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## Frozen Assets: Science, Natural Philosophy, and the Quest for Arctic Gold

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Frozen Assets: Science, Natural Philosophy, and the Quest for Arctic Gold

by

Justin V. Castells

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
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Department of History  
College of Arts and Sciences  
University of South Florida

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# Frozen Assets: Science, Natural Philosophy, and the Quest for Arctic Gold

Justin V. Castells

## ABSTRACT

This paper looks at the emerging conflict between natural philosophy and empirical science in the late sixteenth century by examining the events surrounding the supposed discovery of gold in northern North America by Martin Frobisher in 1577. The discovery of gold in a region thought incapable of producing the metal, and the subsequent assays of ore mined from that region served as a catalyst for conflict between different understandings of the natural world. Proponents of natural philosophy and empirical science each used their theoretical tools to prove or disprove the value of the ore, reflecting the larger discussions taking place about the nature of the natural world.

## INTRODUCTION

The Tower of London has housed England's most dangerous criminals and most precious treasures. In September of 1578, 200 tons of American ore was stored in the tower behind a door with four enormous locks.<sup>1</sup> Three of the keys to the locks were kept in the care of officers of Queen Elizabeth, while the fourth was in the possession of Michael Lok, the chief investor of the expedition led by Martin Frobisher that had mined the ore from the frozen earth of northwestern North America.<sup>2</sup> The ore was believed to be rich in gold, but there were those who had doubts. While alchemists, metallurgists, and court officials were deciding the fate of the ore; the ore remained safe within the Tower. Within the next year, science would prove the ore to be worthless, compromising the reputation of Martin Frobisher until he distinguished himself off the coast of Flanders in 1588, and forever ruining Michael Lok. Two years earlier in 1576, however, Martin Frobisher was optimistic about the success of his first voyage to the New World. He and his crew had braved the North Atlantic in search of the elusive Northwest Passage to the Orient, and he believed he had found the entrance along the coast of northern Canada. Although he did not return to England with the riches of Cathay in his holds, he did bring back the good news of the passage as well as a captive native to prove he had been to

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<sup>1</sup> D.D. Hogarth, P.W. Boreham, J.G. Mitchell, *Martin Frobisher's Northwest Venture, 1576-1581* (Hull, QC: Canadian Museum of Civilization, 1994), 35.

<sup>2</sup> *Ibid.*, 35.

lands beyond the horizon. Before Frobisher had left the shores of the newly christened Meta Incognita before the long voyage home, he had picked up an inconspicuous black stone that he gave to the expedition's chief financier Michael Lok upon his return to England. This was a physical piece of the newly discovered land, as part of an agreement between the two gentlemen. Neither man had any idea how much that stone would affect their lives. It became, however, the primary catalyst for two more voyages to North America and initiated a contest between differing understandings of the natural world.

Historians investigating Martin Frobisher and his expeditions to northwest North America have concentrated on a number of interesting facets of the voyage.<sup>3</sup> However, the interpretation by historians of the justifications for the existence of arctic gold and the assaying of the Meta Incognita ore has largely concentrated on the political maneuvering of the financiers and the misrepresentation of information by greedy and untrustworthy assayers.<sup>4</sup> Another common theme through the historiography has been that those involved in the assays and the voyages refused to acknowledge reason, and persisted in the pursuit of, quite literally, fool's gold.

In "Strange' Ideas and 'English' Knowledge," Deborah Harkness uses the Frobisher expeditions to illustrate the contention that the overwhelming majority of

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<sup>3</sup> Two recent works that illustrate the range of topics associated with the Frobisher voyages are *Archaeology of the Frobisher Voyages*, William W. Fitzhugh and Jacquelin S. Olin eds. (Washington and London: Smithsonian Institution Press, 1993), contains several interesting articles about Charles Francis Hall's 1861 expedition to Kodlunarn Island and the 1991 excavations on the island conducted by William Fitzhugh; and *Meta Incognita: A Discourse of Discovery*, Thomas H.B. Symons ed. (Hull, QC: Canadian Museum of Civilization, 1999), is a collection of articles relating to the Frobisher expeditions that cover a range of topics from Inuit contact to Frobisher's ships.

<sup>4</sup> Assaying in the sixteenth-, seventeenth-, and eighteenth-centuries was the process by which it was established whether or not an ore contained any valuable metals. It was also the process by which the value of the metals were established.

alchemical practitioners in Elizabethan London were foreigners, such as Giovanni Baptista Agnello, the most prominent advocate for alchemical theory during the enterprise.<sup>5</sup> Harkness makes the argument that the learned immigrants to London tended to inhabit parts of the city based upon their profession and training as opposed to their ethnic identity. She identifies three adjacent districts of north-east London: Bishop's Gate, Tower Hill, and Aldgate in which alchemists resided, where the leading assayers of the Frobisher venture all lived and worked.<sup>6</sup> Her interpretation of the significance of the assays and of the gold ore argues the persistence of the assays and the insistence to continue the northwest venture was largely due to political maneuvering by the benefactors of the Company of Cathay as well as the assayers themselves.<sup>7</sup> Harkness explains the conflicts between the assayers as a result of regional differences. Over the course of time, the ore was evaluated by Italians, Germans, French, and English assayers, who were all suspicious of each other's methodology and who all yielded different results.<sup>8</sup> Harkness argues that not only did this rivalry make the assays less than accurate, but prolonged the amount of time the investors were willing to sustain the enterprise.

James McDermott's biography, *Martin Frobisher: Elizabethan Privateer*, deals primarily with Frobisher's naval and privateering exploits on the high seas.<sup>9</sup>

McDermott's work covers the expanse of Frobisher's career, including the events surrounding the North West expeditions and the assaying of the gold. His interpretation

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<sup>5</sup> Deborah E. Harkness, "'Strange' Ideas and 'English' Knowledge" in *Merchants and Marvels*, Pamela H. Smith and Paula Findlen eds. (New York: Routledge, 2002).

<sup>6</sup> *Ibid.*, 152.

<sup>7</sup> *Ibid.*, 153-154.

<sup>8</sup> *Ibid.*, 153.

<sup>9</sup> James McDermott, *Martin Frobisher Elizabethan Privateer* (New Haven: Yale University Press, 2001).



of the events surrounding the ore largely emphasizes the lack of technical expertise of the assayers. He attributes the “ambiguities of technology and reputation that clouded the results of successive assays” as well as the limited information afforded to the adventures in regards to the ore based on the “extreme political sensitivity surrounding the supposed discovery of gold.”<sup>10</sup> This opinion echoes D.D. Hogarth and J.G. Mitchell Boreham’s argument that during the sixteenth century “mineralogy as a science was yet unborn” and that the Frobisher assayers could not be expected to be reliable.<sup>11</sup> McDermott further points out that those who had invested in the venture would not have walked out unless there was absolutely no hope of return on their investment, fearing that “to walk away from a venture in plain sight of one’s peers and customers (particularly a venture of such high profile) invited the ruin of reputation, and thus credit.”<sup>12</sup> McDermott also argues that Spanish success and apparent ease in finding gold in the New World fostered the idea “that a commodity so easily secured had to be widespread” and that this belief artificially prolonged confidence in the enterprise.<sup>13</sup>

McDermott’s insistence that contemporary technology and understanding of the natural world was insufficient to the task of reliably identifying mineral wealth is contrary to the work of Bernard Allaire who insists, “by the sixteenth century, these [assaying] techniques had attained a high level of competence, particularly in the domain

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<sup>10</sup> Ibid., 198.

<sup>11</sup> Hogarth, et al., *Martin Frobisher’s Northwest Venture*, 12.

<sup>12</sup> McDermott, *Martin Frobisher*, 198.

<sup>13</sup> Ibid., 158.

of precious metals.”<sup>14</sup> Despite his defense of the capabilities of sixteenth century assayers, Allaire’s discussion of the assays also relies upon the idea that political ambition, greed, and imperialism are what prolonged the Frobisher enterprise. Allaire argues “the obscurantism practiced by the authorities with regard to the assays did not hide the clear anti-Spanish objectives of Queen Elizabeth and her officers who artificially supported the project from 1577 onwards and who transformed the third voyage into a colonial venture in America to their political profit.”<sup>15</sup>

Historian Robert Baldwin best articulated the argument for the profiteering and politicizing of the ore from *Meta Incognita* in his article “Speculative Ambitions and Reputations of Frobisher’s Metallurgists.”<sup>16</sup> Baldwin argues the assaying of the Frobisher ores undoubtedly deteriorated into deception, political posturing, and scam in order to secure lucrative contracts with the crown for the construction and management of the furnace complex in Dartford, where the ore was to be processed.<sup>17</sup> Baldwin goes further to argue that the discovery of the ore was a fraud perpetrated to support the idea that Frobisher had found the Northwest Passage, that somehow finding gold would validate his claim.<sup>18</sup> He illustrates how, by systematically deceiving the crown and the investors of the Company of Cathay, the assayers of the Frobisher ores and various factions with a vested interest attempted to secure lucrative grants or further political agendas.

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<sup>14</sup> Bernard Allaire, “Methods of Assaying Ore and their Application in the Frobisher Ventures” in *Meta Incognita: A Discourse of Discoverey*, Thomas H.B. Symons ed. (Hull, QC: Canadian Museum of Civilization, 1999), 477.

<sup>15</sup> *Ibid.*, 501.

<sup>16</sup> Robert Baldwin, “Speculative Ambitions and Reputations of Frobisher’s Metallurgists” in *Meta Incognita: A Discourse of Discoverey*, Thomas H.B. Symons ed. (Hull, QC: Canadian Museum of Civilization, 1999)

<sup>17</sup> *Ibid.*, 428.

