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Lawrence M. Principe, *The Transmutations of Chymistry: Wilhelm Homberg and the Académie Royale des Sciences*. Chicago and London: University of Chicago Press, 2020. xv + 464 pp. Table, figures, notes, bibliography, and index. \$45.00 U.S. (cl). ISBN 978-0226700786. \$44.99 U.S. (eb). ISBN 978-0226700816.

Review by Matthew Cobb, University of Manchester.

For over two decades, Lawrence Principe has sought to reinterpret the histories of chemistry and of alchemy. According to the schoolbooks, chemistry was born with the work of Antoine-Laurent de Lavoisier (1743-1794), who recognised and named oxygen and hydrogen and did much to set chemistry on a systematic, modern basis. In contrast, alchemy was marked as medieval because of its arcane language, obscure concepts, and its fruitless fascination with chrysopoeia, the transmutation of gold. In reality, alchemy and chemistry are now seen as a continuum. To avoid anachronistically fitting thinkers from the past into modern categories, Principe and his fellow historian of science William R. Newman have effectively used the archaic term “chymistry” to describe theory and practice in this field from the mid-seventeenth to the early eighteenth centuries.[1]

The life and work of Wilhelm Homberg (1653-1715) provides Principe with a striking demonstration of the validity of this approach, revealing how attempts to transmute metals and alchemical concepts were at the heart of the chymical work of the Académie Royale des Sciences, an institution that has traditionally been seen as profoundly hostile to transmutation and what we would now consider to be the ideas of alchemy. For this alone, the book is invaluable. But *The Transmutations of Chymistry* is so much more than the biography of a largely overlooked figure who was attempting to develop a new view of chymistry. This brilliant, profoundly scholarly book contributes to the growing recalibration of the work of the Académie (the fourteen-page note on archival sources relating to the Académie will be especially helpful to researchers). It also sheds light on the closing years of the reign of Louis XIV, revealing how transmutation obsessed the highest in the land, and involves an extraordinary ‘spelunking’ (Principe’s term) into various archives, resulting in the rediscovery of some of Homberg’s lost manuscripts that turned Principe’s ideas upside down. Although primarily aimed at historians of science, Principe’s masterful account, over two decades in the making, will be vital reading for historians of France in the first half of the eighteenth century. Extremely well written, wry and packed with informative footnotes, this is a sparkling achievement.

Born to a German father who worked for the Dutch East India Company in what is now Java, Homberg voyaged with his family to Amsterdam when he was a teenager. After studying law in

Jena he briefly practiced as a lawyer before becoming fascinated by the “Bologna stone,” a mineral called barite that glows when it has cooled after heating. Homberg travelled to Italy to try and understand the phenomenon, and above all to learn how to produce it, something that had evaded many previous investigators. As Principe has shown in his own chymical reconstructions (he is a professional chemist as well as an historian of science), copper impurities in the barite from the region are responsible, but other forms of barite are not so cooperative. Homberg also recognized the involvement of copper although not, of course, the mechanism.

The Bologna stone was not the only light-producing element that fascinated Homberg. He also mastered the production of white phosphorous from human urine, which he demonstrated to the members of the Académie Royale des Sciences when he visited Paris in 1683. Shortly afterwards he was employed by Armand-Louis Bonnin, the future Bishop of Toulon, on a bizarre project to produce an odorless, transparent oil from human faeces that could, it was claimed, transmute mercury into silver. Although the scatological details of the procedure are amusing, for Principe the key point is that the search for transmutation—the alchemical process par excellence—was at the heart of these experiments.

After a period in Italy, Homberg returned to Paris, and in 1691 he was admitted to the Académie, becoming a regular contributor to the *Mémoires de mathématique et de physique*, the Académie’s short-lived journal. He was also involved in the use of chymical analyses to study plants, as part of the Académie’s project of creating a *Histoire des plantes*. At this point, too, Principe emphasizes the influence on the Académie of alchemical concepts, in particular Joan Baptista Van Helmont’s idea of “ferments,” which particularly occupied Homberg.

Underlying Homberg’s research, Principe shows, was a desire to develop a coherent theory to explain the experimental results he obtained, and to identify the chymical principles that were the building blocks of compound substances, with a view to mastering transmutation. Principe’s realization of the significance of alchemical concepts in Homberg’s thinking came from his discovery of two manuscripts in the archives of the St. Petersburg Military-Medical Academy. These are drafts of Homberg’s posthumously published *Essais de chimie*, long thought to be lost. In Principe’s hands the contrast between the two versions reveals Homberg’s hitherto unsuspected commitment to the alchemical project of transformation.

