# Book Reviews

Bruce T. Moran, *Distilling Knowledge. Alchemy, Chemistry, and the Scientific Revolution*, Harvard University Press, Cambridge, MA, 2005, 210 pp. [ISBN 0-674-01495-2]

The chemist is a horrible, morally corrupt person, and there does not seem to be any single term awful enough to describe him. At least that was Libavius' opinion of those involved in chemical experimentation. This scholar even asked, "What is more abject than a chemist?"

This short quotation from the reviewed book should illustrate its approach. We find here an attempt to address significant points concerning alchemy and chymistry in the turbulent development of ideas during a historical epoch known as the Scientific Revolution. It should be emphasized that Moran successfully draws, in the format of a small book, the multifaceted picture of an epoch in which not only science, but also European society as a whole, endured deep changes under conditions that were often stormy. The Thirty Years War was one such dramatic peak. Concerning Libavius' opinion of chemists cited above, we will leave it to the reader to find the explanation of this seemingly strange attitude. In the book we meet this German scholar repeatedly.

Although the reviewed book does not consider itself to be classified among the 'top scholarly works', Moran's introductory sentences already indicate that his book is not simply easy reading for a Sunday afternoon either. Basic knowledge of history in general, and of alchemy and chymistry in particular, is necessary for understanding it. The author begins with discussing whether or not alchemy can be regarded as 'scientific' with reference to the revolution in science that occurred during the sixteenth and seventeenth centuries. In other words: Was alchemy a science? Past opinions varied broadly, and this has remained so until recent times. Two extremes can be recalled here. On one side there appeared a very strict condemnation of alchemy by Nicholas Lemery, one of the personalities that also appear in the reviewed book. Contrary to Lemery, about two centuries later, the chemist Justus von Liebig (1803-73) did not find anything wrong with alchemy and did not perceive a difference between this science and his contemporary chemistry. Moran's book follows the vicissitudes of alchemy, which had never been included into university curricula, though it had permeated European society not only in the discussed epoch.

The publication of Moran's book coincides happily with William R. Newman's *Promethean Ambitions* (see the following review). Although the latter book covers a much broader historical period and concentrates on different topics, it should be strongly recommended to study both works, as they are in some respects complementary. Taken together they can yield deeper insight into the world of alchemy and early chemistry. But back to Moran's book.

It is divided into six numbered chapters followed by a *Conclusion*, a list of references, and an index. In this review we will briefly discuss these chapters, in some cases with remarks that are not intended as criticisms; the book is written in a compact form, and it would surely be difficult, if not impossible, to include more information into such a focused volume. Some of the following com-

ments are rather suggestions for future editions (the reviewer hopes that they will appear). On the other hand, it is just its compactness that makes this book excellent reading for those who want a basic description of European alchemy during a period of important change. The list of references is a guide for the further study of this topic.

In the *Introduction* the author asks "what would happen if we could find a way to drop into the sixteenth and seventeenth centuries and see the world from the historical inside out?" It is not easy to imagine, because the result would depend on our social status, if we were a nobleman, a beggar, a scholar, or a soldier in the Thirty Years War. The last possibility is unlikely; the author intends to look through the prism of a scholar. Perhaps a broader view that could be observed from this position would yield a picture like that described by Marie Boas-Hall in *The Scientific Renaissance 1450 – 1630* (Dover, New York, 1994), which is not included into the list of references.

In the second chapter, *Doing Alchemy*, the reader meets Libavius for the first time in this book. Moran states that this famous German scholar does not belong "in the pantheon of great chemists". We can agree with this point of view, because Libavius seems to have sat uncomfortably between alchemy, with its belief in transmutation, and the emergence of what gradually became modern chemistry. The latter contradicted the former. Even among historians the wish is sometimes father to the thought, and as a result Libavius has been named as one of the founders of chemistry. This opinion is true to some extent: his contribution to chemical knowledge is indubitable, and his most cited work, *Alchymia*, was surely an important source of information for its time, but it was not a textbook of chemistry as we understand it. Sometimes it is forgotten that Libavius wrote more than just that one book, and therefore Moran's use of some of Libavius' other texts is of considerable interest. Furthermore, there were other scholars who finally helped chemistry to crystallize from a complicated mixture of alchemy, chymistry, and craft. The contribution of artisans should not be overlooked; though most of them will remain unknown, their practical skills introduced various chemical processes, as is summarized in U. Klein's *Verbindung und Affinität* (Birkhäuser, Basel 1994), which would also deserve to be included into the list of references.

