INTRODUCTION

Alchemical Practice: Looking Towards the Chemical Humanities

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This special issue of Ambix *is an outgrowth of the Tenth Annual Postgraduate Workshop titled "Society and the Creation of (al)Chemical Knowledge" hosted by the Embassy of the Free Mind in Amsterdam, 29-30 November 2019. This meeting of early career scholars with a shared interest in the history of alchemy and chemistry illustrated the diversity of methodological approaches that contribute to this subfield. Alchemical knowledge, created through practice, language, and material culture, has permeated society since the ancient world. Adepts and laity alike learned to navigate and appropriate the seemingly paradoxical hermetic language and images of alchemy, applying them to an array of societal needs that span time and place. The editorial essay to this special issue of Ambix considers alchemical knowledge-creation through the social lens of language and practice and proposes the inclusive concept of the "Chemical Humanities" to address the variation within alchemical practice and the diverse scholarly research methodologies presented in this special issue. We examine the history of chemistry using approaches from the humanities, arts, and sciences and consider the effects of interdisciplinary research today and for the future of alchemical scholarship.*

Keywords: *alchemy, practice, historiography, interdisciplinarity, Chemical Humanities.*

Introduction

This special issue of *Ambix* seeks to present an inclusive path forward in studies of the history of alchemy and chemistry by leading by example. The authors featured within this issue are international early career scholars approaching alchemy from diverse disciplines, none of which are exclusively history. The diversity in methodological approaches with the shared goal of uncovering social and cultural impacts of and on alchemy reflects the variety within alchemy practice. Thus the theme of this special issue, "Alchemical Practice: Looking Towards the

Chemical Humanities," proposes a reconceptualization of alchemical scholarship to address contemporary trends in the sciences and humanities of interdisciplinary collaboration, which will in turn allow for a more nuanced understanding of alchemical practice that incorporates the myriad historical actors and social institutions that participated in and were influenced by alchemy. Early career scholars are engaging with the history of alchemy and chemistry in novel ways and bringing specific skill sets to the field. When imaging a future in which the scholarly study of alchemy and its relationship to the past transcends traditional disciplinary boundaries, perhaps a more inclusive overarching category of Chemical Humanities is appropriate.

The papers in this issue were first presented at the postgraduate workshop of the Society for the History of Chemistry held at the Embassy of the Free Mind's Ritman Library in Amsterdam in November 2019. The Ritman Library is home to the *Bibliotheca Philosophica Hermetica*, a specialist collection that belonged to Amsterdam businessman Joost Ritman (b. 1941) centred on early modern Christian-Hermetic texts, including over five thousand books and three hundred manuscripts dating from the fifteenth to the eighteenth centuries. However, the rare materials put on display for the workshop[1] immediately illustrated the limitations of thinking of the Ritman Library as solely a library of texts. On the walls were an assortment of extraordinarily framed prints, paintings, and ceramic dishes suspended from hooks. One wall carried three remarkable oak panel paintings of emblems taken from Michael Maier's *Atalanta fugiens* (1618), most likely produced in seventeenth-century Germany (**figures 1, 2, and 3**).[2] The alchemical texts on the table in the centre of the room were of various sizes and thicknesses, with fold-out plates, hand-painted illustrations, and printed diagrams. Books and sculptures stood on carved antique wooden cases and shelving. An elaborate golden bird cage hung in one corner. The collection was reminiscent of the vibrant nature of the methods of alchemical scholarship. Any collection is enriched not only by its thematic focus, but also by reference to variations and exceptions to that theme. The things that lie on its borders, or diversify its contents, become, in

[1] This display of treasures from the collections was curated by Professor Peter Forshaw, head of the Embassy of the Free Mind's Ritman Research Institute.
[2] Cis van Heertum & José Bouman, "Emblems in Print and Paint: Atalanta fugiens and a curious case of 17th-century applied art," *Embassy of the Free Mind*, << https://embassyofthefreemind.com/en/library/202-emblems-in-print-and-paint-atalanta-fugiens>> (accessed 01/01/21).

this way, desirable items to include, and provide thereby an additional way to understand the focus itself.

FIGURES 1-3: Seventeenth-century German oak panel paintings of emblems from Michael Maier's Atalanta fugiens (1618) (photo by the authors)

The workshop began with a public lecture given by Megan Piorko titled, "The Secret Rosicrucian State of Arthur Dee's *Fasciculus Chemicus*." This lecture approached the social impact of Rosicrucianism on seventeenth-century alchemy by analysing material bibliographical evidence from extant copies of a specific issue of an alchemical hand-press text dedicated to the secret brotherhood.[3] This initial lecture, given the evening before the workshop, set the tone for the diversity of scholarly approaches to the workshop's theme that would be presented by early career scholars in the next two days. In addition to the international group of postgraduate scholars bringing various disciplinary training to the workshop, the event had two keynote lectures. Marieke Hendriksen's lecture was titled "(No) Laughing Matter: Alchemy between Academy and Society," during which she reflected on the divergent social representations of alchemy and alchemists as both respectable and fraudulent in the context of seventeenth-century mining and metallurgy in the Netherlands. The following day, Simon Werrett gave a talk titled, "Sweete Chymistry: Domestic Thrift and Experimental Inquiry in Seventeenth-Century England," in which he investigated the practice of material reuse of everyday scientific objects in the home and the subsequent effects on seventeenth-century experiment. These two keynote addresses exemplify the range of chemical practice within diverse social institutions, from the academy to the home and in between, while the public lecture considered the printing house and the page as a space for alchemical knowledge-creation.