The story of how Principe found these documents is partly told in a section of the acknowledgements, although he frustratingly tells us that the full details of his archival adventure can be told “only over drinks, and not in print” (p. xiv). Principe’s encounters with missing manuscripts include his discovery that Homberg’s 1708 marriage certificate was witnessed by such prestigious members of the court circle that the page of signatures was stolen by an autograph hunter. He eventually stumbled across the original in the Wellcome Library in London. As he explains in an understandably irate footnote, he was less successful in his search for a manuscript that the catalogs claimed was to be found in the *ancien fonds* of the library of the Université de Bordeaux. It turned out that a mid-twentieth century administrative decision to split the library along disciplinary lines led to the loss, sale, or theft of fourteen manuscripts. Typically, the library did not know the documents were missing until Principe asked to see them.

The key period of Homberg’s life spanned a decade beginning in 1702, when Philippe II, Duc d’Orleans, nephew to Louis XIV and sixth in line to the throne, appointed Homberg as his tutor in chymistry and his personal physician (Homberg had no medical qualifications). Philippe’s

interest in Homberg's research was so intense that they worked together for many years. Homberg also made a great impression on Philippe's mother, Elisabeth Charlotte von der Pfalz, who repeatedly mentioned the chymist in the warmest terms in her voluminous correspondence. Philippe's interest in chymistry could usefully have been contextualised further. As a high-ranking royal it is not clear if his academic pursuits were unusual, and if so, why he adopted them.

Homberg's connection with the Duc d'Orleans led him to be installed in a swanky laboratory and apartment in the Palais Royal (Principe has identified their exact locations) and to acquire an amazing item of scientific equipment: a concave lens more than one metre in diameter, weighing around 75 kg, that powerfully concentrated the sun's rays, providing intense heat that could vaporize gold in a few moments. Made by the Saxon inventor Ehrenfried Walther von Tschirnaus, the lens cost around 6,000 livres and was probably the largest and most expensive piece of apparatus in Europe at the time. It enabled Homberg to study how different substances reacted to different degrees of heat (gold would instantly melt if placed at the focal point but would merely give off fumes if elsewhere in the cone of light). And it prompted him to reflect on why the effects of concentrated light might differ from those of flame. News of the lens and Homberg's use of it inspired Isaac Newton, also influenced by alchemical concepts, to create his own device involving seven mirrors in order to carry out similar experiments. As revealed by the archival documents, Homberg's findings, in particular his careful measurement of the weights of his samples before and after treatment with the lens, led him to develop a new, alchemically tinged theory in which alchemy's "sulphur principle" was identified as light itself, while the sun and the stars were, in Principe's gloss, "engines that power the universe" (p. 219). Principe misses the opportunity to consider how this might have been viewed by the Roi Soleil.

Although discussion of chrysopoeia had been officially banned by the Académie at its foundation in 1666, much of Homberg's work with the Duc d'Orleans was framed by an interest in transmutation. The subject was forbidden not because of its whiff of alchemy but rather because of the potential for economic instability. The fear was that the currency, the *Louis d'or*, might be viewed as debased through the potential involvement of gold that might be less "real" than the usual stuff dug out of the ground. Nevertheless, in 1705, Homberg reported in print that it was possible to change mercury into a "philosophical mercury," something that the alchemical cognoscenti would immediately recognize as a key step in the creation of the Philosopher's Stone, which was thought to enable the transmutation of mercury into gold. In subsequent publications, Homberg identified the substance finally produced by this process as gold, albeit in tiny quantities. At this point, and at several others, the chemically unsophisticated reader could really benefit from a straightforward explanation of Homberg's alembics.

Given the negative views of chrysopoeia, these experiments were largely conducted away from prying eyes—often in a secret room in the Palais Royal laboratory—and both the experimental objective and the Duc's interest were denied in public. Homberg was not alone in his focus on transmutation. As Principe shows, the two other leading chymists in the Académie's first half-century, Samuel Cotterau Duclos and Etienne-François Geoffroy, were also attempting to transmute metals. Although Homberg claimed success in his venture, he was only ever able to produce traces of gold. The Philosopher's Stone, which would have made the process scalable, eluded him.