<sup>18</sup> *Ibid.*, 428.

In *Subject Matter*, Joyce E. Chaplin uses the Frobisher expeditions as part of her argument that the English used their perceived technological and biological superiority as a means of justification for the colonization and subjugation of native peoples in the Americas.<sup>19</sup> Without discrediting the idea that there were political aspirations and deception, Chaplin interprets the Frobisher expeditions as “a surprising attempt to transplant English people and technology to an unlikely corner of the new world.”<sup>20</sup> Chaplin’s assessment of the events surrounding the ore is that the expeditions were formed in order to demonstrate the plausibility of English settlement in the northeast of the North-American continent. Through means of farming, Frobisher intended to prove the arctic habitable for the English. The gold ore found by Frobisher helped to support this claim and would serve to encourage settlement in the north. Furthermore, Chaplin argues the claims surrounding the ore were based on questionable assayers and unfounded speculation about the nature of the northern Americas.

The argument that the assayers and investors in the Frobisher venture stretched the truth in their reports and prolonged the enterprise in order to maximize personal gain is persuasive. However, to pass off Giovanni Battista Agnello as merely a charlatan does not do justice to the impact of the natural philosophy worldview and the belief in the veracity of his science or that of his contemporaries. Agnello’s approach to the ore was consistent with contemporary ideas about the natural world, ideas that are reflected in

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<sup>19</sup> Joyce E. Chaplin, *Subject Matter*. (Cambridge, MA: Harvard University Press, 2001). Chaplin deals with the Frobisher expeditions primarily between pages 46-57. The main argument of her book is that the English used their perceived technological and biological superiority to justify their exploitation of the American continent and the subjugation of its peoples.

<sup>20</sup> *Ibid.*, 49.

George Best's narrative of the Frobisher voyages. The assayers of the Frobisher voyages, whether alchemist or metallurgist, and the promoters of the venture formulated their arguments within the context of popular and scientific knowledge of the time. They did not frivolously insist that gold existed in the Arctic, but they formulated justifications within the framework of the way in which Europeans understood the natural world to function. Moreover, in the actual assaying of the ores, a conflict between the metallurgical understanding of natural philosophy and empirical science emerged, foreshadowing the changes of the scientific revolution.<sup>21</sup> In the hands of alchemists, the ore promised wealth for the investors of the voyages and the English crown. In the hands of the skeptical metallurgists, the ore was nothing more than stone. The assays of the Frobisher ores and the justifications for their existence offer an opportunity to understand the way in which Early Modern Europeans understood the natural world.

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<sup>21</sup> The Scientific Revolution and the differences between empirical science and natural philosophy will be discussed in greater detail in Chapter Two.

## CHAPTER ONE

The first of Frobisher's expeditions to North America set out in 1576 with the intention of finding the Northwest Passage. The voyage was backed by the Muscovy Company, headed by Michael Lok, who had managed to raise enough capital to outfit three ships for the voyage across the Atlantic. When Frobisher arrived at what he humbly named 'Frobisher Straights' (now Frobisher Bay), he believed he had found the entrance to the elusive Northwest Passage. However, Frobisher limited his explorations of the bay to the area around Baffin Island where he and his crew encountered, traded with, and kidnapped native Inuit. Upon Frobisher's return to England, he presented Michael Lok with a black stone he had found on Baffin Island. The American stone was later thought to be gold ore and ensured that the focus of Frobisher's subsequent voyages to North America in 1577 and 1578 would be on the recovery of more ore. There was disagreement, however, as to the value of the ore, the original stone from the 1576 voyage as well as stones from the 1577 voyage were subjected to extensive testing for value by goldsmiths, metallurgists, assayers, and alchemists who could not agree whether the ore was actually gold. The world in which the Frobisher expedition set out was, in many ways, different and alien to the world in which we live today. Frobisher's natural world, while strange to modern sensibilities, adhered to a particular logic and uniformity that made sense to the people of the sixteenth century. Before Newton and Bacon, before

the scientific process and the Enlightenment, Europeans interpreted the natural world according to natural philosophy. The parameters and practices of natural philosophy have been difficult for historians to qualify. Debates on natural philosophy address the function and parameters of the discipline, its place within the larger contest of the scientific revolution, and whether natural philosophy should be considered an independent discipline at all.

An important component of natural philosophy was not only the belief in the supernatural, but that supernatural forces were constantly affecting the natural world. In many aspects of natural philosophy, including alchemy, the paranormal and mystical elements of the universe were crucial to understanding nature. Charles Webster in *From Paracelsus to Newton: Magic and the Making of Modern Science* argues, “the growth of the scientific worldview is regarded as one of the primary manifestations of the demystification of the worldview that occurred in the seventeenth century.”<sup>1</sup> Webster asserts that the natural philosopher Paracelsus (1493-1541) has been denied his place among the pantheon of thinkers responsible for the scientific revolution because of the strong relationship his work had with the occult, despite the intrinsic similarities with Newton’s work in natural philosophy. Webster compares Newton and Paracelsus’ views on prophecy, spiritual magic, and demonic magic to suggest there was little difference between the two thinkers in these matters. Webster goes farther to bridge the gap between Paracelsus and Newton pointing out “the Paracelsus idea of magic extends across a broad spectrum lying between traditional magic and experimental science” drawing Paracelsus’

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<sup>1</sup> Charles Webster, *From Paracelsus to Newton: Magic and the Making of Modern Science* (Cambridge: Cambridge University Press, 1980), 1.

experimentation closer to empiricism.<sup>2</sup> Webster's argument allows for a fluid exchange and indefinite divisions between science and magic. The implication is that, when looking at Early Modern science, inclusion of supernatural elements in experimentation and thinking does not exclude the possibility of those experiments yielding similar results and using similar processes to empirical science. For historian William Eamon, however, it is the progression beyond a supernatural worldview that distinguishes empirical science from natural philosophy.

William Eamon uses the Aristotelian terms of "scientia" and "secreta" to define differences between natural philosophy and empirical science in *Science and the Secrets of Nature*. Scientia, according to Eamon, "meant demonstrable knowledge of the universal and necessary causes of normal, quotidian phenomena" based upon "the manifest qualities of the four terrestrial elements."<sup>3</sup> Eamon equates scientia with the Early Modern period's university learning based upon Humanist principles. Eamon's description of secreta involves "manifestations of occult qualities, or events that occur unexpectedly or idiosyncratically as a result of insensible causes."<sup>4</sup> This interpretation of secreta relegates elements of the supernatural to what he considers popular or folk science and the practices most closely associated with alchemists. This form of knowledge was primarily being transmitted to the masses through inexpensive pamphlets called books of secrets. Eamon argues that the "secrets of nature" the books of secrets were attempting to penetrate transformed from the idea of unexplainable phenomena to

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<sup>2</sup> Ibid., 11.

<sup>3</sup> William Eamon, *Science and the Secrets of Nature* (Princeton, NJ: Princeton University Press, 1994), 54.

<sup>4</sup> Ibid., 54.

the replicating of nature's workings within the laboratory setting due to the incorporation of popular science into university science. He argues that Francis Bacon and his followers incorporated popular science into their model of scientific research by removing occult connotations and framing the experiments within the context of re-producing nature's own workings. This moved the study of the natural world further towards empirical science. Eamon's argument implies that natural philosophy existed as a distinctive discipline within the context of a proto-empirical science. For Eamon it was not until popular science and university science came together that a discourse of natural philosophy came to exist. In this view, the incorporation of popular ideas into a scholastic framework and the systematic removal of occult elements was part of a process that culminates with empirical science. By relegating the supernatural to popular science, Eamon equates the occult with folk knowledge while placing natural philosophy firmly as proto-science. Eamon's argument implies that the practice of natural philosophy, in a way, serves to disprove itself and becomes empirical science, and that the melding of popular and university science facilitated that transition.

Like William Eamon, Allison Kavey interprets the books of secrets as a bridge between what may be considered popular knowledge and university knowledge; however, Kavey conceptualizes the nature of that knowledge in a different way. While Eamon discerns the incorporation of popular knowledge into a university framework, Kavey sees a more mutually beneficial situation in which university knowledge was transmitted to the masses, while folk knowledge was transmitted to the university. Kavey argues that books of secrets were part of an "inexpensive print market devoted to



revealing knowledge about recounting various phenomena in the natural world.”<sup>5</sup> This knowledge was intended for a wide range of audiences, from the casual reader to the university scholar, but with varying implied levels of understanding. Gradations of knowledge were transmitted in the books of secrets and were conveyed to the initiated through symbolism and metaphor, while at the same time they transmitted accessible information to the casual reader. Kavey argues that the midwife, the alchemist, and the academic could all read the same book of secrets and walk away with different information, but the key is that all the gradations of information were formatted within a uniform theoretical framework: natural philosophy.<sup>6</sup> Kavey’s argument differs from Eamon’s in that she indicates an overarching framework to which all levels of learning adhered within the books of secrets, while Eamon argues for the incorporation of the secreta into the scientia, the popular science into the university science, and the systematic elimination of the secreta from the scientia. In Kavey’s interpretation, tenets of the supernatural were retained within the books of secrets and were as pertinent to the university as they were to the market place. The supernatural persisted within both university and popular thinking as an element of a shared discourse well into the nineteenth century, and arguably to the present day.

Alchemy served, in many ways, as the application of natural philosophy in practice. In its most basic form the goal of alchemy was to reduce impure substances to their core elements and through replicating the processes of nature create a perfect substance, gold. Beyond this basic aim, historians seem to have found it difficult to

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<sup>5</sup> Allison Kavey, *Books of Secrets: Natural Philosophy in England, 1550-1600* (Urbana and Chicago: University of Illinois Press, 2007), 92.