The postgraduate workshop presentations and resulting articles featured in this special issue contribute to the theme of diversity in scholarly approach and locations of alchemical practice and knowledge-making. In her special issue essay, Sarah Lang asks if digital techniques

[3] For more on material bibliography and alchemy, see Megan Piorko, "Material Evidence in Alchemical Texts and Arthur Dee's Career as Royal Physician," in The Proceedings of 'Alchemical Laboratories Vienna 2020' (Graz: Leykam Buchverlag, 2022) and Piorko, "Seventeenth-Century Chymical Collections: A Study of Unique Copies of Fasciculus Chemicus," *The Papers of the Bibliographical Society of America* 113 (2019): 409-445.

can be used to elucidate the nature of alchemical cover names by mining alchemical texts for both the *Decknamen* themselves and the correlated terms that might reveal their diverse uses and meanings. For Umberto Veronesi and Marcos Martinón-Torres, by contrast, the material remnants of the old Ashmolean laboratory in Oxford provide the basis of an archaeological analysis that reveals connections between Oxford's early modern chymical laboratories and artisans and scholars from across Europe. If Lang practices what she calls "distant reading" using digital tools, Fabiana Lopes da Silveira employs an intensive close reading of the Graeco-Egyptian text "Letter from Isis to Horus" to situate it in a diverse context of cultural and textual influences. The Letter evinces a remarkable combination and revision of elements drawn from diverse cultures and genres which Da Silveira elucidates through a close textual analysis, and like the Ashmolean vessels, the Letter was at once dependent on distant resources and strived to gain distinction from them. Lopes da Silveira carefully unpacks the genre of the text and the details of its language to reveal its role in both establishing connections to and marking distinctions between the Letter and a series of near contemporary texts. Similarly, Lyke de Vries employs philosophical analysis of two works by Andreas Libavius to reassess his condemnations of the Rosicrucian order in the early decades of the seventeenth century.

The variety of approaches to the history of alchemy and chemistry presented at the workshop and included in this special issue reflect the diversity of disciplines that comprise alchemy studies today. In 2017 in her final editorial essay as Editor of *Ambix*, Jennifer Rampling asked: what is the future of the history of chemistry?[4] Five years later, this introduction and special issue aim to respond to this historiographical query. Rampling pointed out the increase in special issues of *Ambix* with guest editors during her tenure, as well as a rise in interdisciplinary collaboration. The early career scholarship featured in this special issue is representative of this trend toward specialization and diversification of approaches within the history of alchemy and chemistry. Rampling also noted a methodological turn toward material culture studies and alchemical practice contributing to the broadening scope of scholarly topics considered "chemical" in nature. This is largely thanks to a renewed scholarly interest in alchemy by historians of science over the past decades. As chemist and historian of science Lawrence R.

[4] Jennifer M. Rampling, "The Future of the History of Chemistry," *Ambix* 64 (2017): 295-300.

Principe put it, "The speed of alchemy's rehabilitation today rivals that of its eighteenth-century demise."[5]

The reappreciation of alchemy as an epistemic culture also fits into larger developments in historiography. On the one hand, the emphasis on the social and material within the humanities mean that the history of science has become less focused on institutional histories of science and hagiographies of "great minds." Moreover, many scholars now study texts no longer purely as information repositories, but as objects whose reception history, provenance, materiality, and contents combined provide us with clues about how the knowledge they convey was produced, circulated, and interpreted and about how these processes were enmeshed in practices and social structures. On the other hand, our understanding of the history of science has broadened to include actors, objects, sources, practices, and knowledge systems that were previously ignored. The history of science is now understood by many as thoroughly intertwined with histories of art, craft, and knowledge, and hence alchemy, with its strong practical component, is considered a legitimate part of it.

Our introduction considers these historiographical phenomena within the sub-field of alchemy and chemistry and responds by offering a more inclusive scholarly category of "Chemical Humanities" by analogy to medical and health humanities. This interdisciplinary sub-field would be concerned with interrogating human chemical cultures using diverse and interdisciplinary approaches from the humanities and arts, as well as the sciences.[6] Rather than ask how chemical ideas and knowledge progress (or change) over time, Chemical Humanities would reflect on the historical, social, and cultural dimensions of chemistry and assess their meanings for human and non-human actors in both the past and present. Such works might consider the interactions of chemistry and traditions of chemical knowledge broadly construed with religion, economics, education, and the visual arts, for instance. It might use tools from art history, archaeology, computer science, theatre and performance studies, or chemistry itself to analyse, criticize and influence chemical cultures. Of course, historians of chemistry have made

[5] Lawrence M. Principe, "Alchemy Restored," *Isis* 102 (June 2011) (on 307).
[6] See e.g. Therese Jones, Delese Wear, Lester D. Friedman, eds., *Health Humanities Reader* (Rutgers University Press, 2014); Anne Whitehead, Angela Woods, eds., *The Edinburgh Companion to the Critical Medical Humanities* (Edinburgh: Edinburgh University Press, 2016); Craig M. Klugman and Erin Gentry Lamb, *Research Methods in Health Humanities* (Oxford: Oxford University Press, 2019).

this kind of inquiry before, but with a concerted focus on novel interdisciplinary approaches and a sensitivity to the contemporary consequences, the "human interest" of such research might be further emphasized.

