

Gems in the Geocosm:
Athanasius Kircher and the Science of Gems in the Early Modern Period

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Dedication

To Mom and Dad

Abstract

This paper is written with several intentions. One of them is to place Athanasius Kircher in a wider context of gems in the seventeenth century. Much work has been done on Kircher such as his views on alchemy, his work on languages, and his explorations into volcanos and fossils, but little has been written about his theories and ideas concerning the origins of gems, the artificial creation of gems, or his experiments that support his chemical theories. His discussion of gems is primarily in chapters eight and twelve of the *Mundus Subterraneus*, neither of which has been translated into English. Thus a portion of this thesis was dedicated to translating sections of these two chapters. His experiments, theories, vocabulary, and ideas surrounding the “geocosm” become clearer in this attempt to add to the discussions of Kircher’s work already analyzed by other scholars.

This research reveals that Kircher depended greatly on his contemporaries and past authorities to be able to write on gems. Another portion of this paper explores the authorities he most likely used in order to place the science of gems into a larger context. The last portion of this paper compares previous early modern authorities in the context of medicine using ten commonly known gems to track the sources Kircher depended on.

Kircher relied on other sources selectively, leaving out much of what they had observed about gems. In order to add to the discussion of gems, in particular, he framed them in a new way through the organization of the chapters in the *Mundus* and through his original idea of the geocosm. The purpose of the *Mundus* was to combine all aspects of the material world, which included gems and their place in God’s earthly realm.

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**Gems in the Geocosm:
Athanasius Kircher and the Science of Gems in the Early Modern Period**

Originating in antiquity, the study of minerals from the earth is one of the oldest sciences. It was a science that allowed individuals to participate by simply collecting what one found on the ground. Stones, rocks, fossils, and gems were collected, traded and sold across regions, countries and continents because of the value placed on them by humans over time. These commodities therefore needed to be categorized and studied to be able to know their value in the markets. Often this information was collected in lapidaries (from the Latin word for stone, *lapis*) which included all information possible on mineral substances. Authors wrote about coral, fossils, bezoar stones, marble, and geodes, but the most precious were the gems. What each author claimed as a gem versus a stone or other mineral is different depending on the source, but the following is a general definition as given by Georgius Agricola in his *Natura Fossilium* (1546):

A gem, as I have said, is exceptionally hard and transparent, as the diamond and *smaragdus*, or it is exceptionally beautiful because it is adorned with pleasing or variable colors as most species of *jaspis*. Transparency, unusual beauty of color, luster and brilliancy are, in great part, responsible for the value.¹

As Agricola stated, gems (*gemmae*), unlike rocks (*saxi*) and stones (*lapides*), are appealing but also hard, such as the diamond, one of the hardest minerals on earth. But they are also uncommon in the earth. One does not ordinarily find one while on a stroll, and thus gems

¹ Georgius Agricola, *De Natura Fossilium*, Trans. Mark Chance Brandy and Jean A. Brandy (Menasha, WI: George Banta Publishing Company, 1955), p. 112. It should be noted that when I talk about gems in this paper, I follow Kircher's definition of gems, that is, the "small, hard, rare, and transparent" natural materials such as diamonds, rubies, sapphires, and emeralds. As shown above, Agricola considered the stone jasper as a gem, but following Kircher's chart in the *Mundus*, placed jasper in a different category due to its opaque nature. However, other gems/stones will make it into this discussion, such as amethyst and quartz (both common and large according to Kircher) because in Book XII, Kircher was interested in only replicating the "small, hard, rare, and transparent" gems. See Athanasius Kircher, *Mundus Subterraneus* VIII, (Amstelodami: Apud Joannem Janssonium & Elizeum Weyerstraten. 1665), pp. 2 and 4, for the charts to which I refer.

became precious and available to only those who were willing to pay for them. They became symbols of royalty and the upper class, men and women who adorned themselves and their belongings with them. Gems were made part of collections and museums and were placed next to oddities and artifacts of the natural world; they shared space with machines of wonder and technical expertise. They were symbols of nature in its grandest form.² As collecting became fashionable among Europe's upper class and collections multiplied, scholars started taking interest in these objects and began to collect and study them.

Athanasius Kircher (1602—1670) is a famous example of one who collected gems and other natural artifacts. As a Jesuit with an academic background, he was brought to Rome to be the curator for the Vatican's Collegio Romano, where he was given the space and time to establish and create a collection that popes, queens, and other important persons would visit. While nurturing the museum, he was also given time and money to publish scientific works based on his experiments. He published over forty books in his long life, many of them hundreds of pages long. Kircher wrote on a variety of topics: his first book was on magnets, but he also he wrote about topics such as Egyptian hieroglyphs, Chinese culture, machines and other natural magic objects, geology, medicine, music and concerns from the Bible (e.g. the Tower of Babel and Noah's Ark) to name a few.³

² For more on museums and collecting in the early modern period, see Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1994).

³ For further reading on his mechanical artifacts, see Mark A. Waddell, "Magic and Artifice in the Collection of Athanasius Kircher," *Endeavour* 34, no. 1 (2010), 30—34. For other topics, see Paula Findlen, ed., *Athanasius Kircher: the Last Man Who Knew Everything* (New York: Routledge, 2004), and Daniel Stolzenberg, ed., *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher* (Stanford: Stanford University Libraries, 2001). For more on Kircher's life, see Findlen, *Possessing Nature* and the recently published biography, John Glasse, *A Man of Misconceptions: The Life of an Eccentric in an Age of Change* (New York: Penguin Group, 2012).

One of Kircher's largest and most interesting works is his *Mundus Subterraneus* (or *The Underworld*, 1664—5) which covered many topics. His interest in geology was spurred when he took a trip to the Mediterranean in the years 1637—8 where he experienced an earthquake and observed two volcanic eruptions (Mount Etna and Vesuvius). He climbed to the top of Mount Vesuvius before its eruption and saw what few had seen- the mouth of hell. He later wrote that while he peered down into the volcano, he cried out to God, "How incomprehensible are your ways!" and later described the sight: "...it was terrible to behold. The whole area was lit up by the fires, and the glowing sulfur and bitumen produced an intolerable vapor. It was just like hell, only lacking the demons to complete the picture!"⁴ These experiences are described in his *Mundus* and help account for his eclectic interests in a text that also included chapters on *chymistry*, alchemy, medicine, geology, fossils, hydrology, and creatures that live beneath our feet.⁵ These topics make up what Kircher coined as the "Geocosm" or the earthly part of God's creation. The geocosm comprised plants, minerals, animals, humans, demons and his investigation of these elements included physics, geometry, studies of fire, water, and wind, alchemy and chymistry, as well as theories on fossils and the creation of mountains.⁶ The

⁴ Kircher, *Mundus Subterraneus*, p. 200. This translation is taken from P. Conor Reily, *Athanasius Kircher S.J., Master of a Hundred Arts, 1602—1680* (Rome and Wiesbaden: Edizioni del Mondo, 1974), p. 71.

⁵ Kircher made a distinction between alchemy and "chymistry" as seen in the titles of his later chapters in the *Mundus*. For more general information on the epistemology of alchemy and chymistry, see 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. William R. Newman and Anthony Grafton (Cambridge, Mass.: MIT Press, 2001), pp. 385—431. Also see their earlier article, "Alchemy Vs. Chemistry: the Etymological Origins of a Historiographical Mistake," *Early Science and Medicine* 3, no. 1 (1998), 32—65.

⁶ In the first volume, he defines the geocosm as "The terrene globe, which we call the Geocosm or the Terrestrial World, is the end and the center of the whole Creation and is also disposed by that Divine Wisdom, worker, skill and industry of things, so that whatever forces lie latent in the universe and whatever hidden properties are latent in the singular globes of stars, all appear crammed into this globe, as it were an "epitome" [of the whole universe]" (v. 1, p. 55, cited in Toshihiro Yamada, "Kircher and Steno on the 'Geocosm,' with a Reassessment of the Role of Gassendi's Works," *Geological Society of America Special Papers*, no. 411 (2006), p. 74).

geocosm was a living thing; connected to the perfection and divinity of the heavens, but simultaneously corrupted and therefore, he suggested, tended to be less prominent in the studies of natural philosophy.⁷ Such subjects, including gems, were part of the geocosm and thus deserved analysis.

In the *Mundus*, Kircher included a section on gems, a lapidary of sorts. Yet it is absent from traditional histories of lapidaries which mention works like Pliny's *Natural History*, Marbode's *De Lapidibus* of the Middle Ages or Anselm de Boodt's early seventeenth-century *Gemmarum et Lapidum Historia Lapidibus*. Modern authors also seem to ignore Kircher: Lynn Thorndike in his volumes of the *History of Magic and Experimental Science* includes sections on gems and mineralogy, but does not mention Kircher's ideas on gems.⁸ John Sinkankas in his *Emeralds and Other Beryls*, looks at a history of lapidaries, but again Kircher is not considered.⁹ Paula Findlen's compilation of essays on Kircher includes an essay on fossils, but nothing on gems.¹⁰

Therefore, the purpose of this paper is to examine Kircher's lapidary. What did he say about gems? Is his lapidary different from those published before his? To anticipate, I answer yes to the second question. Even though Kircher used several past authorities to write his section on gems, he had a different goal. Rather than focusing on categorizing gems, listing their

⁷ Tara E. Nummedal, "Kircher's Subterranean World and the Dignity of the Geocosm," *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher*, ed. Daniel Stolzenberg, (Stanford: Stanford University Libraries, 2001), pp. 38–40.

⁸ See Lynn Thorndike, "The Lore of Gems," *The History of Experimental Science: The Sixteenth Century*, vol. 6 (New York: Columbia University Press, 1941), pp. 298–324. In volume seven, Thorndike includes entries on "Mineralogy" and "The Underground World of Kircher and Becher."

⁹ John Sinkankas, *Emeralds and Other Beryls* (Radnor, Pennsylvania: Chilton Book Company, 1981): 23–59; John Sinkankas, *Gemology: An Annotated Bibliography*, vol. 1 (Metuchen, N.J.: The Scarecrow Press, Inc., 1993), pp. 547–549, gives detailed bibliographical information on the book and briefly lists what Kircher includes in book VIII, and states that "None of the authorities comment upon the considerable gemological material incorporated by Kircher...".

¹⁰ Paula Findlen, *Athanasius Kircher*. The essay on fossils is Stephen Jay Gould, "Father Athanasius on the Isthmus of a Middle State: Understanding Kircher's Paleontology," pp. 207–238.

virtues, or telling of their worth, Kircher focused on their chemical makeup. He asks: "How are gems made?" "How are the different colors of gems created?" "How are their forms made different from one another?" These are not new questions. Previous lapidaries also presented these questions, but usually within the context of understanding what gems did for people medically and economically. Kircher devoted most of his section on gems to discussing these origin questions and attempted to answer them by presenting experiments that his readers could perform. The first chapter of this paper examines in detail what the *Mundus* said about gems and demonstrates why and how Kircher's lapidary is different.

The second chapter focuses on medicinal uses of gems, not just in Kircher's text, but in the lapidaries that influenced him. Kircher himself did not include very much information on the virtues of gems, but it is clear he got his information from lapidaries such as Marbode's *De Lapidibus* and de Boodt's *Gemmarum et Lapidum Historia*. Since these earlier lapidaries add more content on the uses of gems, this account will establish a context for his account as well as the place of gems in the early modern period.

Kircher's lapidary, as I demonstrate, is different from previous influential lapidaries and thus deserves to be recognized amongst the books of gems in the early modern period. Kircher's attention to experimentation and gem creation is distinctive from lapidaries that typically emphasized comparisons. At the same time, Kircher also included information that can be found in these other lapidaries, making his a well-rounded text on gems. Focusing on these similarities and differences, this paper establishes the nature of Kircher's unique contribution to the subject.

Kircher's main source seems to be Anslem de Boodt's *Gemmarum et Lapidum Historia*. One obvious reason is his use of vocabulary and theories that are part of de Boodt's text. Kircher

even followed de Boodt in including Paracelsus' theory of the *tria prima* (of salt, sulphur and mercury), even though at other points in his work he claimed he did not approve of Paracelsus or most alchemists. But de Boodt was influenced by Paracelsus and therefore his chemical work found its way into Kircher's theories on gem creation. Also, as shown in the second half of this paper, Kircher relied mostly on de Boodt's views on the virtues of gems, condensing rather than going into the extensive detail of his predecessor. Finally, Kircher included his lapidary was because the account contributed to the overall argument in his *Mundus. Gems*, although only a fraction of the geocosm, were part of the comprehensive and interlinking nature that existed under God's reign.

**Geocosmic Gemology:
The Science of Gems in Kircher's *Mundus Subterraneus*, Books VIII and XII**

Kircher's discussion of gems is divided into two sections, books VIII and XII in the second tome. Book VIII is a more general approach to gems while the latter book is about the creation of artificial gems and enamels. Both are primarily descriptions of experiments and discussion of theories with some charts and almost no images. All of the translations (except those noted) are my own.¹¹ In these sections on minerals of the earth, I have chosen to focus on gems even though there existed a thin line between the categorization of gems (*gemmae*), stones (*lapides*), rocks (*saxi*) and fossils (*fossiles*) in the early modern period. This survey of the contents of books VIII and XII, focuses on gems in order to place gems in their early modern context: Kircher's book is unique in that he was not writing a lapidary or museum catalogue like previous writers had written; he was using Paracelsian alchemy (but he would never call it by that title) and placing it within his geocosm. Although he did not provide clear, step-by-step descriptions of experiments, some appear to be thought experiments meant to demonstrate his theories, which supported his ideas of the *Spiritus Architectonicus* (from de Boodt, his main source) and the geocosm.

I. The Analysis of Gems in the Seventeenth Century

Before considering what Kircher wrote about gems in his *Mundus*, I pose two questions that situate his work: "What has already been said about gems?" and "What were the lapidaries and authorities Kircher might have used?" By 1664, when the *Mundus* was first published,

¹¹ Articles written by Stephen Gould, Hiro Hirai, Toshihiro Yamada, and Joscelyn Godwin helped me decipher Kircher's terminology and I use some translations that they had already made from the *Mundus*.

several lapidaries had already been available on the market. By typically relying on Greek and Medieval writers such as Theophrastus (*On Stones*), Albertus Magnus (*De Mineralibus*) and Marbode (*De Lapidibus*), writers in the sixteenth century categorized gems and stones and identified the physical and medical properties of each stone.¹² In the seventeenth century, additional types of books of gems were published, primarily catalogues that detailed museum collections. Ulisse Aldrovandi's (1522—1605) collection of metals was published in 1648, only a few years before Kircher's *Mundus*. This book, *Musaeum metallicum*, focuses on items collected by Aldrovandi pertaining to gems, stones, metals, objects made out of these substances (such as knives and statues), and descriptions of them. When writing about gems, some authors included images accompanied by lengthy and detailed descriptions of each type of gem. Each entry had a physical description, uses (mostly medical, and sometimes separate chapters are devoted to general uses and medical uses), locations where it might be found, mystical ideas associated with the gem, in addition to other descriptive categories depending on the stone.¹³ Kircher did something similar with his fossils and also included brief descriptions on medical uses of gems, but he clearly had something different in mind than just showing off his collection.¹⁴

¹² See Thorndike, "The Lore of Gems," pp. 298—324, for a general history of gems in the sixteenth century. Writers included: Camillo Lunardi (*Speculum lapidum*, 1502), Franciscus Rueus (*De gemmis*, 1547), Conrad Gessner (*De Omni Rerum Fossilium Genere*, 1565), Christophorus Encelius (*De re metallica*, 1557), and William Gilbert (*De Magnete*, 1600). Agricola in his *De re metallica* (1566) wrote very little about gems, but they are included in brief descriptions throughout his book.

¹³ Ulisse Aldrovandi, *Musaeum Metallicum*, (Bononiae: Typis Io. Baptistæ Ferronij, 1648). Other collectors also created catalogues including their gems and stones, but they were usually included in larger texts containing other parts of their collection such as animals or items from the Americas.

¹⁴ Kircher did use several images from Aldrovandi's *Musaeum metallicum*. (See Yamada, "Kircher and Steno on Geocosm," p. 76). For example, an image of a double fish fossil appears on page 37 in the *Mundus* and on p. 103 of Aldrovandi's book; another image of a stone with an image of a cat appears in the *Mundus* on p. 36 and in Aldrovandi's on p. 762. There is also an image of a fossil of coral in Aldrovandi's on 767, but it is inverted in the *Mundus* on p. 32, suggesting that the image was copied. In chapter 9 Kircher cites Aldrovandi's collection in the text but does not cite the images (Kircher, *Mundus Subterraneus*, VIII, p. 33).