<sup>6</sup> *Ibid.*, 196.

further define or qualify alchemy. The nebulous nature of the boundaries between natural philosophy and empirical science are placed into no greater contrast than through the discussion of alchemy.

William R. Newman and Lawrence M. Principe address this issue in their article “Alchemy vs. Chemistry.”<sup>7</sup> Newman and Principe argue that, in the seventeenth century, alchemy and chemistry were two interchangeable terms, and “find that efforts to differentiate alchemy from chemistry prove to be anachronistic, arbitrary, or presentist.”<sup>8</sup> They argue that for historians such as Marie Boas Hall and others “of her generation, alchemy represents the archaic, irrational, and even consciously fraudulent, while chemistry represents the modern, scientific and rational.”<sup>9</sup> They attribute this misconception to the influences of “ahistorical interpretations of alchemy advanced by nineteenth-century occultists and twentieth-century partisans of analytical psychology.”<sup>10</sup> That historians such as Hall, B.J.T. Dobbs, Marco Bretta, and Hélèn Metzger treated alchemy and chemistry as two independent disciplines is directly a result of the application of nineteenth- and twentieth-century definitions of the terms that resulted in an etymological mistake and influenced subsequent writing on the subject.<sup>11</sup> The authors

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<sup>7</sup> William R. Newman, Lawrence M. Principe, “Alchemy vs. Chemistry: The Etymological Origins of a Historiographic Mistake” *Early Science and Medicine*, 3:1 (1998), 32-65.

<sup>8</sup> *Ibid.*, 33.

<sup>9</sup> *Ibid.*, 34.

<sup>10</sup> *Ibid.*, 35.

<sup>11</sup> Newman and Principe cite the following works in their footnotes: Marco Bretta, *The Enlightenment of Matter: The Definition of Chemistry from Agricola to Lavoisier*, (Canton, MA, 1993); Marie Boas Hall, *Robert Boyle and Seventeenth-century Chemistry*, (Cambridge, 1958); B.J.T. Dobbs, *The Foundations of Newton’s Alchemy, or the Hunting of the Greene Lyon*, (Cambridge, 1975); Hélèn Metzger, “L’èvolution de rège metallique d’après les alchemists du XVIIe siècle” *Isis* 4 (1922).

contend that by looking at the primary source material, it is evident that no such differentiation existed. The authors look at scientific writings in English, French, German, Italian to discern how contemporaries were using the terms “alchemy” and “chemistry.” They conclude that the terms were being used interchangeably and were not viewed as separate disciplines until the end of the eighteenth century, at which time alchemy became the practice of quacks and charlatans and chemistry became a discipline of facts.<sup>12</sup> They argue, “early writers recognized the actual distinctions of activities within chymistry, but used now largely discarded terminology (chrysopoeia, chemiatria, etc.) to refer to them,” while they did not differentiate by using the term alchemy.<sup>13</sup> The authors call for the uses of contemporary terminology within the discussion of alchemy, contending that the use of “alchemy” and “chemistry” as two different things serves no purpose, but instead suggest the use of the term “chymistry,” which would encompass what the seventeenth-century writers of the subject were intending the term to mean. What the authors seem to be stressing most is that the fluidity of the two terms within contemporary discussion makes the separation of the two terms in current scholarly discussion irrelevant and counter-productive.

The article “Alchemy and Chemistry” by Ferdinando Abbri enters into a dialogue with Newman and Principe.<sup>14</sup> Abbri agrees with Newman and Principe’s argument that the differences between “alchemy” and “chemistry” can be traced etymologically, but argues that what they failed to consider is how cultural and social influences affect this

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<sup>12</sup> Ibid., 39.

<sup>13</sup> Ibid., 64.

<sup>14</sup> Ferdinando Abbri, “Alchemy and Chemistry: Chemical Discourses in the Seventeenth Century” in *Early Science and Medicine*, 5:2, (2000), 214-226.

topic. Abbri argues that “alchemy” and “chemistry”, while closely related, were two separate disciplines as is evident by the social and cultural influences that informed the methodology and theoretical bases of the two. Abbri argues that the aims of alchemy differed from those of chemistry, since it was beholden to a different intellectual tradition and while methodology, results, and professional classifications may have overlapped, the intellectual framework under which the experimentation was being conducted was different. Abbri argues that “alchemy did not miraculously transmute into chemistry; instead, chemistry began to construct its specific domain and to define its proper subject matter.”<sup>15</sup> While the author contends that alchemy and chemistry drew upon the same corpus of work, as a discipline, chemistry was a historical construct built out of cultural and historical factors.<sup>16</sup> Abbri argues that the ideas of alchemy and chemistry were often interchangeable, but by the end of the seventeenth century they were defined by different intellectual and cultural traditions and as such a “historical view strictly focused on the passage from alchemy to chemistry is unacceptable” and that the scholarship in regards to alchemy should define “alchemy” and “chemistry” based upon the cultural and historical treatment of them.<sup>17</sup>

Michela Pereira argues along similar lines as Abbri. Pereira argues that “whatever its amaterial and concrete operations, the aim of alchemy was to produce an agent of perfection which could transmute metals into gold and grant perfect health and even

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<sup>15</sup> Ibid., 215.

<sup>16</sup> Ibid., 223, 225.

<sup>17</sup> Ibid., 232.

rejuvenation to human bodies” which he argues, is a different objective from chemistry.<sup>18</sup> Like Abbri, Pereira argues that chemistry and alchemy as defined disciplines, in the sixteenth and seventeenth centuries were often mercurial and shared similar methodology and results, but it seems that for Pereira the intellectual framework of Hermeticism is what separated alchemy from chemistry.<sup>19</sup> The argument is not dissimilar to Eamon’s idea of *scientia and secreta*, but Pereira’s article does not suggest the merging of the two into modern empirical science. While he seems to agree that there are particular elements shared and borrowed between the two, he suggests that alchemy as a discipline extends into the seventeenth century as a thing unto itself. Pereira also illustrates in his article a common theme in the writing on alchemy and the sciences, the idea of transnational learning. Pereira explains how the Hermeticism that helped to form alchemical thinking was based upon “the Greek, Arabic, and Latin textual traditions” and further informed by cross-cultural exchange in Europe.<sup>20</sup>

When looking at the impact of natural philosophy on gold in early colonial America, it is important to be able to identify differences, if any, in traditions of natural philosophy based on geographic considerations. If it can be established that there were little to no divisions between what is considered natural philosophy and what is considered proto-science, were there differences based on country, or is there an overarching Western-European cultural tradition of natural philosophy?

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<sup>18</sup> Michela Pereira, “Alchemy and Hermeticism: An Introduction to This Issue” in *Early Science and Medicine*, 5:2 (2000), pp. 115-120, 118.

<sup>19</sup> Hermeticism was a theoretical tradition stemming from the second century writings of Hermes Trismegistus upon which much of western alchemy and natural philosophy was based. It relied more heavily on occult and supernatural elements than sixteenth and seventeenth century natural philosophy.

<sup>20</sup> *Ibid.*, 116.

Deborah E. Harkness has done considerable work on natural philosophy in Early Modern England. Her work stresses the international nature of learning in seventeenth-century England, highlighting the transnational community of scientists that inhabited Elizabethan London. In “‘Strange’ Ideas and ‘English’ Knowledge: Natural Science Exchange in Elizabethan London,” Harkness looks at how “neighborhoods of science” formed within seventeenth-century London. These neighborhoods were enclaves of medical practitioners, instrument makers, distillers, alchemists, and various other trades related to science concentrated in certain parts of the city.<sup>21</sup> Harkness contends that these communities were made up of people from all over Europe, creating communities that were “international in composition and outlook” among whom were French, Italian, Dutch, and German practitioners who had settled in London.<sup>22</sup> For Harkness, sections of Elizabethan London became centers of scientific thought and industry particular to a specific craft, just as certain streets and districts of the city became centers for textiles or produce. Within these small communities, the scientific knowledge of Europe was exchanged and disseminated. In her article, Harkness frames this exchange within an economic context stating how “natural science ideas and expertise, be they English or alien, had definite economic worth” not only to the citizens of London but to the English government.<sup>23</sup>

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<sup>21</sup> Harkness, “‘Strange’ Ideas”, 138.

<sup>22</sup> *Ibid.*, 138.

<sup>23</sup> Deborah E. Harkness, *The Jewel House: Elizabethan London and the Scientific Revolution* (New Haven and London: Yale University Press, 2007), 216.