Chymists were viewed with suspicion not only because of their interest in transmutation, but also because of their very real ability to produce poisons. In the 1670s, France was rocked by the

Affaire des Poisons, featuring a supposed network of poisoners and enchanters that involved one of Louis XIV's mistresses. This scandal led to an edict of 1682 that expressly forbade the creation of chemical products—including searching for the Philosopher's Stone—without an official license. Chymistry was seen as threatening, not only to the royal exchequer, but potentially to the royal person. In the early years of the eighteenth century, a number of unregulated chymists were prosecuted for their activities, including Etienne Vinache, who claimed that the Duc d'Orleans had asked him to build three chymical furnaces. After an unpleasant interrogation, Vinache apparently committed suicide in the Bastille. Other cases followed, and Principe's exploration of these affairs, which mixed up real fraud and fears of both criminality and economic dangers, makes for fascinating reading.

For Homberg, these events were significant because they formed the backdrop to what was to mark the end of his influence, and nearly the end of his life. In 1711 and 1712, a series of tragedies rocked the court, leading to rolling uncertainty over the succession. In April 1711, Louis the Dauphin died, probably of smallpox. The new Dauphin was Louis' son and Louis XIV's grandson, the Duc de Bourgogne (also called Louis). At the beginning of 1712, there were allegations of a plot to poison the new Dauphin and his wife, and sure enough, they were both dead within weeks. Autopsies revealed that they had been poisoned, or so their doctors said. The Duc d'Orleans was now two places closer to succeeding the Sun King, and he was widely suspected of poisoning the Dauphin and his wife. It was assumed that Homberg had made the poison. Encouraged by Philippe, Homberg turned himself over to the Bastille in order to calm public suspicions, but the king was advised that there was no truth to the rumors, and a no doubt relieved Homberg was turned away from the prison.

That was not the end of the matter. A few weeks later, the five-year-old Duc de Bretagne, who was now the Dauphin, also died. Although modern sources suggest that the little boy and his parents all died of measles, suspicion once again focused on the Duc d'Orleans. Posters appeared on the walls of the Palais Royal proclaiming "Here's where the best poisons are found," and Philippe decided to close the laboratory. Although Homberg apparently tried to carry on his work at the Academie's own facility, his illustrious experimental career had effectively come to an end. Within three years he was dead, only a few weeks after the death of the Louis XIV. Philippe Duc d'Orléans became Regent to the Duc d'Anjou, the Duc de Bourgogne's younger son, who acceded to the throne as Louis XV in 1723 and reigned for over half a century.

Principe identifies two hidden legacies of Homberg's life and work. In a speculative section, he explores the longstanding interest of the Duc d'Orléans in transmutation in the context of governmental responses to the French financial crisis of the early 1720s and in particular the Mississippi Bubble. Principe implies that Philippe may have hoped he could literally magic up some more money. This may excite or infuriate economic historians of the period, but for the non-specialist it makes for intriguing reading. Principe contrasts this covert interest in transmutation with the known history of the period, in particular a 1722 paper by academician Etienne-François Geoffroy that denounced transmutation and the 1715 *éloge* of Homberg by the perpetual secretary of the Académie, Bernard de Fontanelle. That document described Homberg's hostility to transmutation, and until the appearance of this book was our sole source of biographical details regarding Homberg. Principe demonstrates that both documents were deliberately deceptive. Virtually everything in Fontanelle's *éloge* turned out to be incorrect, beginning with Homberg's date of birth. In fact, not only was Homberg profoundly interested in transmutation, this supposedly forbidden topic continued to be a focus of work in the Académie

into the nineteenth century. It had immense practical implications, if only it could be made to work.

The second legacy involves a precise link between Homberg's methods and that of his illustrious successor, Lavoisier. In 1772, academicians started experimenting with Homberg's lens once again (it had been in storage for decades). Among them was the young Lavoisier. Attempting to repeat and reinterpret Homberg's experiments, Lavoisier followed his predecessor in carefully noting the weights of the samples before and after being subjected to the white-hot heat produced by the apparatus. This precision would eventually provide Lavoisier with the key to identifying the existence of oxygen in his experiments on calcination. As Principe convincingly demonstrates, alchemical interests and practices were at the heart of the eventual emergence of modern chemistry. In science, as in other disciplines, modernity did not spring fully-formed like Athena from the forehead of Zeus. It was marked by the conditions of its birth and still carries those marks today.

NOTE

[1] William R. Newman and Lawrence M. Principe, "Alchemy vs. Chemistry: The Etymological Origins of a Historiographic Mistake," *Early Science and Medicine* 3 (1998): 32-65.

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