Along with descriptions of stones and gems, Kircher included theories. According to Hirai's essay, "Kircher's Chymical Interpretation of the Creation and Spontaneous Generation," Kircher based some of his philosophical ideas on stones on the views of the mineralogist, Anselm de Boodt (1550–1632) in his *Gemmarum et Lapidum Historia* (1647). This lapidary has been called "the most important lapidary of the seventeenth century,"¹⁵ covering hundreds of stones and gems, describing their properties (physical and medical) and citing authorities both ancient and recent. What is significant about de Boodt's work is that unlike previous lapidaries, de Boodt chose to dismiss the magic involved in images carved on stones and gems and introduced gems from distant places that had not yet been discussed in print, such as Peruvian emeralds. Having received his medical degree from Padua, he focused on the medicinal aspects of the stones and disregarded the more "magical" properties such as the claim that gems can cause invisibility or that gems can receive virtues from the stars (although, for de Boodt virtues associated with gems should be associated with demons). However, he did include the claim that gems contain "tiny bodies of God" that can give the gems their medical properties.¹⁶

Deeper analysis of vocabulary in the *Mundus* will show that Kircher has clearly read de Boodt,

¹⁵ Peter Marshall, *The Magic Circle of Rudolf II: Alchemy and Astrology in Renaissance Prague*, (New York: Walker & Company, 2006), p. 79.

¹⁶ As cited by Thorndike, "The Lore of Gems," p. 321, de Boodt also includes the "story" that bones that would normally take forty days to heal, with the aid of the stone ossifrage, heal in three or four days. Another in the *Historia* is that wearing a crucifix stone can "stay the flow of blood, enrich the milk, and ward off ills coming from demons. Suspended from the neck, it is said to cure all fevers." Hirai concludes in his essay "Kircher's Chymical Interpretation" that Kircher plagiarized several ideas about corpuscular conception at the origin of life, sometimes word for word from Fortunio Liceti, *De Spontaneo Viventium Ortu* (1618). It seems that within his own work concerning spontaneous generation, Kircher combined Liceti, Johannes Marci's (1589–1639) optical theory of plastic power, and chemical ideas from Paracelsus (1493–1541) as we will see further in his experiments. See Hiro Hirai, "Kircher's Chymical Interpretation of Creation and Spontaneous Generation," *Chymists and Chymistry: Studies in the History of Alchemy and Early Modern Chemistry*, ed. Lawrence M. Principe, Sagamore Beach: Watson Publishing International LLC, 2007), pp. 86-87.

which shows the importance of the *Historia* in the seventeenth century and also demonstrates how Kircher set out to write the *Mundus*, by reading other authorities besides the ancients.

II. Alchemy, Chymistry, and Experimenting

Kircher's purpose in adding a chapter on gems and stones was not to publish simply another museum catalogue or another lapidary. In Book VIII, he not only provided a categorization of stones and gems, but he placed them within his geocosm. Beyond theory, he also experimented. Using methods similar to those in his chapters on alchemy and fossils, (where he also provided suppositions and experiments), he demonstrated curiosity about color theory and used "chymistry" to make several claims about the color in gems. Although alchemy and chemistry were not yet distinct, clear disciplines in the seventeenth century, Kircher and others attempted to draw a clear line between the two. This is a linguistic issue that will not be addressed here,¹⁷ but I do wish to point out that Kircher purposely used the term "chymistry" in Book VIII, and when he mentioned alchemy, he was making a distinction from "alchemy."¹⁸ Jesuits in the seventeenth century rarely wrote on alchemy even though they were permitted to do so. Those who did write on alchemy did not write books dedicated to the subject, but instead included it in larger works such as Kircher's *Mundus*.¹⁹

Kircher first wrote about alchemy in his *Oedipus Aegyptiacus* (1652–6) where he stated that he believed it was the Egyptians who first "mastered" the skills of distillations, sublimation,

¹⁷ For more insight on alchemy and chemistry and the debate of linguistic and practice, see Ferdinando Abbri, "Alchemy and Chemistry: Chemical Discourses in the Seventeenth Century," *Early Science and Medicine*, 5 (2000), pp. 214-226.

¹⁸ For example Kircher, *Mundus Subterraneus*, VIII, p. 10: "Dico secundo, ex Spragyrica arte infinitis experimentis jamdudum innotuit, ex sulphure varie per ignem tormentaro innumeras colorum species resultare, unde tanta de cauda pavonis & phoenice *fabulantur Alchymistae*," (my italics).

¹⁹ Martha Baldwin, "Alchemy and the Society of Jesus in the Seventeenth Century: Strange Bedfellows?" *Ambix* 40 (July 1993), pp. 41–64, p. 41.

and extraction of metals from the earth. He further examined the art of alchemy in Book XI of the *Mundus*, differentiating between true and false alchemy and justifying his interest. He described three types of alchemy: metallurgical, spagyric, and transmutatory. Kircher defined metallurgical alchemy as including the skills of preparing, dissolving, and separating metals which he saw as an ancient art that all cultures use. Spagyric alchemy referred to the art of distilling and extracting oils, salts, and spirits to create medicines; this was also an honorable part of alchemy. However, transmutatory alchemy referred to the “false” alchemy practiced by charlatans who tried to make gold by use of the philosopher’s stone.²⁰ Alchemy fit into Kircher’s geocosm because it attempted to mimic nature: Kircher pointed out that those practicing metallurgical alchemy should study the processes that occur in the earth to create metals and gems. He also compared alchemical furnaces and tools to fiery chambers in the earth and distillation activities to natural springs and rivers.²¹ In the *Mundus*, there are several images of these furnaces and other alchemical tools; many of which were actually in the laboratories of the Collegio Romano.²²

²⁰ Findlen, *Possessing Nature*, p. 239: "... Kircher also condemned alchemists who 'corrupted' the art of chemistry by claiming to affect fantastic transmutations and improbable generations, for example, the *homunculus*." Nummedal, "Kircher's Subterranean World and the Dignity of the Geocosm," p. 44, quoted from Kircher, *Mundus Subterraneus*, XI, p. 234: "To be successful, he argued, transmutational alchemy stepped into what was for Kircher the dangerous territory of natural magic. 'In theory such a transmutation is possible,' he confessed, 'but in practice I think it could only be accomplished with the help of angels or devils'."

²¹ Martha Baldwin, "Alchemy and the Society of Jesus in the Seventeenth Century," pp. 46—47. Kircher was never a licensed physician, but he was interested in medicine, such as in the use of plants and minerals in elixirs. He also never favored the idea of potable gold or a universal elixir to cure all, but he cited several alchemists and their elixirs, including Andreas Libavius and Paracelsus (p. 51). Kircher was particularly interested in the plague, and published the *Scrutinium Pestis* in 1658, in which he argued that the plague was caused by tiny worms. He was able to see these worms through a microscope, being one of the first men to use one. For more on this episode in Kircher's life, see Harry Beal Torrey, "Athanasius Kircher and the Progress of Medicine," *Osiris*, 5 (1938), pp. 246—275.

²² For example, one elaborate image of a furnace is in Book XI and is labeled as being housed in the Collegio Romano. Kircher, *Mundus Subterraneus* XII, p. 392.

It is known that Kircher himself was involved in alchemical experiments performed at the Collegio Romano. As Tara Nummedal suggests, "This was not the stereotypical alchemical laboratory, solitary and secretive; rather, it resembled the type of bustling workshops maintained by princely patrons of alchemy, employing numerous people to work on diverse experiments and projects."²³ Kircher viewed himself as the authority on alchemy in the Collegio, watching over others as they prepared most, or perhaps all, of the work required for experiments which would more than likely be saved for public performance (to reinforce his arguments and his position).²⁴ In the *Mundus*, he described several experiments to create transmutations (including the experiments on gems found in Book VIII) that were based on others- Antonio Musa Brasavola, Georgius Agricola, Paracelsus and Gabriele Falloppio- are all presented in books VIII, XI and XII. As will be shown with the experiments on gems, Kircher used many chemicals throughout the *Mundus*, describing vitriol, sal ammoniac, and alum (all saline additives) as well as sulphur and mercury.²⁵ Before analyzing his experiments, I will explain the organization of Kircher's lapidary.

²³ Nummedal, "Kircher's Subterranean World and the Dignity of the Geocosm," p. 45.

²⁴ Hirai, "Kircher's Chymical Interpretation," p. 77.

²⁵ Baldwin, "Alchemy and the Society of Jesus in the Seventeenth Century," p. 53. Other experiments in the *Mundus* include showing the concept of fermentation through mixing oil of the terebinth tree with wine: "When a very mild heat was applied to the concoction, the substance dramatically shattered the glass vessel which contained it. Kircher's account of the experiment included a corpuscular explanation of the sulphuric particles of the oil... these particles so agitated and rarefied the inimical, but formerly dormant, particles of the wine that as they attempted strenuously to separate themselves from the sulphuric particles, they burst the container in their attempt to fly off." Baldwin also wrote an article about Kircher's experiments on snakestones before the completion of the *Mundus*. In front of a crowd, he showed that a snakestone could take the poison from a dog bit by a viper. See Martha Baldwin, "The Snakestone Experiments: An Early Modern Medical Debate," *Isis* 86, No. 3 (September 1995), pp. 394—418. Kircher also attributed the materials of subterranean fire to these chemicals, as will be seen in the creation of gems: "The material of the subterranean fire is not only sulphur, bitumen, or fossil carbon, but also alum salt, nitre, antimony, carbonized earth, *calcanthum* [limestone?], and that type called metallic. For sulphur and bitumen, cannot make so fierce a fire as to overturn mountains and bury cities in the ashes and pumice that the volcano expels..." Kircher, *Mundus Subterraneus*, vol. I, p. 190; translated by

III. The Organization of Gems in the Mundus Subterraneus

There are two places in the *Mundus* where gems are discussed: Book VIII: “The Stony Earth Substances: concerning bones, horns, fossils, also subterranean animals, humans, demons,” and Book XII: “The Simulation of Nature.” Book VIII is where the bulk of Kircher’s text on gems is situated. It is divided into four sections, of which gems appear in the first: “Concerning Stones in General.”²⁶ This first section on stones in general is further divided into nine chapters and topics:

- (1) The manifold diversity of stones [*De multiplici Lapidum differentia*]
- (2) The origin of stony substance, which is perceived in the geocosm, and the origin of mountains [*De Lapidosa Substantiae, quae in Geocosmo cernitur montiumque origine*]
- (3) The stone-making virtue that is diffused throughout the Geocosm [*De Virtute Lapidifica per totius Geocosmi corpus diffusa*]
- (4) The origin of stones and rocks, and how they become so hard during the course of time [*De Lapidum Saxorumque origine, & quomodo successu temporis in tantam duritiem coaluerint*]
- (5) Experiments on the colors of stones and gems, and how they receive their colors [*De Lapidum Gemmarumque colore, & qua ratione is a Natura iis sub tanta colorum differentia insitus sit*]
- (6) Colors that they call apparent [*De Coloribus, quos apparentes vocant*]
- (7) The cause and origin of transparent stones and gems; first something about the source of crystalline stones, and then about the source of diamonds [*In quo de transparentium lapidum gemmarumque causa & origine, & primo quidem de crystallinarum, deinde de Adamantum ortu agetur*]

Joscelyn Godwin, *Athanasius Kircher’s Theatre of the World*, (Rochester, VT: Inner Traditions/Bear, 2009), p. 132.

²⁶ *De lapidibus in communi*. The other three sections are: (2) “Concerning the transformation of juices, salts, herbs, plants, trees, animals and humans converted into stone, or the faculty of petrification” (*de transformatione succorum, salium, herbarum, plantarum, arborum, animalium hominumque in saxum conversorum, sive de facultate petrifica*), (3) Concerning asbestos, amber, and the rest of the bituminous fluid gums, as well as those fossils that exert wonderful virtues” (*de asbestos, succino, caeterisque bituminosis gummiis fluoribus, nec non de iis fossilibus, quae mirandis virtutibus pollent*), and (4) “Concerning animals under the earth” (*de animalibus subterraneis*.)

- (8) The various shapes, forms, and images with which nature has furnished stones and gems [*De variis figuris, formis & imaginibus, quibus Natura Lapides & gemmas instruxit*]
- (9) Nature's wondrous artistic works, forms, shapes, and images that it draws on stones and gem and their origin and causes [*De admirandis Naturae pictricis operibus, formis, figuris, imaginibus quas in lapidibus & gemmis delineat, eorumque origine & causis*]

From this list of chapter titles, it is obvious where Kircher's interests lay in presenting gems in the *Mundus*. The science of gems is the dominant topic: How are they created? How do the chemicals in the earth govern the aspects and virtues of gems?

IV. Categorizing Gems and the Spiritus Architectonicus

First, in the preface to Book VIII, Kircher added to his definition of geocosm by comparing the earth to the human body, more specifically, a woman's body.²⁷ According to Kircher, the human body was a microcosm and the earth was an organic macrocosm, and he used this image to demonstrate how different systems in the human body can be compared to those in the earth: nerves, arteries, veins and cartilage are similar to veins of metal in the earth, or fossils that can be extracted from the ground.²⁸ Kircher then presented a large chart (figure 1-

²⁷ "And having exposed the foundations of terrestrial bodies, remaining are stony substances, which in the Geocosmos are the immense receptacles of her womb, contain different vast number of stones, rocks, and gems..." Kircher, *Mundus Subterraneus*, VIII, p. 1. Earlier in volume I, he compared the earth to a human body in the terms of micro/macrocosm: "Just as in the microcosm of the human body, heat, diffused through all the channels of the whole body, animates everything with its spirits, vivifies it, renews it, agitates it, united with the mass of the humours, even so nature's Artificer has constituted the geocosm no less providentially. He has provided it with copious and plentiful fires in conformity with such a mass, lest anything be lacking necessary for its natural operations." Kircher, *Mundus Subterraneus*, vol. I, p. 175; translation taken from Godwin, *Athanasius Kircher's Theatre of the World*, p. 131.

²⁸ Kircher is not the first to compare the human body to the earth. In the century before, there was concern about digging ("violating") the "mother earth" for its goods. Agricola addressed this problem in his *De re metallica*, arguing that humans were meant to mine and extract the earth's wonderful resources. The combination of this strong argument and new technologies, the argument became more

Schematismus Lapidum resolutorius- “A table that separates stones,”) that divided stones and gems into different categories, beginning with animal (fossils, corals, bezoars, etc.) and non-animal. The inanimate category (the larger of the two) is further divided into “those that do not melt and have shape” and “those that melt, juices, gagates (jet), and coal.” The first category further splits off into firm (*certam*) stones and stones that are not firm (*nullam; sunt vel*). Firm stones include geometrically shaped stones such as crystals, geodes, and basalts; and also “others” (*alicujus rei*) that include stones such as cat’s eyes, stalagmites, stalactites, and several others. The “flexible” stones include gems: lapis lazuli, opals, jasper, rubies, sapphires, and amethysts are all considered part of this category under individual smaller categories.²⁹ This chart is copied word for word from de Boodt’s *Gemmarum et Lapidum Historia*, published almost twenty years before the *Mundus*.³⁰

one-sided as time went on, and violating mother earth no longer was a concern. For more on the violation of mother earth, see Carolyn Merchant, *The Death of Nature: Woman, Ecology and the Scientific Revolution*, (New York: HarperCollins, 1980), especially chapters “Nature as Female,” “The World as an Organism,” and “Production, Reproduction, and the Female.”

²⁹ Kircher, *Mundus Subterraneus*, VIII, p. 2.

³⁰ Anselm Boéce de Boodt, *Gemmarum et lapidum historia*, (Lugduni Batavorum, ex officina Ioannis Maire, 1647), p. 22.

