

7-1-2000

Police Chemistry

Andre Wakefield
Pitzer College

Recommended Citation

Wakefield, Andre. "Police Chemistry." *Science in Context* 13.2 (Summer 2000): 231-267. doi: 10.1017/S026988970000380X

This Article is brought to you for free and open access by the Pitzer Faculty Scholarship at Scholarship @ Claremont. It has been accepted for inclusion in Pitzer Faculty Publications and Research by an authorized administrator of Scholarship @ Claremont. For more information, please contact scholarship@cuc.claremont.edu.

R. ANDRE WAKEFIELD

Police Chemistry

The Argument

Johann von Justi, the foremost literary cameralist of his generation, served as chief police commissioner in Göttingen between 1755 and 1757. While in Göttingen, Justi offered lectures at the university on the “oecconomic, police and cameral sciences.” He also arrested vagrants, wrote on chemistry, disciplined unruly students, conducted chemical experiments, supervised the pricing of Göttingen’s staple goods, engaged in a public controversy with a prominent Berlin chemist, edited and published a bi-weekly periodical (*Göttingische Policey-Amts Nachrichten*), and worked with the university’s curator to refashion the academic structure of the sciences. Taken together, these various activities reflected his broad vision for social and academic change, a vision with important implications for the form and content of the sciences. Drawing on archival material in Göttingen, on articles from the *Policey-Amts Nachrichten*, and on Justi’s other cameralist and chemical writings, I use his everyday experiences as a local police official to explore the meaning of his chemical work. I argue that Justi’s chemistry was suffused with the cameralist dreams and ambitions of a small-town police commissioner. It is what I call police chemistry.

The lands of eighteenth-century Central Europe saw the birth of a new administrative elite. Improvement-minded territorial governments, increasingly ambitious about the material advancement of their lands and the effective control of their subjects, worked to educate a cadre of skilled cameral and police officials. During the second half of the eighteenth century, universities and academies began to foster this new species of state official, the professional cameralist, on a diet of natural sciences.¹ Patterning itself on the existing professional faculties — theology, law, and medicine — cameralism sought to enlist auxiliary sciences, or *Hilfswissenschaften*, in the service of professional training. Botany and chemistry, the most prominent of cameralist *Hilfswissenschaften*, intermingled with the core

¹ Here, and in what follows, I understand cameralism as an aspiring eighteenth-century profession, and cameralists as its advocates and practitioners. The oeconomic (see following note), police, and cameral sciences, in turn, I regard as the triad of foundational sciences for this young profession. Moreover, I distinguish cameralists — the improvement-minded champions of an aspiring profession — from cameral administrators (i.e., those who staffed the treasuries, collegia, and other cameral bureaus of Central Europe’s fiscal-military states). This approach differs from most existing scholarship on the subject, which tends to view cameralism as a science or a body of writings. I explore the issue more completely in section 2, below.

cameralist disciplines of police and oeconomy.² The resulting hybrid sciences united cameralism with the natural sciences. Police chemistry was such a hybrid science.

The deep eighteenth-century linkages between *Policey* and chemistry remain largely unexamined.³ At least two scholars, however, have noted the importance of cameralism for the development of eighteenth-century chemistry. Karl Hufbauer, in his study about the formation of the German chemical community between 1720 and 1780, noted that cameralists like Justi and Daniel G. Schreber helped to disseminate a “rational-utilitarian” image of chemistry. This in turn helped to represent chemistry as an important and useful science and ultimately served to establish the preconditions for creating a “national discipline-oriented community” of chemists in Germany (Hufbauer 1982, 12–29, 62). Cristoph Meinel extended and modified Hufbauer’s argument, claiming that cameralism was crucial to chemistry’s transformation from lowly *Hilfswissenschaft* for the “medico-pharmaceutical profession” to an autonomous discipline. Meinel argued that Georg E. Stahl and his disciples inserted chemistry into the oeconomic-cameralist programs of state reform, hoping to harness its academic future to the cameral sciences. This “strategy of institutionalization” was so successful, according to Meinel, that chemistry benefited greatly — more than any other natural science — from its connection to cameralism. The connection between chemistry and cameralism in the middle of the eighteenth century, he concluded, was comparable in scope and importance only to the connection between chemistry and medicine a century earlier (Meinel 1985, 25–26, 36–41).

By the end of the 1980s, it seemed the time had come for a closer examination of cameral chemistry and utilitarian science generally. Hufbauer’s research had generated interest in the national and institutional settings of eighteenth-century chemistry, and Meinel’s contribution had suggested the importance of the Enlightenment’s “rational-utilitarian” strains in liberating chemistry from its status as an auxiliary science to medicine (Hufbauer 1982; Meinel 1983, 1985). Their work, in turn, prompted Jan Golinski to investigate the contours of utilitarian science in eighteenth-century Britain (Golinski 1988).

But the direction of research began to change course at the end of the decade with the appearance of Frederic L. Holmes’s *Eighteenth-Century Chemistry as an Investigative Enterprise* (Holmes 1989). Arguing that historians still identified eighteenth-century chemistry “more by what was missing than what was present,”

² I translate “*Oeconomie*,” which had more in common with householding and agriculture than it did with economy, as “oeconomy” throughout. For more on the term and its eighteenth-century connotations, see Tribe 1988, 23–25, 35–54.

³ Though Pamela Smith has examined the profound interactions between chemistry and early cameralism in the seventeenth century (Smith 1994), the eighteenth-century part of that story has yet to be written. Most of the scholarship on eighteenth-century chemistry involves Lavoisier (see Holmes 1989; *Isis Current Bibliography* 1989–97). Those with other research interests in eighteenth-century chemistry have tended to concentrate on the Paris Academy (see e.g. Holmes 1989; Klein 1994, 1996) or on Britain (see Golinski 1992).

and that historians had largely ignored experimental practice, Holmes shifted the discussion, carefully reconstructing the internal features of the pre-Lavoisier chemical world (*ibid.*, 6, 17). After that, the *Académie royale des sciences*, with its collection of chemical celebrities — Homberg, Lemery, Geoffroy, etc. — began to receive more attention (*ibid.*; Klein 1994, 1996; Roberts 1991, 1993). Moreover, during the last decade affinity tables, epistemic objects, conceptual frameworks, technologies of assent, material cultures and experimental practices seem to have displaced questions about utility and power (Holmes 1989; Golinski 1992; Klein 1994, 1996; Roberts 1991, 1993; Riskin 1998).

Perhaps now, armed with the knowledge gained from the careful studies of the past decade, it is time to return to some of the older questions. William Clark's recent work about the imposition of cameralist "ministerial-market rationality" on German academics points the way. Clark has demonstrated how, during the eighteenth century, the everyday practices of government ministries gradually altered the nature of academics and academic knowledge (Clark 1996). Chemistry was not immune to these changes. University professors, for example, felt the increasing pressure of ministerial expectations. Powerful officials like Gerlach Adolph von Münchhausen in Göttingen and Johann Peter Ludewig in Halle could exert enormous pressure on the occasional starving professor in need of a raise. And they often did.

In the mid-eighteenth century, these officials became increasingly interested in good police, and the territorial governments of Central Europe began to appoint an increasing number of officials to positions such as *Policeydirektor*, *Policeykommissar*, and *Policeyinspektor* (Knemeyer 1980, 183). The traditional promulgation of myriad ordinances dedicated to the maintenance of order in the community, so typical between the fifteenth and seventeenth centuries, gave way to more activist forms of police (*ibid.*, 172–73; Raeff 1983). *Policey*, which now joined a concern for welfare and prosperity to its older concern with order, became an important weapon in the arsenal of state-building (see Lehmann 1980; Vierhaus 1984; Hinrichs 1986). The increasing prominence and expanding jurisdiction of *Policey* generated concern about the cultivation of skilled police officials. Who would train these people? In Göttingen, Münchhausen, who was convinced about the value of good police, supported university training in the economic, police, and cameral sciences (StadtArchGö.1 1750–55; UniArchGö.6, 1735–36; UniArchGö.13, 1763). His decision to invite Johann von Justi to Göttingen in 1755 had the two-fold aim of improving Göttingen's police and adding lectures in the cameral sciences to the university's course offerings (UniArchGö.8 1755, 24–25).

Justi devoted considerable time to chemistry after his arrival in Göttingen. And though his chemical work never achieved the same level of recognition as that of such Berlin academicians as Andreas S. Marggraf, Johann H. Pott, or Johann T. Eller, he was nevertheless considered an accomplished chemist (Gmelin 1797–99; Pott 1757, 4; Pott 1760, 23). Given the paucity of good work on the luminaries of eighteenth-century chemistry, it may seem perverse to study the work of that

century's lesser chemical talents. By focusing on the chemical writings of Central Europe's most prominent police-cameralist, however, I intend to offer a new perspective on the relationship between cameralism and chemistry.

1. *Gute Policey*

In February of 1757 the founding father and curator of Göttingen's *Georg-August Universität*, Gerlach Adolph von Münchhausen, received the following letter from Göttingen's chief police commissioner.

I send Your Excellency, in the enclosed, the names of those who are unfit for the position of police assistant. And I remain my life long, with the most perfect deference and gratitude, Your Excellency's humble servant,
 Johann Heinrich Gottlob von Justi.

[Enclosure]

3/ Johann Heinrich Kleinschmidt, is an idle and lazy person.

8/ Johann Georg Weitekamp, is too simple and awkward.

10/ Johann Wilhelm Lütje, is consumptive and sickly.

11/ Tobias Riemenschneider, is given to drink, lazy, simple, and completely unqualified.

13/ Georg Andreas Kaufmann, is reputedly an idle and lazy man.

15/ Daniel Polle, is very attached to schnapps and is always lying around the pharmacy. (UniArchGö.12 1757, 10–11)

Police Commissioner Justi was frustrated. All his efforts to hire useful staff had been blocked by Göttingen's town council. In 1756, for example, the council had completely ignored Justi's personal recommendations, appointing instead "the worst of all the candidates," a man who "sits day and night at the gambling tables, as is well known." Now the second police assistant, Hildebrandt, had died "from drinking too much schnapps," leaving another vacant position. Justi therefore asked Münchhausen to intercede with Göttingen's town council and "to reject those whom I deem unsuitable." The authorities in Hanover followed Justi's advice. "You will," the ministry wrote to Göttingen's town council a few days later, "not consider Joh. Heinr. Kleinschmid, Joh. Georg Weitekamp, Joh. Wil. Lütje, Tobias Riemenschneider, Georg Andreas Kaufmann, and Daniel Polle at the upcoming vote" (*ibid.*, 8).

Justi had come to Göttingen in 1755, soon after the publication of his cameralist textbook *Staatswirthschaft*. Good police (*gute Policey*), he explained in that work, should establish the conditions under which the people would be useful and productive. This meant, among other things, that the state could not afford to tolerate lazy, sickly, disorderly, schnapps-drinking burghers. "Useless and burdensome members of the community," Justi wrote, "diminish the powers of the

state since they consume a part of its wealth without being of any use" (Justi 1755b, 50). Idle, useless, burdensome people also set a poor example for the rest of the community, and Justi's new regime of policing aimed to root out the threat at its source through aggressive oversight and punishment. In December of 1755 Justi took his police principles to the streets. He arrested a seemingly innocuous beggar named Kretzer and suggested that the ministry make an example of the man by handing him over to the criminal courts for "harder punishment" (UniArchGÖ.10 1755, 1–4).

In the summer of 1756 Justi reached beyond the good burghers of Göttingen and into the university community itself. He complained that a band of unruly students was terrorizing the once quiet neighborhoods around Göttingen. Led by two students, la Pic and la Peine, the band had insulted the municipal guard and abused "honest people" in the streets at night. The group had passed through Justi's own neighborhood, stopping in front of *Amtmann* Hiepen's house "this past Sunday night between 10 and 11 o'clock," and shouting shameful things about Mademoiselle Hiepen. They stopped in front of Hiepen's house again the next night, singing "the most shameful songs." And they came through again the night after that "screaming, shouting, and singing in the streets." Though he had no direct jurisdiction over university students, Justi felt that his orders from the privy council to maintain "the nightly peace and order" warranted his direct involvement in the matter. Accordingly, he urged Prorector Ayrer to expel la Pic and la Peine from the university and remove them from town (HandAbtGö.3 1756, 138–39; Frensdorff 1901, 520).

But Justi's ambitions extended well beyond the denizens of one small university town. He not only sought to discipline burghers and students but also aspired to become a policeman of knowledge. He aimed to refashion the existing academic structure of the sciences by reforming the faculties and their auxiliary disciplines. Due to Münchhausen's personal efforts, Justi obtained permission to offer "oeconomic and cameral courses" at the university, which gave him the opportunity to act on his ambitions. And so he did, advertising his Göttingen lectures with a sweeping attack on the existing structures of academic knowledge, an attack that elaborated on arguments from the preface of his *Staatswirthschaft*.