The disciplinary innovations presented in this special issue are remarkable and are testament to the diverse backgrounds of scholars coming into the history of alchemy and chemistry at present, offering new perspectives that radically alter many assumptions of existing scholarship in this area. By reflecting on the relevance and uses of history for making sense of the present, as opposed to a purely scholarly appreciation of the past for its own sake, they invite the use of new tools, technologies, and scientific methods to interrogate a history that has tended to insist that technology and science remain only its subject matter and not its methodology. New approaches diverge from traditional textual exegesis, through an increased reliance on the digital, both in terms of the extraordinary pool of digitized texts now available and the research and data analysis digital resources. These new scholarly approaches have been informed by an increased attention to material things—residues, objects, and physical traces, transformed into useful historical evidence by an array of archaeological methods that enable historians to contextualize words written on a page. Digital humanities, art historical, and literary methods invite historical figures and ideas into dialogues normally distant from their scholarly domains. Past, present, and future speak to one another in these translations in interesting ways. The remaining discussion will illustrate the variety within alchemical practice and spotlight the benefits of interdisciplinary approaches, to suggest that the future of alchemical scholarship should reflect the diversity within the history of alchemy and chemistry.

Alchemical Practice

The practice of alchemy is unique in that it consistently has historically transcended academic, artisanal, institutional, courtly, private, and public spaces. Alchemical practice, concerned with transformation, was fluid and reflected the society in which it existed and took place. Practitioners belonged to divergent social contexts and amended alchemical pursuits in various ways to meet the specific geographical and socio-political needs of the sites of alchemical knowledge-production. Thus, academic and public understandings of alchemical practices and practitioners could vary wildly, even within the same or very similar societies.

Alchemical knowledge is socially constructed and reliant upon accepted norms within a particular social group.[7] However, just as alchemical practice reflected developments in contemporary society, it could also serve as a scapegoat for social anxieties. This does not mean that alchemical practice did not create valid knowledge. Alchemists were not necessarily perceived as the (exaggerated) fraudulent alchemist depicted in popular culture of the sixteenth and seventeenth centuries. Take for example contemporaries Robert Boyle (1627—1691) and Goossen van Vreeswijck (ca. 1626—after 1689). Both were active in north-western Europe in the seventeenth century, and each believed in the possibility of metallic transmutation through alchemy. Yet while Boyle was a nobleman, an internationally respected natural philosopher, and a Fellow of the Royal Society, and is now remembered as one of the figureheads of modern science, van Vreeswijck was a mining specialist who went from traveling consultant to impoverished author and is now all but forgotten. Such diverging careers and perceptions of people whose practices and beliefs at least partly overlapped can only be explained from social perspectives, including personal geographical, political, and socio-economic circumstances.[8]

Examining alchemical practice from a variety of geographic and temporal spaces illustrates the ways in which alchemists participated in, and in some cases were excluded from, social institutions. Diverse approaches to alchemical research mirror the multifaceted experience of alchemical knowledge-making, and prevent a narrow, limited understanding of alchemy and its historical place in society. The term "practice" encapsulates an array of human activity, as well as the skills, tacit knowledge, and assumptions which activities rely on. The historical study of practices is, by necessity, mediated by artifacts.[9] For example, the diverse alchemical treasures on display at the Embassy of the Free Mind reflect the pluralistic practices of alchemical knowledge-creation, as well confusion as to how to define alchemical practice from scholars and adepts alike.[10] Alchemical influence permeated a wide range of social spaces, including academic, courtly, private, and public institutions. As a result, many alchemists produced an

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[7] Stephen P. Turner, *The Social Theory of Practices: Tradition, Tacit Knowledge, and Presuppositions* (Chicago: University of Chicago Press, 1994) (on 9).
[8] Marieke M. A. Hendriksen, "Criticizing Chrysopoeia? Alchemy, Chemistry, Academics, and Satire in the Northern Netherlands, 1650–1750," *Isis* 2 (2018): 235-253.
[9] Theodore R. Schatzki, "Introduction: practice theory," in *The Practice Turn in Contemporary Theory*, ed. Theodore R. Schatzki, Karin Knorr Cetina, and Eike von Savigny (New York: Routledge, 2001), 10-23.
[10] Bruce Moran, "Andreas Libavius and the Art of Chymia: Words, Works, Precepts, and Social Practices," in *Bridging Traditions: Alchemy, Chemistry, and Paracelsian Practices in the Early Modern Era,* ed. Karen Hunger Parshall, Michael T. Walton, and Bruce T. Moran (Penn State University Press, 2015), 59-78.

array of practical knowledge in the form of medicine, metallurgy, and inventions, as well as contributed to intellectual and scientific discourse. Alchemy also contributed to the economy through cures, books, and mining and laboratory technology.

Alchemy integrated many skillsets, combining intellectual, religious, medicinal, technical, and economic knowledge-bases. The variety of skills that alchemists could draw upon to create an alchemical persona attracted a wide array of practitioners from divergent social backgrounds. Attacks against and dismissals of alchemy, in the form of libel cases, scathing newspaper articles, and visual and textual satire in the seventeenth and eighteenth centuries were often rhetorical, morally, and socially motivated.[11] While alchemy was not a profession or a discipline in the modern sense, certain practices, knowledge, and beliefs would have been understood as "alchemical" by many. However, these aspects that defined alchemy were influenced by social conditions and ultimately reflect societal trends.