Harkness developed the core of this article into a book length study entitled *The Jewel House*.<sup>24</sup> Harkness' book expands on the idea of scientific communities in England arguing further the international makeup of those scientific communities and the effectiveness and utility of the Elizabethan London model of the exchange of ideas. Harkness frames her book within the context of two metaphorical models of learning that were representative of early modern science. Hugh Plat, a London lawyer and student of the natural world and his contemporary Francis Bacon each conceptualized an ideal structure through which to study the natural world. Bacon's conceptualization was the "Solomon House," in which the sciences were ordered and professionalized into what we may recognize as similar to the modern university system. Plat conceptualized the exchange of learning into what he called the "Jewel House," a less formal and free exchange of ideas between professionals and laymen alike. Harkness sees evidence of the existence of Plat's Jewel House in the streets of Elizabethan London. As she pointed out in "'Strange' Ideas and 'English' Knowledge" London was divided into scientific communities. The Jewel House, as she describes it, is the relationship and exchange in and between those scientific communities. Harkness sees the streets of Elizabethan London as a place of informal and free exchange of ideas that were subject to a peer review based on experimentation and theoretical soundness to Aristotelian principles. The interdisciplinary and plebian nature of the Jewel House of the London streets differs from the orderly and professional atmosphere in which formally educated specialists exchanged ideas with other formally educated specialists envisioned by Bacon in his Solomon House. Harkness sees Bacon's Solomon House as a re-structuring of what was

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<sup>24</sup> Ibid.

already occurring in the streets of London. For Harkness, the city practitioners were engaged in practical science that would serve immediate monetary or technical ends to serve the crown. It is for this reason that figures associated with the Royal Court like William Cecil, twice Secretary of State (1550-1553, 1558-1572), Lord High Treasurer, and chief advisor to Queen Elizabeth I, took more interest in alchemists like Giovanni Baptista Agnello who promised immediate returns on investments than in theoretical thinkers such as John Dee, who was denied the ambiguous position of “Court Philosopher.”<sup>25</sup> Harkness contends that the Jewel House was already producing the results the Solomon House would strive to achieve. Harkness’ arguments suggest that the Scientific Revolution was not a revolution, but rather a reformatting of practiced methods of knowledge sharing. Her arguments further serve to dissolve the distinction between empirical science and natural philosophy, suggesting a far more nuanced read of the disciplines than perhaps has previously been made. Through the case study of Elizabethan London, she also manages to illustrate the international make-up of scientific-knowledge exchange, showing that local scientific traditions were in fact international scientific traditions.

As these historians have shown, during the sixteenth and seventeenth centuries, methodologies were fluid between scientific disciplines and different ideas of how the universe functioned competed with one another for supremacy in the public consciousness. The emerging theoretical framework of science often borrowed from natural philosophy. Natural philosophy can be described as the belief that nature adhered to a set of uniform and imitable principles that relied on the relationships between

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<sup>25</sup> Ibid., 241-242.



temperature, solidity, and basic elements of matter. The interrelationships between these forces were responsible for the whole of existence. Contemporary treatises on the subject reflect this interpretation of the natural world, especially on the subject of metals.

The prevailing wisdom of the sixteenth century for the generation of metals held that a system of heating and cooling in the earth purified base materials such as stone and lead into noble materials like silver and gold. A combination of interior and exterior heat caused the transformation of the lesser minerals. Barba Alvaro Alonzo outlined this process in a treatise on metals and addresses different interpretations of the natural generation of metal in the earth. Alonzo identified with certain theoretical principles that can be described as natural philosophy. He outlined the basic principles he attributed to Plato, Aristitotle, and their students in which metals were created from “a certain moist and unctuous exhalation, together with a portion of thick and tough Earth, from which, being mingled together” was created the stuff of metals as well as stones.<sup>26</sup>A predominance of dryness in the mixture would result in stone while a predominance of humidity would result in the creation of metals. From this state, “the various temperament, and purity of the aforesaid matter, comes the divers kinds of Mettals, the most pure and fine of all which, and (as it would seem) Nature’s principal intention, is Gold.”<sup>27</sup> Alonzo also described what he saw as the antithesis of this process, the belief that when God created the world, he placed all the veins of metals in the earth as they were found in Alonzo’s time. He found this belief does “nature a great affront, by

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<sup>26</sup> Barba Alvaro Alonzo, *The Art of Metals* (London: S. Mearne, 1674), 69-70.

<sup>27</sup> *Ibid.*, 70.

denying her (with out reason) a productive vertue in this matter.”<sup>28</sup> To support this vision, Alonzo cited an instance in which where an iron mine in Tuscany was exhausted and abandoned. Fifteen years later, workers returned to the mine and found it as rich as before, full of iron that “the new Earth hath been converted into.”<sup>29</sup> This instance made clear, according to Alonzo, that there was some validity in the idea that metals “grow” in the earth and their amount was not limited by the initial inclusion of metals in the earth by God at the beginning of time. He argued that “the most proper place for the generation of Mettals is the veins of the Earth” where “subterranean and Celestial heat meet and unite the one with the other, stirring up vapours, mingling and purifying the matter of which Mettals are made.”<sup>30</sup> Alonzo argued that sunlight and starlight heat the earth “with their subtil Rays, penetrate through its veins; and we see things long burnt in fire are converted into other terrene substances,” including gold.<sup>31</sup> The minerals in the earth were subject to periods of heating and cooling. Heat from the sun, stars, and Earth combined the “solid” and “humid” elements of the Earth, boiling and thickening the raw materials. The mixture would then cool and congeal, the lesser elements having been burnt off, into metal.<sup>32</sup>

According to Alonzo, alchemists worked to “anatomized the mixtures of nature, and reduce them from their first principles” and after doing so, to reconstruct those elements into a desired result, in this case gold.<sup>33</sup> By systematically replicating the

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<sup>28</sup> Ibid., 70.

<sup>29</sup> Ibid., 71.

<sup>30</sup> Ibid., 48.

<sup>31</sup> Ibid, 39.

<sup>32</sup> Ibid., 43.

<sup>33</sup> Ibid., 71.

processes of nature, he believed an alchemist could transmutate baser metals into gold. The idea of transmutation was not outside the realm of reality for the world in which Alonzo lived. He provided evidence to the validity of transmutation in aspects beyond metals, “for we see like transmutations, and for more difficult performed both by art and nature,” he claimed. He cited the example that wasps and beetles are made from animal droppings, that scorpions could be made through the proper treatment of the “*Alvaca*” plant, and that as “it is notoriously known, that in *Scotland* pieces of old Ships, and of fruit that falls into the Sea turn into living Ducks.”<sup>34</sup> This claim not only enforced Alonzo’s assertion that transmutation was a possible if not common occurrence but also adds a certain amount of credibility to the witch-crazed villagers in *Monty Python and the Holy Grail* and the comparison of wood to ducks..<sup>35</sup> Assuming the validity of these examples, Alonzo pointed out “there is no comparison between the distance of things inanimate to Animals, and that of one Metall to another.”<sup>36</sup>

Like Alonzo, Gabriel Plattes found that heat was essential to the generation of metals. Plattes contended that nature was contingent on two primary forces, the terrestrial and the celestial or ethereal.<sup>37</sup> Plattes argued “if either of these [the terrestrial or celestial] predominate, then the earth is barren and bringeth forth nothing that is beneficiall: for if the Aethereall part be not of force and quantitie sufficient, by the heate of the Sunne, to

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<sup>34</sup> Ibid., 81.

<sup>35</sup> *Monty Python and the Holy Grail*. Directed by Terry Gilliam and Terry Jones. 89 minutes. Python (Monty) Pictures, Ltd., 1975.

<sup>36</sup> Alonzo, *The Art of Metals*, 81.

<sup>37</sup> Gabriel Plattes, *A Discovery of Infinite Treasure, Hidden Since the Worlds Beginning*, (London: I.L. and George Hutton, 1639), 4.

lift up the Terrestriall part, then no fruit thereof springeth.”<sup>38</sup> A balance between sunlight and earth was responsible for the existence and growth of the fruits of the natural world. Should there be an imbalance in the two, plant, animal, and minerals would not form. In the extreme, Plattes argued, “if the terrestriall part be not of force to coagulate and harden the other into profitable fruits, then all is turned into smoake.”<sup>39</sup> Plattes did differ from Alonzo on the subject of Alchemy. He argued that the belief “that the substance of the best metals are convertible into Royal metals by heat and digestion, hath filled the world with false books and Receipts, in *Alchemy*, and hath caused many men to spend much money, labour, study and charges to no purpose.”<sup>40</sup> Plattes contended that the role of heat was not to transmute one substance into another, but to strip away the inherently impure elements of metals to reveal the inherit gold. He argued that “for as a Tree of other vegetable being burned, doth yield a fixed salt or Ashes: so the base *mettalls* do contain in them some small quantity of matter of the same nature that the royal metals are composed of.”<sup>41</sup>

For both Plattes and Alonzo, heat from the Earth or from the sky was essential to the generation of metals. In the crucible of celestial and earthly flame, the stuff of matter was purified, the lesser elements removed, substances transmuted until a more perfect substance was created. Without heat, these things could not happen. It is this reliance on celestial heat that made natural philosophers skeptical about the probability for gold to be found in the arctic regions. Gabriel Plattes left little room for debate when it comes to the

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<sup>38</sup> Ibid., 4.

<sup>39</sup> Ibid., 4.

<sup>40</sup> Ibid., 10-11.

<sup>41</sup> Ibid., 11.

global local wherein gold can be generated naturally. He contended, “there is no probability that any Mettals can be generated near unto the North and South poles of the Globe.”<sup>42</sup> Plattes speculated that the poles were nothing but “Islands of ice” and as such “can by no means have any convenient Matrix” for the generation of Mettals. Plattes was so certain that the poles were islands of ice that he asserted, “if they were anything else the course of Nature must needs alter, and change, and run presently out of order.”<sup>43</sup> How then, without the aid of celestial heat could metals, let alone gold, be created in newly discovered Meta Incognita just below the North Pole? When the world functioned in such a way that it was impossible for gold to have been found in northern Canada, how could Frobisher’s claims be taken seriously?<sup>44</sup>

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<sup>42</sup> Gabriel Plattes, *A Discovery of Subterranean Treasure* (London: Peter Parker, 1679),3.

<sup>43</sup> *Ibid.*, 3.

<sup>44</sup> Although both Alonzo and Plattes published their treatises on metals after the Frobisher expeditions, the next two chapters will illustrate the way in which their interpretations of the natural world reflected the interpretations of those associated with the voyages.