"Human knowledge," Justi argued, "is necessary, or it is only useful, or it is merely charming and amusing (*bloßergötzlich und anmuthig*)." The useful sciences included "the knowledge of nature and the greater part of the sciences which are to be found in the philosophy faculty." But Justi added an important proviso: the sciences of the philosophy faculty remained useful only so long as professors avoided "elaborate subtleties" and "the invention of knowledge-structures that are merely possible, but whose actuality cannot be proven, something not at all uncommon in metaphysics, astronomy and certain other of the philosophical sciences." Justi's police-cameralist calculations of utility banished such "subtle" sciences to the realm of the merely charming and amusing. If one measured the value of a science purely according to its charm or interest, he cautioned, then the

“stupidest kind of alchemy, chiromancy, and other foolish sciences would be on a par with the most useful knowledge.” These *ergötzliche und anmuthige Wissenschaften*, he claimed, “have no relation to our duties but simply multiply our ideas and extend our knowledge. . . . They regard us merely as thinking beings, and insofar as they fill our spirit with knowledge, they please it” (Justi 1755b, ix–xi). His blacklist of charming and amusing sciences included not only metaphysics, literature, philology, and alchemy but also the higher forms of astronomy and mathematics.

The metrologist (*Meßkünstler*),⁴ the astronomer, sees his science, especially the higher aspects of the same, as the most noble and sublime kind of human knowledge. He speaks with rapture about what a stroke it would be for a thinking being if he could at once measure the immeasurable heavens and discover the laws of motion to which the Creator has bound so many worlds. And maybe, if only each successor didn’t chuck out what his predecessor is supposed to have discovered, one could forgive him his raptures. . . . The metaphysician, when his imagination has penetrated into the primordial corpuscles of substance, into the bond between body and soul — and perhaps even further — believes that he is engaged in the most splendid science. And he forgets that these are merely his fairy tales . . . and that the *origin of corporeal things and the essence of creation will always remain hidden from human knowledge.* (Ibid., x–xi)

A consistent commitment to such useless sciences as metaphysics and higher astronomy, Justi argued, had generated sweeping disdain for universities and professors. Accordingly, the learned (*Gelehrten*) generally failed to obtain important posts in the government. Rather, it was the *Ungelehrten*, those onetime “footmen, flatterers, clerks, ordinary hunters, petty tax collectors and the like,” who rose to the most important and lucrative state offices. Not that Justi found anything especially unfair in that, since these “unlearned” men had worked to gain useful and practical knowledge while university professors merely cultivated their useless sciences. Nor could one blame the sovereign or his ministers for the success of the *Ungelehrten* within the cameral bureaus of Central Europe’s territorial states. “My God! What could a regent or a prime minister do with the most profound metaphysician, the greatest metrologist, the most famous astronomer, or the most thorough archaeologist (*Altertümerkennner*) in the business of state?” (ibid., xxii–xxiii)

Justi’s attacks on academic uselessness and pedantry carried significant moral overtones. Profound metaphysicians and astronomers, those caught up in fictitious

⁴ Metrology could refer to an array of measuring techniques: “Meßkunst, *arpentage, mesurage, geometria practica, mensoria, ist die Wissenschaft allerley weiten, höhen, tieffen auszumessen, selbige aufzunehmen, und auf das Papier zu tragen, oder von dem instrument ins Feld abzustecken*” (Zedler 1732–50, 20:1203). In this context, however, Justi was more particularly concerned about the applications of celestial mechanics.

worlds of their own making, were guilty of neglecting their duties as state officials. For Justi, useless science was at bottom selfish science, living parasitically, like the common idler or drunk, from the labor of a productive society. Göttingen's useless professors, the *la Pics* and *la Peines* of academic life, deserved expulsion from town and university. These useless learned, alone in their studies and divorced from the productive society that sustained them, created fancy systems of no interest to anyone but themselves. Metaphysicians, philologists, and astronomers were the beggars, gamblers, and drunkards of the academic world. Self-absorbed and deluded, they fed off productive society. Useless professors and their useless sciences needed policing.

2. Chemistry and Cameralism

Most secondary literature presents cameralism not as a profession but as a body of thought with a well-defined literature. Albion Small, for example, defined cameralists as "a series of German writers, from the middle of the sixteenth to the end of the eighteenth century, who approached civic problems from a common view point" (Small 1909, vii–viii). Karl Marx considered cameralism "a silly mish-mash of notions inflicted on aspiring bureaucrats" (Marx 1961–74, 23:19). Others have approached cameralism as a variant of mercantilism, a baroque science, a science of praxis, or a university discipline.⁵ A small number of scholars, however, have suggested that cameralism behaved more like an early modern profession than a science. While Meinel has compared cameralism with medicine, R. Steven Turner has claimed that cameralism "came close" to achieving the status of theology, law, and medicine (Turner 1987, 62). Others, especially those who focused on the struggle between jurists and cameralists during the latter half of the eighteenth century, have also noticed its professional aspirations (Bleek 1972).

Approaching cameralism as a profession, however, presents certain problems. Some historians of eighteenth-century medicine, for example, have expressed doubt about the value of most professionalization literature for their subject, arguing that it often introduces preconceived notions from another disciplinary tradition (i.e., sociology) into the histories we write and employs assumptions wholly inappropriate to the eighteenth century (Lindemann 1996, 18–19; Broman 1996, 1–3). In view of these problems, Thomas Broman has suggested that we tie early modern professional status exclusively to the three higher faculties of the university. This "minimalist" approach restricts the early modern professions to only three: theology, law, and medicine. Broman follows Turner in emphasizing

⁵ On mercantilism see Schmoller 1910, 50–51; also Heckscher 1955. On cameralism as baroque science, mode of thinking, or system of principles, see Walker 1971, 145; Outram 1995, 102–4; Brückner 1977. A few authors have acknowledged practice more explicitly. See e.g. Schumpeter 1954, 159–60; or, more recently, Lindenfeld 1997. The most complete and thorough overview of cameralist literature remains Tribe 1988.

the status conferred by a professional degree in the eighteenth century. Membership in an early modern profession, he argues, had more to do with what kind of *person* one was than with what kind of *work* one did. The early modern professional degree, more than anything, guaranteed membership in the class of learned gentlemen, the *Gelehrtenstand* (Broman 1996, 7; Turner 1980, 62).

In the context of this “minimalist” approach to the professions, what can it mean when a pretender like cameralism “comes close” to breaking the centuries-long monopoly over professional status? Neither traditional learned profession nor modern discipline, cameralism spanned the divide between the jealous faculties of the old order and the autonomous disciplines of the new, bridging the gap between “modern” forms of disciplinary organization and older faculty-based structures of knowledge. The aspiring new profession, that is, served as a hybrid agent of transition. While turning its back on many of the traditional trappings of *Gelehrt-samkeit* — Latin eloquence, attachment to antiquity, encyclopedic erudition — cameralism still aimed to glean advantages from attaching itself to the *Gelehrt-stand*. As an aspiring professional faculty, moreover, cameralism sought to shape and control its auxiliary sciences, and its designs on certain auxiliary sciences were to bring the young profession into direct conflict with the established higher faculties.

As a rule, historians have emphasized the struggle between cameralism and law during the second half of the eighteenth century (see e.g. Bleek 1972). But where issues of jurisdiction over the natural sciences were concerned, cameralists more often came into conflict with medicine. Without exception, cameralist reform stressed significant training in the natural sciences, especially chemistry and oeconomic-botany (see Tribe 1988, 91–118). Most cameralist curricula — both proposed and actual curricula — that appeared between 1750 and 1780 relied every bit as much on the natural sciences as did medicine. Still, most scholars, even those who have noted the preponderance of natural-scientific knowledge in cameralist curricula, have persisted in regarding the natural sciences as somehow peripheral to the cameral sciences proper (Small 1909; Tribe 1988, 114–17).

Cameralism’s claims on chemistry and botany in particular tended to provoke consternation among professors of medicine. As one of medicine’s traditional auxiliary sciences, chemistry remained closely bound to the rights and interests of academic medical faculties until the end of the eighteenth century (Broman 1996, 28–29, 36). Even after 1780, members of the lower faculty often needed permission from the medical faculty to offer courses in chemistry (Hufbauer 1982, 209–10). Moreover, those who wished to study metallurgical or technical chemistry at the university usually had to join the medical faculty, even when, as in the case of Johann Andreas Cramer, anatomy courses made them sick (*ibid.*, 181). The issue was one of jurisdiction. Medical faculties jealously guarded their traditional rights over auxiliary sciences. In challenging those rights, academic cameralists could and did provoke conflict with professors of medicine. In 1767, for example, Justi’s successor, Johann Beckmann, angered Göttingen’s medical faculty by presuming

to offer courses in oeconomic-botany without the explicit consent of the medical faculty. Beckmann was prohibited from offering the course after the medical faculty insisted on its statutory privileges (UniArchGö.4 1767, 17–18). In Uppsala, oeconomic reform helped create the first independent professorship of chemistry in the lower faculty, a development that Linnaeus and his colleagues in the medical faculty bitterly opposed (Meinel 1985, 29–30).

These examples seem to support Meinel's claim that cameralist reform helped to liberate chemistry from the fetters of a stubborn medical profession. But Meinel's perspective is that of a chemist. Things looked altogether different to cameralists, who had no intention of freeing chemistry. They intended, rather, to subject it to a new master. Like medicine, that is, cameralism sought to shape and control its auxiliary sciences.

3. Justi in Göttingen

Let us return now to Göttingen. The year is 1755 and Münchhausen has just offered Justi a position as Göttingen's chief police commissioner, despite the latter's record as a bragging, troublemaking imperial mining councilor (UniArchGö.8 1754, 26–27, 34–36). Münchhausen's offer would have important ramifications. Justi was after all the foremost literary cameralist of his generation, and Münchhausen wielded enormous power at the period's preeminent Central European university. Together they began to rethink and refashion the existing structures of knowledge. Moreover, they took aim at the *kinds* of knowledge appropriate for university instruction. Justi, as we have seen, considered such sciences as higher astronomy and metaphysics too "subtle" and self-indulgent for university instruction. He proposed, therefore, that the sciences of the lower faculty, especially the natural sciences, be reorganized and refashioned to serve cameralist purposes. Most important, his plan involved an entirely new "arrangement of the faculties" (Justi 1755a, 10).

The existing professional faculties of theology, law and medicine would be supplemented by a new one: a Faculty of Oeconomic and Cameral Sciences (*ibid.*, 10).⁶ The professors of this new faculty would need to be skilled in many areas: forestry, manufactures, taxes and contributions, chemistry, etc. "The professor of chemistry would be chosen so that he could lecture on assaying and smelting, and not just the preparation of medicaments. . . the teacher of mechanics would be able to lecture on mining machinery, and the professor of *Naturkunde* would need adequate knowledge about the essence of ores and of deposits (*Fossilien*)." There would be six teachers in all, "to which one might add a teacher of civil and military

⁶ Though many eighteenth-century cameralists laid out plans for cameral faculties and academies, especially after 1760, Justi was an early proponent of institutionalization. Daniel Gottfried Schreber's 1763 outline for a course of study in the oeconomic sciences served as a model for the first cameral college, the *Kameral-Hohe-Schule* in Lautern, which opened in 1774 (Tribe 1988, 91–118).

engineering.” Not only would the new faculty train skilled cameral officials, but it would offer “advice for the many institutions and undertakings of the state for which one must often turn to foreigners at great expense” (Justi 1755b, xxxi–xxxiv).

It was a vision that Justi shared with Münchhausen.⁷ Their imagined fifth faculty would train a new breed of professional, the university-educated cameralist, to manage Central Europe’s rapidly expanding network of bureaucratic institutions. Cameralist reformers believed that the traditional higher faculties had become increasingly irrelevant to the world inhabited by most cameral and police officials. Of what use was extensive legal training to the mining official or the forestry inspector? What good was an education in theology or medicine for the factory overseer or the tax official? Perhaps most importantly, none of the existing faculties offered the right kind of training in the natural sciences. Jurists and theologians received at best only a smattering of natural philosophy from their preparatory studies in the lower faculty. And though medicine provided training in the natural sciences, especially botany and chemistry, medical faculties generally failed to provide appropriate training for future mining councilors, forestry inspectors, tax officials, and the like.