European accounts of alchemical practice can be traced back to the twelfth century, although it is well documented that an even longer tradition exists in Arabic and Greek speaking cultures.[12] By the time the practice of alchemy reached its apex in early modern Europe, entirely new answers to age-old questions about longevity and the natural world entrenched in sixteenth- and seventeenth-century European society had emerged, impacting alchemical knowledge. These new conceptualizations of alchemy were oriented around its social role, and the figure of the alchemist, both real and imagined, became inseparable from the practice of alchemy. As alchemy reflected new societal trends, the public perception of alchemy shifted away from relative celebration and reverence for the art with the advent of empirical chemistry in the later seventeenth century. By the eighteenth century, chemistry had taken hold in academic institutions and alchemy became increasingly disconnected from the experimental practice of chemistry.[13]

The eighteenth century simultaneously saw a new emphasis on scientific societies and learned institutions (spaces from which alchemy, especially in practice, was traditionally

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[11] Hendriksen, "Criticizing Chrysopoeia? Alchemy, Chemistry, Academics, and Satire in the Northern Netherlands, 1650–1750," (on 236).
[12] Tara Nummedal, *Alchemy and Authority in the Holy Roman Empire* (Chicago: University of Chicago Press, 2007) (on 4-5).
[13] Principe, "Alchemy Restored," (on 306).

excluded) and a surge in anxiety around the idea of the fraudulent alchemist. During medieval and early modern periods, alchemical practice was excluded from guild systems and universities, beyond its theoretical influence on iatrochemistry and medicine.[14] In response, alchemists drew upon all aspects of society to practice and create alchemical knowledge in flexible and variant ways. As eighteenth-century proponents of this new chemistry attempted to position it in legitimate professional and social roles, alchemy was increasingly painted as socially inappropriate and a taboo practice. However, alchemy and chemistry were not always so divorced from one another. The belief in the process of transmutation of metals was synonymous with the term "chemistry" during the seventeenth century. In order to deal with this historiographic linguistic confusion, the term "chymistry" can be used to refer to the entire subject before the separation between alchemy and chemistry.[15]

Alchemical language

Alchemy is in many ways a vernacular science. It thrives in urban settings and draws on societal norms as a means to investigate the natural world. The language of science, and certainly alchemy, was based on urban ways of exploring nature and creating knowledge. Additionally, much of alchemical practice relied upon the patronage and social institutions that thrived in cities.[16] This tension between the city and nature is reflected in the alchemical claim of reproducing nature through experiment-based chemical processes. To resolve this inherent alchemical paradox, alchemists used practice to create a vernacular language of nature. This language of alchemy was performed both linguistically and tacitly through experimentation with matter.[17]

In defining alchemical terms for themselves, historical actors applied a combination of theory and practice in which linguistic and intellectual preparation was a prerequisite for the

[14] Ute Frietsch addresses alchemy's complicated place in the university in the introduction to the special issue of *Ambix*, "Alchemy and the Early Modern University." Ute Frietsch, "Alchemy and the Early Modern University: An Introduction," *Ambix* 68 (2021): 119-134.
[15] Principe, "Alchemy Restored," (on 306).
[16] Deborah E. Harkness, *The Jewel House: Elizabethan London and the Scientific Revolution* (New Haven: Yale University Press, 2007) (on xvii).
[17] Pamela H. Smith, Harold J. Cook, Amy Meyers (eds.), *Ways of Making and Knowing: The Material Culture of Empirical Knowledge* (Chicago: University of Chicago Press, 2017) (on 9).

artisanal workshop.[18] At many European courts, mutually beneficial relationships between artisanal experts and royal officials allowed for the institutionalisation of an empirical culture in pursuit of useful knowledge—knowledge having an economic or practical purpose, or that helped officials to demonstrate their competency as administrators.[19] This could include an array of alchemical pursuits, such as mining, transmutation, distillation, glass and porcelain making, and the production of medicaments and publications. The systematic acquisition of useful knowledge often began on a courtly or governmental level, and this allowed for it to enter institutional spaces. Royal societies were granted authority by the state and thus were logical social institutions for alchemy to enter, as alchemy was frequently practiced in courtly settings. Useful knowledge also had an association with occult or secret interests.[20] Similarly, alchemy was and is often associated with secretive practices and languages, although that secretiveness has also been exaggerated at times.[21] One means of ensuring that written alchemical knowledge could not be deciphered by laymen was the creation of a coded language; the use of *Decknamen*.

The concept of *Decknamen* refers to the secret vocabulary of alchemy. The term originates from the German tradition meaning "cover-names."[22] Initially conceived as a response to the Jungian model of projecting alchemical symbolism, *Decknamen* posits that alchemy included a shared linguistic tradition, rather than a psychic state, which allowed alchemical imagery to transcend time and place. European alchemy was dependent on specialized language of images and tropes, which led to an association between alchemy and hieroglyphics and cabala. The "riddling image-language of early modern alchemy" created a multitude of alchemical linguistic techniques, in which both practical and theoretical alchemy were encoded in alchemical *Decknamen*.[23] Alchemical adeptness required a social knowledge of alchemy and the coded language of alchemists. By illustrating how recipes using alchemical *Decknamen*