Libavius is not the only name that appears in this chapter; for we also meet personalities who were active well before the Scientific Revolution. The changes in meaning of the term *fifth essence* are illustrated by the works of John of Rupescissa, Raymund Lull (alchemist), and Roger Bacon. Doing alchemy was surely not an easy job, because it had been accompanied by the repeated failure to transmute metals throughout the centuries. Yet there was continuous interest in gold production, and King Henry VI is mentioned as a high-ranking supporter of this aspect of alchemy. On the other hand, a papal bull against alchemy issued by John XXII is also discussed. The part of the latter text that refutes the possibility of metallic transmutation deserves particular attention. The attitude of the church toward the question of alchemy is discussed extensively in the above-mentioned book by Newman.

In the second chapter, "*That Pleasing Novelty": Alchemy in Artisan and Daily Life*, the reader meets famous figures of metallurgy, like Biringuccio and Georgius Agricola, as well as the much less-known alchemist Isabella Cortese, an example of a woman active in this field. Among the prominent representatives of mining and metallurgy Lazarus Ercker is missing. He could serve as a striking example of how difficult the question of metallic transmutation actually was. The threshold between alchemy and chemistry was not easy to overcome, although the obstacle in Ercker's

case was the chemical reaction in which copper is deposited from a cupric solution onto the surface of metallic iron. This reaction, known from antiquity, remained difficult to interpret even into the eighteenth century. In the statement that appeared in his *Beschreibung Allerfürnemisten Mineralischen Ertzt* (1574), Ecker admitted that seeing iron nails and ladders in mines changed into copper by vitriolous drainage water convinced him that metallic transmutation is a possible process. We can follow Ercker's change of mind through time. Unfortunately the source we will cite here is written in the Czech language, which makes it largely inaccessible to the broader international public. In a manuscript dated 1569 Ecker had written: "Many think that iron can become copper by the action of vitriolic water. I will, of course, oppose that iron could have become copper [...] it [iron] draws copper down and digests it." (L. Kubátová, *Neznámý rukopis Lazara Erckera 1569* ["An unknown manuscript of Lazarus Ercker 1569"], Státní ústřední archiv v Praze, 1996). Five years later, this skilled metallurgist gave up and accepted the transmutation of iron into copper.

To the second part of the title of this chapter, *daily life*, we can perhaps add that it is not easy to describe the social status of alchemists in the sixteenth and seventeenth centuries. This is especially true for the German-speaking countries that formed the Holy Roman Empire, which was a complicated world, split into some three hundred states. There were numerous reasons for employing alchemists. The most straightforward was of course the wish to gain access to a source of gold, but in some cases it was also an effort to simply demonstrate the status of a court. As P. Vágner has pointed out (*Theatrum chemicum* [in Czech], Paseka, Prague 1995), alchemists were sometimes considered as part of the 'living inventory' of a court, together with astrologers, musicians, painters, and various other artists. In Bohemia there is even a typical example of belief in the medical effects of the philosopher's stone. The family of Rosenberg died out without a male heir in 1611, and the last Rosenbergs wanted alchemists to produce something that would change this fatal situation. *Doing alchemy* had been a complicated process in the European Renaissance that still calls for further study.

An interesting passage of the Moran's book deals with 'books of secrets', a tradition reaching back to the Middle Ages. These books combined knowledge from various fields for practical purposes. The fourth manual that Moran discusses (p. 58) deals with solutions for hardening steel tools, and recommends that files be quenched in linseed oil or the blood of a male goat. This is reminiscent of a medieval recipe that recommends the urine of a goat fed on fern for similar purposes (*Theophilus, On Divers Arts*, Dover, New York, 1978). The books of secrets are interesting in more respects. They show that various fields, including alchemy, communicated with each other to some extent. The goat products appearing in such recipes, a reflection of natural magic, are illustrations of belief in the supernatural that was deep in the human mind for centuries.

Did Paracelsus really burn the books of the most respected medical authorities of his time (p. 73)? As some historians have pointed out, he could have hardly collected enough means to purchase such an expensive commodity. Yet this legend is not so important, and does not dominate the third chapter, entitled *Paracelsus and the "Paracelsians"*. Here the reader again meets the omnipresent Libavius and his division of the types of people active in medicine and chymistry. Libavius thus tried to draw a distinction between various ideas current in his time. Also included in this chapter is the dramatic history of the French Paracelsians. Considerable space is devoted to van Helmont, whose medical philosophy and famous tree experiment are discussed.