Events in Göttingen formed part of a larger pattern. The years between 1727 and 1780 saw steadily increasing institutional support for cameralism. When Frederick William I of Prussia established the first university chairs in the cameral sciences — his so-called “*Oeconomie-Profession*” — at his universities in Halle and Frankfurt an der Oder in 1727, the intention was to create a new breed of university-trained professional (Ludewig 1727). By mid-century, Münchhausen’s efforts to build a separate oeconomic faculty in Göttingen had already moved beyond the Prussian model (UniArchGö.8 1755, 24–25; UniArchGö.3 1766, 43–50; Frensdorff 1901). A decade later, soon after the end of the Seven Years’ War, the oeconomist Schreber proposed a plan for a separate cameral academy. His plan sketched a curriculum for training cameralist administrators and outlined the requirements for an imagined cameralist faculty. In addition to one “Professor of Cameral Sciences or Oeconomics,” Schreber’s faculty would include professors responsible for teaching chemistry, natural history, mineralogy, mathematics, and physics, and related courses on commerce, factories, and manufactures (Schreber 1763, 417–436; Tribe 1988, 92–94). The trend continued between 1765 and 1770, as the perceived failure of the universities to provide adequate technical-cameralist

⁷ Münchhausen’s efforts to establish a fourth professional faculty encountered considerable resistance from prominent Göttingen professors of law and medicine. In the end even Münchhausen, the most powerful university administrator in Central Europe, proved unable or unwilling to contravene directly the wishes of Göttingen’s higher faculties. Contemporaries around Europe were familiar with Münchhausen’s efforts in this regard. When the first university Faculty of Oeconomy was established at the University of Giessen, for example, Friedrich Casimir Medicus, founding father of the Cameral College in Lautern, considered it a giant step, especially since Münchhausen himself had proven, as he put it, “too weak to do so in Göttingen” (Medicus to Friedrich Carl von Moser, letter of 25 June 1777; reprinted in Stieda 1906, 325). On Giessen see also Klippel 1995.

training for mining administrators prompted the establishment of several Central European mining academies (Freiberg [1765], Berlin [1770] and Schemnitz [1770]; (GehStaatArch.1 1770, 10; Wagenbreth 1994, 26). Many prominent cameralists were involved in the founding of the mining academies. Justi, for example, who came to Göttingen as a “mining councilor” (*Bergrath*), had been among the most vocal proponents of such mining academies.⁸ Moreover, the first textbook for the Imperial Mining Academy in Schemnitz (Hungary), written by Justi’s half-brother Christoph Traugott Delius, included a special appendix on the nature and value of “*Bergkammeralwissenschaft*” (Delius 1773). By 1770 cameralist reform reached its peak, as manifested in the birth of the Cameral College in Lautern (1774), the first institution of its kind, and the establishment of an official Oeconomic Faculty at the University of Giessen (1777) (Lowood 1991, 312–21; Tribe 1988, 101–10; Klippel 1995). Each of these instances — mining academies, cameral colleges, university faculties — represented a specific institutional outgrowth of the pressures exerted by cameralist reform.

Justi was among the first to propose the establishment of a separate cameralist faculty. In Göttingen, and with Münchhausen’s support, he began to work toward that goal. He offered a series of lectures in the oeconomic and cameral sciences at the university (Justi 1755b), worked as a local police official (UniArchGö.8 1755–57; UniArchGö.9 1755), provided advice and assistance to the Göttingen Royal Society on matters of oeconomy and oeconomic-chemistry (AkArchGö.1 1755; AkArchGö.5 1755; AkArchGö.2 1756; AkArchGö.3 1756), and began publishing an official bi-weekly police periodical, the *Police Department News* (*Göttingische Policey-Amts Nachrichten*), in 1755 (HandAbtGö.2 1755, 488; Justi 1755–57 [1755], 1–3). Together, these activities embodied Justi’s professional vision. He had begun to fashion himself, that is, as the ideal police-cameralist.

4. Police Chemistry

Justi dedicated his *Police Department News* to the improvement of the “*Nahrungsstand*,” a term he used to denote society’s laboring classes. The *Nahrungsstand* consisted of three major groups: (1) those, like miners and farmers, who cultivated and extracted raw materials; (2) those, like manufacturers, who worked upon raw materials; and (3) those, like merchants and shopkeepers, who traded raw and finished goods (Justi 1755–57 [1756], 93).⁹ It was the central organizing category of his police-cameralist program.

⁸ Justi taught the mining sciences at the Theresianum in Vienna and claimed to have discovered a new type of silver-bearing ore in the mountains of lower Austria. The title, *Bergrath*, however, may have been of his own making (UniArchGö.8 1755, 34–36; Frensdorff 1903, 375–83). He later became a Prussian *Berghauptmann* for Frederick the Great (Frensdorff 1903, 441–43).

⁹ The term has proven a difficult one for Justi’s assorted translators and interpreters. Albion Small translated *Nahrungsstand* as “laboring class,” while Keith Tribe has rendered the term as “state of subsistence” (Small 1909, 379; Tribe 1988, 76). The clearest definition of the term I have encountered

The *Nahrungsstand* is the driving engine of the great machine of the state. Each occupation must assume its proper place therein and contribute as much to the movement of the whole as the well-being of the commonweal demands. Each type of occupation (*Nahrungsart*) must constantly serve to support and further the others, and none may be detrimental or burdensome to the others. Many laws and regulations are needed in order to maintain this crucial coherence (*Zusammenhang*) of the *Nahrungsstand*, and these laws are the object of police. (Ibid., 89)

Justi's "machine of state" was no mere abstraction. Through his experience as *Bergrath* in the Habsburg imperial mines, Justi had become acquainted with some of the most elaborate machines of his day. Many of the most advanced of eighteenth-century mining operations still relied on waterpower as a source of energy. The intricate machines built to harness that power — in the Saxon mining regions around Freiberg, in the Hanoverian mines of the Harz mountains, in the imperial Hungarian mines near Schemnitz — were the technical marvels of their time (Wagenbreth 1994).

Labor was the waterpower driving Justi's metaphorical machine of state. The energy of the *Nahrungsstand* — cultivating, extracting, manufacturing, trading — became reflected in exchange, and circulating coin was the vehicle of that energy. Like the mining engineer, the police official had to design and construct a machine. Police-cameralists, that is, had to engineer the ideal *Nahrungsstand* by constructing the social machine best able to harness the collective energy of its members. *Gute Policy*, the dream of every police-cameralist, would arrange and direct the mass of society — its merchants, peasants, burghers, craftsmen, manufacturers — in the most productive possible way.

Accordingly, Justi divided the state into two great realms: the directors and the directed, *Gelehrtenstand* and *Nahrungsstand*. The health of the *Nahrungsstand* depended on "the industriousness of the people" on the one hand and the "rational direction and leadership of all *Nahrungsarten* and occupations" on the other (Justi 1755–57 [1756], 89). The countless members of the *Nahrungsstand*, that great mass of productive activity, existed on one side of the great divide. The *Gelehrtenstand*, learned professionals and state officials, the keepers of knowledge and lords of direction, existed on the other. Neither realm could subsist alone. The "directive class" of *Gelehrten* and state officials would remain sterile without the *Nahrungsstand*, and the *Nahrungsstand* would remain a chaotic mess of productive activity without proper direction and control. A *Nahrungsstand* without direction was blind; a *Gelehrtenstand* without productive activity was empty. Police-cameralists mediated these two worlds.

in any of Justi's writings renders *Nahrungsstand* as the commercial, agricultural, and manufacturing class of the population (Justi 1755–57 [1756], 89). Nevertheless, Justi uses the term elsewhere in ways that suggest it could also mean "state of subsistence" or "level of prosperity."

Justi's *News*, as an organ of good police, was itself a mediating instrument between *Gelehrtenstand* and *Nahrungsstand*. Each issue would include four parts:

1. "Learned essays for the benefit of the *Nahrungsstand*"
2. Police ordinances from the local Göttingen "Police Directorate" (i.e., Justi)
3. The fixed-prices (*Policey-Taxen*) of various staple goods;
4. "All manner of advertisements and news" (Ibid. [1755], 1)

Each part was subject to a single criterion: it must benefit the *Nahrungsstand* in some way. Justi believed that most periodicals (*Intelligenzblätter*) like the *News* were filled with all manner of learned garbage, and he questioned "of what use treatises on history, antiquity, old coins, jurisprudence, and even philosophy (*Weltweisheit*) and theology are supposed to have for those concerned with the trades." Accordingly, he promised that the "learned essays" in each week's *News* would not suffer from the pedantry and irrelevance of *Gelehrsamkeit*. The only objects of importance to the *Nahrungsstand*, and therefore to the *News* as well, were "commerce, manufactures, factories, handicrafts, brewing, gardening, agriculture, and other subsistence occupations (*Nahrungsgeschäfte*) in town and country" (ibid., 1–2).

The second part of the *News* would include those local police ordinances judged to be of special importance to the *Nahrungsstand*. The third part, which included set prices for various staple goods (see fig. 1), would appear in every issue since, for Justi, the maintenance of correct and reasonable prices was crucial for the well-being of the *Nahrungsstand*. Even part four, containing advertisements and news of local interest, remained subject to the overall strictures of the *News*: "one will accept no news about servants or lost knick-knacks," Justi wrote, "since these things really don't belong to the promotion of the *Nahrungsstand*" (ibid., 2–3).

Together, the four parts of Justi's *News* aimed to link Göttingen's government officials and *Gelehrten* with the area's merchants, farmers, and manufacturers; to establish and impose control-oriented knowledge upon a seemingly chaotic realm of productivity. With its bi-weekly juxtaposition of chemical treatises and police ordinances, oeconomic-botanical essays and price tables, the *News* became an embodiment of Justi's cameralist vision. Learned essays about lixivial salts appeared next to police ordinances about vagabonds and obstructed walkways. Treatises on smelting and assaying appeared alongside the weekly prices for bread and carp. Sometimes the linkages between the learned essays and the police ordinances were explicit — as, for example, when Justi followed his essay about the harmful effects of door-to-door sales (*Hausirengehen*) with a police ordinance prohibiting *Hausirengehen* (Justi, 1755–57 [1755], 73–75). Other issues of the *News* linked the price tables with the police ordinances. The July 7 issue in 1755, for example, scolded local butchers for ignoring the published price controls and warned them to stop abusing customers who insisted on the official prices (Justi ibid., 5–7).

8. III. **Polizei-Taxen und Marktpreise.**

1. Brodtaxe vom 5ten Julii an.						3. Fruchtpreise den 5. Julii.				
		Soll wägen								
		mgr.	pf.	Pf.	Sch.	gr.	bet.	rthlr.	mgr.	pf.
Weizenbrod	-	1		2	1	3			37	
von besten	-	4		9	3				27	
Wehl vor	1			19	2				15	
Weizenbrod	-	4		12		3			9	
von zweyten	-	4		24	1	2				
Wehl vor	1									
Frantzbrod von	-	4		8	2					
Weizenmehl	-	4		17						
vor	1									
Frantzbrod halb	-	4		12	1	1				
Weizen und	-	4		24	2	2				
Knocken vor	1									
Knockenbrod von	-	4		18		2				
besten Wehl	1			1	4	1				
vor	1	4		1	22	1	2			
	3			3	12	3				
Knockenbrod von	-	4		22	2	2				
zweyten Wehl	1			1	13	1				
vor	1	4		2	3	3				
	3	4		4	7	3				

2. Fleisch- und Fisch-Taxe.			4. Victualienpreise den 5. Julii.					
		mgr.	pf.			rthlr.	mgr.	pf.
Rindfleisch	von besten das H	2	6	Ein Welscher Hahn	-	-	-	-
	von geringern	-	-	Ein Welsch Huhn	-	-	-	-
Kalbfleisch	von besten	2	6	Ein alt Huhn	-	5	-	-
	von geringern	2	4	Ein jung Huhn	-	3	-	-
Schweinefleisch		2	6	Ein paar Tauben	-	3	-	-
Lammfleisch		2	4	Frische Butter das Pf.	-	5	-	-
Karpfen	wenn sie unter 2 H			Widjenter But. das Pf.	-	6	-	-
	halten 2 H	4	-	Ireländische B. das Pf.	-	5	-	-
	über 2 H 2 H	4	4	Räse 4 Stück vor	-	1	-	-
Forellen 2 H	9	-	Eyer 5 Stück vor	-	1	-	-	
	18	-						
Schleim, oder Schleim 2 H	2	4						

Figure 1. Tables of *Policey-Taxen* (i.e., set prices for staple goods) from *Justi's Police Department News*. The prices, determined and issued by Göttingen's local Police Directorate, appeared in every issue of the *News*. Reprinted with permission from the Niedersächsische Staats- und Universitätsbibliothek Göttingen.