## CHAPTER TWO

George Best's accounts of the Frobisher voyages serve as a record of the adventures, but also as an insight into sixteenth-century European understanding of the natural world.<sup>1</sup> Best attempted to reconcile what he had observed on the voyages with his understanding of the natural world. For Best and his contemporaries to comprehend what he had seen, it had to fit within the context of the world he understood to exist. What Best had encountered had not been monsters or impossible kingdoms, but subtler wonders of nature's apparent triumph over the most adverse conditions. Best, and the other adventurers accompanying Frobisher, had to account for the existence of plants, animals, people, and minerals existing in a part of the world previously thought incapable of supporting life or capable of producing precious metals.

For Early Modern Europeans, celestial and terrestrial heat was instrumental in the generation of metals within the earth, as we saw. Heat from the sun and stars was thought to penetrate into the earth and aid in the transformation of lesser materials into precious metals such as gold. For this reason, it was largely believed that only in warmer climates, primarily in the areas around the equator, could metals such as gold exist. For Europeans, particularly Englishmen, the promises of riches the warmer climates held was a trade-off

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<sup>1</sup> George Best, "A True Discourse: The fyrst Booke of the first voyage of *Martin Frobisher*," *The Three Voyages of Martin Frobisher, Vol. 1*, Vilhjalmur Stefansson ed., (London: Argonaut Press, 1928).

for the potential risks this climate held for them. Karen Ordhal Kupperman addresses this issue in the article “Fear of Hot Climates in the Anglo-American Colonial Experience.”<sup>2</sup> Kupperman argues that English traveling to the hotter climates of the New World were nervous about the potential physiological effects that area would have on the body.<sup>3</sup> She argues that this was because in Early Modern science “the human constitution was responsive to and shaped by climate, air, and diet;” you are what you eat, but more importantly, you are where you live.<sup>4</sup> An excessively cold climate, such as Martin Frobisher’s Meta Incognita, would have also been thought to have adverse effects on the European body. Kupperman does point out that, as English colonization spread, these fears were largely put aside, but the specter of these fears, or at least the theoretical underpinnings of those fears, can be seen in the accounts of the Frobisher voyages. George Best found it curious that the native inhabitants of Meta Incognita possessed dark skin like the people of the equatorial regions. He reasoned that this could not be because of exposure to the sun, as they were “tenne degrees more towards the North” than England.<sup>5</sup> He concluded that, like Ethiopians, their skin color “proceedeth of some natural infection of the first inhabitats of that Countrey” and not as a result of the climate.<sup>6</sup> Best began his defense of the accessibility of Meta Incognita by using the

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<sup>2</sup> Karen Ordhal Kupperman, “Fear of Hot Climates”, *The William and Mary Quarterly*, 41:2 (1984), pp. 213-240.

<sup>3</sup> *Ibid.*, 220.

<sup>4</sup> *Ibid.*, 213.

<sup>5</sup> Best, “A True Discourse”, 34.

<sup>6</sup> *Ibid.*, 34.

example of native skin color as a means to discredit the idea that extremes of climate would affect the bodies of Europeans who came there.<sup>7</sup>

George Best attempted to ease the contemporary reader's apprehensions about the habitability of regions of extreme temperature. He made the argument that the temperatures in the region were, in fact, not that extreme. Best described the summers in Meta Incognita as "warmer & fruitful, & the Winters nights under the pole, are tolerable to living creature."<sup>8</sup> The heat in the summer, he reported, was so great that it thawed out "monstrous mountains of Ise" resulting in "ebbes, flouds, windes, and currents."<sup>9</sup> He found no contradiction in the reports of continual snow on the tops of mountains citing "it is there no otherwise, than is in the hottest parte of the middle Zone, where also lyeth great snowe al the Sommer long upon toppes of mountains."<sup>10</sup> Chaplin illustrates that the adventurers were going so far as to experiment with the growing of a variety of crops in order to demonstrate not only the capacity to sustain a permanent English settlement, but the region's "unexpectedly temperate nature."<sup>11</sup>

Despite Best's assurances that the climate was milder and more habitable than previously assumed, he still had the particular extremities of the northern climates to deal with. In addressing these issues, Best betrayed his adherence to the natural philosophical worldview. He recounted the general opinions of those in Early Modern Europe about the extremities of global temperature, and how those ideas about areas of extreme heat and

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<sup>7</sup> See: Chaplin, *Subject Matter* about how the English used bodily difference between native peoples and Europeans to legitimize their domination of the American landscape.

<sup>8</sup> Best, "A True Discourse," 45.

<sup>9</sup> *Ibid.*, 45-46.

<sup>10</sup> *Ibid.*, 45-46.

<sup>11</sup> Chaplin, *Subject Matter*, 49-50.



cold were largely unfounded, how it was largely believed that the area “between the two Tropicks was no dwelling or being, for y extreme heate,” and that the areas surrounding the poles were equally uninhabitable due to “the extreme frostes, colde, and snow, whiche continuallye hath there.”<sup>12</sup> Best found these accounts to be false, undoubtedly due in no small part to the fact that he had actually been to the area beneath the poles and had encountered people living there and that Europeans had been inhabiting the tropics and had contact with indigenous people for some time. He did offer an explanation, he argued “the course of the Sunne... can induce no such kinde of extremitie: and so lastly to confirme all partes of the worlde to be habitable.”<sup>13</sup> For Best, the sun, particularly the angle of the sun, played a crucial role in his explanation not only for the surprisingly mild climate of Meta Incognita, but also in the seemingly inexplicable presence of gold in that region.

In the prelude to his accounts of the Frobisher voyages, Best enticed the reader with an indication of those things they would find within the pages to follow. He takes a moment to reflect upon the wondrous time in which he lived, he remarked that “No, Solomon himselfe, with all the pretious metal of Ophir, which he (one only King) had in that only place, can not be comparable to the greate store of golde, and all other metals, which dayly are digges out of the bowels of the earth.”<sup>14</sup> He was referring to the reports of Spanish success in the Americas, but pointed out that an abundance of mineral wealth

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<sup>12</sup> Best, “A True Discourse”, 26.

<sup>13</sup> Ibid., 28.

<sup>14</sup> Ibid., 14.

had also been discovered “in the supposed hard and congealed frozen Lands, almost under the Poles.”<sup>15</sup>

Best did concede that during the winter months, the temperature did get exceedingly cold, but was quick to point out how nature had allowed for adaptation to that weather. He argued that animals in the arctic cope with the winter cold by growing thicker fur proportional to the extreme of cold.<sup>16</sup> He also cited that the birds in the region “have thicker skins, thicker feathers, & more stored down, than in other hot places” in an attempt to have the reader conclude, as he had, that “hath not nature left the unprovided therefore.”<sup>17</sup> Dionyse Settle made around the same time a similar claim in regards to spiders when he reported that “there is no manner of creeping beast hurtful, except some Spiders (which, as many affirme, are signes of great store of Golde:).”<sup>18</sup> Best implied that nature adapts to the cold climates as was evident by the local animal life: should this aspect of nature adapt, why not others? Why, if animals and birds could adapt to the cold, could metals not? Settle’s logic may be viewed, especially to contemporary eyes, as a little more pragmatic. The presence of spiders in and of itself suggested the relatively mild nature of the climate, but how did he make the leap to the conclusion that it in some way indicated gold? It probably had to do with the belief that veins of metal, particularly gold, emit heat. While both Best and Settle argue for the presence of gold in Meta Incognita, Settle’s report recounted a much harsher climate than did Best. He described that even in the summer time the ground is frozen, that “the heate of Summer, is nothing

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<sup>15</sup> Ibid., 14.

<sup>16</sup> Ibid., 45.

<sup>17</sup> Ibid., 45.

<sup>18</sup> Dionyse Settle, *Laste Voyage Into the West and Northwest Regions*, originally published London, 1577, (Amsterdam and New York: Da Capo Press, 1969), 4.

comparable, or of force, to dissolve the extremities of colde, that commeth in Winter.”<sup>19</sup>

In this kind of climate it does not seem all that unreasonable to believe that the only way in which the spiders in the ground might have survived was through the heat emitted from veins of gold.

Best argued that the American arctic provided sufficient celestial heat necessary for the generation of metals. He believed the sun heats the Earth in two ways, the first of which was dependent upon the angle of the sun in the sky. The severity of the angle of the sun in the sky directly related to the amount of heat that was being generated.<sup>20</sup> Best argued that “if the Sunnes beams do beate perpendicularlye at righte Angles” then heat, like the intense heat in the Tropics, was created.<sup>21</sup> While ninety degrees was thought to be the optimal angle for the production of heat, the lack of such direct sunlight, as in the arctic, could be offset by length of exposure.<sup>22</sup> Best contended that the angle at which the sun hits the Arctic, while weak, created conditions in which there were periods of “continuall daye and lighte, withoute anye hinderaunce of moiste nightes,” the length of which he claimed was 182 days.<sup>23</sup> This line of reasoning worked in a way to suggest, as Joyce E. Chaplin presented it, “that the constant exposure to the sun during one season might offset the climate’s cold.”<sup>24</sup> In addition to the long periods of continual daytime, light from other celestial bodies was also thought to contribute to the formation of gold. Like the rays of the sun, the heat caused by starlight and moonlight that would shine upon

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<sup>19</sup> Ibid., 5.

<sup>20</sup> Best, “A True Discourse”, 41.

<sup>21</sup> Ibid., 41.

<sup>22</sup> Ibid., 41.

<sup>23</sup> Ibid., 42.

<sup>24</sup> Chaplin, *Subject Matter*, 50.

the earth during the long periods of night was thought to be conducted by stone into deposits of minerals and baser metals, such as lead, that would transform into “other terrene substances” such as gold.<sup>25</sup> The long arctic nights would then further offset the weak angle of the sun by exposing the earth to long periods of moon and starlight.