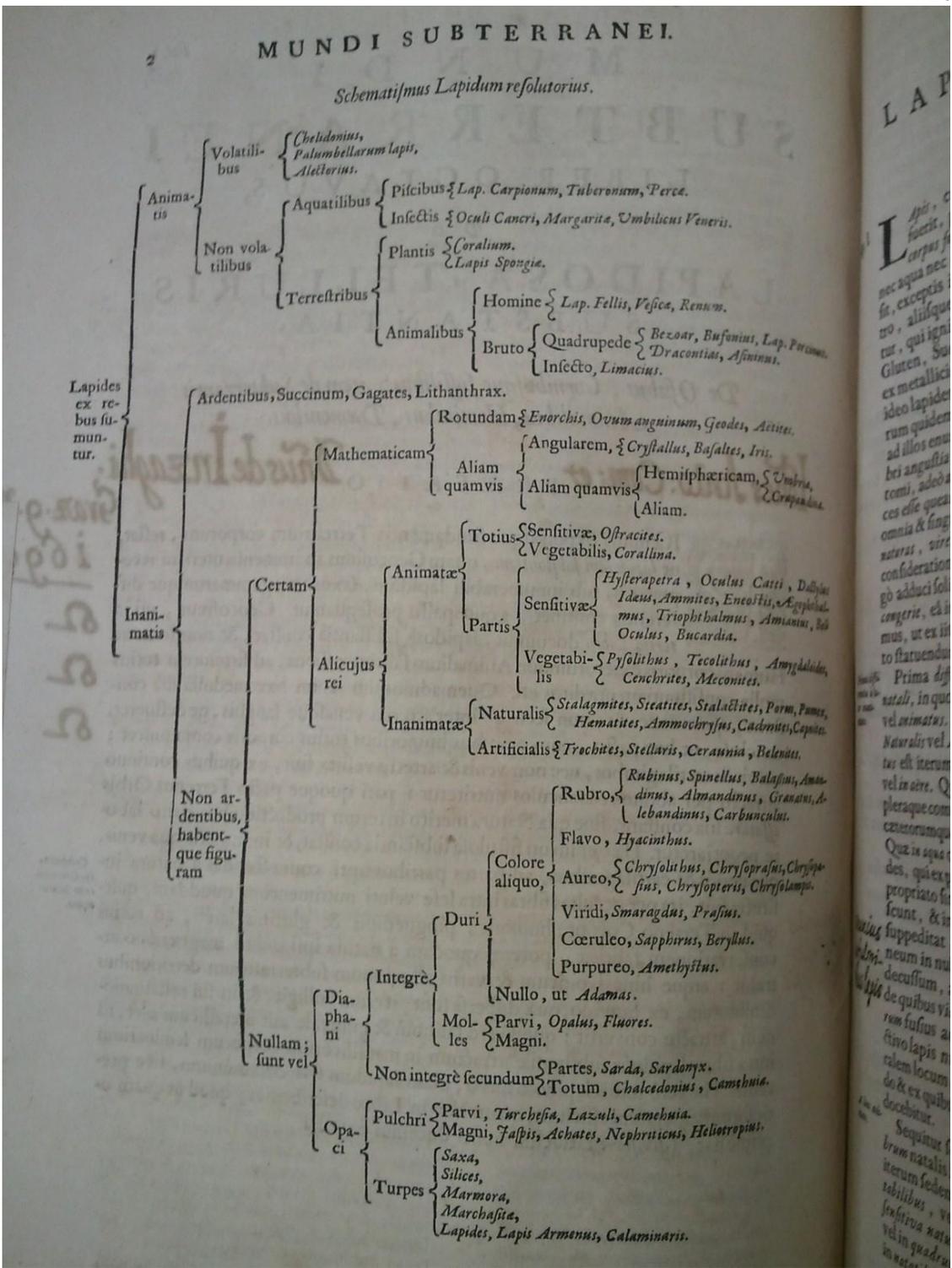


Figure 1: Kircher, *Mundus Subterraneus*, VIII, p. 2. *Schematismus lapidum resolutorius.*

There is a second chart titled “Division of Stones and Gems” (figure 2) which excludes several minerals from the other chart such as the corals and fossils but adds more gems and stones.³¹ The first division is between small and large types, and then each is further divided into rare and common, which is further divided into hard and soft and finally, pretty and ugly. Some of these smaller categories are further categorized as shadowed, transparent or colored (or without color). Some of the gems and stones are repeated from the first chart (such as lapis lazuli, jasper, and rubies) while others are newly introduced (alabaster, marble, and specific types of pseudo-diamonds for example). Similar to the first chart, the second chart is not Kircher’s original work; the same exact chart (with some grammatical differences) is found in de Boodt and an almost exact chart can be found in Thomas Nicols’s *A Lapidary: or, the History of Pretious Stones, with Cautions for the Undeceiving of All Those That Deal with Pretious Stones*, published five years after de Boodt’s.³² Kircher was not trying to create another lapidary. His goal was to place stones, gems, and past authorities on the subject within a geocosm. Instead of arguing with accepted authoritative texts on “basic” information such as categorizing, he focused on the geocosm and his theories.

³¹ Kircher, *Mundus Subterraneus*, VIII, p. 4.

³² Anselm Boéce de Boodt, *Gemmarum et lapidum historia*, p. 3, and Thomas Nicols, *A Lapidary: or, the History of Pretious Stones, with Cautions for the Undeceiving of All Those That Deal with Pretious Stones*, (Cambridge: Thomas Buck, 1652), p. 1. Thomas Nicols’s book was the first known English lapidary, and due to the similarities between his chart and de Boodt’s, its reliance on the *Gemmarum et lapidum historia* is clear. Nicols did in fact state that he spent some time with de Boodt’s book: “... Then by partly acquainting Anselmus Boetius with the English tongue: In doing to which, I have endeavoured... and withal, I have not onely labored with Boethius, but also with divers other Lapidists, to shew the true way of discerning factitious and artificiall stones or gems, from those that are really and truly the works of nature...” (Nicols, *A Lapidary*, Preface).

filices huminum ac formis imbuuntur. Sunt denique, qui omnium rerum figuras, sylvarum, urbium, camporum, herbarum, plantarum, homi-

in hujus Libri decursum agendum; quod antequam fiat, jam *Synopsis analyticam* omnium hucusque dictorum apponimus.

Divisio Lapidum & gemmarum.

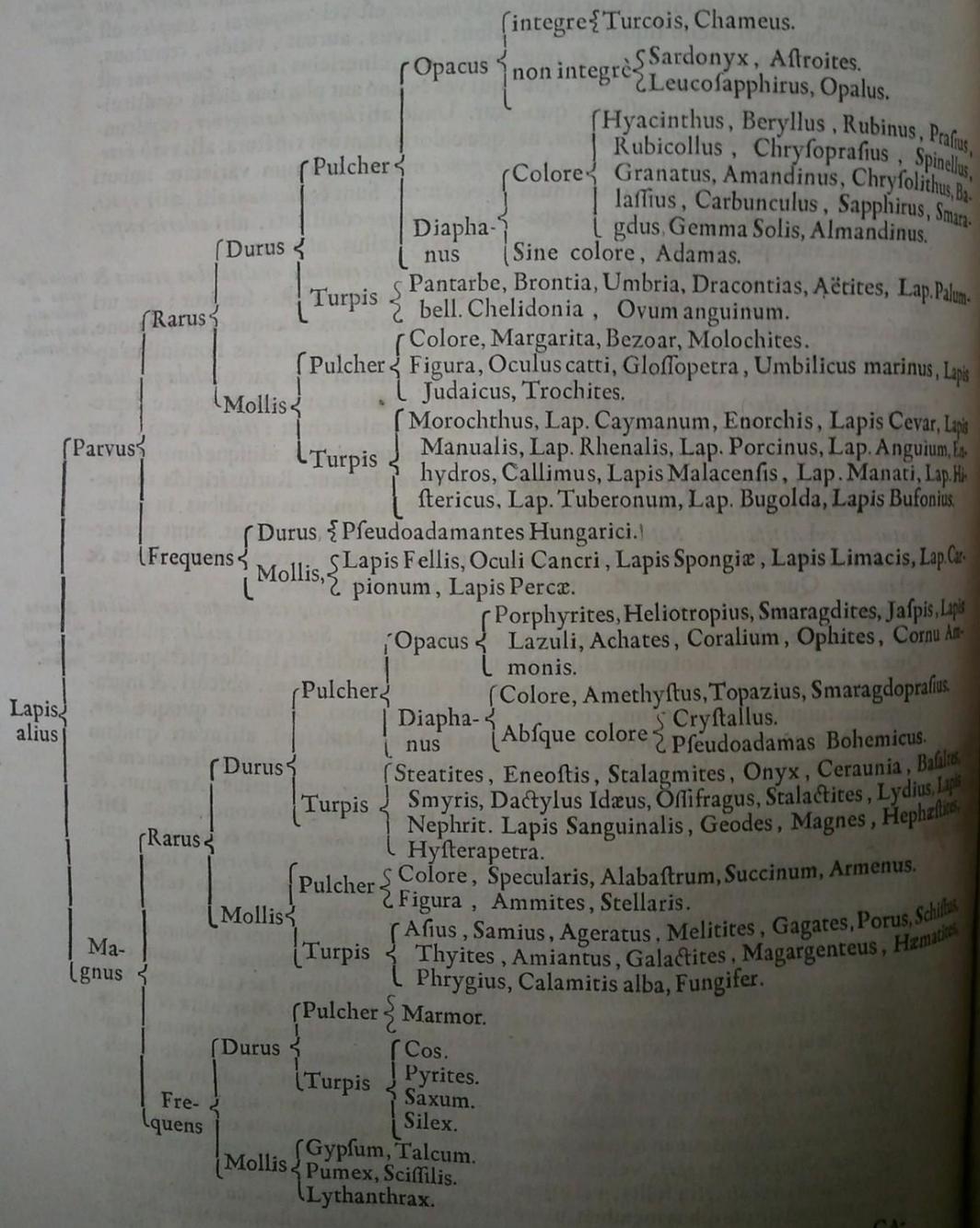


Figure 2: Kircher, *Mundus Subterraneus*, VIII, p. 4. *Divisio lapidum & gemmarum.*

The first chapter, titled *de multiplici Lapidum differentia* (“concerning the manifold diversity of stones”) explains these charts and division criteria: “place of birth” (of the earth, air, or water and those of animals; insects and quadrupeds), colors, the environment in which they are found, the use of the five senses to classify them, and their shapes.³³ Together, these five classifications “created” this chart, and his discussion is an explanation of the categories.

The second chapter, titled “Concerning the origin of stony substance, which is perceived in the geocosm, and the origin of mountains” considers fossils found on mountains and the origins of mountains. This chapter does not look at gems, but does introduce a few terms that require further explanation in order to comprehend Kircher’s theories on gems. One of these terms is the *spiritus architectonicus*. This “architectonic spirit” is the agent or universal seed created by the *Divinus Architectus* that Kircher claimed is the basic virtue that allows fossils to petrify and stones with images to be formed. As will be shown, there are other names that Kircher gave this agent and it should be noted that the idea of a universal seed with this power is not his but dates back to Aristotle (his principle of spontaneous generation) and is further described by Avicenna and Albert the Great as *vis plastica* (another term that Kircher uses).³⁴ Kircher seems to have taken the term *spiritus archectonicus* from de Boodt’s *Historia*: in chapter nine of this book, de Boodt examined the forms and essence of stones and briefly mentions this

³³ Sight is used for color, sound for the noises stones/gems can make such as “dull,” “acute” or rattling. Some stones, Kircher points out, smell like sulphur or perfume (*lapis Mariaebergicus* for example). In terms of touch, some are soft to the fingers; and finally for taste, Kircher says that some stones taste salty. He does not go into much detail, but also made use of the senses in his sections on color theory and chemical make ups of the gems and stones. Kircher, *Mundus Subterraneus*, VIII, pp. 3–4.

³⁴ For more information on this particular chapter, see Gould, “Father Athanasius on the Isthmus of a Middle State,” pp. 207–237. Godwin points out that Kircher “did not hold that creatures could arise out of inanimate matter, but he was certain that an embryo could develop from sperm alone, without womb or egg.” Godwin, *Athanasius Kircher’s Theatre of the World*, p. 146.

term.³⁵ De Boodt's *spiritus archectonicus* and its relation to seeds was not the only thing Kircher pulled from this influential text.

The third chapter, on the virtues of stones in the geocosm, introduces several new terms that again need deciphering in order to further understand Kircher's general view on stones. First, we get a more developed definition of *Spiritus Architectonicus* and *vis plastica* (plastic virtue) as the power that causes the forms and figures of stones, the colors in them, and it "operates in the economy in the rocky substances."³⁶ Through the "architectonic spirit" and the "plastic force," gems are created due to the combination of nitre, alum and vitriol:

And from this joining of salt with diverse clumps of different earths, three other kinds of salts, nitre, alumina, and vitriol gradually emerged, which when joined with one or other earth substances in due proportion, brought forth the whole variety of stones and gems ... which we cannot wonder at enough. And we say that the material cause of the stones is nothing other than Nature's salt, by which everthing acquires its consistency and solidity; but we say that the formal cause is a virtue endowed with a saline species, that is, a petrifying, hardening, and coagulative virtue.³⁷

The *vis salina*— "saline virtue" — water with dissolved salts, is further a part of the *spiritus architectonicus* as part of a trinity combined with sulphur and mercury; as stated in a later book in the *Mundus*:

I say that a certain material *spiritus* was composed from the subtlest [part] of the celestial breath of from the portion of the elements and that a certain

³⁵ "...from the work of the architonic spirit... seminaries (seeds), however, were created by God, the principle of things as it were, from which the species of things to every one of their essential forms, acquire. (De Boodt, *Historia lapidum et gemmarum*, p. 31-32). Also see Hirai, "Kircher's Chymical Interpretation," p. 80.

³⁶ Kircher, *Mundus Subterraneus*, VIII, pp. 6-7. "...*vis sit lapidiscia quis Spiritus Architectonicus...in saxosae substantiae oeconomia operetur...*" (6)

³⁷ Kircher, *Mundus Subterraneus*, VIII, p. 6-7: "Atque ex hac salis cum diversis terrarum differentium glebis conjunction, paulatim alia tria salium genera, nitri, aluminis, vitrioli emergerunt, quæ aliis et aliis sibi proportionatis terrestribus substantiis conjuncta, omnem lapidum gemmarumque varietatem pepererunt ... quam satis mirari non possumus: adeoque materialem causam lapidum nihil aliud esse dicimus quam Naturæ salem, quo omnia subsistentiam suam soliditatemque acquirunt; formalem vero causam esse vim salino generi inditam, Id est, lapidificam indurativam atque coagulationem."

spirituous salino-sulfuro-mercurial vapor, a universal seed of things, was created along with the elements by God as the origin of all things, which were established in the world of corporeal entities.³⁸

This trinity of “spirits” is clearly based on Paracelsus’ idea of the *tria prima* (salt-sulphur-mercury) which are said to be the primary elements that make up the physical world.³⁹ Though Kircher did not support the ideas of this alchemist directly, he did not hold back from using Paracelsian ideas concerning the chemical makeup of gems.⁴⁰ Like Paracelsus, Kircher attributed the salino-sulfuro-mercurial mixture with the Holy Trinity and God’s power:

So that a single thing would be seen as established with triple power, in which glorious GOD impressed the sign of his ineffable and adorable Trinity on his primordial creation as a future principle for all things; hence, not without merit, we observed that this saline-sulphurous-mercurial spirit, like the universal seed of Nature, can be called one substance distinguished in three powers, the proximate cause of all things.⁴¹

³⁸ Taken from the translation in Hirai, “Kircher’s Chymical Interpretation,” 79. (Kircher, *Mundus Subterraneus*, XII, p. 327).

³⁹ Outside of Book VIII, Kircher revisited the idea of the connections between God and this mixture; later in the second volume he stated: “It may properly be asked in this context what this *panspermia* and seminal power that produced all things was. I say that it was once a material spirit made up either of a more subtle heavenly breeze or a portion of elements, and that it was once a spirituous Sulphurous-saline-mercurial vapor, the universal seed of things, created by GOD together with the elements, the origin of all the extant bodies that have been created in the world.” (Kircher, *Mundus Subterraneus*, vol. 2, 327; Taken from a translation from Ingrid D. Rowland, “Athanasius Kircher, Giordano Bruno, and the *Pansperma*,” *Athanasius Kircher: The Last Man Who Knew Everything*, ed. Paula Findlen, p. 199). In the section on alchemy in the *Mundus*, Kircher states that he believes all diseases also come from the *tria prima*. Kircher, *Mundus Subterraneus*: 135, from Thorndike, “The Underground World of Kircher and Belcher,” Vol. 7, p. 574.

⁴⁰ In fact, Kircher later vocally states that he despised the alchemist. He “considered [him] a dangerous lunatic” and devoted two pages in the *Mundus* to the “fulmination to the sins and follies of the Swiss alchemist, then shows how Paracelsus’s recipes could not possibly work.” Godwin, *Athanasius Kircher’s Theatre of the World*, pp. 182, 189. Yet Godwin also points out that Kircher used Paracelsus in other ways, such as when talking about how plants have a corresponding metal. (Godwin, *Athanasius Kircher’s Theatre of the World*, p. 155).

⁴¹ Kircher, *Mundus Subterraneus*, vol. 2, p. 258; Taken from a translation from Rowland, “Athanasius Kircher, Giordano Bruno, and the *Pansperma*,” p. 200. Also see Charles Webster’s chapter “Matter and Magic” in his book *Paracelsus: Medicine, Magic and Mission at the End of Time*, (New Haven: Yale University Press, 2008): pp. 131—168. Kircher also related the *tria prima* to his theory of volcanism, found in volume I. “Observing the peculiar substances thrown up by volcanoes and other geophysical anomalies led Kircher to formulate a theory of metallic formation. The framework within which develops it was already almost obsolete- the Paracelsian triad of sulphur, mercury, and salt as the parent principles of all

This brings the *Spiritus Architectonicus* back to Kircher's geocosm; the universal seed of nature not only causes fossils to emerge or gems to be formed, but is a central key piece to understanding the connection between the geocosm and God: the geocosm is not simply the earthly world, but is the *created* earthly world.⁴² Kircher spent most of the chapter describing these terms, and because he used the *Spiritus Architectonicus* as the basis of his theories about the origins and formations of gems, it is necessary to go into detail beyond Book VIII to discuss how he defined and used the salino-sulfuro-mercurial mixture in his experiments in later chapters.