4.1 Cupellation with Wismuth

The “learned essay” appearing in the issue of July 7, which examined the advantages of producing silver with *Wismuth*¹⁰ in gold and silver factories, illustrates how Justi wove his cameralist principles seamlessly into the fabric of his police chemistry. He began by ridiculing the “great fuss” made by certain learned men about the use of gold and silver for ornamentation. Though these critics argued that such frivolous use of gold and silver would harm the circulation of coin, Justi countered that gold and silver factories actually promoted the *Nahrungsstand* by supporting productive work. Moreover, since it had become fashionable to wear gold and silver, he noted that police ordinances to the contrary were unlikely to succeed. In fact, good cameralist principles dictated that each territorial government should establish gold and silver factories inside its borders, since “silver and golden lace command a much higher price than is warranted by the worth of the gold and silver that they contain; in this way, much money leaves the land.” Accordingly, Justi argued that the production of clothing adorned with gold and silver, and the establishment of factories to do the work, should be encouraged and improved in every possible way (Justi 1755–57 [1755], 5).

Though most of the German lands had already established such factories, Justi noted the abiding superiority of French ornamented lace. Superior quality, in the absence of considerable import duties, also meant that consumers would prefer the French product. Accordingly, Justi sought the cause of French superiority. The French, he had been told, usually produced ornamental silver through cupellation with *Wismuth*, a practice that not only ensured greater delicacy and pliability but also brought out the brilliance of the metal.¹¹ Still, Justi had his doubts since “chemists consider *Wismuth* very rapacious (*räuberisch*),” and since it was known to cause brittleness in combination with other metals. Nevertheless, the matter seemed to warrant investigation, and Justi resolved to conduct experiments and report them in the *News* (*ibid.*, 6).

Justi’s remarks to this point, which comprise almost half of the entire article, illustrate the way police-cameralism could insinuate itself into every aspect of chemical reasoning. Justi’s original decision to pursue the *Wismuth* experiments depended on his specific stance in an ongoing debate about luxury. Unlike many of his contemporaries, Justi held that luxury represented a possible incentive to industry rather than a dangerous vice (*ibid.*; Koschwitz 1968). This, in turn, led him to encourage the production of such luxuries as gilded lace in government-

¹⁰ Later called bismuth, *Wismuth* owed its discovery largely to the efforts of Johann Heinrich Pott, who was to make the mistake of crossing Justi’s path at the end of the 1750s. More on Pott below.

¹¹ Cupellation (*Abtreiben*) was an ancient process that involved separating silver and gold from other metals, especially copper and lead. The cupel, generally made of bone ash, would absorb the oxidized lead, leaving behind unoxidized silver (Tylecote 1992, 45; Liebig et al. 1842–64, 66). Cupellation with bismuth, discovered by Dufay in 1727, had been the subject of experiments by Pott and Geoffroy (Liebig et al. 1842–64, 76). At the time Justi wrote, however, it was still not considered commercially viable.

supported factories. Moreover, Justi's deep commitment to a favorable balance of trade, and his belief that France's own trade had benefited from the production of superior luxury goods, prompted a sort of eighteenth-century chemical espionage, a commitment to chemically-based technology transfer. It was an approach that often privileged material result over prior theoretical commitment. In this case, for example, Justi ignored what he knew about *Wismuth* in principle, deciding instead to embark on a series of experiments mainly because of local artisanal rumors and French commercial success.

As it happened, Justi found that his chemical principles had misled him. "The fear that one will suffer a loss of silver through cupellation with *Wismuth* is completely groundless." After fusing a *Quintlein* of fine silver with eight *Schweren* of *Wismuth*, he noted a small weight loss — the 236th part of the silver's weight — but argued that no silver had been lost.¹² Rather, he claimed, the loss could be explained through the elimination of copper impurities, since silver prepared in the usual way, through cupellation with lead, always left behind certain copper impurities. In order to check his conclusions, Justi prepared a pure silver (i.e., one largely free of copper impurities) by taking common "cupel silver," dissolving it in *aqua regia*, recovering the precipitate with a spirit of salt, and smelting together the resulting "calx" according to the usual "chemical operations."¹³ Upon fusing this purified silver with *Wismuth* in the cupel, Justi found absolutely no loss of weight, thus proving, he argued, that the loss of weight in the original trial had been due solely to the removal of copper impurities. Cupellation with *Wismuth*, in short, presented an important alternative to lead cupellation (Justi 1755–57 [1755], 5–6).

Justi found his conclusions reinforced by the test of visual and tactile inspection. Not only did silver purified through cupellation with *Wismuth* prove whiter and more brilliant than that treated with lead, *Wismuth* also increased the pliability of silver, something that seemed contrary to accepted chemical principles. Though initially unable to convince himself that *Wismuth* increased pliability, since the silver remained brittle when he worked it with a hammer, Justi eventually discovered that ideal pliability could be attained by producing silver through cupellation with a mixture of lead and *Wismuth* (four parts *Wismuth* to two parts lead). The resulting silver, Justi claimed, had proven "fully pliable and more workable under the hammer than the best cupel-silver." Moreover, it accorded with reports that the French generally smelted silver with a 2:1 mixture of *Wismuth* and lead (*ibid.*, 6).

Justi explained that the procedure also had "other advantages for factory owners." Though even the better factories required five or six hours to complete the cupellation of twelve to fifteen marks of silver, Justi claimed that with *Wismuth*,

¹² Four *Quintlein* made a *Loth*. Thirty-two *Loth* made a "common pound." Two *Loth* made an ounce. One *Mark* made sixteen *Loth*. See Zedler 1732–50, 18:498, 19:1254.

¹³ Justi's use of the term "calx" here may seem odd, since the term is usually understood as the powder derived from calcination, or the heating of a substance in air. Eighteenth-century use of the terms "calx" and "calcination," however, was somewhat more flexible. See Eklund 1975, 13.

because of its ability to drain more quickly from the cupel than lead, one could process an equal amount of silver in only three hours. "One thus saves a large amount of charcoal," he explained, "which certainly deserves great consideration in this sort of work." Moreover, since he found *Wismuth* twice as effective as lead at separating out semi-precious metals and removing impurities, the size of the cupel itself could be reduced, which resulted in "a notable savings" for silver factories (ibid., 6–7). The high price of *Wismuth* remained a concern, but Justi assured his readers that larger yields and increased quality would more than compensate for it. Moreover, he predicted that the price of *Wismuth* would fall as increased demand spurred greater production. The article ended with a straightforward recommendation: "The owners of gold and silver factories are therefore counseled to employ *Wismuth* in the cupellation with silver in the previously specified proportion; namely, that they should use one mark of *Wismuth* and two marks of lead for the cupellation of one mark of twelve-*Loth* silver" (ibid., 7).

Justi's article on *Wismuth*, typical of his early essays in the *News*, was the literary embodiment of police chemistry. Concern for the *Nahrungsstand* penetrated every aspect of chemical investigation. The choice of proper objects for chemical investigation, for example, depended on an array of specific cameralist considerations. Justi's stance on luxury and his belief in the importance of keeping money inside territorial borders, for example, supported the establishment of gold and silver factories. His conviction that France produced gold and silver ornamentation of the highest quality, and that this contributed to her prosperity, led him to examine the sources of French superiority in silver ornamentation. His willingness to trust the hearsay of artisans and the evidence of commercial success instead of prevailing chemical theory prompted him to examine the use of *Wismuth* in silver production. His focus on the *Nahrungsstand* even led Justi to consider effects on production time, to note the reduced demand for scarce wood, and to pick up the *Handwerker's* hammer.

Justi's police-cameralism shaped not only the content but also the form of his chemical investigations. Like the essay on *Wismuth*, most articles in the *News* included recommendations for the reform of existing practice. Police chemistry, that is, commanded change even as it offered information. In the perfectly policed world, chemical recommendations would generate police ordinances, and new knowledge would dictate immediate reform. The *News*, with its juxtaposition of learned essays (part 1) and police ordinances (part 2), prefigured an ideal world in which knowledge, joined with power, generated material change. With sweeping police powers at his disposal, Justi would no doubt have mandated the use of *Wismuth* in Hanover's gold and silver factories. In reality, though, he remained a frustrated small-town police commissioner, blocked at every turn by a stubborn town council. So he channeled his ambitions, which far outstripped the reality of his situation, into a copious display of literary production.

4.2 *The Chemistry of Beer and Branntewein*

As Göttingen's chief police commissioner, Justi not only maintained peace and order but also had responsibility for ensuring the material welfare of the town's residents. Of course, these two activities were hardly separable for contemporaries, since stable and affordable supplies of staple goods such as bread, beer, and wood also helped to guarantee the peace. The preferred instrument for securing supplies of staple goods was the public depot. Justi himself, for example, planned and advocated a large wood magazine for Göttingen and attempted to win Münchhausen's support for the project. He encountered resistance, however, from members of the town council (UniArchGö.8 1756, 39; UniArchGö.9 1755, 4). Similarly, Justi's predecessors on the police commission, mayors Insinger and Hattdorf, had proposed the establishment of a "malt magazine" years earlier in 1735. Driven largely by concern for the new university in Göttingen, the mayors, who had also proposed that a new brewery be founded to serve the university, wanted to improve the general "defectiveness of drink" in Göttingen. The town's awful beer, they suggested, was the result of bad malt and bungling brewers. Some brewers used too little malt, some used bad malt, and others simply allowed the beer to get too hot. By establishing a malt magazine, they argued, Hanover's privy council could at least ensure a regular supply of good malt for town and university (UniArchGö.6 1735–36, 24–38).

In Göttingen, as in most German towns, beer brewing played a prominent role in everyday life. The town had 424 officially sanctioned breweries and, among its roughly 8,600 residents, about 390 burghers with brewing rights. Along the major streets of the town's center, almost every house was licensed as a brewery (Winnige 1996, 103, 330–31). In 1750 Göttingen's officially sanctioned beer production amounted to a little over 3,000,000 liters, or about one liter of beer per resident per day.¹⁴ As in other towns throughout the Holy Roman Empire, Göttingen's local officials had long subjected brewing to a web of police ordinances. These special brewing ordinances regulated, among other things, the physical characteristics of breweries, the number of brewers, the accepted periods for brewing, the varieties of beer, the acceptable ingredients, and the quantities of beer that could be brewed (*ibid.*, 332–33; Corran 1975, 46–47). The town's 1734 brewing ordinance, for example, directed licensed brewers to brew sixty barrels of beer, or about 20,500 liters, on each officially sanctioned brewing day (*Brautag*). As we have seen, however, these brewing ordinances did not guarantee good beer.

As Göttingen's chief police commissioner, Justi inherited responsibility for beer oversight, and he endeavored to reform brewing practice through articles and ordinances published in the *News*. Justi's ambitions as police commissioner extended well beyond those of his predecessors, for he hoped to enlist chemistry and

¹⁴ The exact amount cannot be determined because the beer brewed in residual brewings (i.e., the "Nachbier") was not regulated by the brewing ordinances (Winnige 1996, 333).

the knowledge of nature in his efforts to improve the *Nahrungsstand*. As a police commissioner versed in the principles of chemistry, that is, Justi felt that he could direct Göttingen's burghers on *how* to brew a good, healthy beer. Implicit in his approach was the assumption that many conventional brewing techniques, resting as they did on the routines of one ignorant generation after another, could be dramatically improved through the systematic application of police-chemical principles.

Justi turned his attention to beer in the third issue of the *News* (July 11). "Beer brewing," he wrote, "is undeniably one of the arts (*Handthierungen*) which, though it is so common and so frequently practiced by very ignorant people, nevertheless rests on solid principles and allows of an orderly system (*Lehrbegriff*)." In particular, Justi argued that good brewing rested on a thorough knowledge of nature, "especially that part of chemistry which deals with the unlocking, breakup, and extraction of things from the plant kingdom and which treats of fermentation." Though he had devoted far less time to the study of grains and fermentation than to metallurgical chemistry, Justi seemed confident that, on the basis of his police principles and chemical knowledge, he could offer useful advice to Göttingen's brewers. By reducing the brewing process to its component operations, he aimed to isolate the "principles" of good brewing. Still, Justi was no Pasteur or Hansen, and he did not offer anything especially new in the way of techniques or discoveries. Rather, his delineation of the separate brewing operations followed a centuries-old pattern that included malting, mashing, wort boiling, and fermentation. The malt, or sprouted barley, was ground and combined with hot water to generate the wort. The wort, in turn, was boiled with hops. Finally, the hopped wort was cooled, yeast was added, and the beer fermented in fermenting vessels (Teich 1983, 117–18; Corran 1975, 11–14; Justi 1755–57 [1755], 9–10).