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[18] Bruce Moran, "Andreas Libavius and the Art of Chymia: Words, Works, Precepts, and Social Practices," in *Bridging Traditions: Alchemy, Chemistry, and Paracelsian Practices in the Early Modern Era,* ed. Karen Hunger Parshall, Michael T. Walton, and Bruce T. Moran (Penn State University Press, 2015), 59-78.
[19] Daniela Bleichmar, "A Visible and Useful Empire: Visual Culture and Colonial Natural History in the Eighteenth-Century Spanish World," in *Science in the Spanish and Portuguese Empires, 1500-1800*, ed. Daniela Bleichmar, Paula De Vos, Kristin Huffine, and Kevin Sheehan (Stanford: Stanford University Press, 2009), 290–310.
[20] Kelly J. Whitmer, "Imagining uses for things: Teaching 'useful knowledge' in the early eighteenth century," *History of Science* 1 (2017) (on 38).
[21] Lawrence M. Principe, *The Secrets of Alchemy* (Chicago: University of Chicago Press, 2013).
[22] William R. Newman, "'Decknamen or pseudochemical language'? Eirenaeus Philalethes and Carl Jung" *Revue d'Histoire des Sciences* 2-3 (1995) (on 161).
[23] Newman, "'Decknamen or pseudochemical language'?" (on 163, 166).

produced real chemical results through modern reproduction, we can properly situate alchemy in the history of scientific practice and highlight practical alchemical methods for investigating the history of alchemy and chemistry.

Hermeticism is an even older tradition utilized by alchemists to communicate alchemical concepts. Hermetic philosophy is a merging of ancient Greek natural philosophy (especially Platonism), astrology, magic, and alchemy. Hellenized hermetic writings from the second century were attributed to an ancient figure called Hermes Trismegistus, which was a pseudonymous name for a group of authors based in the ideals of Egyptian god Thoth and Greek god Hermes. Usually written in dialogue form, this textual corpus from the Hellenistic period was rediscovered during the Renaissance and had a deep impact on humanistic views of the relationship between man and nature.[24] Drawing from late-antique Egyptian mysticism, hermetically veiled alchemical terminology requires a textual consensus in order to understand the practical procedures of alchemy. Thus, artisanal experience can be understood by unpacking the meaning behind mutually agreed upon hermetic *Decknamen*.[25]

However, this is complicated by the fact that alchemical terms frequently had varying contemporary definitions: Some understood alchemy as transmutation of metals, some as preparing medicaments, others said it was purely esoteric, and many believed it was a combination of many or all these things.[26] Hermeticism can illuminate the role of religion and mysticism within alchemy, as hagiographical hermetic writings and hermetically secretive language mediate layered alchemical meaning.[27] Hermeticism also played a part in early modern social change by championing the belief that control over the forces of nature, or natural magic, could affect religious and political reform. Andreas Libavius (ca. 1550—1616) is an example of reconciliation between religion and alchemy through his condemnation of mystical Rosicrucian texts. Libavius believed that alchemy was the oldest human practice after theology, and as such it gave structure to society. Thus, in order to practice alchemy correctly, specific social norms must

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[24] For more on hermeticism, see Robert S. Westman, *Hermeticism and the Scientific Revolution* (Los Angeles: University of California, 1977) and Frances A. Yates, *Giordano Bruno and the Hermetic Tradition* (Chicago: University of Chicago Press, 1964.

[25] Bruce Moran, "Eloquence in the Marketplace: Erudition and Pragmatic Humanism in the Restoration of Chymia," *Osiris* 29 (2014): 49-62.

[26] Moran, "Andreas Libavius and the Art of Chymia," 59-78.

[27] Peter Forshaw and Kevin Killeen (eds.), *The Word and the World: Biblical Exegesis and Early Modern Science* (New York: Palgrave Macmillan, 2007) (on 10).

be agreed upon.[28] While alchemy and natural magic were largely unsuccessful in creating immediate social reform, this failure would later contribute to scientific paradigm shifts during the seventeenth century.[29]

Material Culture

In addition to linguistic and philosophical interpretations of alchemy, there is an important material component that benefits specifically from analysis of archaeological evidence. Because of the ephemeral character of many alchemical processes and equipment, very few experimental alchemical objects remain in museum collections.[30] The materiality of extant scientific artifacts informs our understanding of how these objects were used by historical actors, and can compensate for a lack of tacit knowledge on the part of historians attempting to reconstruct or understand physical processes based solely on available historical sources.[31] This is especially helpful when trying to understand the material processes described in esoteric alchemical experiments. Scientific material culture objects show that knowledge-creation includes experiment, observation, and drawing conclusions from nature and matter.[32]

From an historical perspective, people used the tools that created alchemical knowledge, and by examining the materiality of alchemical objects historians can better understand practical aspects of alchemy.[33] Even the act of making the tools that will be used in alchemical practice creates knowledge that can be shared across social networks. While the social context of the experimental sciences was institutionally situated in scientific societies and academies,[34] alchemy transcended institutional boundaries as it permeated so many aspects of society. Alchemy in the broadest sense covers every practice of material transformation, from cooking and dying to metalworking and pharmacy. It permeated virtually every realm of society. Possibly