Chapter four is titled: "Concerning the origin of stones and rocks, and how they become so hard during the course of time." Again, the reader receives further explanation of phrases and key words such as *Spiritus lapidificus* and *lapidifica vis* (lapidifying spirit/force). These terms are similar to *vis plastica* and are part of the *Spiritus Architectonicus* that causes stones and gems to harden and look and feel the way they do by forces under the earth (especially heat, *calor*). In this chapter, he asked, "Why are some stones pure or impure in substance?" He argued that the ratio between the salts of nitre, alum, and vitriol accounts for pure and impure stones.⁴³ Some combinations of these salts make the pure, "correct" type of stone or gem, while others might make combined stones or imperfect gems. At the end of the chapter, he provided a specific example. The gem Marchasite⁴⁴ according to Kircher has a magnetic nature, is

substances- and the process he describes is sheer alchemy. This is how he integrates it with his theory of vulcanism." Godwin, *Athanasius Kircher's Theatre of the World*, p. 134.

⁴² Rowland, "Athanasius Kircher: Giordano Bruno, and the *Panspermia*," pp. 199—201.

⁴³ Kircher, *Mundus Subterraneus*, VIII, p. 7.

⁴⁴ Today, marchasite is also known as white pyrite. This gem today is still used for jewelry (it is a silver, metallic-colored "gem," usually used in inexpensive jewelry with silver) though alone it is brittle. On some surfaces, it can appear a yellow color; perhaps the reason Kircher (and others?) believed it was

metallic in spirit, inflammable and generated from sulphur. Due to the heat produced in the earth and the amount of sulphur involved, this stone can be created from a seed with metallic properties. Here he also mentioned that the Spagyric art brings out an abundance of sulphur, but if the reader has not already looked at his sections on alchemy and chemistry, it is difficult to know exactly what the “Spagyric art” is in the context of Kircher’s experiments.⁴⁵ Beginning in the next chapter, Kircher turns to the Spagyric art and experiments based on theories surrounding gems.

V. Salt and Sulphur: The Chemistry of Gem Colors and Shapes

The next five sections represent a change in style and focus. Each chapter now focuses on a specific aspect of gems and/or stones. Chapter five looks at colors of gems and stones and begins with a few pages on Kircher’s theory on colors in gems and concludes with three experiments. In the first paragraphs, Kircher included the ancients, both Plato and Aristotle, to suggest the ways people can perceive colors. Clearly Kircher planned not only to include gems and stones, but also to describe vegetables and metals (and in other books, flowers, herbs and animals). He presented several questions that he wanted to clarify: What is the quality of colors? How are they produced? From what? When?⁴⁶

In the first sub-section on color theory, Kircher provided three suppositions in attempt to answer these questions. Just as with the creation of different forms, shapes, and properties

sulphurous. Robert Webster, *Gems: Their Sources, Descriptions and Identification*, (Washington: Butterworths, 1962), pp. 214—216.

⁴⁵ Kircher, *Mundus Subterraneus*, VIII, p. 8: “In lapidis generatione si sulphura pars & metallicis foeta spiritibus materiam pervadit ... hanc enim plenam sulphure & odor & inflammabilis naturæ virtus, quin & spagyrica ars, qua ex eadem copiosum sulphur educitur, abunde docent.”

⁴⁶ Kircher, *Mundus Subterraneus*, VIII, p. 9.

of stones and gems, colors are also created through different mixtures of sulphur and fire under the earth.⁴⁷ First he discussed the differences between opaque and transparent stones; basically stating that colors are somewhat different in each kind of stone, but not really explaining why. Next he looked at specific colors and their chemical natures. He focused on white and black but briefly mentioned others such as red, yellow and blue. After restating his belief that the colors are caused by various amounts of salts and sulphur, he again mentioned the Spragyrical arts as a way of experimenting on colors: “Second, I say, an infinite number of experiments come from the spragyrical art, and an innumerable species of colors result from sulphur and the torment of fire...”⁴⁸ Using salt, sulphur, water and “mineral spirit” (*spiritus mineralis lapidificus*), Kircher proceeded to tell the reader how the combination of these four materials affect the variety of colors in stones and gems. For example, “when a body of salt, sulphur and the predominance of the smallest part are made, a white stone is born, as white as marble. If however, it becomes swollen and inflamed by the predominance of impure sulphur” then the stone becomes black and rough.⁴⁹ Sulphur is a key substance in Kircher’s experiments: “...sulphur makes a difference, being mixed and digested in various ways, with its binding natural moistness, as daily experiments teach us.”⁵⁰

Salt is another important ingredient in Kircher’s experiments. He stated that: “hence it is also clear why salt corpuscles, which contribute chiefly to the production of stones, although they are transparent, do not admit those same colors which the diaphanous include; this is

⁴⁷ Kircher, *Mundus Subterraneus*, VIII, p. 9.

⁴⁸ Kircher, *Mundus Subterraneus*, VIII, p. 10.

⁴⁹ Kircher, *Mundus Subterraneus*, VIII, p. 11.

⁵⁰ “...sulphur refert, vario modo se habens cum humido conglutinante nativo permixtum & concoctum, uti experientia quotidiana docet.”

because they are mixed with sulphur, and spread through the whole substance of the stone...”⁵¹

The purpose of the experiments is therefore to prove his suppositions and also to show the significance of the sulphur-saline-mercurial mixture in the formation and appearance of the colors in gems.

Kircher’s first experiment examined how the color of lead with acetum (vinegar or a strong acid) changes color in heat. When this is done, the lead changes from white to an intense red color, and then to a black slag as the acetum dissolves into the metal. Without giving any details on how long it takes for the colors to change or how much acetum or lead is used, he first concluded that the colors change depending on the heat of the fire. Then he claimed that it is not based on heat alone but depends also on the saline content, which in this experiment is the *calx*. The more salt that is added to the experiment, the greater the variety of colors produced.⁵² The purpose of this particular experiment is to show that colors can change due to the combination of the variety of degrees of heat and the amount of salt, which is important to understanding how colors are created in gems.

The next experiment is set up to be able to explain “how saline corpuscles mutually destroy and strengthen each other.”⁵³ This time the main ingredients are galls and vitriol mixed in water (which turns the water black, *atramentum*- ink like) with the purpose of seeing if the gall takes in the vitriol. Due to the sulphurous nature of the gall, the vitriol should be sucked up, making the black colored water clear.

⁵¹ “*Hinc patet quoque cur corpuscula salina, quae ad generationem lapidum potissimum concurrunt, cum diaphana sint, non eosdem qui diaphana ambiunt colores admittant; quia videlicet sulphuri admixta sunt, & per totam substantiam lapidis diffusa...*” Kircher, *Mundus Subterraneus*, VIII, p. 11.

⁵² Kircher, *Mundus Subterraneus*, VIII, p. 12.

⁵³ “*Quomodo vero salina corpuscula se mutuo destruant & instaurent...*” Kircher, *Mundus Subterraneus*, VIII, p. 12.

The last experiment is focused on how colors can mix to create different shades and different colors all together. The experiment explains these combinations, and includes a diagram that shows clearly how each color is mixed.⁵⁴ As preface, however, he returned to the geocosm theory to reinforce the point that such colors are produced naturally in the earth:

I say, many rocks and stones are composed of sulfur and salts. It is as if the spirit and vapor of the mineral salts in the underground fire are exalted, for their insight in the cracks and veins penetrate the very heart of the mountains... volatile sulphur is fixed... [and] joined, then that variety of the spirit of the tincture... is converted to another color, later added [to] the *spiritus lapidiscus*... [it] hardens.⁵⁵

Thus, this experiment of mixing colors is to show that these colors are produced naturally through the combinations of salts and sulphurs in the heat of the earth, a process that can be duplicated by experimentation. He concluded with the following statement: “Hence it is clear also in what way, from a diverse concoction of sulpher mixed with various salts, various and very diverse colors also could emerge according to the degrees proposed here, and it was more than enough evident from the experiments adduced.”⁵⁶ These experiments represent the microcosm of Kircher’s geocosm and represent what actually happens in the earth.

Kircher’s conclusions come under a sub-section titled *Experimentum*. First, he described how colors can mix to create others as demonstrated on a chart. For example, red and yellow

⁵⁴ For example, he explains that when white and yellow mix, one gets “whiteish” (*Subalbius*); red and blue create purple; white and black create gray; blue and black create “blueish” (*Subcoeruleus*); and yellow and red create golden. Kircher, *Mundus Subterraneus*, VIII, p. 14.

⁵⁵ *Dico itaque, cum pleraque saxa & lapides suo constant sulphure & salibus, sit, ut si spiritus minerales salium igne subterraneo in vaporem aut exhalationem exaltati, ob eorundem summam subtilitatem intimas montium rimas venasque penetrant... volatili fixove sulphure, quod illi materiae in est, junctam, tunc illa pro varietate tingentis spiritus, nunc in hunc, nunc in alium colorem convertitur, quam postea superveniens lapidiscus spiritus five succus in saxosam tandem substantiam indurat.* Kircher, *Mundus Subterraneus*, VIII, p. 13–14.

⁵⁶ *“Hinc patet quoque, quomodo ex varia sulphuris variis salibus mixtis concoctione, varii quoque diversissimique colores juxta gradus hic propositos emergant, & experimentis adductis sat superque patuit.”* Kircher, *Mundus Subterraneus*, VIII:, p. 14–15.

made a golden color, yellow and blue make green, and a red glass and blue glass laid on top of each other will make a purple tint.⁵⁷ Kircher concluded this chapter with specific tincture combinations that make different types of gems. Carbuncles and other red gems are influenced with “ammoniac salt and the most flawless sulphur” which creates the most red of reds.⁵⁸ Emeralds are created from a mixing of yellow and blue, and thus green is created from a tincture of salt and sulphur.⁵⁹ He finished with the statement: “So it is clear that in the precious stones, the colors are not so much apparent, but are true and real and have arisen from a true and real tincture.”⁶⁰ He thus claims that the colors of gems are based in the material composition rather than merely perceived, created through cognition. Kircher then proceeded on to the next section which uses the same chemicals and elemental theory to discuss the creation of possible shapes of gems.

Chapter six continues the focus on colors and includes more theories and experiments. Looking at this chapter, titled “Concerning colors that they call apparent,” the first thing that catches the reader’s eye is the image of the *trigonum crystallinum* and the labeling of the sun’s rays going through the crystal. Kircher spent most of the theory section explaining how clear sun rays create colors on the other side. Again, there is nothing particularly new about the investigation of the different colors that can be created by a prism, but it is simply part of the

⁵⁷ Kircher, *Mundus Subterraneus*, VIII, p. 15. The chart is found on page 14.

⁵⁸ “*Carbunculus ammoniaco sale, sulphure maxime defaecato decoctoquo tinctus ruberrimo colore rutilat.*” Kircher, *Mundus Subterraneus*, VIII, p. 15.

⁵⁹ “*Smaragdus ex flavi & coerulei coloris mistura resultans virore nitidissimo splendescit; qualia itaque fuerint salina tingentia sulphuri adjuncta, talis erit gemma, quae inde lapidescit, de quibus postea.*” Kircher, *Mundus Subterraneus*, VIII, p. 15. His commentary on sapphires is somewhat inconclusive. First he states that they are “inspired by the splashing of salt-sulphur” and then later that they can be created from a “tincture of vitriol containing copper of the most heavenly blue color dye.” (Kircher, *Mundus Subterraneus*, VIII, p. 15).

⁶⁰ “*Patet itaque in gemmis colores non apparentes tantum esse, sed veros & reales ex vera & reali tinctura ortos.*” Kircher, *Mundus Subterraneus*, VIII, p. 15.

encyclopedic function of the *Mundus*.⁶¹ He then used the rest of the chapter to describe four experiments. The first explores how colors change through a spherical object, such as a glass ball; another diagram is provided to show the geometry of light refractions and colors that the eye can see.⁶² The second experiment examines the color of flames when types of oils are thrown in the fire.⁶³ The third experiment focuses on the colors of metals. Kircher showed here that one can change the color of different metals depending on what chemical one uses. For example, to change the color of lead from black to white, pound together the dust of white arsenic, lime tartar, salt of gems and ammoniac, then put it over the casted lead; this should turn it white.⁶⁴ His reasoning for the colors changes in the metals is as follows: “If you seek the reason for this wonderful metamorphosis, I say these changes originate from the refraction of the light within, whence all the colors are generated.”⁶⁵ Thus including the experiment on the color of metals fits within this section on refractions of light. The final experiment is on the tincture of colors in vegetables, which fits in this chapter due to the color of the juices (*succi* - the same word he uses to label the petrifying juice that creates fossils) from the vegetables.⁶⁶

The seventh chapter further discussed transparency, and focused on the diamond. As suggested by the title (the cause and origin of transparent stones and gems, specifically of crystals and diamonds), the first half of the chapter examined crystals (quartz) and their locations and chemical origins. First, Kircher listed the geographical locations where crystals can be found such as “various locations in Europe,” Africa, America, the Andes in Chile, and India. In

⁶¹ Kircher, *Mundus Subterraneus*, VIII, p. 15—17.

⁶² Kircher, *Mundus Subterraneus*, VIII, p. 17—18 (18 for the image).

⁶³ Kircher, *Mundus Subterraneus*, VIII, p. 18. Here he gives the example of the flame changing from red to blue if sulphur is added to cinnabar.

⁶⁴ Kircher, *Mundus Subterraneus*, VIII, p. 18.

⁶⁵ Kircher, *Mundus Subterraneus*, VIII, p. 19.

⁶⁶ Kircher, *Mundus Subterraneus*, VIII, p. 19.

these locations, diamonds are made in mountains where they receive heat from the earth and the vapor of salt.⁶⁷ Next, Kircher argued that “it is evident that crystals are composed of salt” (*Experimentum- Crystallus ex sale constat*). Before focusing on diamonds in this sub-section, he explained that if one distills the sulphur and saline from crystal that has been pounded into a fine powder, one is left with a “dazzling” or “fair white” salt (*instar candidissimi salis*).⁶⁸

For the rest of the chapter, Kircher focused on the diamond, examining several different aspects of this gem. He called it the “King of Gems,” because of its history as a favorite of royalty, but also due to its hardness and transparency. He cited Pliny concerning its hardness and strength and de Boodt concerning its supernatural uses and also briefly discussed where it can be found (not just India and the Orient, but Bohemia and Hungary as well). Next he compared what he dubbed as “stupid philosophers” (*stupidi philosophastri*) have said about the origins of the diamond to the “real and genuine causes” of the birth of diamonds.⁶⁹ He concluded the section by comparing diamonds from Central Europe with those of India, arguing that the Central European diamonds have flaws compared to diamonds from India; but those that are still interested in the virtues of diamonds (and other stones) should read on.

⁶⁷ Kircher, *Mundus Subterraneus*, VIII, p. 19–20. “In the mountains, where the purity of salt is hidden inside the hollow of the mountains, as an underground heat, the vapor of the Salina salt, and from all other parts of the purified thick raised, that in the interior...” (*In montibus itaque, ubi plurimum purgatissimi salis intra concava montium latet, sit ut calore subterraneo agente, alia salina corpora per vaporem salinum, & ab omnibus aliis grossioribus partibus purgatissimum eleventur, qui per intimas, uti dixi...*) p. 20.

⁶⁸ “...deinde exemptum distilla, distillatione peracta, corpora salina separata, & frigore denuo condensata, in fundo recipientis, instar candidissimi salis reperies...” (Then distill what has been removed, and when the distillation is completed, and the saline bodies are separated and again condensed by the cold, you will find something resembling a very bright white salt, in the bottom of the receiver.) Kircher, *Mundus Subterraneus*, VIII, p. 20. He also added a short description of how colored gems are made in the same way emphasizing specifically beryl and topaz and their yellow-ish colors.

⁶⁹ The argument is basically focused on locations of where diamonds can be generated; he is arguing that diamonds can be produced anywhere in a natural hot place (*humido loci naturali*). (Kircher, *Mundus Subterraneus*, VIII, p. 21).