There is no evidence to suggest that anyone on the Frobisher expedition had intended to find indigenous gold; his primary concern on the first voyage was to find the Northwest Passage.<sup>26</sup> By time the sailors set out on Frobisher’s first voyage, there had been over eighty years of European presence in the New World and the South American mines had been “worked three-quarters of a century.”<sup>27</sup> Many, if not all of the men involved on Frobisher’s first voyage must have been aware of the Spanish success with indigenous gold. To say that not a single man on that voyage once in America did not look to the ground half hoping for something that sparkled, despite contemporary discourses on the generation of metals, seems to underestimate the impact that Spanish New World wealth had on Europeans.<sup>28</sup>

The Spanish had been the first of the Europeans to set up permanent settlements in the Americas, and had been the first Europeans to exploit its mineral wealth. The Spanish empire had grown fat on New World silver and gold for nearly a century by the time of the Frobisher expeditions. Contemporary to the Frobisher voyages, the Spanish

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<sup>25</sup> Barba Alvaro Alonzo, *The Art of Metals*, R.H. Earl of Sandwich, (London, 1669), 39.

<sup>26</sup> Hogarth,, *Martin Frobisher’s Northwest Venture, 1576-1581*, 2.

<sup>27</sup> George D. Hubbard, “The Influence of Precious Metals on American Exploration, Discovery, Conquest and Possession”, *Bulletin of the American Geographical Society*, 42:8 (1910): pp. 594-602: 597.

<sup>28</sup> James McDermott in *Martin Frobisher: Elizabethan Privateer* makes the point that Spanish New World wealth had such an impact on the people involved in the Frobisher voyages, that it was in part why the enterprise was prolonged for as long as it was.

naturalist Jose de Acosta produced his famous *Natural and Moral History of the Indies*.<sup>29</sup> In it, he outlined the way in which metals were formed in the earth and where they were thought to be likely located. He likened the generation of gold to that of a plant, comparing the association of larger and smaller underground veins to that of trunks and branches of trees. Acosta remarked that metals grew like plants, not because they possessed any “real vegetable and inner life,” but because like plants they grow “by the virtue and efficacy of the sun and the other planets.”<sup>30</sup> In his work, Acosta also described the kind of terrain that would likely yield precious metals. He described landscapes such as “very harsh, dry, and barren lands, among the high mountains, on wild peaks, with very unfavorable weather” as being the most suitable for the finding of gold.<sup>31</sup> He cited Philo of Alexandria when pointing out that in exceedingly mild and temperate locals, nature’s energy is focused upon “the commodities most necessary for the organization and life of animals and men,” not of the production of metals.<sup>32</sup> The landscape of the places where the Frobisher expeditions had reportedly found gold met with Acosta’s description of likely gold-bearing landscapes. In addition, George Best’s explanations of the offsetting of arctic winter by continual starlight and long periods of daylight also corroborated with Acosta’s belief that the sun and other planets were responsible for the formation of gold.

Despite meeting the criteria set forth by Acosta, the Spanish seemed to find it difficult to let go of the idea that the arctic was incapable of producing gold. The Spanish

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<sup>29</sup> Jose de Acosta, *Natural and Moral History of the West Indies*, Jane E. Mangan ed., Francis Lopez-Morillas trans., (Durham and London: Duke University Press, 2002).

<sup>30</sup> *Ibid.*, 161.

<sup>31</sup> *Ibid.*, 165.

<sup>32</sup> *Ibid.*, 165.

had maintained an understandable interest in the discovery of gold in the Americas by England, but maintained skepticism about the validity of the claims. In November of 1578, the Spanish ambassador to England assured Philip II that despite the outfitting of a third voyage to the arctic, the likelihood that it would yield legitimate returns was slim. He argued that the arctic was so cold that it was incapable of producing anything.<sup>33</sup> The diplomat, Don Bernardino de Mendoza, was sent to England in a primarily diplomatic capacity, but was also instructed to inform Philip II on Frobisher's activities in the Americas. Mendoza proved to be exceptionally accomplished at this task. He was able to plant a spy on Frobisher's third and final voyage to the New World and sent samples of the ore to the Spanish king to be assayed in Spain.<sup>34</sup> The Spanish assays revealed what the English assayers would also conclude, that the ore was worthless, confirming their own doubts about the validity of the initial claim.<sup>35</sup>

By the time of the third voyage, Best's enthusiasm for *Meta Incognita* waned. Gone were the praises for mild climate and habitable summers, however, until the very end he advocated for the promise of arctic riches. He concludes his final account of the Frobisher voyages with "I finde, in all the Countrie nothing, that maybe to delite in, either of pleasure or of accompte, only the shewe of Mine, both golde, silver, steele, yron and black lead."<sup>36</sup> That there were no further English mining expeditions to the Arctic would indicate that this were not the case, and that the failure of Frobisher to return to England

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<sup>33</sup> McDermott, *Martin Frobisher*, 157.

<sup>34</sup> Bernard Allaire, Donald Hogarth, "Martin Frobisher, the Spaniards and a Sixteenth-Century Northern Spy" in *Meta Incognita: A Discourse of Discover*, ed. Thomas H.B. Symons, (Hull, QC: Canadian Museum of Civilization, 1999), 577.

<sup>35</sup> *Ibid.*, 585.

<sup>36</sup> Best, "A True Discourse", 129.

with gold-bearing ore had effectively confirmed the belief that gold could not be found within the colder climates. However, factors such as the inadequacy of Elizabethan mining technology, high expense, and the difficulty involved in Arctic mining expeditions may account for the lack of further interest. Growing tensions with the Spanish empire that would culminate with the defeat of the Spanish Armada in 1588 may have also have stunted further prospecting operations.

## CHAPTER THREE

The history of the assays of the Frobisher ores is both complicated and convoluted. Many historians have addressed the political and economic factors that surrounded the series of assays that took place between the years 1576-1578, particularly those during the second and third voyages. While the personal motivations of the people involved in the assays and the political context within which they took place is undoubtedly important, it is only part of the story. During the earliest moments of the assaying drama, there was a time when competing understandings of methodology, empiricism and natural philosophy, converged upon the ore reflecting the broader context of the changing view of the natural world in the sixteenth century. Ultimately, empirical methodology won out and proved the ore to be worthless, but the initial adherence to an older form of knowledge recognized the ore as gold. One methodology saw the ore as gold; the other saw it as worthless. While there may have been some chicanery, the process by which the gold was discovered adhered to the principles of the then prevailing understanding of the natural world.

When Martin Frobisher arrived in England in 1576, newly returned from his first voyage to find a northwest passage to Cathay, he presented the Gentleman Michael Lok with an innocuous black stone. Lok was the chief investor in the Frobisher ventures, and had previously made an agreement for Frobisher to bring back the first thing he found in



the New World. Frobisher had brought him a rock. Lok's feelings on this matter are not recorded, but we can speculate that they may have ranged from mild amusement to anger.<sup>1</sup> As the story goes, Lok returned home to his wife with the American stone; she threw the stone into the fire and "at the length being taken forth, and quenched in a little vinegre it glistered with a bright Marquesset of golde."<sup>2</sup> This seemingly spontaneous action, one born perhaps in frustration or perhaps a more calculated move, helped set in motion events that secured funding for the subsequent Frobisher expeditions as well as create the circus that would surround the assays and trials of the Frobisher ores.

Whether the actions of Lok's wife were true or not is a point of some speculation. Lok's report of the event to the Queen lacks these details. In his primary account, he received the stone and within a month gave a piece of the stone "to [Mr.] Williams, saymaster of the Tower" who found the sample to be nothing more than "marquesite s[tone]."<sup>3</sup> Lok was not satisfied with those results and sought counsel elsewhere, but he did not mention the incident involving his wife in his official report. George Best, however, recounts that "a gentlewoman, one of ye adventurers wives," the wife of Michael Lok, cast the stone into a fire, let it cook, removed it, washed it in vinegar and found it to appear as gold.<sup>4</sup> This moment in the narrative is interesting in many ways, not the least of which is its connection to alchemy. Arguably, this was the first moment in which alchemy entered the equation in regards to the assaying of the Frobisher ores.

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<sup>1</sup> Best, "A True Discourse", 51.

<sup>2</sup> Ibid., 51.

<sup>3</sup> Ibid., 83.

<sup>4</sup> Ibid., 51.

The use of vinegar by Lok's wife as a cleaning agent on the stone may not have been accidental. In early modern metallurgy, vinegar was a recognized solvent, a concept with alchemical roots.<sup>5</sup> Lazarus Ercker advised the use of vinegar to identify and separate gold from stubborn ores. He recommended the combination of a half-pound of alum to every gallon of strong wine vinegar; they had to be boiled together, and then the ore was submerged in the liquid for two to three nights; then the gold would more easily be identified and separated.<sup>6</sup> Johann Jacob Wecker in *Eighteen Books of the Secrets of Art and Nature* also offered a similar process in which vinegar is used to coax out gold from stubborn ores.<sup>7</sup> Wecker suggested placing the ore into the fire until it is red hot and then to dip it into a "Verdigrease, and Salt Armoniac" powder mixture "or else they put it into Vinegar."<sup>8</sup> There is no indication that Lok's wife followed Ercker or Wecker's specific procedure, or that the vinegar was combined with anything or that the stone was submerged in the liquid for any number of days, but the specific use of vinegar seems to be a telling moment.

How then did Lok's wife come by such knowledge? What gave her the idea that vinegar, and not another liquid, was appropriate for the washing of the stone? Allison Kavey argues that many people in sixteenth and seventeenth-century England had access to knowledge about the natural world through the books of secrets, a genre of pamphlets that recounted home remedies, recipes, folk knowledge, as well as formalized

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<sup>5</sup> Lazarus Ercker, *Fleta Minor or The Laws of Art and Nature* (London: Thomas Dawks, 1685), 115.