*Sites of Learning and the Language of Chemistry* is the informative title of the fourth chapter, from which the introductory sentence of this review was taken. Libavius' definition of chemistry is considered in this chapter, based on his division of what belonged to chemistry and what not. Moran's familiarity with the history of alchemy at German courts allows him to describe the picture of Marburg in the seventeenth century. This description is central to the development of the chapter, though his discussion of how chemical ideas developed and ripened in France from Beguin to Lemery is perhaps more interesting, as anglophone books on the history of chemistry do not always give enough attention to that country. Moran tells the story of the origin of Beguin's textbook, which was intended to open the secrets of alchemy, something not thought about before. Beguin's view that chemistry is "the art of dissolving natural mixed bodies, and coagulating the same when dissolved" was later expressed in similar words by Glaser. Here Moran briefly describes the crucial point that led eventually to chemistry; though there was still a long way to go. Also of interest is the further development of ideas concerning acids and bases.

The 'English school' with its prominent representatives Boyle and Newton is discussed in the fifth chapter *Alchemy, Chemistry, and the Technology of Knowing*. Here, the reader should remember the previous chapter, because it is especially interesting to compare the French and English chymists. Yet alchemy in the British Isles is not the author's only focus, as suggested by the term 'technology' in the title of this chapter, which begins with a discussion of the difference between experiment and experience. As the author states, "something happened in the seventeenth century". The experiments could be performed with a wider variety of new apparatus, though only the air pump is mentioned. There could surely be more examples collected, because this topic is of considerable importance for the Scientific Revolution.

A newly discovered substance, phosphorus, had attracted the attention of chymists and the broader public in the seventeenth century. The discovery of this mysterious substance is attributed to Johann Kunckel (p. 148) in the reviewed book. Kunckel, however, had received instructions for its preparation from its true discoverer, the Hamburg alchemist Henning Brand (M.E. Weeks, *Discovery of Elements*, 1968). Another famous story has linked the German alchemist Johann Böttger with the discovery of European porcelain, whereas the fate of his tutor, Walter von Tschirnhaus, is presented as being secondary in this epochal event. As Prandtl had pointed out (W. Prandtl, 'Zur Vorgeschichte des Meissener Porzellans', *Chymia*, 4 [1958], 115), the "Waldenburger Gefässe", vessels made from vitreous ceramic material, were already known in Agricola's time. In his *De natura fossilium* Agricola even described how to achieve the vitrification of ceramic material, though the product was not white. According to Prandtl, von Tschirnhaus had proposed to the Saxonian Elector August II to build a porcelain factory as early as 1702, but the latter was involved in a war during that time, and thus had different problems to deal with. Böttger was accepted in von Tschirnhaus' laboratory in 1705, and the death of his master three years later opened the way for him to accept the laurels of the discoverer.

The contribution of chemistry and mechanics to medicine is one of the topics of the sixth and final chapter, *The Reality of Relationship*. Here Moran first discusses the position of various sciences in the Scientific Revolution, and this question leads to the role of mechanics in scientific thinking. As a striking example of this approach, the explanation of the action of organisms by the German physician Friedrich Hoffmann is given. This scientist applied the laws of mechanics to this problem. Due space is

of course devoted to Newton as an alchemist, and to his role in the Scientific Revolution.

In the *Conclusion* the author points out that "chemistry itself did not so much replace alchemy as subsume it". In his opinion, "in a disciplinary sense, chemistry is an extract, a derivative of alchemy". In this chapter Libavius appears for the last time, praised for his attempts to spread chemical knowledge. Finally, when summing up what was said before, Moran emphasizes the role of alchemy in the Scientific Revolution. Alchemy was one of numerous voices in a chorus of growing sciences, a voice that has not always been quite understandable, because alchemy vacillated between dream and the sober reality of unsuccessful attempts to transmute metals and spoke in its special language. In the epoch covered by the reviewed book, the language of chymistry was not much more consistent.

As was said at the beginning of this review, *Distilling Knowledge* is a book that is not easy to classify into a certain group of literature. In such a small volume not all facets of the complicated structure of the Scientific Revolution can be touched upon. Therefore the author selected only details that had far reaching effects. However, this book is not simply introductory reading about European alchemy and chymistry in the sixteenth and seventeenth centuries. Instead, it is something in between: though not a source for the fully uninitiated, it is built upon classic original texts and modern secondary sources, and previous knowledge about the history of alchemy and chymistry is expected. Moran's book provides a very interesting picture of the Scientific Revolution observed through the prism of the alchemical laboratory. This book can be suitable to those who want to be acquainted with an epoch that played a crucial role in the further development of Europe. Therefore, it would be interesting for students of the history of science, as well as of general history, but also as a source for scholars to find points worthy of further consideration. We can close by saying that this book is an attempt to distill the essence of alchemical and chemical thinking in an epoch of turbulent changes in Europe. The distillate that Moran has prepared fulfills the expectations – it is very tasty and stimulating.

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