Chapters 8 and 9, though larger and full of interesting pictures of stones with images and different shapes, do not focus on gems.⁷⁰ Chapter 8 does include a section on the shapes of gems, but for the most part the chapter is focused on stones with lines and eggs with symbols on them. Chapter 9 (on Examples of Stones with Images Drawn on them by Nature) is the longest chapter of Book VIII, with several images of stones and fossils from many different collections that Kircher cites. This chapter does not seem to include gems except for a small section on crystals (which was repeated from earlier), so it will not be included in this survey of gems in the *Mundus*.⁷¹

The only images of gems found in Book VIII (besides the prism diagram from chapter six) are found in chapter eight in the short sub-section on the generation of polygonal gems (*De Polygonarum gemmarum genesis*, see Figure 3). Here the reader is provided detailed images of “Pseudo-crystals,” topaz, amethyst, beryl and a beautiful example of crystal taken from the Museum of Anidori.⁷²

⁷⁰ For more information on these two chapters (especially on fossils), see Gould, “Father Athanasius on the Isthmus of a Middle State,” pp. 207–237. For a description of Kircher’s theories on images on stones, see Godwin, *Athanasius Kircher’s Theatre of the World*, pp. 147-50. One example of a secondary source looking at images in stones during this period is David Jaffé’s “Aspects of Gem Collecting in the Early Seventeenth Century, Nicholas-Claude Peiresc and Lelio Pasqualini,” *The Burlington Magazine*, 135, no. 1079 (Feb., 1993), pp. 103–120.

⁷¹ The section on crystals is repetitive from earlier passages (chapter 7). There is also a section on colors which is a summary of what has already been discussed in chapter 5. Kircher, *Mundus Subterraneus*, VIII, pp. 43, 46.

⁷² Kircher, *Mundus Subterraneus*, VIII, p. 25.

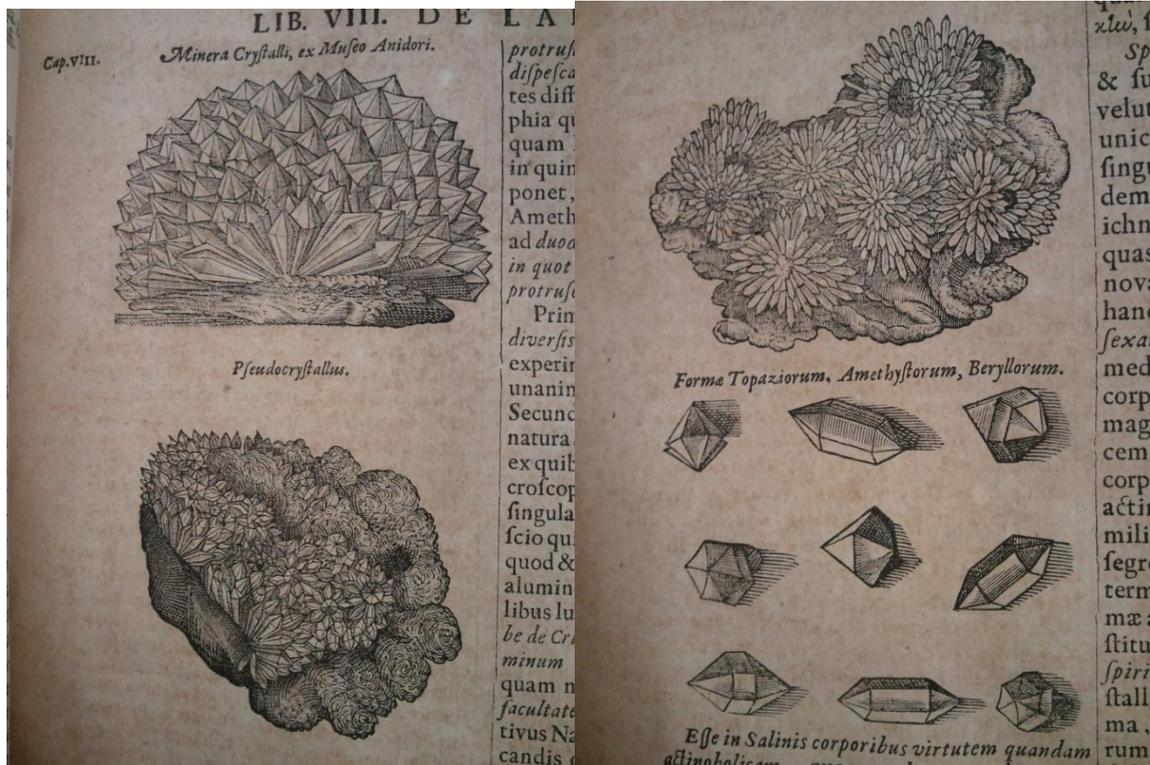


Figure 3: Kircher, *Mundus Subterraneus*, VIII, p. 25. Top left- a crystal from the museum of Anidori, left bottom and top right- “pseudo-crystals,” right bottom- examples of different shapes of topaz, amethyst, and beryl. Interestingly enough, these images appear in de Boodt as well (pages 217–8).

In this section, Kircher returned to his primary thesis that the combination of salt and heat are what make up different colors and shapes, listing specific transparent and semi-transparent gems with their associated colors.⁷³ In terms of the shapes of gems, he referred to the last image (the bottom right one above) stating that gems not only appear triangular, but may also be tetrahedrons, and most of them appear as hexagonal and topaz in particular can appear as a

⁷³ A yellow tincture with salt makes topaz, blue makes sapphire, red for carbuncles, green for emeralds. After listing these types, he again states that diamond is the combination of all colors and that it is the hardest stone. (Kircher, *Mundus Subterraneus*, VIII, p. 24).

dodecahedron.⁷⁴ Not surprisingly, following his earlier observations, he claims the shapes made are due to the *spiritus salis*:

“There is in saline bodies a certain actinobolic virtue, which we call radiative, as many years of experiment have taught us. This force consists in the spirit secreted in the body of salt, which of itself, its own nature and natural appetite, proceeds from the centre to the circumference, and gradually divides by corpuscular protrusion into rays. Thus if the diameter is divided into four parts, that will be the basis and as it were the map upon which the gem is drawn, when nature wishes it to be of a square figure," if, in five, pentagonal shape will be made, if in six, hexagonal, proper to amethysts and crystals, and for the others up to twelve [sides]; The saline spirit will constitute a shape with as many sides as it will send forth its corpuscles in as many rays.⁷⁵

Thus, according to Kircher, salt combinations are what caused gems to have different shapes, especially polygonal ones. This is the last claim Kircher offered concerning experiments and theories surrounding the science of gems. He then continued on to other sections which look at the transformation of juices, herbs, plants, animals, and humans into petrified stones.

At the end of section 3, however, he returned to gems: he dedicated a few pages to a long table of several gems along with their properties and virtues (this chart will be fully discussed in the second half of this paper). It is of interest to point out that for the diamond at least, it is clear that Kircher does not believe in the more “supernatural” virtues of the diamond, with his statement “but in vain” This is another example of how Kircher wishes his book to be an

⁷⁴ “...non-nullae triquetrae; quaedam tetraedrae, pleraeque, potissimum crystalli, hexaediae; in topaziis subinde quoque dodecaedrae inveniuntur.” Kircher, *Mundus Subterraneus*, VIII, p. 24.

⁷⁵ Kircher, *Mundus Subterraneus*, VIII, p. 25. “... crystallis & Amethystis propriam; Figuram tot lateribus constituet in quot radios spiritus salinus corpuscula sua protuserit.” The first part of the quotation is taken from Godwin, *Athanasius Kircher’s Theatre of the World*, p. 147. Godwin commentates on his crystallography: Crystallography had not yet graduated from the *Kunstammer* to the status of a science when Kircher felt obliged to offer a theory of it. As a mathematician, he was intrigued by the regular polygons and other geometric forms displayed by crystals, but lacking a molecular concept of matter, he could not explain the phenomenon without resort to ‘virtues’, ‘spirits’ and the ‘appetites’ of nature...”

encyclopedia of sorts, providing readers with all the possible information on gems that he can provide, even if it means adding “superstitious” views that he does not support.⁷⁶

Following this chart, he also included a list of gems and stones with their Greek names followed by a brief passage on the twelve stones of the Bible. As Kircher noted, these stones have been interpreted differently depending on the source, but Kircher included the names of them from each source in Hebrew, Latin, Greek, and Arabic.⁷⁷ Kircher further included a chart with explanation of the association between the stones and the Tribe of Israel they represent. This section overall does not seem to fit in Book VIII, but rather it is included in an encyclopedic fashion for convenience for the reader. Kircher’s geocosm, and thus his *Mundus* included everything connected to the Earth; so by including gems, Kircher needed to include popular stories and ideas about gems in his book.

VI. Book XII: Creating Gems

Book XII looks at several different topics, of which gems are only a small fraction. Kircher presents a table that shows how different substances of the four elements (fire, air, water, and earth) are used in medicine. Gems are categorized under earth, along with pearls, plants, and other earthy substances. Kircher’s discussion adds little to the information on the chart.⁷⁸ Here he offers only a clear and rather short description of gems.

⁷⁶ Kircher lists the more specific supernatural views of the gems, and uses the term “superstitious” (*superstitiosus*) in chapter seven where he looks specifically at the diamond. See Kircher, *Mundus Subterraneus*: VIII, p. 20-21.

⁷⁷ These stones (Latin/according to the Rabbis- as listed by Kircher) are: Sarius/Carnelian, Topaz, Emerald, Carbuncle, Sapphire, Jasper/diamond, Ligurion/Turchesia, Achates/Hyacinth, Amethyst/Onyx, Chrysolithus, Onyx/Smaraldus, and Beryllus/Jasper. (Kircher, *Mundus Subterraneus*, VIII, p. 90.

⁷⁸ See Kircher, *Mundus Subterraneus*, XII, pp. 419 (chart) and 420—1 (discussion).

The second appearance gems make in Book XII is further back, in chapters II-IV of section three. Chapter II, titled *De Artificiosa gemmarum lapidumque pretiosorum confectio* (Concerning artificial preparation of gems and precious stones) is an introduction to a section in which Kircher offered to show the reader how to create artificial gems such as the sapphire, emerald, amethyst, hyacinth, carbuncle and topaz from enameled material alone.⁷⁹ In these chapters, Kircher included many authorities on gem and enamel making such as de Boodt, Giovanni Battista Della Porta, Isaac Holland, Alexius Pedemontanus (Alisso Piemontese,) and Girolamo Cardano.⁸⁰ Kircher's discussion of gem making helps identify his sources, but I also argue that as in Book VIII, Kircher mainly used these previous sources in order to summarize the art of gem making from the words of the authorities to support the authenticity of the *Mundus* as a whole.

Chapter III (*Quomodo gemmae ex Smalto seu Encausio confici possint*- "How gems from enamel or *encausium* can be created") describes enamels of different colors and metals. First Kircher briefly discussed how specific chemicals create different colors of enamels. This is done by putting the chemical in a furnace; for example, Kircher claimed that to get a blue or turquoise colored enamel, one should add silver to sulphur and put it in the furnace for twenty-four hours

⁷⁹ *Dico itaque primo quomodo ex sola smaltea materia sapphiri, smaragdi, amethysti, hyacinthi, carbunculi, topazii, & similes pretiosae gemmae ad vivum elaborari possint; Et ne hoc loco avaritiae labe depravatis hominibus imposturae detur occasio, simul addemus modum, qua qua ratione adulteria gemmarum facili negotio cognosci queant.* Kircher, *Mundus Subterraneus*, XII, p. 474.

⁸⁰ Interestingly enough, these men are all men of "secrets." Alexis of Piedmont published *Secreti del reverend donna Alessio piemontese*, which included hundreds of recipes, both medical and magical. Isaac Holland was a name that most likely was used as a pseudonym, but later authors used his recipes and secrets nonetheless. Della Porta's *Magia naturalis (Natural Magick)*, later published in English in 1658) published secrets on creating gems, but also included topics such as technological inventions, recipes, and more. Cardano is best known for his works on mathematics, but it is probably his *De secretis* (1562) that was used by Kircher; this book "was essentially an attempt to construct a taxonomy of various kinds of secrets and to the methods by which they are discovered." William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture*, Princeton: Princeton University Press, 1994, p. 278. Also see Eamon's chapter on "The Professors of Secrets and Their Books" (pp. 134—167) for more information on Alexis and Della Porta.

until the matter becomes crystal-clear.⁸¹ Kircher was very brief in listing these instructions for making the enamels, perhaps showing that he copied them from elsewhere. Della Porta's *Natural Magick* listed similar instructions, but in more detail.⁸² Though Kircher did not name Della Porta as a source in this section, it is possible that he took his information from the *Natural Magick*, or from another source that cited Della Porta (possibly through de Boodt?).⁸³ It is also likely that Kircher included only a summary of enamel making in order for the procedures to be part of his encyclopedia of the geocosm in which both natural and man-made projects were discussed.

Chapter IV is lengthier and is mostly compiled of several "experiments" and "propositions" (similar to Book VIII).⁸⁴ From a first glance, it seems that Kircher took much of his experiments and information from other authorities. De Boodt is referenced several times and Kircher took sections from the *Historia* when describing foils for the setting of gems.⁸⁵ He also copied instructions on how to make fake sapphires from de Boodt.⁸⁶ Della Porta's *Natural*

⁸¹ ...*si addiditis argentum istum cum sulphure, coeruleum Turquinum effeceris*. Earlier, he stated that it takes twenty-four hours for hot material from the furnace to be purified (*donec 24 horis materia fervens purgatissima & limpidissima fiat*), but it is unclear whether these are instructions for making the enamels that he listed later on the page. Kircher, *Mundus Subterraneus*, XII, p. 475.

⁸² Giambattista Della Porta, (*Natural Magick*, London: Printed for J. wright, 1669), pp. 182—186.

⁸³ De Boodt does not list Della Porta as an authority (See De Boodt, *Gemmarum et Lapidum Historia*, p. 10) but he does cite him several times in various chapters; see the general section on foils (see de Boodt, *Gemmarum et Lapidum Historia*, 83—84) or concerning colors and tinctures (de Boodt, *Gemmarum et Lapidum Historia*, pp. 66—71).

⁸⁴ This chapter is titled: *De fucata lapidum gemmarumque compositione, partim proprio experiment, partim peritissimorum scriptorium auctoritate & amicorum communicatione comprobata*. Kircher, *Mundus Subterraneus*, XII, p. 478.

⁸⁵ See Kircher, *Mundus Subterraneus*, XII, p. 480. Kircher stated that he took instructions on making *bractum* (metal leaves for the setting of gems) from de Boodt, but de Boodt stated that he took his information from Della Porta (de Boodt, *Gemmarum et Lapidum Historia*, pp. 73-4). To compare, in the English version of the *Natural Magick*, Della Porta gives instructions on *bractum* in Book six, chapters ten and eleven. Della Porta, *Natural Magick*, pp. 186—8.

⁸⁶ Here Kircher (from de Boodt) tells the reader to use blue glass and cast it into fire with two drachmas worth of zaffer (a mixture of cobalt sulfide) using an iron hook. If done correctly with the right heat and timing, a blue glass that appears to be like a sapphire will be created. (*Solet Sapphirus vitro coeruleo inter duos Bohemicos Adamantes glutinato, egregie adulterari. Alii ex vitro massam coeruleam in igne conflant,*

Magick is also used in writing this chapter; Kircher used Porta to discuss how to make fake pearls, opals, and topaz.⁸⁷ Cardano is also referenced numerous times in instructions for imitating emeralds and turquois.⁸⁸ However, it seems that Kircher may have copied the instructions for creating rubies, emeralds and topaz directly from de Boodt.⁸⁹ In fact, when it

eamque expoliri jubent, indurant, & imperitis pro Sapphiro venditant. Solet id artificium variis modis perfici; Plerumque in massam vitream ex crystallo aut filicibus paratam, momentum Zapharae injicitur, videlicet drachmae duae ad libram unam, ac movetur massa igne candens, quam optime ferreo unco; Deinde exempta particula exploratur, num plus Zapharae aut massae addendum fit, si justa mensura apparuerit, per fex horas effervesce finitur, postea eximitur, ac Sapphirum referens massa perito sculptori sculpenda ac expolienda traditur. Sirite massa facta fuerit, vix a vero Sapphiro distingui pseudo-Sapphirus poterit. Qui fictitii sunt, plerumque bullulas seu atomos in corpore habent, qui propter ignem non aequaliter in massam agentem proveniunt. Ita Boet.) It is interesting to note that he actually names de Boodt as its author, but as will be shown, he does not for many other recipes. Kircher, *Mundus Subterraneus*, XII: 481 and de Boodt, *Gemmarum et Lapidum Historia*, p. 190.