<sup>6</sup> *Ibid.*, 115.

<sup>7</sup> Jacob Johan Wecker, *Eighteen Books of the Secrets of Art & Nature*, (London: Simon Miller, 1660), 186.

<sup>8</sup> *Ibid.*, 186.

institutional knowledge for mass consumption.<sup>9</sup> Some of the more popular works in this genre even managed to reach the illiterate masses through theatrical productions.<sup>10</sup>

Following Mrs. Lok's revelation that there was potential value in the seemingly worthless chunk of rock from North America, a series of assays took place. Lok turned first to the Queen's assay master and then to two of London's Goldsmith's company, all three of which found the ore to be of no value.<sup>11</sup> When all three assayers returned negative results, Lok turned to a Venetian alchemist, now a resident of London, Giovanni Baptista Agnello.<sup>12</sup> Where three recognized experts did not find value, the fourth, an expert of a different sort, was able to produce "very little powder of gold" and assured Lok that with more of the ore he could produce the same results but to greater effect.<sup>13</sup> Lok was impressed in a way the three previous assays were unable to achieve and "marvayled moche" at the work of Agnello.<sup>14</sup> Lok asked why Agnello could find value where three others could not; one can almost imagine the look on the alchemist's face when he replied to his potential benefactor in Italian, "Bisogna sapere adulare la natura."<sup>15</sup> One must know how to flatter nature.<sup>16</sup>

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<sup>9</sup> Kavey, *Books of Secrets*, 156.

<sup>10</sup> Ibid.

<sup>11</sup> Harkness, "'Strange' Ideas", 152.

<sup>12</sup> Agnello was part of a growing community of Protestant men of learning who came to London as a result of the reformation. William M. Jones, "Two Learned Italians in Elizabethan England", *Italica*, 32:4 (1955), pp. 242-247; and Harkness, "'Strange' Ideas".

<sup>13</sup> Michael Lok, "Mr. Lok, Captain Frobisher, and the Ore," *The Three Voyages of Martin Frobisher, Vol. II*, Vilhjalmur Stefansson ed, (London: Argonaut Press, 1928), 84.

<sup>14</sup> Ibid., 84.

<sup>15</sup> Ibid., 84.

<sup>16</sup> Chaplin, *Subject Matter*, 50.

When Agnello first arrived in England, he had already acquired a reputation as an alchemist, and one to be trusted in such matters. A 1569 letter of reference from Vidame of Chartres to William Cecil, chief advisor to Queen Elizabeth, vouched for Agnello's intelligence and character, and conveyed a certain level of confidence in Agnello's alchemical ability.<sup>17</sup> Vidame hoped for a return of trans-mutated gold for his kind words in Agnello's favor.<sup>18</sup> With a reputation as a trustworthy alchemist in place, and a possible further recommendation by a mutual acquaintance, John Dee, Lok had turned to Agnello to test the value of the ore.<sup>19</sup> Such endorsements would have been valuable to Agnello or any person claiming to be an alchemist. By the sixteenth century, alchemists had by and large garnered a reputation as con men, charlatans, and frauds. Their practice was increasingly marred by reports of chicanery. Various forms of metallurgical fraud existed during the sixteenth century. Most involved hiding precious metals within the various chemical components involved in the assaying process. When the process was complete, the charlatan alchemist would identify the planted gold as evidence of his or her ability to transmute substances in an attempt to secure funding from unwitting patrons. In one such instance, a clever alchemist managed to contaminate all available lead samples in a given area with precious metals "in order to produce a positive assay even if the victims provided their own equipment and additives."<sup>20</sup> Not many would go to such lengths to

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<sup>17</sup> Jones, "Two Learned Italians", 245.

<sup>18</sup> *Ibid.*, 245

<sup>19</sup> Harkness, "'Strange' Ideas and 'English' Knowledge", 152.

<sup>20</sup> Allaire, Bernard. "Methods of Assaying Ore and their Application in the Frobisher Ventures", *Meta Incognita: A Discourse of Discovery, Vol. I*, ed. Thomas H.B. Symons, (Hull, QC: Canadian Museum of Civilization, 1999), 497.

fool potential investors, but contemporary people were aware of that possibility.<sup>21</sup> Barba Alvaro Alonzo remarked on the “multitude of ignorant pretenders to the Art,” disturbed by the threat charlatan alchemists posed to the credibility of men like him.<sup>22</sup> Agnello was faced with further difficulties when he began to involve himself into the Frobisher venture beyond the general reputation of those who claimed to be of his profession. Queen Elizabeth I, just previous to Frobisher’s first voyage, had dealings with the Polish alchemist Cornelius Altnetanus, who failed to deliver on a contract to produce gold out of lead.<sup>23</sup> Altnetanus fled the country with the bankrupt Princess Cecilia of Sweden, and was pursued by William Cecil who was dead set on Altnetanus producing something for the Queen’s investment.<sup>24</sup> Despite their negative reputation, many alchemists found work in Elizabethan London. According to Deborah Harkness, at least “seventy-four alchemists are known to have practiced in the city [of London] during the reign of Elizabeth,” but there are no numbers as to how many of them managed to turn any substance into gold.<sup>25</sup> One may assume that none did.

The actual methodology Agnello used during his assays was and remains a mystery. It is not known just how exactly in those early trails he managed to “flatter nature” into revealing what previous assayers who looked at the materials could not find. The combination of Agnello’s results and his credibility was enough to warrant further investigation into the ore, but not enough to instill complete confidence in the Queen and her advisors. Following Agnello’s revelation that there was gold in the ore, eight more

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<sup>21</sup> Ibid., 497-498.

<sup>22</sup> Alonzo, *The Art of Metals*, 71.

<sup>23</sup> Harkness, “‘Strange’ Ideas”, 151-152.

<sup>24</sup> Ibid., 151-152.

<sup>25</sup> Ibid., 151.

assays by eight different people were performed to confirm the findings. Of those eight assays, only Jonas Shutz, a German assayer and metallurgist living in London, reported the presence of gold in the ore sample he was given.<sup>26</sup> Shutz blamed the failure of the other assayers on their inability to cope with the difficult nature of the ore and the inadequacy of their furnaces to achieve a high enough temperature to deal with the exceedingly stubborn material.<sup>27</sup> Jonas Shutz was a native of the mining region of Annenberg, in what is now Germany; where he would have learned the methods of metallurgy described by Georgius Agricola.<sup>28</sup>

Arguably the most influential work on metallurgy in the sixteenth century *De Re Metallica* was written by the German metallurgist Georgius Agricola; he offered a system of standardization within the field of metallurgy that Bern Dibner called “the leading textbook for miners and metallurgists for nearly two centuries.”<sup>29</sup> Agricola’s work provided instructions and diagrams that addressed the range of tasks and technologies used in the finding, excavating, assaying, and refining of metals. He did not, however, hold a high opinion of alchemy and those who practiced it. Agricola’s understanding of what alchemists claimed to do was that they reduced material “to the primary parts and remove whatever is superfluous in them, and by supplying what is wanted make out of them precious metals.”<sup>30</sup> Agricola found this practice unlikely, and argued that were this

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<sup>26</sup> Hogarth, *Martin Frobisher’s Northwest Venture, 1576-1581*, 20, 32.

<sup>27</sup> Hogarth, *Martin Frobisher’s Northwest Venture, 1576-1581*, 73.

<sup>28</sup> Donald D. Hogarth, “Mining and Metallurgy of the Frobisher Ores”, *Archaeology of the Frobisher Voyages*, eds. William W. Fitzhugh and Jacqueline S. Olin (Washington: Smithsonian Institution Press, 1993), 138.

<sup>29</sup> Bern Dibner, *Agricola on Metals*. (Norwalk, CN: Burndy Library, 1958), 25.

<sup>30</sup> Georgius Agricola, *De Re Metallica*, Herbert Clark Hoover and Lou Henry Hoover trans. and ed. (New York: Dover Publications, 1950), xxviii.

possible, there would have been scores of exceptionally wealthy alchemists, and he was aware of none.<sup>31</sup> He also found these practitioners to lack credibility in that he found them not to have a solid theoretical tradition, and that “their books proclaim their vanity, for they inscribe in them the names of Plato and Aristotle and other philosophers, in order that such high-sounding inscriptions may impose upon simple people and pass for learning.”<sup>32</sup> Though Agricola did not think too highly of those who claimed to be alchemists, certain aspects of his thinking included remnants from natural philosophy. When describing the signs to look for when searching for veins of metal in the Earth, Agricola advised to look to the plants during the wintertime. Identifying places where the frost does not take, where the water is unable to freeze, and where “the soil will produce only small, and pale-coloured plants” the presence of a vein was betrayed.<sup>33</sup> Agricola surmised that this occurred, “because the veins emit a warm and dry exhalation which hinders the freezing of the moisture.”<sup>34</sup> While this seems to be an idea rooted in natural philosophy, it also upholds the basic association between metals and heat, and discredits the idea that the metal ore can only be found in warm climates. While Agricola’s work was largely characterized by empirical reasoning devoid of the supernatural, he was unwilling to concede the powers of the divining rod and its effectiveness in finding veins as fantasy.<sup>35</sup>

Among the notable names associated with the Frobisher ventures was the notorious English polymath John Dee. John Dee’s role within the Frobisher venture is,

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<sup>31</sup> Ibid., xxviii.

<sup>32</sup> Ibid., xxix.

<sup>33</sup> Ibid., 38.

<sup>34</sup> Ibid., 37, 38.