The ignorance of the common brewer, argued Justi, had caused many errors in practice, leading artisans and workers to "undertake much that is unnecessary." Were they armed with better knowledge, he claimed, they might achieve their ends more perfectly and more efficiently. "In fact, most trades admit of a much greater level of knowledge. There are very few trades and occupations that cannot be reduced to set principles that can be applied with great advantage (*Nutzen*) in all circumstances." Justi noted a common error he had witnessed in mashing — namely, "that in certain places one commonly fills the mash-tun or mixing vessel... with cold water after putting in the ground malt." The water in the mash-tun would then be heated by repeated dipping and heating with the brewing pan, or copper. Justi found this practice both inefficient and ineffective. Some brewers, he noted, even neglected to grind the malt sufficiently, so that the malt was ground "extremely coarsely or even just squashed" (Justi 1755–57 [1755], 9–11). As a result, Göttingen's brewers left "very many powers in the malt." The brew-hands, Justi counseled, should be directed to put less water in the mash-tun, thereby saving wood and allowing the water to heat faster and more efficiently, and to grind the malt more thoroughly. Bad brewing techniques, he complained, resulted largely from laziness

and ignorance, and it was “difficult to understand why the commonweal should suffer for the comfort of the brew-hand” (ibid., 14).

If one understood the primary operations of brewing, Justi argued, then one could “make a number of rules and observations” based on a “knowledge of nature, and especially chemistry.” Though he promised not to indulge in learned discourses on the chemical principles of decomposition and extraction, Justi nevertheless called attention to his knowledge of those principles (ibid., 10). Just as Justi’s universal cameralist dictated proper behavior based on an understanding of the whole state, so the police chemist would enlist his knowledge of nature in the service of the *Nahrungsstand*. Justi thereby expanded the traditional role of the police official to include chemistry. Police chemists, that is, would translate chemical knowledge into rules of behavior for artisans and farmers. Whereas Hattdorf and Insinger had merely worked to ensure a regular supply of good malt, Justi sought to alter the very practices of brewing on the purported strength of his chemical knowledge.

Justi’s faith in his own approach, and in the value of his advice, rested on a profound disdain for Göttingen’s brewers and on his conviction that conventional brewing practices were deeply flawed. The “comfort of old habits,” he argued, had given rise to many prejudices and superstitions among brewers. Justi believed that brewing, like most other everyday activities of the *Nahrungsstand*, had suffered from centuries of unquestioned adherence to blind routine (ibid., 10). Brewing, he believed, would improve if “we [i.e., police-cameralists like himself] could impart knowledge to artisans and workers” so that they might understand the reasons for their actions. While contemplating better beer, Justi imagined a future of “happy times in which reason and the sciences have reached the highest point of their perfection and have spread their blessed influence through all classes,” a world in which “artisan-like” activities would be overcome in favor of systematic, reasoned practice. Those times were not, however, yet at hand, and Justi believed that cameral and police officials like himself had a duty to spread the influence of the sciences among the many members of the *Nahrungsstand*. Police-cameralists, that is, would be the midwives of material enlightenment (ibid., 9).

Though fermented barley mash was typically used to brew beer, it could also be employed in distilling schnapps, or “*Branntewein*.”¹⁵ From the perspective of police, however, beer and schnapps were altogether different. Whereas beer was a staple good, schnapps was generally considered either a medicine or a luxury. According to Zedler’s *Universal-Lexicon*, for example, “Poles, Russians and others use schnapps almost like a drink.” The situation, however, was apparently quite different farther west. “Here in our lands, it [schnapps] doesn’t go on the table but is used in doses as a medicine for cold, damp constitutions and against bad digestion” (Zedler 1732–50, 4:1086–87). But by mid-century, when Justi

¹⁵ The term “*Branntewein*” could refer to all manner of liquors, whether distilled from fermented fruit mash or grain mash (Zedler 1732–50, 4:1082).

arrived in Göttingen, consumption habits around Central Europe were changing as increasing numbers of people turned to coffee, tea, chocolate, and spirits (Wyrwa 1990, 17–19). Chief Police Commissioner Justi himself, as we have seen, had personal experience with schnapps drinkers. His assistant, Hildebrandt, had died from drinking too much of it, and he worried that Daniel Polle, who tended to hang around the pharmacy for the same reason, might be appointed as a replacement.

In the 25 July 1755 issue of the *News*, Justi moved to examine schnapps in an article entitled “Considerations on Distilling *Branntewein* according to the Principles of Police.” Distilling grain spirits, Justi acknowledged, could be “among the most profitable of trades.” But it was the duty of the police official to examine what effect schnapps distillation might have on the general welfare since, he argued, “the point of view from which a private person regards a trade is often very different from the way the institutions of police (*Policeyanstalten*), or the government of the land, will see it. Though schnapps distillation might benefit one or another private person, it can also prove harmful for the whole land.” In other words, the police official, who was expected to examine each occupation in the context of the whole state, often approached beer and schnapps from a different perspective than the individual brewer or distiller. “The primary aim of good government in its police measures,” Justi explained, “must be the coherence of the whole *Nahrungsstand* in the land; that is, it must always focus on the mutual influence that all occupations have upon one another and on the welfare of the commonwealth.” Police measures had constantly to aim at improving and perfecting this interlocking machine of trades and occupations. Police officials thus had the obligation to root out all activities that harmed the *Nahrungsstand* while encouraging those that benefited it (Justi 1755–57 [1755], 25–26).

These general principles of police, however, could not yield any single answer about the benefits or drawbacks of schnapps distillation. Rather, the diversity of local circumstances demanded different approaches for different regions. In lands rich with grain, for example, the police should encourage schnapps distillation for export. Since the “powers of the grain” could be concentrated in schnapps, grain-rich lands could reduce transport costs, leading to a profit for the land. In territories with little grain, however, the police were to discourage the distillation of grain spirits, since it would lead to even greater shortages (ibid., 26). In any case, Justi claimed, the good burgher, imbued with the principles of *gute Policey*, should understand intuitively the impact of schnapps distillation on the general welfare.

A well-intentioned burgher — yes, I might even say an honest man — must never seek his own special advantage when it injures either his fellow burghers or the commonwealth. We are bound to the republic with such essential and sacred bonds that we could not break them without destroying our own moral character. (Ibid., 27)

Ultimately, though, the police official or universal cameralist would decide what was good for the commonwealth, what should be encouraged and what prohibited. The good police chemist, in turn, would investigate and explain those chemical processes — and *only* those processes — that furthered the common welfare.

Justi left Göttingen abruptly in 1757, fleeing before the advance of French troops at the beginning of the Seven Years' War. Despite his relatively short time in Göttingen, however, he left behind an enduring legacy. Münchhausen worked for over a decade to replace him until his successor, Johann Beckmann, was confirmed as Göttingen's first "ordinary professor of oeconomy" in 1770 (UniArchGö.4 1770, 25). Beckmann, a student of Linnaeus, was deeply influenced both by Justi's writings and by the memory of his activities in Göttingen.¹⁶ In the preface to his famous *Anleitung zur Technologie*, for example, Beckmann presented his new discipline of "technology" as an auxiliary science for police-cameralism, explaining that the "knowledge of trades, factories and manufactories is indispensable for anyone who wishes to apply himself to the police and cameral sciences. For one should at least be familiar with what one intends to arrange, design, direct, judge, govern, maintain, improve, and be of use to" (Beckmann 1777, preface). Beckmann enlisted Linnean classification and description in the service of cameralism, systematically dissecting the *Nahrungsstand* and producing a series of enormously popular works on agriculture, mining, commerce and the trades (Beckmann 1769, 1777, 1789).¹⁷

The traces of Göttingen's police-cameralist tradition stretched on into the works of Johann Friedrich Gmelin, the Tübingen chemist who joined Beckmann as a member of Göttingen's faculty in 1774 (UniArchGö.1 1774; Gmelin 1786). Gmelin's textbook on "technical chemistry," which relied on Beckmann's conception of *Technologie*, was intended primarily for cameralists. Gmelin acknowledged, moreover, that university teachers of chemistry had to serve "the cameralist," as well as "the physician and the natural researcher" (Gmelin 1786, preface). By the end of the eighteenth century, however, German chemists like Gmelin had formed an independent community (Hufbauer 1982, 145–48), and chemistry gradually cast off its status as a purely auxiliary discipline for cameralists and physicians.

Gmelin's massive three-volume *Geschichte der Chemie* (1797–99) absorbed Justi's police chemistry into the larger narrative of an autonomous discipline, presenting Justi as one of the important heirs to Georg Stahl. Justi had, Gmelin wrote, been among the first to seek the basis of agricultural fertility according to chemical principles; he had been among the most prominent in systematically applying chemical principles to the arts and manufactures; he had contributed to the knowledge of saltpeter and alum extraction; he was prominent in the synthesis

¹⁶ Beckmann published a biography of Justi (Beckmann 1770–1806, 10:458f.) and in 1782 produced new editions of Justi's *Grundsätze der Policewissenschaft* and his *Abhandlungen von den Manufakturen und Fabriken*.

¹⁷ Beckmann's textbooks on agriculture and technology each went through six editions during his lifetime.

and description of dyes; he had contributed to the chemistry of metals, especially tin, copper, steel, and brass; and he had been instrumental in the development of many other chemical techniques (Gmelin 1797–99, 2:361, 644–46; 3:5, 8, 25, 31, 36, 50–54). But Gmelin's history was itself part of the larger effort to constitute chemistry as an independent science, part of the long process that systematically erased the contours of older chemical worlds. He thus presented chemistry as a single science and chemists as a unified group of practitioners with common aims. His history transformed such well-known cameralists as Bergius, Hohenthal, Schreber, Zincke, and Suckow into chemists (*ibid.*, 2:487–97). In creating the history of a new science, Gmelin had systematically eradicated the memory of an old profession.

5. The Controversy

Between 1755 and 1757, while he was directing police affairs and publishing the *News* in Göttingen, Justi issued a series of attacks on Johann Heinrich Pott, the well-known Berlin academician and elder statesman of German chemistry. In the years that followed, Pott and Justi engaged in a nasty and protracted dispute over a number of chemical issues. Their controversy illustrates, I think, how the principles and purposes of Justi's police chemistry had begun to diverge from the aims and approaches of academicians like Pott around the middle of the eighteenth century. Whereas Pott defended his chemical work with appeals to truth and honesty, Justi sought to defend his own position by demonstrating its usefulness for the *Nahrungsstand*. While Pott invoked the impartial gentleman judges of an imagined public sphere, Justi brandished his secret knowledge, proudly displaying his privileged access to a restricted sphere of powerful state officials.

Pott, who had been commissioned by Frederick William I to uncover the secret of Saxony's famous Meissen porcelain, is supposed to have conducted more than 30,000 experiments on all manner of earths and rocks (Partington 1961–70, 2:718). He published the conclusions of his research in the 1746 *Lithogegnosia*, in which he distinguished four major classes of earth: (1) *terra alcalina* or calcareous earth (limestone), (2) *terra gypsea* (gypsum), (3) *terra argillacea* (clay), and (4) *terra vitrescibilis* (silica) (Pott 1746, 3). Justi rejected Pott's distinction between gypsum and calcareous earth, claiming that the creation of a separate class of earths for *terra gypsea* was both unnecessary and harmful (Justi 1757, preface, 198). He also flatly denied Pott's claim to have successfully fused fluorspar with marble and alabaster.¹⁸ Nor did Justi accept the claim that fluorspar facilitated the smelting process for many ores, accusing Pott instead of employing an impure crucible in his experiments (Justi 1754–58, 2:297–301). Finally, Justi rejected

¹⁸ Justi refused to recognize Pott's distinction between fluorspar (*Flußspat*) and heavy spar (*schwerer Spat*), something that consistently aggravated Pott.

Pott's assertion that phlogiston contributed only little to the weight of zinc (Justi 1755–57 [1756], 79).

Pott responded to Justi's criticisms in 1757. "The most prominent of my critics," he wrote, "is the renowned and learned Herr Mining Councilor von Justi." Pott, who expected their dispute to prove useful to the sciences and the public, expressed admiration for Justi's abilities.

I have always had the greatest respect for this very skilled and learned man, and his very special industriousness, application, penetration, and range in so many other sciences deserves to be valued by all impartial people, especially if one reflects that he has made so much important progress in the extensive subject of chemistry in the short time of only eight years. (Pott 1757, 4)

Pott apparently assumed, at least at this stage, that Justi's attacks had been motivated by a love of truth. In reality, however, Justi's criticisms were intended to gain the favor of powerful men at the Berlin Academy, especially Johann T. Eller, director of the Academy's physical class, with whom Pott was embroiled in a bitter dispute. Pott's position at the Berlin Academy continued to deteriorate during the ensuing years, until Eller's death in 1760 (Hufbauer 1982, 231; Hoefler 1866–69, 2:405; [Lehmann] 1756; Pott 1756a, 8–9; Partington 1961–70, 2:718). In September of 1760, Andreas S. Marggraf, almost twenty years Pott's junior, was nominated to succeed Eller as director of the Berlin Academy's physical class. Pott, who took the nomination as a tremendous insult, submitted a formal letter of protest about Marggraf's nomination, but Marggraf was elected anyway. On October 30, as a final insult, Pott was officially "retired (*quiescirt*)" from the Academy.