⁸⁷ For the pearl, see Kircher, *Mundus Subterraneus*, XII, p. 481; Kircher directly quotes Della Porta, but I could not find where in the *Natural Magick* he does so (Kircher takes the first part of his text from de Boodt, who also used Della Porta, de Boodt, *Gemmarum et Lapidum Historia*, p. 181). For opals, see Kircher, *Mundus Subterraneus*, XII, p. 481 (again, I could not locate where Della Porta discussed opals, but de Boodt also used him when discussing imitating opals- de Boodt, *Gemmarum et Lapidum Historia*, 194. His wording is almost identical to Kircher's). For the topaz, see Kircher, *Mundus Subterraneus*, XII: 482. In the *Natural Magick*, Della Porta stated that to counterfeit a topaz, "Put your material into a pot, and cover it with a lid full of holes. Over which there must be laid another, that it may exhale, and yet receive not hurt from the smoke. Let it stand in its Furnace to the middle of the space of a whole day, and it will be a Topaz." (Della Porta, *Natural Magick*, p. 183). On the previous page, Della Porta included a general note for making all gems: The manner which I have set down, is peculiar and usual to our artificers, and by them is also accounted a secret. But I will set down another way, which I had determined always to keep secret to myself. For by it are made with less charge, less time, and less labor, much more refulgent, bright, and livelier gems. Whose surfaces and luster, the Salt shall not deface in a much longer time... Take the comb of a Cock, and cutting his gullet in two, keep the head and neck. Put it into a pot, and set it in a hard fire. Stop it close that no coals or ashes arising with the smoke, or soot, fall in, and spoil the luster of it. When the fire is kindled, you will hear it hiss. When it is red hot, take it up with Iron tongs, and quench it in clear water, and dry it. Do this three times, changing the water, lest there be any filth. Then grind it on a Marble till it be so fine that you may blow it about, and reserve it for use." (Della Porta, *Natural Magick*: 182). Kircher summarized Della Porta's "lengthy" instructions by saying: "Topaz emerges without any addition if lead is added three times to the calcinated crystal, and if it kept in the furnace for a day." (*Si crystallo calcinato triplum plumbi addatur, Topazius absque aliqua adjunctione emergit, si per diem in fornace moretur*).

⁸⁸ See Kircher, *Mundus Subterraneus*, XII, p. 483 for turquois.

⁸⁹ Kircher, *Mundus Subterraneus*, XII, pp. 480 (rubies), 481 (emeralds) and 482 (Topaz). To compare, see de Boodt, *Gemmarum et Lapidum Historia*, pp. 181 (rubies) 203 (emeralds) and 213 (topaz). Outside of some grammatical and mechanical differences, Kircher's text on emeralds is exactly the same as de Boodt's. However, since de Boodt also used Cardano, it is possible they both copied from him (though de Boodt only names Garcias ab Horto as his source for making emeralds, and for Topaz, he names Della Porta).

comes to the composition of the Beryl, Kircher and de Boodt's texts are almost identical.⁹⁰ Some of the experiments first included here make it into Kircher's later work, the *Physiologia* (1680) including the experiments on creating tinctures for rubies, sapphires, emeralds, and lapis-lazuli.⁹¹

It is clear from these examples and portions of the text that Kircher copied (often almost word for word) from other lapidaries and texts. De Boodt again seems to be his primary source, but both de Boodt and Kircher obviously read Della Porta's *Natural Magick*. Kircher did not seem to include many of his own, original theories about imitating gems when compared to his ideas in Book VIII, but I believe this is due to the encyclopedic nature of the *Mundus*; he wanted to include everything he could on the geocosm and on gems, so he relied on the expertise of others in order for his information to be correct, concise, and comprehensive.

VII. Reception of the Mundus

The *Mundus* as a whole received various critiques and responses. On one hand, since one of the purposes of the book was to present the audience with experiments they could perform to understand Kircher's theories, many critiques were about the experiments themselves. For example, Henry Oldenburg (1619–1677) of the Royal Society stated that the “very first Experiment singled out by us out of Kircher” failed, “and yet 'tis likely the next will doe so too.”⁹² Other natural philosophers such as Leibniz and Descartes portrayed him as a

⁹⁰ Kircher, *Mundus Subterraneus*, XII, p. 482 and de Boodt, *Gemmarum et Lapidum Historia*, p. 216.

⁹¹ Kircher, *Mundus Subterraneus*, XII, pp. 485-6 and Athanasius Kircher, *Physiologia Kircheriana Experimentalis*, (Amstelodami, Ex officinâ Janssonio-Waesbergiana, 1680), pp. 67—9.

⁹² Findlen, *Possessing Nature*, p. 237. Previously, Oldenburg found the book to be of interest. He stated: “I have turned over part of Kircher's *Subterranean World*, and all his arguments and theories are no credit to his wit, yet the observations and experiments there presented to us speak well for the author's

charlatan when it came to his experiments.⁹³ The Royal Society did not accept them as legitimate experiments on natural phenomena; however, they did accept the book as a resource of rich information that could be used to further expand other's research interests.⁹⁴

John Webster (1610–1682), an English clergymen and physician stated the following on the *Mundus* in general:

Athanasius Kircher, the universal scribbler and rhapsodist, who after a great many huge and barren volumes did promise the world a work by him styled *Mundus Subterraneus* which put all the learned into great expectations of some worthy and solid pieces of mineral knowledge. But alas! When it appeared, every reader may soon be satisfied that there is but very little in it except the title that doth answer such conceived expectations or fulfill such great promise.⁹⁵

Not everyone was disappointed by the *Mundus*; Gabriel Clauder, a physician, anticipated refuting Kircher's ideas on alchemy, but instead was impressed. He stated: "Not our Europe only but the whole world knows how much light he has shed by his laborious dexterity and rare keenness of genius in this current age on many sciences' but especially by his *Mundus Subterraneus*."⁹⁶ Johannes Kestler, who wrote the preface for one of Kircher's later books, called Kircher "the prodigious miracle of our age who has excited the admiration of the whole world by the innumerable experiments on which he has based his universal sciences."⁹⁷

Despite the mixed reviews of the *Mundus*, Kircher's goal for the book was to create a *major opus* dedicated to the geocosm. Everything he found suitable that was part of the

diligence and for his wish to stand high in the opinion of philosophers." (Findlen, "The Last Man Who Knew Everything... or Did He?," p. 37).

⁹³ Findlen, "The Last Man Who Knew Everything... or Did He?," pp. 7, 22-3. Findlen further notes that Descartes in particular did not care for Jesuits and their science.

⁹⁴ Findlen, "The Last Man Who Knew Everything... or Did He?," p. 23.

⁹⁵ Thorndike, Vol. VII, p. 568.

⁹⁶ Thorndike, Vol. VII, p. 568-9.

⁹⁷ Thorndike, Vol. VII, p. 569.

material, corrupted creation of God was placed in this book; showing his vast knowledge of many topics that could only be done in an encyclopedic fashion such as this. Even if his experiments did not receive honors from the Royal Society, they were only part of this grand work. By modern standards, Kircher was overly ambitious to attempt to try to understand everything, yet as Findlen states, he “was the pinnacle of the renewed optimism in encyclopedism that characterized late Renaissance and Baroque collectors.”⁹⁸ Historians should not attempt to look at his mistakes, but rather look at him within his context of the seventeenth century and the role he played in creating interest in the sciences.⁹⁹

⁹⁸ Findlen, *Possessing Nature*, pp. 92-93.

⁹⁹ Paula Findlen further looks at this point in her introductory essay. Findlen, “The Last Man Who Knew Everything... Or Did He?,” pp. 41-43.

Medicinal Gems of the Mundus Subterraneus and Kircher's Authorities

In Kircher's *Mundus Subterraneus*, the discussion of the medicinal uses of gems appears at the end of Book VIII (pages 83-87). The purpose of the following discussion is to assess how Kircher discussed the medical uses of gems in this chart. Then Kircher will be put into a larger context: how did other lapidaries discuss medicinal uses? Also by looking at the diseases that the gems "are able" to treat, one can also place gems in general in a larger context and also identify what illnesses people were concerned with in the early modern period.

I. The Lack of Virtues: Kircher's Treatment of Medicinal Gems

The *Tabula Combinatoria* lists seventy gems and stones (and other minerals) in alphabetical order, beginning with the diamond (*adamas*) and concluding with turquoise (*Turcois, turchesia*). Most of the minerals listed are not gems, but are rather other earthly minerals such as geodes, marbles, the dragon stone (*dracontias*), and magnets (*magnes*). Kircher included information on each individual substance into two columns: Forms, Color, and Natural Location; and Virtues and Properties. The first column includes information on the physical aspects as well as sometimes giving geographical locations where one can find the material. The second column contains brief descriptions of medical and nonmedical uses and virtues of the object. For example, the first gem, the diamond is presented as seen below:

Name	Form, Color, Natural Locations	Virtues and Properties
Diamond	The best of all gems, indomitable hardness; transparent; In India it grows clear and genuine.	When taken internally, it is a poison, on account of its caustic power; When carried, it is said to be a gem of reconciliation, courage and firmness, but wrongly, as we have said elsewhere. ¹⁰⁰

Kircher made special note of the diamond; its “indomitable hardness” and transparency make it the “King of all Gems.” Earlier in his text, he dedicated an entire chapter to diamonds and quartz where he gave more details on the properties of the transparent gems (chapter seven: the cause and origin of transparent gems).¹⁰¹ In the first third of the chapter, he focused on the quartz, spending much time listing and describing the multiple geographical locations where it can be found (it is a fairly common stone). The last part of the chapter turns to the diamond, where Kircher describes why he claims the diamond is the “King of Gems” (again, due to its transparent nature and hardness). These properties of the diamond are reasons royalty has chosen this gem as a reflection of their power and “indomitable” strength.¹⁰² Kircher briefly mentions that there are supernatural stories surrounding the diamond that involve demons. These stories are based on other writers; specifically he named Marbode, who mentioned some of these virtues in his *De Lapidibus*.¹⁰³ By stating “...so I did not want to dwell on them at this

¹⁰⁰ *Omnium gemmarum praestantissimus; duritiei indomabilis, diaphanous; In India crescit verus & genuinus. Introsumptus venenum est, ob causticam vim; portatus dicitur gemma reconciliationis, fortitudinis & constantiae, sed perperam, uti alias diximus.* Athanasius Kircher, *Mundus Subterraneus*, VIII, p. 83.

¹⁰¹ Kircher categorizes “quartz” (*crystallus*) along with amethyst and topaz separately from the rest of the gems on his second chart (p. 4), due to their size alone. Most other authorities still categorize them as gems (with the exception of quartz), so they will still be part of this discussion on gems. Kircher, *Mundus Subterraneus*, p. 4.

¹⁰² Kircher, *Mundus Subterraneus*, VIII, p. 20.

¹⁰³ Marbode states: “In magic rites employed, a potent charm,/ With force invincible it nerves the arm:/ Its power will chase far from thy sleeping head/ The dream illusive and goblin dread...” He then continues

point” at the end of this brief section, the reader might see that Kircher is not interested in the supernatural virtues of the diamond. Here he does not state anything about the medical uses of the gem.¹⁰⁴

Kircher did not give this much attention to any other gem, most likely due to the fact that the diamond has properties the other gems lack (at least, according to Kircher). To find the medical virtues associated with rubies, sapphires, and emeralds, one has to suffice with the table at the end of section 1. Below is a table that I have constructed from Kircher’s chart with the gems (in their order) and their medical/supernatural properties as they appear in the chart.

Gem	Virtues and Properties
Amethyst	“Is thought to resist intoxication, from which it derives its name; the superstitious also think [it] bestows intellect and grace to leaders.” ¹⁰⁵
Beryl	“When reduced to powder in rose water or lilac water, it is said to heal the eyes especially, [it] corrects liver damage. The superstitious hold that it reconciles minds.” ¹⁰⁶
Carbuncle, bronze, ruby	“It opposes poisons, suppresses lust; cheers the soul; provokes anger; lessens sleep; and is reported to change color when misfortune is at hand.” ¹⁰⁷

to talk about medical uses for the diamond, which will be discussed later. Marbode of Rennes, *De Lapidibus*. Ed. John M. Riddle. Trans. C.W. King, (Wiesbaden: Franz Steiner Verlag GmbH, 1977), pp. 35—6.

¹⁰⁴ Kircher, *Mundus Subterraneus*, VIII, p. 21. The entire section states: *Quae vero de stupendis ejus virtutibus narrant scriptores, pleraque falisissima comperta sunt; uti sunt, dum conjuges diffidentes in concordiam revocare, fascinationes & incantationes tollere daemonumque insultus reprimere fertur: sed hae facultates uti natura superiores sunt, ita quoque, quae ab humana voluntate & proprio arbitrio dependent, utpote supranaturales, similes longe remotos effectus producere non potest; neque quicquam virtutis daemonibus incorporeis ad eorundem dispulsionem imprimere potest; praesertim si superstitiones accedant, uti Marbodeus docet, qui putat inaestimabiles eum vires acquirere, si sub tali aut tali Adscendente, talis aut ei figura insculpta fuerit: Verum cum hujusmodi maleficatorum hominum deliria jam multis in meis operibus, argumentis confutaverim, ita iis hoc loco immorari nolui.* Kircher finishes off the chapter by talking about the locations where diamonds can be found, those being Malacca, Nova Batavia, India (the region of Bisnaga) and central Europe (Hungary and Bohemia).

¹⁰⁵ *Ebrietati putatur resistere, a qua & nomen sortitur; Superstitiosi quoque eum ingenium Principumque gratiam conferre putant.* Kircher, *Mundus Subterraneus*, VIII, p. 83.

¹⁰⁶ *Oculis potissimum mederi dicitur pulvis aqua rosacea aut liliacea subactus, Vitia hepatis corrigit. Superstitiosi, animos conciliare perhibent.* Kircher, *Mundus Subterraneus*, VIII, p. 84.

Garnet	"It works by a power for drying, it strengthens the heart; [garnets] enter into the mixture of the elixir of life, and the composition of the hyacinth." ¹⁰⁸
Hyacinth	"It opposes the plague by giving strength to the heart; induces sleep; [and] is said to bring liveliness to the mind." ¹⁰⁹
Ruby	"Helps expel poisons; a noble antidote." ¹¹⁰
Sapphire	"Remedy for the heart; it is said to become dirty when carried by impure men and those given to luxury. Opposes poisons." ¹¹¹
<i>Smaragdus</i> [Emerald]	"Opposes poisons; cures diarrhea, and all blood flows; helps epileptics." ¹¹²
Topaz	"Useful for melancholy, epilepsy, and flowing of blood." ¹¹³

Without going into too much detail, some clarifications need to be added. Beginning with the amethyst, Kircher identified its medical property as offering those who drink a way to prevent intoxication. This was a common claim amongst lapidaries, due to the fact that the word "amethyst" which comes from the Greek word ἀμθύειν, translates to "not (ἀ) to be drunk."¹¹⁴ The next gem listed was the beryl, a gem that can be multiple colors; but Kircher listed it as being greenish blue (*ex viridi coeruleum*). Also, when grounded up in rose water or lily water, beryl can be used to heal problems of the eyes. It can also help with liver problems.

¹⁰⁷ *Venenis resistit, libidinem coerces; animum exhilarat; ad iram concitat; somnum minuit; infortunio instante mutare colorem perhibetur.* Kircher, *Mundus Subterraneus*, VIII, p. 84.

¹⁰⁸ *Ex siccandi vi pollet, cor corroborat; intrant compositionem elixiris vitae, & confectionem hyacinthi.* Kircher, *Mundus Subterraneus*, VIII, p. 85.

¹⁰⁹ *Pesti resistit, robur cordi dando; somnum conciliat; alacritatem animi adferre dicitur.* Kircher, *Mundus Subterraneus*, VIII, p. 85.

¹¹⁰ *Venenis pellendis prodest, antidotum nobile.* Kircher, *Mundus Subterraneus*, VIII, p. 86.

¹¹¹ *Cardiacum remedium; dicitur sordescere ab homine impuro & luxuriae dedito portatus.* *Venenis resistit.* Kircher, *Mundus Subterraneus*, VIII, p. 86.

¹¹² *Venenis resistit; diarrhoeam sanat, & omnes sanguinis fluxus; Epilepticis prodest.* Kircher, *Mundus Subterraneus*, VIII, p. 86.

¹¹³ *Melancholiae, epilepsiae, sanguinis flucui prodest.* Kircher, *Mundus Subterraneus*, VIII, p. 87.

¹¹⁴ Georgius Agricola, *De Natura Fossilium*, p. 131. Agricola stated in detail that as far back as Pliny, authors have noted that "the ignorance of some learned men believed that it would prevent drunkenness." Kircher also clearly knows that an amethyst cannot prevent drunkenness.

