and Thomas Thomson." *Ambix* 19:1-46.
- Morrissey, S. K. (1998) *Heralds of Revolution: Russian Students and the Mythologies of Radicalism*. Oxford: Oxford University Press.
- Pickering, A. (1995) *The Mangle of Practice: Time, Agency, and Science*. Chicago: University of Chicago Press.
- Riese, R. (1977) *Die Hochschule auf dem Wege zum wissenschaftlichen Großbetrieb: Die Universität Heidelberg und das badische Hochschulwesen, 1860-1914*. Stuttgart: Ernst Klett.
- Riskin, J. (1998) "Rival Idioms for a Revolutionized Science and a Republican Citizenry." *Isis* 89:203-232.
- Roche, A. J. (1993) *The Quiet Revolution: Hermann Kolbe and the Science of Organic Chemistry*. Berkeley: University of California Press.
- . (2001) *Nationalizing Science: Adolphe Wurtz and the Battle for French Chemistry*. Cambridge, MA: MIT Press.
- Rottenburg, R. (1996) "When Organization Travels: On Intercultural Translation." In *Translating Organizational Change*, edited by B. Czarniawska and G. Sevón. Berlin: Walter de Gruyter. pp. 191-240.
- Ruane, C. (1994) *Gender, Class, and the Professionalization of Russian City Teachers, 1860-1914*. Pittsburgh: University of Pittsburgh Press.
- Savchenkov, F. (1870) "Istoricheskie materialy po russkoi khimicheskoi nomenklature Historical Materials on Russian Chemical Nomenclature." *ZhRFkO* 2:205-212.
- Schulze, L. (1985) "The Russification of the St. Petersburg Academy of Sciences and Arts in the Eighteenth Century." *British Journal for the History of Science* 18:305-335.
- Thomas, L., and D. Wulff. (eds) (1992) *Deutsch-russische Beziehungen: Ihre welt-historischen Dimensionen vom 18. Jahrhundert bis 1917*. German-Russian Relations: Their World-Historical Dimensions from the 18th Century to 1917. Berlin: Akademie Verlag.
- Tuchman, A. (1993) *Science, Medicine, and the State in Germany: The Case of Baden, 1815-1871*. New York: Oxford University Press.
- Twain, M. (1880/1997) *A Tramp Abroad*. New York: Penguin Books.
- Venturi, F. (1960) *Roots of Revolution: A History of the Populist and Socialist Movements in Nineteenth Century Russia*. Chicago: University of Chicago Press.
- Volhard, J. (1870) "Die Begründung der Chemie durch Lavoisier. The Founding of Chemistry through Lavoisier" *Journal für praktische Chemie Journal for Practical Chemistry* 110, N.F. 2: 1-47.
- Volkova, V. (1950) "Russkoe fiziko-khimicheskoe obshchestvo i Petersburgskii-Leningradskii universitet. The Russian Physico-Chemical Society and Petersburg-Leningrad University" *Vestnik Leningradskogo universiteta Leningrad University Courier* 5:120-125.
- Vucinich, A. (1963) *Science in Russian Culture: A History to 1860*. Stanford: Stanford University Press.
- . (1976) *Social Thought in Tsarist Russia: The Quest for a General Science of Society*. Chicago: University of Chicago Press.
- Wildman, A. K. (1960) "The Russian Intelligentsia of the 1890's." *American Slavic and East European Review* 19:157-179.
- Wurtz, C. A. (1868) *Dictionnaire de chimie pure et appliquée* (Dictionary of Pure and Applied Chemistry). Paris: Hachette.