Justi's polemical piling-on, all for personal ambition, against poor old embattled Pott, has earned him the general opprobrium of historians. Partington, for example, dismissed Justi's chemical writings as "mostly superficial and polemical, especially against Pott, who replied to Justi in a special work" (Partington 1961–70, 2:718). Justi's contemporaries, however, did not share Partington's opinion. Even Pott praised the extent of Justi's chemical knowledge and marveled at his breadth of learning. Moreover, Justi's chemical writings — in the *Neue Wahrheiten* (1754–58), *Policey-Amts Nachrichten* (1755–57), *Grundriss der Mineralogie* (1757), and *Gesammlete Chymische Schriften* (1760–61) — garnered almost universal approval from contemporaries (Koschwitz 1968, 158–61, 212–16; Gmelin 1797, vol. 3).

In fact, Pott and Justi agreed about many things. Like Justi, Pott believed that experimental chemistry could yield many new discoveries, and he rejected all "empty ideas, doubtful speculations, and abstract metaphysical notions." Moreover, he echoed Justi's censure of the charming and amusing sciences, criticizing the learned tendency to focus attention on "rare curiosities" rather than on more common and "essential" minerals. "My method," he claimed, "can be directly employed for the use of human society and oeconomy" (Pott 1746, preface). Pott

did not, however, share Justi's cameralist vision. Rather, his salaried position at the Berlin Academy made him one of the first truly independent chemists, largely unfettered by the impositions of a university medical faculty and free from the expectations of academic cameralist reformers.¹⁹ As a result, though Pott and Justi shared a thoroughly rational-utilitarian approach to chemistry, they had entirely different notions about chemistry's proper place among the sciences.

Justi's dispute with Pott reached its climax in 1760, the same year in which Pott was "retired" from the Berlin Academy. His initial response to Justi's criticisms had been moderate, if somewhat condescending. But Justi's rebuttal, which appeared in the preface of his 1760 *Gesammlete Chymische Schriften*, verged on the insulting. Justi began by restating three major objections to Pott's work: (1) he denied the validity of Pott's experiments with heavy spar, (2) he rejected Pott's claim that sand, silica (*Kiesel*), and clay were infusible, and (3) he ridiculed Pott's fourfold classification of earths (Justi 1760–61, vol. 1, preface). Pott's distinction between gypsum and calcareous earth, a distinction that diverged from earlier systems of classification, rested on his discovery that, though all alkaline earths effervesced with acid spirits, gypsum did not (Pott 1746, 15–16). But Justi rejected the discovery, claiming instead that Pott's conclusions rested entirely on the characteristics of a peculiar variety of gypsum discovered near Sperenberg. Moreover, Justi ridiculed the notion that someone "who has only assayed the gypsum of a single quarry" could presume to reclassify all the rocks and types of earth in the entire world (Justi 1760–61, vol. 1, preface). It was an outrageous accusation, especially since the conclusions in Pott's *Lithogognosia* reputedly rested on over 30,000 experiments.

More damaging for Pott, however, were Justi's claims that he was the wrong *kind* of scholar. Calling on the right of retaliation, or *jus talionis*, Pott had sifted through all of Justi's chemical writings, detailing various faults and mistakes. "This revenge," complained Justi, "is proof enough that he can abide no contradiction; because of my love for humanity and my keen desire for the increase of the sciences, it is a disposition that I hate to see." Useful scholars, argued Justi, had to accept their own fallibility. Those who did not ignored the "duties of society." One could not conduct a useful dispute with *Gelehrten* like Pott who considered themselves infallible. Though it would be only too easy to pick apart Pott's writings and point out mistakes on every page, "what would be the use? Nothing at all . . . I know how to employ my time better." Justi, that is, rejected Pott's *style* of disputation, rejected both his painstaking point-by-point response to every charge and the careful delineation of every error (Justi 1760–61, vol. 1, preface).

In contrast to Pott's useless style of disputation, Justi painted himself as a friend of useful controversy. The initial objections to Pott's writings, he insisted, had aimed only to provoke a useful learned dispute. Since his own experiments had

¹⁹ As a member of the Berlin Medical-Surgical College between 1723 and 1777, Pott did maintain some connection with the medical profession.

suggested that heavy spar contained a metal, one that he had been unable to isolate, he had hoped to engage Pott in an experimental dialogue. Pott's experiments "would have given me occasion for counter-experiments, and thus I imagined that the two of us, through our experiments and counter-experiments, would examine heavy spar in such a way that something useful for chemistry might come of it." Alas, it was not to be. Not only did Pott fail to conduct any new experiments, Justi complained, but he even neglected to check his chemical diary and to note the quantities and proportions used in the initial experiments. Pott, it appeared, simply did not "possess the qualities that useful learned disputes demand" (ibid.).

Pott published an open letter, *Send-Schreiben an den Herrn Berg-Rath von Justi*, in response to Justi's criticisms. Like Justi, Pott repeatedly expressed his concern for utility. Unlike Justi, however, he emphasized truth and the judgment of an "impartial public" as his guiding principles: "I am everywhere concerned only with the truth" (Pott 1760, 4). Pott also fretted over insults to his reputation, complaining that "one should not have presented me as a man unworthy of trust, as a man who deceived the public with untrue, or even impossible, experiments" (ibid., 7). It was, above all, Justi's claim about the impossibility of fusing heavy spar and marble that provoked Pott's ire. "It must be unpleasant for an honest man," he wrote, "when one not only questions and disavows the truth of his experiments before the eyes of the public, but actually presents them as genuine impossibilities" (ibid., 16). Nor did he deem it necessary to engage Justi in an experimental dialogue about the fusibility of fluorspar, having already conducted the necessary experiments a hundred times over. Instead, he proposed to establish the truth of his claims before Justi and other witnesses:

I hereby offer publicly, in your presence and that of friends, if it suits you, to pulverize fluorspar, to mix it with marble or chalk, and to bring it to full fusion in my oven before your eyes. The whole process should be fully completed in two hours, and should convince you that you have wronged me through your flat denials. This fluorspar is certainly heavy, and it could be true that some alkaline spars are also heavy, perhaps even heavier, but I am speaking here only of fluorspar, and not of any alkaline spar. In addition, I can also furnish the experience and witness of external scholars who have found my completed experiments actual and correct. (Ibid., 16)

Like Robert Boyle nine decades earlier, old Pott was accustomed to establishing chemical matters of fact in front of respected groups of gentleman witnesses (see Shapin and Schaffer 1985, 78–79). But Pott's recent estrangement from the Berlin Academy had shaken his ability to establish matters of fact. By 1760 he no longer had access to the members of the Academy as witnesses, nor could he publish findings in the Academy's written proceedings. He had descended into a learned state of nature, reduced to simple insistence on the truth of his factual claims: "it

[the fusibility of fluorspar and marble] is *res facti*, against which all criticism and contradiction, which is hopeless, cannot help!" (Pott 1760, 17)

Justi simply ignored Pott's proposals and continued to hammer away at the old man's credibility. As a member of the Berlin Academy, Pott had long taken for granted the recognition of his personal integrity and chemical experience. Now Justi explicitly questioned those assumptions. Pott responded in the *Send-Schreiben* with constant references to his experiences — his "countless experiences," his "reputable and continual experiences," his "long experiences," etc. — and even suggested that Justi believe him because of his "much greater experience" (*ibid.*, 17, 20–23). "I don't wish to speak of my own experiences," Justi responded. "But I request the same courtesy of the Professor; namely, that in the future he spare me all of his supposed experiences in this dispute. I would rather have the testimony of the least significant and least important chemical author count against me" (Justi 1760–61, vol. 2, preface).

Not to be outdone, Pott rejected one of Justi's own central experimental claims: the alleged discovery of an acid salt in iron (Justi 1757, 51). Pott had first expressed reservations about Justi's "iron salt" in 1757, arguing that raw iron exhibited none of the qualities of an acid salt; it did not, for example, effervesce with alkalis (Pott 1757, 13). "Honestly!" Justi replied, "as if one had to prove the existence of an acid salt in such a strange and impossible way, one that goes against the nature of all metals." Justi insisted that he had actually extracted an acid salt from iron without the use of any additional acid spirits or acid salts. But Pott rejected Justi's presumed iron salt once again in the *Send-Schreiben*, claiming that it conformed to none of the essential characteristics of acids, "for every true *Sal acidum* effervesces with *Alkali* and converts it to a middle salt, and dissolves in water." Justi, he insisted, had offered no real proof about the existence of this iron salt, nor had he provided actual instruction about how to extract the fictive acid salt from iron (Pott 1760, 5).

Justi did not, like Pott, insist that his experiments were matters of fact. He did not maintain his devotion to the truth or his reliance on the fairness of an impartial public. He did not even demand recognition of his own honesty and integrity. Instead, he elected to demonstrate the legitimacy and importance of his discovery through the interest it provoked among powerful state officials.

He [Pott] can believe whatever he wants. Only, he shouldn't take it amiss if, for the moment, I avoid sharing the procedure publicly. A physician in Lüneburg wanted several thousand taler for the secret of the true iron salt.... The Hanoverian privy council was not unwilling to purchase the secret for the benefit of the Göttingen orphanage. . . . It is altogether remarkable that the Professor hasn't heard anything about this true iron salt, which is such an excellent medicine when it is made genuine and pure. It seems that he has generally little acquaintance with the salts of metals, and that one cannot expect any more knowledge from him than one does in the practice of every apothecary (Justi 1760–71, vol. 2, preface).

Where Pott appealed to the impartial judges of a public sphere, Justi now chose to brandish his secret knowledge, to display his privileged access to a restricted sphere of powerful officials, and to speak of patents, trade secrets, and state interests. Old Pott's model natural philosopher — that modest, impartial, truth-loving, matter-of-fact gentleman reminiscent of Robert Boyle — had gone out of fashion. Justi's privy councils and trade secrets, his in-your-face rhetoric and satirical style, were a far cry indeed from those old well-disciplined public spaces (see Shapin and Schaffer 1985, 55–79).

Though Justi's dispute with Pott began as an effort to curry favor with influential members of the Berlin Academy, it served to bring two very different theories of knowledge into stark relief. Though they shared a common understanding of experimental practices, Pott and Justi disagreed entirely about the purposes of chemical knowledge. While Pott aimed always to establish chemical truths before an impartial public of learned gentlemen, Justi's guiding principle had always been the benefit of the *Nahrungsstand*, that chaotic realm of artisans, merchants, miners, and farmers. Justi had no time for useless truths. Pott, who considered all truth useful, never understood that.

Conclusion

Justi subjugated chemistry to the billy-club epistemology of his police-cameralism. He disdained the “elaborate subtleties” of charming and amusing sciences, insisting instead that the “principal goal” of his chemical experiments had always been the benefit of the commonweal and the improvement of the *Nahrungsstand*. “Chemical experiments from which one can see no use, and which are nothing more than chemical playthings,” he explained, “have never held any attraction for me” (Justi 1760–61, vol. 1, preface). Justi intended to banish intellectual idlers and their useless sciences from German-speaking universities and academies.

In Göttingen, and with Münchhausen's help, Justi began to give his police-cameralist vision institutional life. As the demand for skilled cameral officials began to generate significant institutional reform at Central European universities and academies, Justi's individual experience became part of a general trend. Like medicine, academic cameralism demanded extensive study of the natural sciences, especially botany and chemistry. And like medicine, cameralism approached chemistry as a *Hilfswissenschaft* whose value depended on its contribution to professional status and training. Justi's police chemistry was thus the auxiliary science of an aspiring professional faculty, and the central concerns of oeconomy and police (i.e., the benefit and improvement of the *Nahrungsstand*) became the central concerns of police chemistry as well.

Justi's conception of the *Nahrungsstand* also placed him in the vanguard of a great shift that occurred in the middle of the eighteenth century, for it was around 1750 when the meanings of “state” and “civil society” (*bürgerliche Gesellschaft*),

two traditionally synonymous terms, began to separate (Riedel 1975). Like modern notions of civil society, Justi's *Nahrungsstand* — the class of farmers, miners, merchants, and artisans — posited a space of activity separate from the political realm of governance and authority. But the *Nahrungsstand* was not an autonomous civil society subject to laws of its own. Rather, police-cameralism treated the members of the *Nahrungsstand*, with their drives and urges and propensities, as labor power to be directed and arranged by the *Gelehrtenstand*.