Alphabetically, the next gem is the carbuncle, but Kircher combines this gem with bronze and ruby because of their similar physical natures (they are all bright red-colored, which often caused species confusion). Most of the medical aspects here are mental, basically causing the mind to stir and be excited, maybe in good (creating cheer) and bad ways (causing anger, causing the mind not to rest). Kircher also added that it can “resist poison” but did not include any details how this could be done. Next came the garnet (*granatus*), which is a darker, red gem. Kircher claimed the garnet could be used to make the elixir of life where he also referred to the hyacinth, the next gem. Hyacinths can generally be multiple colors, though for Kircher it is the red hyacinth with which he was concerned.¹¹⁵ For the last red gem, Kircher relisted the ruby, but gave it a very different medical property, namely, the ability to remove poison (a characteristic also attributed to the diamond). He did not include any instructions on how to apply the solution, only stating that it is a “noble antidote” perhaps referring to the fact that gems are expensive; only nobility or those with money could afford to use gems for medical purposes.

Next Kircher lists the *smaragdus*, the Latin word for “emerald.” By the time the *Mundus* was published, this identification may have been true, but in ancient, medieval, and some early modern lapidaries, *smaragdus* could have referred to any green stone (σμάραγδος, the Greek word, translates to “green stone”) such as green sapphire or green alabaster. Today the emerald is associated with a rich, dark green colored gem, but this was not true until after the early expeditions to South America.¹¹⁶ However, due to the flooding of these dark emeralds into the markets, or perhaps due to loyalty to the ancients, the American emeralds were worth half of

¹¹⁵ For example, Agricola claimed that the hyacinth was purple, similar to the amethyst. Agricola, *De Natura Fossilium*, p. 130–132.

¹¹⁶ For a very detailed and well written report on emeralds from the new world, the dangers of mining emeralds, and the release of emeralds into the market, see Kris Lane, *Colour of Paradise: The Emerald in the Age of the Gunpowder Empires* (New Haven: Yale University Press, 2010), especially: xii, 25–6.

the price of the “old world” emeralds despite their rich color.¹¹⁷ The last gem that is mentioned is the topaz, another gem that can be easily confused with other gems based on its color. Topaz can be blue, green, orange, yellow, or pink; but here Kircher seemed to be talking about an orange/yellow color because he compared it to “saffron water” in the physical description column.¹¹⁸ Due to its golden color, Kircher (and other authorities as will be shown) claimed it would help with Melancholy due to its likeness to the sun.

II. Kircher’s Influences: Other Authorities on Medicinal Gems

To be able to speak further on how gems were used medically in the Early Modern Period, one must go beyond Kircher’s *Mundus*. For the following survey, I focused on lapidaries that may have had an influence on Kircher’s account of gems. Before following the connections between the early modern lapidaries, I first will introduce each lapidary, then comment on how each suggested uses of gems in healing. I examined five such lapidaries. I began with an important source for many medieval and early modern lapidaries, that is, Marbode of Renne’s *De Lapidibus* (c. 1096).¹¹⁹ Jumping to the sixteenth century, I also included Agricola’s *De Natura*

¹¹⁷ Thomas Nicols and Robert Boyle state in their lapidaries the differences between the new and old world *smaragdos*: their “cloudiness” or “whiteness” causes them to not be as pure as a green sapphire might. John Sinkankas, *Emeralds and Other Beryls*, 33, 35-6. Thomas Nicols, *A Lapidary*, p. 95. Robert Boyle, *An Essay About the Origine and Virtues of Gems*, ed. George W. White, (New York: Hafner Publishing Company, 1972) p. 40. Despite the fact that emeralds from the new world made it to Europe within the first few years after Pizzaro first went to South America, they did not make it into the lapidaries until the beginning of the seventeenth century. They were mislabeled as Peruvian, but they actually came from Colombia. Later lapidaries, including the ones in the group I focus on, still label the new emeralds as “Peruvian,” the first being de Boodt’s, as well as Agricola’s and Nicols’. It is curious that Kircher does not include Peru as a source for *smaragdos*, or any other locations except Scythia (an ancient region of Eurasia). For more on the region of Scythia, see Saul B. Cohen, ed., *The Columbia Gazetteer of the World*. 2nd ed. (New York: Columbia University Press, 2008), vol. 3, p. 3489.

¹¹⁸ *Chrysolithorum Species est; aquam croco tinctam colore refert; ab Insula Topaza Maris rubri, in qua reperitur, sic dictus*. Kircher, *Mundus Subterraneus*, VIII: 87. For more on the “color change” topaz faced in the Middle Ages, see, D.B. Hoover, *Topaz* (Oxford: Butterworth-Heinemann, 1992), pp. 13—15.

¹¹⁹ For this source, I used an English translation with commentary; see Marbode, *De Lapidibus*.

Fossilium (1546) which has a chapter dedicated to the description of gems.¹²⁰ Continuing into the seventeenth century, Anselm de Boodt's *Gemmarum et Lapidum Historia* was published in 1609. Another influence on Kircher was Ulisse Aldrovandi's *Musaeum Metallicum*, which was published only two decades before the *Mundus* (1648). And lastly, I include the English lapidary published by Thomas Nicols in 1652 which also used de Boodt as a primary source.

Marbode (c. 1035-1123) wrote his *De Lapidibus* sometime before 1096 (but most likely after 1090) before becoming Bishop of Rennes.¹²¹ His lapidary was written more in the style of an epic poem rather than in the style of a scientific text- it consists of 732 lines (in Latin) describing sixty stones. Some stones are repeated or confused with others, as common with early lapidaries. The descriptions range from around twenty-five lines to only a few depending on the stone, and include details on descriptive properties, types (which often mention locations where they can be found), medical uses, and supernatural uses. As noted previously, Marbode's text was very influential for later lapidaries, including Kircher's.

Agricola (1494—1555) is perhaps best known for his work on mining (*De Re Metallica*, 1552), but his expertise is expanded with his publication, *De Natura Fossilium*. The latter book as a whole is focused on categorizing and describing minerals; gems are treated in Book VI. Agricola first wrote a general introduction to the classification of gems mainly by giving examples of what is and what is not considered a gem. In the bulk of his text, he described each gem by color, starting with the colorless (such as crystal and diamond) and then green, blue and purple, red, black, and the various color types (opals, jasper, agate, for example). He was focused on the descriptions and classification of gems from other stones and from each other,

¹²⁰ For this source, I used an English translation; see Agricola, *De Natura Fossilium*.

¹²¹ For more biographical information on Marbode, see Riddle's "Introduction" in Marbode, *De Lapidibus*, pp. 1—3.

but he also included some (but limited) detail on medical and supernatural uses, as well as geographical origins.

De Boodt's (c. 1550—1632) *Gemmarum et Lapidum Historia* has been named "the most important lapidary of the seventeenth century," so it only seems fitting to include his text in this group.¹²² Kircher only directly cites de Boodt a couple times in his "lapidary" but when comparing the charts at the beginning of Book VIII of the *Mundus* with the charts de Boodt included in the beginning of his book; it is obvious he had a more substantial influence on Kircher.¹²³ The lapidary is divided into two books, the first establishes categorization and chemical theories, and the second presents a detailed description of each gem, stone, and other minerals. For gems, he included separate sections on physical description, natural locations, medical and supernatural uses, artistic uses (jewelry and statues), artificial versions and enameling, and their worth on the market or compared to other gems.

Lynn Thorndike stated that:

The work of de Boodt shows a marked advance in several respects... it completely omits all matter concerning marvel-working images carved on gems. It profits by the discovery of the new world and knowledge of other distant lands.... [But] He makes an attempt, although not a very satisfactory one, at more exact description and more methodical classification of gems than those found in previous writers. He complains that all previous works on the subject have admitted foreign, magical, superstitious and false matter, and even intentional fictions. Nor does he himself entirely omit such.¹²⁴

¹²² Peter Marshall, *The Magic Circle of Rudolf II*, p. 79. For more biographical information or general information on de Boodt and his lapidary, see Thorndike, *The History of Experimental Science*, "The Lore of Gems," 318—324 and Sinkankas, *Emerald and Other Beryls*, pp. 37—39.

¹²³ For the section on diamonds, see Kircher, *Mundus Subterraneus*, VIII, pp. 20-21. I have yet to find the section he cited in de Boodt's lapidary. Kircher cites de Boodt multiple times in the later section on creating gems in Book XII. Kircher's charts: Kircher, *Mundus Subterraneus*, VIII, pp. 2, 4. De Boodt's charts: De Boodt, *Gemmarum et Lapidum Historia*, pp. 1, 22.

¹²⁴ Lynn Thorndike, "The Lore of Gems," pp. 319—20.

Thorndike continues and points out that de Boodt spent some time focusing on the question of gem virtues in his text, arguing that “supernatural effects are ascribed to divine or demonic influence, not to stones. Nor can gems receive such virtues from the stars...”¹²⁵ When it comes to medical virtues though, de Boodt affirmed their properties, but denied “them [the gems] influence on the human intellect or morals except indirectly and to a slight degree.”¹²⁶ However, our next author apparently ignored de Boodt’s distinctions concerning virtues when citing him.¹²⁷

Ulisse Aldrovandi (1522—1605) created one of Italy’s prominent early modern museums, collecting thousands of items such as natural minerals (gems, fossils, metals), animals or parts of their bodies (dragons, “unicorn horns,” shells), plants and flora from across the world, and other global oddities and natural or man-made objects.¹²⁸ He proudly wrote and published them in several books of encyclopedic nature, each filled with detailed images and descriptions worthy of discussion; but for the purpose of this paper, I only considered his *Museum Metallicum*. This thousand page book includes metals and tools (many from the new world, Aztec for example), fossils, and lastly, gems and stones. Aldrovandi depended on earlier sources for his information on gems, such as Marbode, Agricola, de Boodt, Pliny, and Albertus Magnus, all whom are often directly quoted. Like de Boodt, he included detailed descriptions on physical identity and natural locations, medical and supernatural uses, and the creation of artificial gems. Different from previous authorities however, Aldrovandi also included some images of gems (most likely ones in his collection) to show forms and types. Though Kircher did

¹²⁵ Thorndike, “The Lore of Gems,” pp. 320.

¹²⁶ Thorndike, “The Lore of Gems,” p. 321.

¹²⁷ Thorndike, “The Lore of Gems,” p. 321.

¹²⁸ For more information on Aldrovandi and the nature of collecting in the early modern period, see Paula Findlen, *Possessing Nature*.

not directly cite Aldrovandi in this section on gems, he did use (and cited) images from this book in Book VIII, which proves that he did know of Aldrovandi's book when writing his.

Lastly, Thomas Nicols (fl. 1659) published what Sinkankas calls, "the first worthy gemological monograph published in the English language..." about ten years before the *Mundus* appeared.¹²⁹ The book is set up in a similar way to de Boodt's lapidary; in fact, Nicols copies a chart from de Boodt's book and states that he used de Boodt as a primary source.¹³⁰ There is no proof that Kircher used or had even heard of Nicols' lapidary, but I include Nicols in this discussion because his lapidary is an example of someone who used de Boodt as a source, like Kircher.

Now with this context of gems in the early modern period and the lapidaries that most likely influenced Kircher, I will turn to each gem that Kircher mentioned and compare his information with past authorities.

III. The Diamond: "The King of Gems"

Below is a chart with what the authorities claim the diamond can do medically:

Marbode	Makes bearer indomitable; drives off spirits at night and vanishes idle dreams; chases away black poison; overcomes quarrels and strife; cures insanity; repels enemies ¹³¹
Agricola	"A diamond can detect poison and render it harmless. For this reason it has always been highly prized by royalty and therefore has always commanded a high price. It is reported to prevent insanity but this is hard to believe." ¹³²

¹²⁹ There is little biographical information on Nicols, the best summary of his work appears in Sinkankas, *Emeralds and Other Beryls*, pp. 39—40. See also Sinkankas, *Gemology*, pp. 754—6 for a discussion of the text and editions.

¹³⁰ Nicols, *A Lapidary*, p. 1. See footnote 31 for the exact quote.

¹³¹ This condensed version is taken from Riddle's commentary on Marbode's text. The following is what Marbode stated: "Its power will chase far from thy sleeping head/ The dream illusive and the goblin dread;/ Baffle the venom'd draught, fierce quarrels heal./ Madness appease and stay thy foeman's steel." Marbode, *De Lapidibus*, pp. 35—36.

De Boodt	Fights poison, plague, bewitchment, incantations, insanity, groundless fears, nightmares, incubus, succubus, demons in the night, and illusions; as an amulet it brings victory, strength and courage; controls anger; and encourages the wives' love; "for this reason it is called the gem of reconciliation" ¹³³
Aldrovandi	Fights poison; but otherwise just quotes Marbode (chases away bad dreams and goblins, fights venom, overcomes quarrels and strife, fights insanity) ¹³⁴
Nicols	Worn in a ring or carried near the heart- could mild the fury of enemies; expels fears from heart; preserves from swooning; drive away dreams and terrors of the night; and "frustrate all the maligne contagious power of poysons"; if a real diamond is put on the top of a woman without her knowledge, it will make her sleep and if faithful to her husband, will cast her in her embraces, but she will turn away if not faithful; ancients claim it can drive away goblins, incubus, and succubus; gives men courage ¹³⁵
Kircher	"Taken as a drug, because the force is caustic; it is said to be a gem that conveys reconciliation, courage and steadfastness, but falsely, as I have said elsewhere." ¹³⁶

Kircher gave the diamond the traits of being a gem of reconciliation and carrying the traits of courage and firmness (no doubt due to its indomitable hardness). De Boodt also called the diamond a "gem of reconciliation" so it is probable that Kircher got his inspiration from De Boodt (who also mentioned that the diamond is related to courage). It is obvious that Kircher did not list several aspects that are listed in other lapidaries, such as the idea that it cures insanity. Insanity is present in every source except Nicols and Kircher. Insanity, or madness, was a common disease of the mind that had been a concern since antiquity; perhaps the clarity and beauty of the diamond was thought to help clear the mind. Interestingly enough, Agricola does

¹³² Agricola, *De Natura Fossilium*, p. 122.

¹³³ *Creditur Adamante contra venena, pestem, fascinationes, incantamenta, insaniam, metus vanos, terrentia intersomnia, incubos, & succubos, daemonumque nocumenta, & praestigia, praesentaneum esse amuletum, eaque omnia arcere, ac praesenta veneno madere, ac constantiam, victoriam, animique fortitudinem efficere. Proditur etiam iram comprimere, coniugumque amorem fovere, ob quam causam reconsiliationis gemma vocatur.* De Boodt, *Gemmarum et Lapidum Historia*, p. 125.

¹³⁴ ... *Marbodeus addit, hoc gestato, rixas sedari, & insanos curari his versibus.* Aldrovandi, *Museum Metallicum*, pp. 948, 951.

¹³⁵ Nicols, *A Lapidary*, p. 51.

¹³⁶ Kircher, *Mundus Subterraneus*, VIII, p. 83.

not believe the diamond can do this. It is clear that Aldrovandi used Marbode (by quoting him) but it appears that de Boodt and Aldrovandi used Marbode as well (again, Agricola seems to be an outlier). However, Agricola does agree with the other authorities in that the diamond can remove the dangers of poison. Agricola claimed that this is the reason royalty has pursued diamonds, but Kircher claimed it was due to its nature (hardness, transparency). The diamond is not the only gem that could remove poisons according to these authorities, as will be shown in further examples.

IV. The Amethyst: A Cure for Intoxication?

Below is a chart on how the authors treated the amethyst:

Marbode	Combats drunkenness ¹³⁷
Agricola	None (but mentions that ignorant people believed it was used against drunkenness) ¹³⁸
De Boodt	Combats drunkenness; also prohibits evil thoughts; brings about happy disposition, vigilance, and industriousness; wins the favor of princes ¹³⁹
Aldrovandi	Combats drunkenness; when holding this gem, prevents perverse thoughts and causes the user to win favor in the presence of princes ¹⁴⁰

¹³⁷ "Famed for their power to check the fumes of wine..." Marbode, *De Lapidibus*, p. 54.

¹³⁸ Agricola, *De Natura Fossilium*, p. 131. See footnote 113 for more details.

¹³⁹ *Putatur gestatus ebrietatem prohibere, idque vini colore, quo praeditus est, indicari, quasi illum pro facultatis characterismo habeat. Ab hac facultate Grace Amethysti nomen accepit. Nonnulli umbilico admotum vini vaporem ad se trahere, eumque discutere, ac proinde ebrietatem, crapulamque arcere scribunt. Addunt alii, malas cogitationes prohibere, felix ingenium, vigilantiam, ac industriam efficere, imo gestantem principum gratiam sibi facile conciliare.* De Boodt, *Gemmarum et Lapidum Historia*, 166.

¹⁴⁰ *Hunc lapidem in lethargo non parum habere momenti aliqui affirmat, quoniam Mercurialis fit, vnde vigilantia prodire solet. Alij hoc, ad arcendam ebrietatem, vtuntur, quoniam a signatura, vel characterismo hanc virtutem ei inesse existimant. Aristoteles auctor est, referente Francisco Rueio (sed non citat locum) Amethystum umbilico admotum vini vaporem ad se trahere, & discutere, consequenterque; Patientem ab ebrietate liberare. Alij voluerunt, hoc lapide gestato, prauas cogitationes reprimi, ingenium faelix reddi, & gratiam Principum conciliari.* Aldrovandi, *Museum Metallicum*, p. 970.