<sup>35</sup> Ibid., 38-41.

however, unclear. When looking at the sources, “it is possible to conclude that his contribution was anything from completely peripheral to absolutely essential.”<sup>36</sup> It is clear that he was involved in the Frobisher ventures as a “scholarly advisor” to the voyages with respect to New World geography and navigational practices; he also was commissioner of the Dartford furnace complex that processed the majority of the ore.<sup>37</sup> What his actual role was as a “commissioner” of the furnaces remains unclear, and he is not mentioned as playing a direct role in any of the assays of the Frobisher ores. Sherman does make the case that Dee might have had gold on the mind during his involvement in the planning of Frobisher’s first voyage. Looking at Dee’s marginalia in his biography of Christopher Columbus and his copy of Strabo’s *Geography*, Sherman noticed that Dee had a particular focus on mention of precious metals.<sup>38</sup> This does not indicate that Dee may have planted the idea of indigenous American gold in the minds of Martin Frobisher and Michael Lok. It may only indicate that Dee, like, arguably, all men involved in overseas exploration in the sixteenth century, had an interest in gold. There is also no indication in the documentary sources that Dee’s alchemical knowledge and theory had an influence in the assaying of the ore. A voice such as Dee’s may have added weight to the claims made by men like Agnello, but in a situation where blame was freely thrown around to account for the disappointing returns of the voyages, he walked away relatively unscathed.

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<sup>36</sup> William H. Sherman, “John Dee’s Role in Martin Frobisher’s Northwest Enterprise” in *Meta Incognita: A Discourse of Discover*, ed. Thomas H.B. Symons, (Hull, QC: Canadian Museum of Civilization, 1999), 283.

<sup>37</sup> *Ibid.*, 287, 290.

<sup>38</sup> *Ibid.*, 288-289, 292.



Neither Agnello nor Shutz alone was able to quell the fears of the Queen and her advisors about the worth of the ore, so a partnership was proposed between the two men, the assayer of the new school and the alchemist of the old guard. As Lok later recounted, the combined “learninge of the sayd Baptista in alchimia and the knowledge of the said Jonas in myneralls and mettalls” was able to produce gold from the original stone brought back to England by Frobisher.<sup>39</sup> Agnello and Shutz each had a particular role to play in the actual testing and assaying of the ores. Agnello, as the alchemist, was responsible for the early part of the process wherein he administered certain “chemical additives” to make the ore easier to process and to “flatter nature” into yielding its bounty.<sup>40</sup> By design or simply by the nature of his profession, Agnello’s exact methodology was unclear, but Shutz’s role in the assays is a little better defined. The assayer’s job, according to historian Bernard Allaire, was to “ensure the quality of ores and finished products” and “in the mining regions, he helped to find mineral deposits and to choose the most profitable veins.”<sup>41</sup> Lazarus Ercker’s *Treatise on Ores and Assaying* claimed that assaying as a practice allowed for the “study [of] the nature of every ore and mineral to determine the kind of metal and the exact amount of it contained.”<sup>42</sup> Shutz’s job in the partnership was to take the ores prepared by Agnello and complete the process of melting and refining the ores in furnaces of his own design that would theoretically achieve the

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<sup>39</sup> Michael Lok, “State Papers relative to the Trial of the Ore subsequent to the *Second Voyage*,” *The Three Voyages of Martin Frobisher, Vol. II*, Vilhjalmur Stefansson ed, (London: Argonaut Press, 1928), 123.

<sup>40</sup> Harkness, “‘Strange’ Ideas”, 151-152.

<sup>41</sup> Allaire, “Methods of Assaying Ore and their Application in the Frobisher Venture”, 478.

<sup>42</sup> Anneliese Grünaldt Sisco, Cyril Stanley Smith, trans. *Lazarus Ercker’s Treatise on Ores and Assaying*. (Chicago: University of Chicago Press, 1951), 9.

temperatures he claimed the other assayer's furnaces could not.<sup>43</sup> With the combination of the mysterious and the mundane, Agnello and Shutz were able to promise enough gold to the crown's satisfaction to justify investment in the Meta Incognita mining project. Each on his own was able to produce gold, but it was not until alchemy and metallurgy were working in accordance that the claim to produce gold from the Frobisher ores proved convincing enough to invest in further ventures.

However convincing the Shutz-Agnello partnership was for the English, it proved to be ill fated. When George Woolfe, an English alchemist, was brought in as Agnello's assistant, disputes about methodology erupted resulting in "irreconcilable differences in method and approach."<sup>44</sup> Infighting, disagreements of methodology and suspicion characterized the analysis of the Frobisher ores the three years following the Agnello-Shutz assays. Lok recounted that the "workmasters cannot yet agree together, eche is jelous of the other to be put out of work."<sup>45</sup> Agnello was then shut out of the enterprise, while Shutz would remain involved as chief assayer until the third voyage, when Robert Denham replaced him.<sup>46</sup> During the entirety of his involvement with the Frobisher expeditions, Shutz continued to justify the enterprise by consistently producing gold from the ore.

Agnello's dismissal from the enterprise marked the removal of the leading force of alchemical thought in the previous assays. Shutz had effectively become in charge of

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<sup>43</sup> Harkness, "'Strange' Ideas", 151-152.

<sup>44</sup> Ibid., 153.

<sup>45</sup> Michael Lok, "Mr. Lockes Discoors touching the Ewre, 1577," *The Three Voyages of Martin Frobisher, Vol. II*, Vilhjalmur Stefansson ed, (London: Argonaut Press, 1928), 84.

<sup>46</sup> Hogarth, "Mining and Metallurgy of the Frobisher Ores", 138.

the assays of the ore and either enlisted or was saddled with assistants versed in empirical metallurgy. During the second voyage, another German metallurgist, Gregory Bona, and an English goldsmith, Robert Denham, accompanied Shutz.<sup>47</sup> Denham, who replaced Shutz as chief assayer of the enterprise, also managed to edge out Burchard Kranich, another metallurgist from the project.<sup>48</sup> After the Agnello-Shutz partnership, the business of assaying the ores fell strictly to metallurgists of the new science. Alchemical theory was effectively eliminated from the assaying process when Agnello left the enterprise. For a moment, natural science and empirical science conflicted, interacted, and then separated, empirical science dominating the further assaying process.

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<sup>47</sup> Hogarth, "Mining and Metallurgy of the Frobisher Ores", 138.

<sup>48</sup> Allaire, "Methods of Assaying Ore", 499.

## CONCLUSION

When Martin Frobisher returned to England, after the largest expedition to the New World until that point in time, the ore mined from the frozen earth of Meta Incognita had been proved worthless.<sup>1</sup> Frobisher, no doubt angered and disheartened at the prospect of losing credibility and favor in the Queen's court, dumped the contents of the holds of his ships, a staggering 1300 tons of ore was dumped off the coast of Ireland.<sup>2</sup> The 1500 tons of ore stored in the tower of London was crushed and used for road construction. Martin Frobisher and Michael Lok bore the brunt of the blame during the fallout after the controversy of the ore. Though Frobisher would again gain the Queen's favor by distinguishing himself against Spanish Armada in 1588, Michael Lok's reputation never recovered.<sup>3</sup>

After Robert Denham and his team of metallurgists decidedly concluded the ore was without value, Michael Lok would lament that "Baptista did but play the alchemist with me." His perception of alchemy had shifted from a legitimate theoretical system to

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<sup>1</sup>Modern geological surveys have found that the ore mined by Frobisher's men was amphibolite and pyroxenite, minerals devoid of gold and of no monetary value. Roy K. Sharat "The History and Petrography of Frobisher's 'Gold Ore'" *Fieldiana: Geology*, 7:2 (May, 1937), pp. 21-38, 36-37.

<sup>2</sup>Chaplin, *Subject Matter*, 51.

<sup>3</sup>Michael Lok spent the years after the last Frobisher voyage in debtor's prison. He was released in 1583 and attempted to rebuild his fortune to little avail. Robert McGhee *The Arctic Voyages of Martin Frobisher* (Seattle: University of Washington Press, 2001), 146

the increasingly popular perception of chicanery.<sup>4</sup> The decision that the ore was worthless, however, did not seem to shake the perception that gold could potentially be found in the arctic. Frobisher and his crew had shown that the extremities of temperature previously thought to exist in the polar region was a misconception according to the theoretical framework within which they formulated their argument. The justifications for the generation of gold in cold climates was later proved false by science. The irony of the results of the Frobisher expedition is that gold can indeed be generated in cold climates, and in great quantity, however not in the manner George Best described.

During the sixteenth and seventeenth centuries there was an upheaval in the way Europeans understood the natural world. Discourses of natural philosophy and science mixed and competed for command of the way in which the universe was viewed. The controversy surrounding the Frobisher ores reflected that controversy. The persistence of natural philosophy in the public consciousness facilitated by popular literature and tradition caused men like George Best and Dionyse Settle to conceptualize the New World according to the way in which they understood it to exist. As a result, the natural environment of *Meta Incognita* was understood to function according to a theoretical framework that would eventually be swept away by the Scientific Revolution. Giovanni Battista Agnello represented the old guard of science, a world in which intangible forces of nature were as important as measurable phenomena while Jonas Shutz and Robert Denham represented a view of nature that valued only what was quantifiable and testable. The conflict between the opposing viewpoints, and the brief partnership of Agnello and Shutz was representative of the conflicts taking place all over the scientific community

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<sup>4</sup> Lok, "Mr. Lok, Captain Frobisher, and the Ore," 86.

during the sixteenth and seventeenth centuries. Science was going through a period of self-definition where superstitions of the past were being reasoned out of existence through empiricism, the casualties were men like Agnello. However, this was neither a quick nor a precise process as natural philosophy persisted in the popular and scientific imagination.