The relationship that Justi posited between *Gelehrtenstand* and *Nahrungsstand* structured every aspect of his police chemistry. As illustrated by the format of Justi's *Police Department News*, police chemistry commanded change and imposed direction even as it communicated knowledge. With its juxtaposition of police ordinances and learned essays, the *News* conjured up a world in which chemical knowledge, joined to police power, would directly refashion the *Nahrungsstand*; a world in which the official castigation of disobedient butchers bore direct connection to chemical experiments on cupellation with *Wismuth*.

Police chemistry distanced itself from traditional models of natural philosophy and *Gelehrsamkeit* as well. Rather than suppressing chemistry's sooty artisanal roots, for example, Justi accentuated its close connections with *Handwerk*. Driven by his concern for the *Nahrungsstand*, the police chemist could proudly wield the smith's hammer and examine gilded lace with a merchant's eye. Some prominent chemists, fretting over the scientific legitimacy of their discipline, may have tried to distance themselves from *Handwerk* (Holmes 1989, 13; Meinel 1981, 1983). Cameralists, with their desire to construct a more productive *Nahrungsstand*, promoted a chemistry that did just the opposite. They moved to examine artisanal practice and strove to improve it. This is not to say, however, that police-cameralists respected artisanal knowledge. Justi's attitude toward Göttingen's brewers and brew-hands, for example, was extremely condescending. Rather, the belief that artisanal and agricultural practice could be improved upon grew out of profound disdain for all knowledge that seemed haphazard and artisan-like (*Handwerksmässig*). For Justi, that disdain translated into the conviction that he could revolutionize the *Nahrungsstand* through the imposition of his own ordered principles.

Justi's police chemistry also lent specificity to utilitarian claims, as his dispute with Pott illustrated. Though both men were committed to a "rational-utilitarian" vision of chemistry, they disagreed entirely about the nature and purposes of chemical knowledge. During his many years at the Berlin Academy, Pott had come to think of chemistry as an independent science concerned with truth and built on matters of fact established before a reading public of learned gentlemen. Justi saw things differently. For him, chemistry had value only insofar as it contributed to his larger police-cameralist vision. Moreover, he did not rely on an impartial public sphere to establish the value of his chemical claims, but chose instead to justify his work through its presumed value in the secret sphere of powerful state officials.

While Justi was fighting with Pott, German chemists were beginning to come together as an independent community, and cameralism was taking shape as a young profession. Some, hoping to liberate chemistry from the fetters of academic medicine, aimed to legitimize chemical knowledge through recourse to fashionable utilitarian-cameralist rhetoric. But cameralists like Justi chose to enlist chemistry in the service of cameralism. The result of their efforts was police chemistry, which fused chemical knowledge with cameralist principles. The myriad chemical publications of these cameralist reformers exist today as the artifacts of an extinct profession. As it became an independent discipline, chemistry absorbed these cameralist works into the larger narrative of its own history, systematically eradicating the contours of older chemical worlds. I have tried to recover some of that history here, endeavoring to show that, once upon a time, chemistry was a cameral science.

Acknowledgments

I owe special thanks to Lorraine Daston, who read more than one version of this paper and never failed to offer incisive criticism and helpful advice. For their comments, criticisms, and other help, I would also like to thank Jim Bjork, William Clark, Martin Gierl, Arne Hessenbruch, Myles Jackson, Kai Kanz, Robert Richards, and the anonymous reviewer for *Science in Context*. Thanks are due as well to the participants in the German Historical Institute's Transatlantic Doctoral Seminar in Göttingen and to the members of the History of the Human Sciences Workshop at the University of Chicago for their helpful suggestions and advice. Finally, this paper, which is part of a larger project, could not have been written without the generous support of the Max Planck Institute for the History of Science in Berlin, the Deutscher Akademischer Austauschdienst (DAAD), the University of Chicago's Morris Fishbein Center for the History of Science, and the Andrew W. Mellon Foundation.

References

Archival Sources

University Archive, Göttingen (UniArchGö)

UniArchGö.1=Kur 4.IV.b.21. Johann Friedrich Gmelin, dossier, 1774–94.

UniArchGö.2=Kur 4.V.a.7. The attempt by the philosophy faculty to hold botanical lectures, 1767.

UniArchGö.3=Kur 4.V.b.35. Johann Christoph Erich Springer, dossier, 1765–97.

UniArchGö.4=Kur 4.V.b.36. Johann Beckmann, dossier, 1766–1811.

UniArchGö.5=Kur 4.V.l.1. The establishment and maintenance of the oeconomic garden, 1767.

- UniArchGö.6=Kur 5.c.2. Investigation of police shortcomings by mayors Hattdorf and Insinger, 1735–36.
- UniArchGö.7=Kur 5.c.7. Appointment of Unger as *Ober-Policey-Commissar*, 1753–62.
- UniArchGö.8=Kur 5.c.8. Johann Heinrich Gottlob von Justi's appointment as *Ober-Policey-Commissar*, 1754–57.
- UniArchGö.9=Kur 5.c.9. J. H. G. von Justi's complaint that the title "Herr" does not appear before his name in the protocols, 1755.
- UniArchGö.10=Kur 5.c.10. Ruling on the Police Commission's authority to arrest beggars, 1755–56.
- UniArchGö.11=Kur 5.c.11. The proposed appointment of a police clerk, 1756.
- UniArchGö.12=Kur 5.c.12. The appointment of the police assistants, 1756–59.
- UniArchGö.13=Kur 5.c.15. Regulation establishing a new organizational structure for the Police Commission, 1763–71.

Manuscript Collection, Göttingen University Library (HandAbtGö)

- HandAbtGö.1=4 Cod., Philos.149, Münchhausen, Briefe. Letters between G. A. von Münchhausen and J. Beckmann, 1766–70.
- HandAbtGö.2=2 Cod., MS Michael. 324. Letters between J. Justi and J. D. Michaelis, 1755–57.
- HandAbtGö.3=4 Cod., Philos. 133:V. Memoranda from Justi to Göttingen's Prorector, 1756–57.

City Archive, Göttingen (StadtArchGö)

- StadtArchGö.1=AA, Polizeyverwaltung, Pol 1,2,1. Göttingen police records, 1750–55.

Archive of the Göttingen Academy of Sciences (AkArchGö)

- AkArchGö.1=Pers 17, Nr. 3-7. Justi's appointment as extraordinary member of Göttingen's Royal Society, 1755.
- AkArchGö.2=Etat 6, 2, Nr.1-3. Justi's suggestions for improving the income of Göttingen's Royal Society, 1756.
- AkArchGö.3=Scient 12, Nr. 21. Concerning Justi's manuscript: "de metallorum per colores, quos in vitro producunt, arte probatoria (de German. translato.)," 1756.
- AkArchGö.4=Pers 12, Nr. 6 and Nr. 9. Concerning Beckmann's appointment to the Royal Society, 1770.
- AkArchGö.5=Scient 196, Fasz. 3, Nr.13. Concerning the prize question on leather tanneries, 1755.

Geheimes Staatsarchiv, Preussischer Kulturbesitz, Berlin (GehStaatArch)

- GehStaatArch.1=I. HA, Abt. D, Rep.121, Tit. II, Sekt.1, Nr.101, Bd. 1. Establishment of a mining academy, 1770–71.

Other References or Secondary Sources

- Beckmann, Johann. 1767. *Gedanken von der Einrichtung ökonomischer Vorlesungen*. Göttingen: Vandenhoeck.
- . 1769. *Grundsätze der teutschen Landwirthschaft*. Göttingen: Dieterich.
- . 1770–1806. *Physikalisch-oekonomische Bibliothek*. 23 vols. Göttingen: Vandenhoeck.
- . 1777. *Anleitung zur Technologie*. Göttingen: Vandenhoeck.
- . 1789. *Anleitung zur Handlungswissenschaft*. Göttingen: Vandenhoeck & Ruprecht.
- Bleek, Wilhelm. 1972. *Von der Kameralausbildung zum Juristenprivileg*. Berlin: Colloquium.
- Broman, Thomas. 1995. "Rethinking Professionalization: Theory, Practice and Professional Identity in Eighteenth-Century German Medicine." *Journal of Modern History* 67:835–72.
- . 1996. *The Transformation of German Academic Medicine, 1750–1820*. Cambridge: Cambridge University Press.
- Brückner, Jutta. 1977. *Staatswissenschaften, Kameralismus, und Naturrecht*. Munich: C. H. Beck.
- Brunner, Otto, Werner Conze and Reinhart Koselleck, eds. 1975–97. *Geschichtliche Grundbegriffe*. 8 vols. Stuttgart: E. Klett.
- [Claproth, Johann C.]. 1746. *Schreiben von dem gegenwärtigen Zustande der Göttingischen Universität*. Göttingen.
- . 1748. *Der gegenwärtige Zustand der Göttingischen Universität, in Zween Briefen an einen vornehmen Herrn im Reiche*. Göttingen: Schmidt.
- Clark, William. 1996. "On the Ministerial Archive of Academic Acts." *Science in Context* 9(4):421–86.
- Corran, H. S. 1975. *A History of Brewing*. London: David & Charles.
- Dear, Peter, ed. 1991. *The Literary Structure of Scientific Argument: Historical Studies*. Philadelphia: University of Pennsylvania Press.
- Debus, Allen G. 1998. "Chemists, Physicians, and Changing Perspectives on the Scientific Revolution." *Isis* 89(1):66–81.
- Delius, Christoph Traugott. 1773. *Anleitung zu der Bergbaukunst nach ihrer Theorie und Ausübung, nebst einer Abhandlung von den Grundsätzen der Berg-Kammeralwissenschaft*. Vienna: T. E. Trattern.
- Delmas, Bernard, Thierry Demals, and Philippe Steiner. 1995. *La Diffusion Internationale de la Physiocratie, XVIII^e–XIX^e*. Grenoble: Presses Universitaires.
- Eklund, Jon. 1975. *The Incomplete Chymist: Being an Essay on the Eighteenth-Century Chemist in his Laboratory, with a Dictionary of Obsolete Chemical Terms of the Period*. Washington: Smithsonian.
- Exner, Wilhelm F. 1878. *Johann Beckmann, Begründer der technologischen Wissenschaft*. Vienna.

- Frensdorff, Ferdinand. 1901. "Die Vertretung der ökonomischen Wissenschaften in Göttingen vornehmlich im 18. Jahrhundert." *Festschrift zur Feier des Hundertfünfzigjährigen Bestehens der Königlichen Gesellschaft der Wissenschaften zu Göttingen*, 495–565. Berlin: Wiedmannsche Buchhandlung.
- . 1903. "Über das Leben und die Schriften des Nationalökonomen J. H. G. von Justi." *Nachrichten der Königl. Gesellschaft der Wissenschaften zu Göttingen. Phil.-Hist. Klasse*, 4:353–503. Göttingen.
- Gasser, Simon P. 1728. *Programma publicum, oder Nöthiger Vorbericht von der von ihro Königl. Maj. in Preussen auf der Universität Halle allergnädigst neufundirten Profession über die öconomischen, Cameral- und Policey-Wissenschaften*. Halle.
- Gmelin, Johann F. 1780. *Einleitung in die Chemie zum Gebrauch auf Universitäten*. Nuremberg: Raspe.
- . 1786. *Grundsätze der technischen Chemie*. Halle: Gebauer.
- . 1786. *Chemische Grundsätze der Probir und Schmelzkunst*. Halle: Gebauer.
- . 1795. *Chemische Grundsätze der Gewerbekunde*. Hanover: Ritscher.
- . 1797–99. *Geschichte der Chemie*. 3 vols. Göttingen.
- Golinski, Jan. 1988. "Utility and Audience in Eighteenth-Century Chemistry: Case Studies of William Cullen and Joseph Priestly." *British Journal for the History of Science* 21:1–31.
- . 1992. *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820*. Cambridge: Cambridge University Press.
- Hannaway, Owen. 1975. *The Chemists and the Word: The Didactic Origins of Chemistry*. Baltimore: Johns Hopkins University Press.
- Harnack, Adolf. 1900. *Geschichte der Königlich preussischen Akademie der Wissenschaften zu Berlin*. Berlin: Reichsdruckerei.
- Heckscher, Eli. 1955. *Mercantilism*. London: Allen & Unwin.
- [Heynitz, Friedrich A. von]. 1786. *Tabellen über die Staatswirthschaft eines europäischen Staates der vierten grösse*. Leipzig: Heinsius.
- Hinrichs, Ernst, ed. 1986. *Absolutismus*. Frankfurt a. Main: Suhrkamp Hoefler, Ferdinand. 1866–69. *Histoire de la Chimie*. 2nd ed. 2 vols. Paris.
- Holmes, Frederic L. 1989. *Eighteenth-Century Chemistry as an Investigative Enterprise*. Berkeley: University of California.
- Hufbauer, Karl. 1982. *The Formation of the German Chemical Community: 1720–1795*. Berkeley: University of California Press.
- Hull, Isabel V. 1996. *Sexuality, State, and Civil Society in Germany, 1700–1815*. Ithaca: Cornell University Press.
- Isis Current Bibliography*. 1989–97. Chicago: Chicago University Press.
- Justi, Johann H. G. von. 1754. *Auf höchsten Befehl an Sr. Röm. Kaiserl. und zu Ungarn und Böhmen Königl. Majestät erstattetes allerunterthänigstes Gutachten von dem vernünftigen Zusammenhange und practischen Vortrage aller Oeconomischen und Cameralwissenschaften*. Leipzig.
- . 1754–58. *Neue Wahrheiten zum Vortheil der Naturkunde und des Gesell-*