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[28] Moran, "Andreas Libavius and the Art of Chymia," 59-78.
[29] Westman, *Hermeticism and the Scientific Revolution* (on 6-7).
[30] Marieke M. A. Hendriksen and Ruben E. Verwaal, "Boerhaave's Furnace. Exploring Early Modern Chemistry through Working Models," *Berichte zur Wissenschaftsgeschichte* 3 (2020), 385-411.
[31] Smith et al (eds.), *Ways of Making and Knowing* (on 8).
[32] See also Sven Dupré (ed.), *Laboratories of Art: Alchemy and Art Technology from Antiquity to the 18th Century* (Cham: Springer, 2014).
[33] Simon Werrett, "Matter and facts: material culture and the history of science," in *Material Evidence: Learning from Archaeological Practice*, ed. Robert Chapman and Alison Wylie (London: Routledge, 2014) (on 340-341).
[34] Bruce T. Moran (ed.), *Patronage and Institutions: Science, Technology and Medicine at the European Court, 1500-1750* (Woodbridge: The Boydell Press, 1991) (on 1).

because of these strong associations with craft knowledge, the practice of alchemy was relegated to the margins of knowledge institutions that were primarily focused on theoretical knowledge, such as universities and learned societies. As a result, people practiced alchemy in any and all available spaces: artisanal workshops, courtly laboratories, on the streets, in marketplaces, households, and on the page. Many alchemists became self-fashioned artisans and used alchemy as a means for social and geographic mobility. Similarly, as alchemists formed their own identities and helped shape the cultural understanding of alchemy, they also contributed to the formation of the state through courtly appointments and competition.[35]

Alchemy and society had a reciprocal relationship. As the social shaped alchemy, alchemy also influenced society by creating the social conditions that allowed for the communal practice of alchemy and the creation of the laboratory as a place of experimentation.[36] By relating alchemy to the material world, a more complex and nuanced understanding of the many types of practitioners and practices involved in what in actuality was a very broad set of ideas emerges. If alchemy is no longer understood as a monolith of fraud, the occult, and pseudoscience, but as a meaningful investigation into the natural world that informed society and culture, then it can no longer be the singular scapegoat to the progress of chemistry.

When viewed in this way, alchemy becomes an integral part of the narrative of the history of science. Alchemical practice blurred boundaries between the academic, artisanal, and popular culture realms. Similarly, the study of alchemy is inherently interdisciplinary. Historical investigation into alchemical practice frequently benefits from philological, archaeological, and performative methods by taking a scholarly approach that mirrors its practical application and rich textual culture. By embracing an interdisciplinary approach to alchemy modelled by its practitioners, scholars may look towards a future of the history of alchemy within the Chemical Humanities.

Hybridity in the Chemical Humanities

The focus of this special issue is alchemical practice, but the striking feature of each contribution rests in the variety of individual approaches and disciplinary perspectives. This

[35] Nummedal, *Alchemy and Authority* (on 12).
[36] Moran, "Eloquence in the Marketplace," 49-62.

"hybridity of chemistry," mirrors the multifaceted nature of alchemical practice that necessitates a bricolage investigation. It is in this way that "hybridity," a term from the life sciences that has been evoked in recent histories of science, might be reconsidered in a more chemical light as a tool to understand historical traditions of alchemical practice. Perhaps the best-known discussions of hybridity in the history of science have occurred in the work of scholars of science and empire such as Kapil Raj and Anna Winterbottom.[37] Seeking to move beyond postcolonial accounts of the role of science in global imperialism, Raj proposed that it would be valuable to speak of knowledge as cross-cultural collaboration via circulations and encounters between persons, objects, and information from diverse communities and knowledge traditions around the world. This understanding of co-production of knowledge has been likened to theories of creolization, entanglement, and intermediation, or as Anna Winterbottom defines it, a form of "hybrid knowledge… an admixture of information drawn from diverse sources together to make something new."[38]

In what sense then, are scholarly approaches to the history of alchemy and chemistry hybrid? There are a multitude of disciplinary approaches being applied and combined to generate new scholarship, just a few of which are presented in this special issue. Digital humanities can be used to elucidate the nature of *Decknamen* by mining alchemical texts for both the *Decknamen* themselves and the correlated terms that might reveal their diverse uses and meanings. If practices such as "distant reading" can be understood using digital tools, intensive close readings help to situate the alchemical tradition in a diverse context of cultural and textual influences. In an essay review of the "Alchemy, Chemistry and the History of Science," Bruce Moran argues that rather than defining mutable early modern alchemical terms by eighteenth- and nineteenth-century standards of classification, and risk slipping into the pseudoscience designations rampant in the historiography of alchemy, scholars could make linguistic and etymological categories for

[37] Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (Basingstoke: Palgrave Macmillan, 2007); Raj and Mary Terrall, "Circulation and Locality in Early Modern Science," Special issue of *British Journal for the History of Science* 43 (2010); Raj, "Thinking Without the Scientific Revolution: Global Interactions and the Construction of Knowledge," *Journal of Early Modern History* 21 (2017): 445-458.

[38] Anna Winterbottom, *Hybrid Knowledge in the Early East India Company World* (New York: Palgrave Macmillan, 2015) (on 2); Raj et al, *Brokered World* (on xvii).

alchemical terms by taking a microscopic lens to the early modern texts themselves.[39] Additionally, the materiality of alchemical texts and objects can contribute to our historical understanding of alchemical practice, including methods as diverse as archaeological analysis that reveals connections between early modern chymical laboratories and artisans from across Europe and the investigation of alchemical texts for copy-specific physical evidence of knowledge-production.

As this special issue demonstrates, alchemy was practiced in specific social contexts, which can be best appreciated by applying equally specific perspectives and tools. Paying attention to the chymical materials of an assortment of beakers, flasks, jars, and crucibles testifies not only to international routes for trade and artisanry, but also to a dynamic effort to make import substitutions drawing on academic and craft expertise. An archaeological approach demonstrates that historically, there was no strong distinction between craft and science or knowledge and utility. Literary sources similarly evince a remarkable combination and appropriation of elements drawn from diverse cultures and genres which can be elucidated through a close textual analysis. Da Silveira compares the literary process with an alchemical procedure, in which, following the words of the ancient philosopher Zosimus, by subduing matter a unique species may be resolved out of multiplicity. The notion of "composition," or mixing elements to produce something new, is suggestive of how a Chemical Humanities approach might reconsider the question of hybridity in the history of alchemy and chemistry.

The idea of hybrid knowledge is a powerful one and has been of great value in rethinking the historiography of global science and science and empire. However, it might be preferable to look not to the life sciences, from whence the idea of "hybrids" comes, but to chemistry for useful ways to think about different modes of mixing and co-production. After all, "circulation," has long been a chemical term to describe the passage of liquids in the process of distillation, and is just one example of a plethora of chemical articulations of different movements and mixtures.[40] Indeed alchemy and chemistry are practices dedicated to the precise articulation of

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[39] Bruce Moran, "Essay Review: Alchemy, Chemistry and the History of Science," *Studies in History and Philosophy of Science* 31 (2000): 711-720.

[40] The term "circulation" is first recorded in English in 1535. Already in 1587, it is used in alchemy. Abraham Fleming, *The first and second volumes (third volume) of [Holinshed's] Chronicles, comprising... the description and historie of England... Ireland... and... Scotland... newlie augmented and continued by I. Hooker and others* (London, 1587), vol. 3 (on 1158) mentions "the order of circulation in alchimicall art."

the myriad ways in which elements can be separated and combined together. These different forms of mixture and circulation offer a vocabulary for thinking about the Chemical Humanities, both in terms of approach and subject matter. If the Chemical Humanities should think in terms of circulation, it should also consider ideas of ablution, coadunation, dealbation, ebullition, fulmination, incorporation, purgation, transudation, and vitrification.[41]

To take an example, consider the use of digital tools to study *Decknamen*. This might be described as a project in *catalysis*, the process of speeding up the rate of a reaction by adding a catalyst. Catalysis has been used metaphorically to refer to episodes which accelerate events or persons who speed up interactions between actors in economic or political negotiations.[42] In this case, the catalyst corresponds to the various digital tools that might enable the analyst to identify the occurrences, frequency, and significance of different *Decknamen* within an alchemical text. The process of tracking words is not new and could in principle be achieved by a committed human researcher given enough time. This has, in fact, been the approach of William Newman and Lawrence Principe, in their method of laboratory testing potential processes associated with *Decknamen* to see if they correspond.[43] But the great time and effort needed to do this on a large scale might be obviated by using digital tools, capable of scanning large texts in an instant to reveal, potentially, the clusters of meanings connected to different terms. Hence a process that could occur "naturally" is accelerated through the inclusion of a catalyst. To push the analogy further: what other processes might be catalysed using digital or analogue techniques?

There are many ways in which the language of alchemical and chemical processes might be applied to Chemical Humanities to reconceptualize the diverse and interdisciplinary methods already present in the scholarship. Many digital tools are catalytic, in the sense that they speed up research processes that could be done slowly by hand. Others are not, performing functions that

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[41] Note George Rousseau and Roy Porter, eds., *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science* (Cambridge: Cambridge University Press, 1980), in which John Heilbron wrote of eighteenth-century natural philosophy, "Eighteenth-century ferments decomposed and recombined it, drove off old parts, fixed new ones, and restructured its bonds with the body of knowledge.

[42] Benjamin Steininger, "The Cultural History of the Concept of Catalysis," outline of a project at the Max Planck Institute for the History of Science (Berlin: 2006-7). Accessed online, 01/01/21 << https://www.mpiwg-berlin.mpg.de/research/projects/DeptIII-Benjamin_Steininger_Catalysis>>

[43] Lawrence M. Principe and William R. Newman, "Some Problems with the Historiography of Alchemy," in *Secrets of Nature: Astrology and Alchemy in Early Modern Europe*, ed. Newman and Anthony Grafton (Cambridge: MIT Press, 2001), 385–432.

have no analogue equivalent, but which nevertheless present great potential for the Chemical Humanities. For example, x-ray phase-contrast tomography is being used to digitally unravel or "virtually unroll" the charred remains of some eighteen hundred Herculaneum scrolls carbonized by the eruption of Mount Vesuvius in 79 CE. This technique is also being used on the Dead Sea Scrolls and Egyptian papyri.[44] While this technology has no precedent in chemistry, it promises to yield many new texts from thousands of currently undecipherable ancient sources. The developer of this method, American computer scientist Brent Seales, claims it will soon be possible to place a charred scroll inside a scanner and immediately see an unravelled and flattened text.[45] One wonders what the impact of such a technique could have on the future of studies of alchemy and chemistry.