- schaftlichen Lebens der Menschen*. 2 vols. Leipzig: Breitkopf.
- , 1755a. *Abhandlung von den Mitteln die Erkenntniß in den Oeconomischen und Cameral-Wissenschaften dem gemeinen wesen recht nützlich zu machen*. Göttingen.
- , 1755b. *Staatswirthschaft*. 2 vols. Leipzig: Breitkopf.
- , ed. 1755–57. *Göttingische Policy-Amts Nachrichten*. Göttingen: J. F. Hager.
- , 1756. *Grundsätze der Policy-Wissenschaft*. Göttingen: Vandenhoeck.
- , 1757. *Grundriss des gesammten Mineralreiches*. Göttingen: Vandenhoeck.
- , 1758. *Vollständige Abhandlung von den Manufacturen und Fabriken*. Copenhagen: Roth.
- , 1759. *Fortgesetzte Bemühungen zum Vortheil der Naturkunde und des Gesellschaftlichen Lebens der Menschen*. Berlin and Stettin: J. H. Rüdiger.
- , 1760–61. *Gesammlete Chymische Schriften*. 2 vols. Berlin and Leipzig: Real-Schule.
- , 1782. *Grundsätze der Policywissenschaft*. Edited by Johann Beckmann. 3rd ed. Göttingen: Vandenhoeck.
- Klein, Ursula. 1994. *Verbindung und Affinität. Die Grundlegung der neuzeitlichen Chemie an der Wende vom 17. zum 18. Jahrhundert*. Basel.
- , 1996. "The Chemical Workshop Tradition and the Experimental Practice: Discontinuities within Continuities." *Science in Context* 9(3):251–87.
- Klippel, Diethelm. 1995. "Johann August Schlettwein and the Economic Faculty at the University of Gießen." In Delmas et al. 1995, 345–65.
- Knemeyer, Franz-Ludwig. 1980. "Polizei." *Economy and Society* 9:172–96.
- Koschwitz, Hansjürgen. 1968. "Die Periodische Wirtschaftspublizistik im Zeitalter des Kameralismus." Ph.D. diss., Göttingen University.
- Lehmann, Hartmut. 1980. *Das Zeitalter des Absolutismus. Gottesgnadentum und Kriegsnot*. Stuttgart: Kohlhammer.
- [Lehmann, Johann G., et al.]. 1756. *Untersuchung von den wahren Ursachen*. Berlin.
- Liebig, Justus, J. C. Poggendorff, and F. Wohler. 1842–64. *Handwörterbuch der reinen und angewandten Chemie*. 9 vols. Braunschweig: Vieweg.
- Lindemann, Mary. 1996. *Health and Healing in Eighteenth-Century Germany*. Baltimore: Johns Hopkins University Press.
- Lindenfeld, David F. 1997. *The Practical Imagination: The German Sciences of State in the Nineteenth Century*. Chicago: University of Chicago Press.
- Lowood, Henry E. 1990. "The Calculating Forester: Quantification, Cameral Science, and the Emergence of Scientific Forestry Management in Germany." In *The Quantifying Spirit in the Eighteenth Century*, edited by Tore Frängsmyr, J. L. Heilbron, and Robin E. Rider. Berkeley: University of California Press.
- , 1991. *Patriotism, Profit, and the Promotion of Science in the German Enlightenment*. New York: Garland.
- Ludewig, Johann P. von. 1727. *Die, von Sr. Königlichen Majestät, unserm*

- allernädigsten Könige, auf dero Universität Halle, am 14 Julii 1727 neu angerichtete Profession, in Oeconomie, Polickey, und Cammer-Sachen.* Halle: Neuen Buchhandlung.
- Marx, Karl, and Friedrich Engels. 1961–74. *Karl Marx, Friedrich Engels. Werke.* 39 vols. Berlin: Dietz.
- McClelland, Charles E. 1980. *State, Society, and University in Germany, 1700–1914.* Cambridge: Cambridge University Press.
- [Medicus, Friedrich C.]. 1784. *Nachricht an das Publikum.* Mannheim.
- Meier, Ernst von. 1898–99. *Hannoversche Verfassungs- und Verwaltungsgeschichte, 1680–1866.* Leipzig.
- Meinel, Cristoph. 1981. “De praestantia et utilitate Chemiae: Selbstdarstellung einer jungen Disziplin im Spiegel ihres programmatischen Schrifttums.” *Sudhoffs Archiv* 65:366–389.
- . 1983. “Theory or Practice? The Eighteenth-Century Debate on the Scientific Status of Chemistry.” *Ambix* 30:121–32.
- . 1985. “Reine und angewandte Chemie.” *Berichte zur Wissenschaftsgeschichte* 8:25–45.
- [Michaelis, Johann D.]. 1768. *Raisonnement über die protestantischen Universitäten in Deutschland.* 4 vols. Frankfurt am Main.
- Multhaus, Robert P. 1966. *The Origins of Chemistry.* New York: Watts.
- Outram, Dorinda. 1995. *The Enlightenment.* Cambridge: Cambridge University Press.
- Partington, James R. 1961–70. *A History of Chemistry.* 4 vols. London: Macmillan.
- Pott, Johann H. 1746. *Chymische Untersuchungen . . . von der Lithogegnosia.* Potsdam: Voß.
- . 1756a. *Animadversiones physico-chimicae circa varias hypotheses et experimenta Elleri.* Berlin.
- . 1756b. *Fortsetzung seiner physicalisch-chymischen Anmerckungen.* n.s.
- . 1757. *Chymische Untersuchungen . . . von der Lithogegnosia.* 2nd ed. Berlin: Voß.
- . 1760. *Send-Schreiben an den Herrn Berg-Rath von Justi.* Berlin: Spener.
- Pütter, Johann S. 1765–88. *Versuch einer academischen Gelehrten-geschichte von der Georg-Augustus-Universität zu Göttingen.* 2 vols. Göttingen.
- Raeff, Marc. 1983. *The Well-Ordered Police State: Social and Institutional Change through Law in the Germanies and Russia, 1600–1800.* New Haven, Conn.: Yale University Press.
- Riedel, Manfred. 1975. “Gesellschaft, bürgerliche.” In Brunner, Conze, and Koselleck 1975–97, 2:719–800.
- Riskin, Jessica. 1998. “Rival Idioms for a Revolutionized Science and a Republican Citizenry.” *Isis* 89(2):203–32.
- Roberts, Lissa. 1991. “Setting the Table: The History of Eighteenth-Century Chemistry as Read through its Tables.” In Dear 1991, 99–132.

- . 1993. "Filling the Space of Possibilities: Eighteenth-Century Chemistry's Transition from Art to Science." *Science in Context* 6(2):511–53.
- Roscher, Wilhelm. 1874. *Geschichte der Nationalökonomik in Deutschland*. Munich: Oldenburg.
- Rössler, Emil, ed. 1855. *Die Gründung der Universität Göttingen*. Göttingen: Vandenhoeck & Ruprecht.
- Sachse, Wieland. 1987. *Göttingen im 18. und 19. Jahrhundert: Zur Bevölkerungs- und Sozialstruktur einer deutschen Universitätsstadt*. Göttingen: Vandenhoeck & Ruprecht.
- Schellhas, Walter. 1957. "Eine 'Bergwercks-Academie' in Bräunsdorf bei Freiberg/Sa.?" *Freiberger Forschungshefte*, D22, 157–185. Berlin.
- Schmoller, Gustav. 1910. *The Mercantile System and Its Historical Significance*. Translated by W. J. Ashley. New York: Macmillan.
- Schreber, Daniel G. 1763. *Sammlung verschiedener Schriften, welche in die öconomischen, Policey- und Cameral- auch andere Wissenschaften einschlagen*. 10 vols. Halle: Curts.
- . 1764. *Zwo Schriften von der Geschichte und Nothwendigkeit der Cameralwissenschaften in so ferne sie als Universitätswissenschaften anzusehen sind*. Leipzig: Dyckischen Buchhandlung.
- Schumpeter, Joseph. 1954. *History of Economic Analysis*. New York: Oxford University Press.
- Shapin, Steven, and Simon Schaffer. 1985. *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life*. Princeton, N.J.: Princeton University Press.
- Small, Albion. 1909. *The Cameralists*. Chicago: University of Chicago Press.
- Smith, Pamela. 1994. *The Business of Alchemy: Science and Culture in the Holy Roman Empire*. Princeton, N.J.: Princeton University Press.
- Sommer, Louise. [1920–25] 1967. *Die Österreichischen Kameralisten*. Aalen: Scientia.
- Stichweh, Rudolf. 1984. *Zur Entstehung des modernen Systems wissenschaftlicher Disziplinen: Physik in Deutschland, 1740–1890*. Frankfurt: Suhrkamp.
- . 1992. "The Sociology of Scientific Disciplines: On the Genesis and Stability of the Disciplinary Structure of Modern Science." *Science in Context* 5:3–15.
- Stieda, Wilhelm. 1906. *Die Nationalökonomie als Universitätswissenschaft*. Leipzig: Teubner.
- Stone, Lawrence, ed. 1974. *The University in Society*. 2 vols. Princeton, N.J.: Princeton University Press.
- Teich, Mikuláš. 1983. "Fermentation Theory and Practice: the Beginnings of Pure Yeast Cultivation and English Brewing, 1883–1913." In *History of Technology: Eighth Annual Volume*, edited by Norman Smith. London: Mansell.
- Tribe, Keith. 1984. "Cameralism and the Science of Government." *Journal of Modern History* 56:263–84.
- . 1988. *Governing Economy: The Reformation of German Economic Discourse, 1750–1840*. Cambridge: Cambridge University Press.

- Turner, R. Steven. 1974. "University Reformers and Professorial Scholarship in Germany, 1760–1806." In Stone 1974, 2:495–531.
- . 1980. "The Bildungsbürgertum and the Learned Professions in Prussia, 1770–1830: The Origins of a Class." *Social History/Histoire Social* 18:105–35.
- . 1987. "The Great Transition and the Social Patterns of German Science." *Minerva* 25, 1–2:56–76.
- Tylecote, Ronald F. 1992. *A History of Metallurgy*. 2nd ed. London: Institute of Materials.
- Vierhaus, Rudolf. 1984. *Staaten und Stände: Vom Westfälischen Frieden bis zum Hubertusbürger Frieden, 1648–1763*. Berlin: Propyläen.
- Wagenbreth, Otfried. 1994. *Die technische Universität Bergakademie Freiberg und ihre Geschichte*. Leipzig: Deutscher Verlag für Grundstoffindustrie.
- Walker, Mack. 1971. *German Home Towns. Community, State and General Estate, 1648–1871*. Ithaca, N.Y.: Cornell University Press.
- Weber, Wolfhard. 1976. "Innovationen im Frühindustriellen deutschen Bergbau und Hüttenwesen — Friedrich Anton von Heynitz." *Studien zur Naturwissenschaft, Technik und Wirtschaft im Neunzehnten Jahrhundert* (Göttingen) 6.
- Winnige, Norbert. 1996. "Krise und Aufschwung einer frühneuzeitlichen Stadt: Göttingen, 1648–1756." *Quellen und Untersuchungen zu Wirtschafts- und Sozialgeschichte Niedersachsens in der Neuzeit* (Hanover) 19.
- Wyrwa, Ulrich. 1990. *Branntewein und "echtes" Bier. Die Trinkkultur der Hamburger Arbeiter im 19. Jahrhundert*. Hamburg: Junius Verlag.
- Zedler, Johann Heinrich, ed. 1732–50. *Grosses vollständiges Universal-Lexicon aller Wissenschaften und Künste*. 64 vols. Halle: J. H. Zedler.
- Zincke, Georg H. 1743. *Grundriß einer Einleitung zu denen Cameral-Wissenschaften*. Leipzig.
- . 1755. *Anfangsgründe der Cameralwissenschaft, worinnen dessen Grundriss weiter ausgeführt und verbessert wird*. Leipzig.

University of Chicago