Conclusions

This introduction points to the importance of recognizing the global diversity and plurality of actors and geographies that shaped alchemical practice.[46] While digital tools might reveal meanings in alchemical texts, fundamentally those meanings were forged through practice, and must be interpreted with this in mind. Additionally, these histories are political, as alchemical knowledge-making implied or demanded a form of social order (Lutheran, secretive, autonomous, redemptive) and was tied up with modes of governance.[47] The material and the moral were invariably entangled, so that chemical manipulations of matter evoked intense and emotive experiences of wickedness, joy, godlessness, suspicion, sorrow, and detestation. Such experiences, and the regimens constructed to manage them, generated and defined material identities and practice, which in turn shaped possibilities for social control and discipline.

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[44] I. Bukreeva et al, "Virtual unrolling and deciphering of Herculaneum papyri by X-ray phase-contrast tomography," *Scientific Reports* 6, No. 27227 (2016).<< https://doi.org/10.1038/srep27227>>; Daniel Baum et al, "Revealing hidden text in rolled and folded papyri," *Applied Physics A* 123: 171 (2017); Heinz-Eberhard Mahnke, et al, "Virtual unfolding of folded papyri," *Journal of Cultural Heritage* 41 (2020): 264-269.

[45] Jo Marchant, "Buried by the Ash of Vesuvius, These Scrolls Are Being Read for the First Time in Millennia," *Smithsonian Magazine*, July-August 2018, accessed 01/01/21 << https://www.smithsonianmag.com/history/buried-ash-vesuvius-scrolls-are-being-read-new-xray-technique-180969358/>>

[46] For recent examples of the global history of chemistry, see e.g. Michael Bycroft and Sven Dupré, eds., *Gems in the Early Modern World: Materials, Knowledge and Global Trade, 1450–1800* (Basingstoke: Palgrave Macmillan, 2019); Linda A. Newson, "Alchemy and Chemical Medicines in Early Colonial Lima, Peru," *Ambix* 67 (2020): 107-134.

[47] See the introduction to Lissa L. Roberts and Simon Werrett, eds., *Compound Histories: Materials, Governance, and Production, 1760-1840* (Leiden: Brill, 2017), 1-32 (on 13-19); Ursula Klein, ed., *Artisanal-Scientific Experts in Eighteenth-Century France and Germany*, special issue of *Annals of Science* 69 (2012): 303-433.

Alchemical practice was a matter of life and death. As the Rosicrucians put it, the "accursed making of gold… has induced… many wayward gallow-bound sycophants to practice great mischief under its name." Alchemists were on their way to the hangman (*henckermässig*).[48]

This special issue offers a rich insight into various social and material compositions of identities, agencies, substances, and locations, which attests to a great variety of social and political orders that constituted alchemical practice. The peculiar nature of alchemical practice can be better understood through interdisciplinary approaches, such as those featured in this special issue. Bringing archaeology, literary studies, philosophy, and digital humanities to the history of alchemy and chemistry, these authors exemplify the wide-ranging and inclusive category of the Chemical Humanities.

In addition to diversity of methodological approaches, expanding the definition of "alchemical practice" allows for the acknowledgement of many more social spaces as sites of alchemical knowledge-production. Due to the multitude of ways in which one might practice alchemy, it is difficult to define. By embracing a broad definition of what it means to be an alchemical practitioner, scholars can diversify the methods for uncovering meaning in alchemical practice, and better understand the ways that alchemy has contributed to, impacted, and been informed by society and culture. This special issue illustrates the crucial role played by class, institutional affiliation, religion, language, and the printing press in defining alchemical practice. Recent trends of interdisciplinary collaboration in the history of alchemy and chemistry are not only continuing, but gaining momentum, as scholars turn toward methodologically diverse investigations into the variety of historical social spaces in which alchemy was practiced. Broader definitions of alchemical practice will necessitate new, broader questions for the future of the Chemical Humanities, such as: what is the role of alchemical practice in the production, validation, and acceptance of knowledge?

The exquisite vocabulary of chemistry itself offers metaphors and concepts for thinking about what such an enterprise might look like. Several articles in this special issue speak to practical chemical processes of ablution and purification in the abstract context of efforts to

[48] Quoted in De Vries, this volume; for more on the high stakes of alchemy, see Tara Nummedal, *Anna Zieglerin and the Lion's Blood: Alchemy and End Times in Reformation Germany* (Philadelphia: University of Pennsylvania Press, 2019).

expunge undesirable elements from texts, philosophies and locations, which in the process were productive of new knowledge and practices. As Lang notes, the use of *Decknamen* reflected the desire of alchemists to police the boundaries of membership in their community through a secrecy. The letter form of the Letter from Isis to Horus served to distinguish it from other texts while Libavius used his attacks on Rosicrucianism to purge Paracelsianism from alchemical scholarship. The Rosicrucians in turn viewed themselves as purifying religion, medicine, and alchemy of Popish pollutions. Each of the authors indicates the agency of human, non-human, and super-human actors in alchemical practice, from female goddesses and angels to Venetian glassmakers and the laboratory experimenter, forging metals and minerals.

This introduction has presented an inclusive category for the expanding study of alchemical practice and the essays comprising this special issue approach the history of alchemy and chemistry with specific methodological skill sets from diverse disciplinary backgrounds. However, we have only presented a case-study for what could be a disciplinary transmutation in the study of alchemy and chemistry. The future of the Chemical Humanities and the Society for the History of Alchemy and Chemistry will be determined by early career scholars, and if the essays in this special issue are any indication, it will be as pervasive as alchemical practice.

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