Nicols	Drives away ebriety [drunkenness]; resists poison; sharpens wit; diminishes sleep. ¹⁴¹
Kircher	“Is thought to resist intoxication, from which it derives its name; the superstitious also think [it] bestows intellect and grace to leaders.” ¹⁴²

The common affiliation for the amethyst is that, due to its name, it combats drunkenness. Agricola and Kircher both state clearly that this idea is only superstition, but perhaps due to the fact that the other sources read Marbode closely, they nonetheless repeat what Marbode claimed. Since amethyst is a common gem (it is actually a purple quartz), it is a gem more popularly accessible than a diamond or sapphire.¹⁴³ Kircher also suggested that the amethyst “bestows intellect and grace to leaders” which could be coming from de Boedt and/or Aldrovandi’s statements that the amethyst can be used to win the favor of princes.

V. The Varieties in Color and Health with the Beryl and Topaz

Below is a chart describing what Kircher and others stated about beryl:

Marbode	Beryl is worn by married couples to bind in love; allows oneself to rise in wealth; grasping it too tightly burns the right hand; Good for watering, feeble eyes; stops belching; removes asthma; cures all illnesses of the liver. ¹⁴⁴
Agricola	None ¹⁴⁵

¹⁴¹ Nicols, *A Lapidary*, p. 74.

¹⁴² Kircher, *Mundus Subterraneus*, VIII, p. 83.

¹⁴³ In fact, Kircher notes that the amethyst can be found in “various conditions and locations.” Kircher, *Mundus Subterraneus*, VIII, p. 83. On Kircher’s charts from the beginning of Book VIII, the amethyst is listed separately from the other gems due to the fact that it can be found in large amounts (like quartz). See pages 2 and 4 of the *Mundus*.

¹⁴⁴ “With mutual love the wedded couple binds;/ The wearer shall to wealth and honours rise/ And from all rivals beart that wished-for prize;/ Too tightly grasped, as if instinct with ire,/ It burn th’ incautious hand with sudden fire./ Lave this in water, it a wash supplies/ For feeble sight and stops convulsive sighs./ Its species nine, for so the learned divide,/ Avail the liver and the tortured side.” Marbode, *De Lapidibus*, p. 50.

¹⁴⁵ See Agricola, *De Natura Fossilium*, p. 126—7.

De Boodt	Good against the attempts of enemies; defects of the liver; deep sighing and vomiting; diseases of the mouth, face, throat, and <i>paristhma</i> ; cures watery eyes; eye wounds. ¹⁴⁶
Aldrovandi	Cites Marbode (does not really give any other attention to medical uses) ¹⁴⁷
Nicols	Wurtzung says beryls are used in all distempers of the heart [but Nicols says make sure you have a real beryl]; if wrapped in linen cloth and put in water (or just put in water by itself) the water will seem to move. ¹⁴⁸
Kircher	“When reduced to powder in rose water or lilac water, it is said to heal the eyes especially, [it] corrects liver damage. The superstitious hold that it reconciles minds.” ¹⁴⁹

Kircher stated that the beryl is good for the eyes, a trait that Marbode (and thus Aldrovandi) and de Boodt both note. However, for the most part, none of the authors really agree with each other, each giving different aspects to the beryl. This could be due to the variety of types of beryl; they can be found in several different colors such as yellow, green, blue, pink, red, and even colorless.¹⁵⁰ Here though, it seems that each author was referring to a pale green colored beryl (or “sea-green” as stated by many of them).¹⁵¹

¹⁴⁶ *Gemmarii Beryllum gestatum contra hostium pericula, vitia hepatis, suspiria, eructationes valere, ac oris morbos, faciei, gulae, & paristhmia prohibere, credunt. Illius ex aqua dilutum oculos humidus sanare perhibetur. Ad vulnera oculorum etiam aliqui celebrant, five illa pupillae, five alteri parti inflicta fuerint. Reducitur Beryllus contusus, & tritus in pollinem exactissime, ut impalpabilis fit. Deinde, lentis quantitate pulvis quotidie mane, supino iacente aegro, in oculum, donec sanetur, infunditur, ac praecipitur ut areger immotus aliquandiu supinus permaneat. Si pupilla vulnerata fuerit, etsi commode sanari non possit, tamen ita emendatur, ut oculus deformis non fiat. Si laesio extra pupillam fuerit, praeclare sanat Beryllus, quemadmodum etiam omnes oculorum contusiones, quacunq; re factae fuerint. Suaderem ad contusiones, & sugillata, ut infusio fieret aqua verbasci: si adiuncta esset inflammatio, aqua rosarum, plantaginis, euphrasiae, vel simili. Si vulnus esset, aqua betonicae, tormentillae, vel plantaginis. Magi putant contra segnitiam hanc gemmam pollere, ingenio prodesse, & coniugatos invicem conciliare.* De Boodt, *Gemmarum et Lapidum Historia*, pp. 215—6.

¹⁴⁷ See Aldrovandi, *Museum Metallicum*, p. 956.

¹⁴⁸ Nicols, *A Lapidary*, p. 116.

¹⁴⁹ Kircher, *Mundus Subterraneus*, p. 84.

¹⁵⁰ Robert Webster, *Gems: Their Sources, Descriptions and Identification* (Washington: Butterworths, 1962), p. 135.

¹⁵¹ Marbode states that the beryl is “like tranquil seas or olive’s oily gleam” (Marbode, *De Lapidibus*, p. 50), while Agricola first states that the beryl is green, but then lists eight variations of green, gold, sky-blue, and clear. (Agricola, *De Natura Fossilium*, pp. 126—7). It seems that Aldrovandi, Nicols, and Kircher

The topaz is another gem that comes in several different colors. Whichever color topaz each author was writing of could have affected the way they viewed their medical properties as seen below:

Marbode	Aids against hemorrhoids; good against lunacy. ¹⁵²
Agricola	None, perhaps due to species confusion ¹⁵³
De Boedt	Reduces and even drives away night terrors and melancholy; strengthens the intellect; opposes troubling dreams; scares away demons; removes folly; promotes wisdom and courage. ¹⁵⁴
Aldrovandi	Disperses night terrors; expels melancholy; good against epilepsy; helps the blood flow. ¹⁵⁵
Nicols	Tells of Cardanus [Cardano?] who claimed he cured Caesar Palavicinus of a fever and another noble man of melancholy with the Topaz; powder good for people with asthma; for fevers, hold it under the tongue to quench thirst. ¹⁵⁶
Kircher	“Useful for melancholy, epilepsy, and flowing of blood.” ¹⁵⁷

used de Boedt, each having similar language to describe the color of the beryl (for example, see de Boedt, *Gemmarum et Lapidum Historia*, p. 214).

¹⁵² “Its yielding nature to the file gives way...” [Riddle notes that it should say “one feels the moon” referring to attacks of lunacy] “One only virtue Nature grants the stone, Those to relieve who under hemorrhoids groan.” Marbode, *De Lapidibus*, p. 51.

¹⁵³ See Agricola, *De Natura Fossilium*, p. 128. It is possible there is species confusion with the peridot.

¹⁵⁴ *Naturae Solaris, cuius speciem aliquo modo resert haec gemma aureo suo colore, est. Proinde ut aurum, ac Sol, vitalis facultatis sumentum est; ita Chrysolithus. Timores enim nocturnos, & melancholiam minuere, atque depellere, intellectum confortare, molestisque insomniis adversari, daemones terrere, & fugere, pusillanimitatem, stultitiamque auferre, sapientiam, animique constantiam promovere, ac a fascinationibus ferentem tueri, brachio sinistro alligatus, aut e collo suspensus, auroque inclusus, creditur. Resert Cardanus in libro de admirandis curationibus mira de Chrysolithi viribus his verbis. Caesarem Palavicinum, aliumque nobilem ex oppido Gallerati, melancholia & comitiali morbo alternatim (quorum unusiam quindecim diebus cum febre, verum cum clamoribus) laborantes, & frustra a medicis vexatos, somniseris lotionibus capitis, solo potu pulveris Chrysolithi ex vino, in octo dierum spatio, sic liberavi, ut nunquam morbus redierit...* De Boedt, *Gemmarum et Lapidum Historia*, pp. 211—2.

¹⁵⁵ *Gemma haec aureo colore referta, non secus ac aurum, naturae est solaris: quapropter facultatem vitalem roborare potest. Itaque, in timoribus nocturnis fugandis, in minuenda, & expellenda melancholis, faeliciter ad hibetur, si brachio sinistro alligetur, vel in collo ita suspendatur, ut curim contangar. Hieronymus Cardanus, in libro de Curationibus admirandis, mira de hoc lapide praedicat, quoniam nobiles quosdam, solo haustu pulueris huius gemmae curavit: siquidem, alijs medicamentis incassum adhibitis, alium melancholis, & alium epilepsia laborantem, o idui spatio, liberavit. Sanguinis etiam profluvia coercere traditur. Huius metninit Marbodeus de Topazio canens hunc in modum. [quotes Marbode] Aldrovandi, *Museum Metallicum*, pp. 978.*

¹⁵⁶ Nicols, *A Lapidary*, p. 111.

¹⁵⁷ Kircher, *Mundus Subterraneus*, VIII, p. 87.

Topaz, like beryl and hyacinth, can be different colors; light green (often species confusion with peridot), yellow, pink, and light blue. Isidore of Seville, (a source for Marbode) claimed it was green, but Marbode stated that it is a golden color. Agricola said there are two types; one is leek-green, and the other a pale yellow. With any of these pale, transparent colors, it was associated with the sun.¹⁵⁸ So again, epilepsy and melancholy are topics listed here by Kircher; epilepsy and melancholy appear in de Boodt and Aldrovandi, and Nicols spoke of the topaz healing melancholy. It was thought that the topaz, like the sun, would help with these diseases. Blood is also a common trend; Marbode states the topaz is good against hemorrhoids, and Aldrovandi and Kircher claimed that it helped the blood flow. Another common thought is that the topaz could help fight against night terrors, perhaps due to its likeness to the sun.

VI. The Red Gems: Rubies, Carbuncles, Garnets and Hyacinths

Due to the problem of species confusion, the red gems will be combined in the next section; first rubies and carbuncles (which often refer to the same gem) and then the garnet and the hyacinth. The ruby and carbuncle:

Marbode	None, probably due to species confusion
Agricola	None ¹⁵⁹
De Boodt	Ruby: resists poison; preserves from the plague; restrains lust and evil thoughts; wards off alarming dreams; cheers the mind; keeps the body in good condition; however, the user loses sleep, stirs up the blood, so that the wearer is easily angered. ¹⁶⁰

¹⁵⁸ Hoover, *Topaz*, p. 13.

¹⁵⁹ See Agricola, *De Natura Fossilium*, pp. 135—6.

¹⁶⁰ *Tradunt authores, Carbunculum, seu verum Rubinum, gestatum, vel ebibitum, venenis vehementer resistere, ac a peste praeservare, tristitiam arcere, libidinem coercere, malas cogitationes, & terrentia somnia avertere, animum exhilarare, corpus incolume conservare... Interim tamen somnum minuere, ac*

Aldrovandi	Ruby/Carbuncle: poison subdued; helps prevent sadness and groundless sleeplessness; When worn around the neck it cheers the heart, and when drunk it opposes melancholy. ¹⁶¹
Nicols	Carbuncle/ Ruby: should be worn as an amulet, or drunk. Good against poison and plague. Keeps body in safety; Drives away sadness, evil thoughts and terrible dreams and evil spirits. Cheareth the mind. It will change color if any danger comes to it. ¹⁶²
Kircher	Carbuncle: It opposes poisons, suppresses lust; cheers the soul; provokes anger; lessens sleep; and is reported to change color when misfortune is at hand. Ruby: Helps expel poisons; A noble antidote. ¹⁶³

The authors each had different views on these two gems; some combined them while others separated them, and Marbode (due to species confusion) did not mention either (or perhaps listed their properties under a different stone). However, there is one common theme between those who do discuss the ruby/carbuncle: it repels sadness and melancholy. Most authorities claimed this property owed most likely to its color—red has been associated with energy and fire since antiquity. Kircher again appears to have received his information on the carbuncle from de Boodt’s analysis of the ruby. For the ruby, Kircher only lists that it is an antidote for poison; de Boodt and Aldrovandi list the same use. What the “noble antidote” refers to is not clear, but Kircher could have meant that because rubies (like other gems) are expensive, only the rich could afford to use them in their medications.

The garnet and the hyacinth have similar issues:

sanguinem nonnihil exagitare, ut gestantes facile excandescant. De Boodt, *Gemmarum et Lapidum Historia*, p.146.

¹⁶¹ *Carbunculo, siue legitimo Rubino, venena profligari, & aerem pestilentem emendari auctor est Mylius. Alij auctores tradunt Rubinum no solum gestatum, immo eius puluerem in aliquo liquore haustum venenis reluctari, & medicamentum praemuniens aduersus pestiferos halitus euadere; item tristitiam, & vana insomnia arcere perhibent. Rubinus autem balascius facultares Carbunculi, sed languidiores possidet. Tandem Rubinus granatus gemma Martialis manifeste exsiccat, & collo suspensus cor exhilarat, necnon haustus in aliquoe affectui melancholico occurrit: hac de causa ingreditur electuaria, cardiaca, quorum descriptiones in Antidotarijs exarantur.* Aldrovandi, *Museum Metallicum*, p. 962.

¹⁶² Nicols, *A Lapidary*, p. 58.

¹⁶³ Kircher, *Mundus Subterraneus* VIII, pp. 84, 86.

Marbode	Garnet: None, perhaps due to species confusion Hyacinth: Vanish sadness and vain suspicions; thought to be cooling when held in the mouth; when hung around the neck or finger, the wearer will receive protection from the plague; the wearer will receive dignity with honor at host's tables. ¹⁶⁴
Agricola	None ¹⁶⁵
De Boedt	Garnet: When hung around the neck or drunk it opposes sadness, strengthens the heart, and fights melancholy. Hyacinth: fights pestilence (if hung from the neck as an amulet or mounted in a ring); causes sleep; protects the heart; increases prudence, riches, and honors. ¹⁶⁶
Aldrovandi	Garnet: None, perhaps due to species confusion Hyacinth: Use if sleep is desired and to strengthen the heart and beat back calamities; for overcoming poisons. ¹⁶⁷
Nicols	None ¹⁶⁸
Kircher	Garnet: "It works by a power for drying, it strengthens the heart; [garnets] enter into the mixture of the elixir of life, and the composition of the hyacinth." Hyacinth: "It opposes the plague by giving strength to the heart; induces sleep; [and] is said to bring liveliness to the mind." ¹⁶⁹

Here, more inconsistencies are found. First, the garnet only exists in de Boedt and Kircher's lapidaries, and the aspects de Boedt gave are different from Kircher (except that the

¹⁶⁴ "With any kind borne on thy neck or hand,/ Secure from peril visit every land./ On all thy wand'rings honours shall attend/ And noxious airs shall ne'er thy health offend;/ Whatever prince thy just petition hears/ Fear no repulse, he'll listen to thy prayers." Marbode, *De Lapidibus*, pp. 51—2.

¹⁶⁵ See Agricola, *De Natura Fossilium*, pp. 135—6.

¹⁶⁶ Garnet: *Granatos manifestam aliam qualitatem, quam exsiccandi, si in pollinem redigantur, haere non puto. Alias collo suspensi, & ebibiti, tristitiae multum resistere, ac cor confirmare, melancholiaeque adversari putantur.* De Boedt, *Gemmarum et Lapidum Historia*, p. 154. Hyacinth: *Precipuus usus est ad pestem arcendam, si pro amuleto collo appensis, aut annulo inclusus gestetur. Ad haec somnum conciliare, virtutes cordis tueri, divitias, honores, ac prudentiam augere, animi alacritatem efficere, ac a fulgure portantem defendere creditur.* De Boedt, *Gemmarum et Lapidum Historia*, p. 161.

¹⁶⁷ *Hanc gemmam magno usui futuram esse scribunt illis, qui somnum conciliare desiderant, necnon ijs, qui cor roborare, & aerumnas pellere colunt. Itaque Marbodeus de virtutibus cuiuseumque; generis Hyacinthorum sic canit. [quotes Marbode] Caeterum Albertus Magnus, & Fernelius, in expugnando toxico, hanc gemmam commendant. Auicennas quoque, in libro de viribus cordis, magnam vim roborandi spiritus vitales ei attribuit. Praeterea pestem saeuientem arcet, si collo suspensus cutim regionis cordis cotangat. Immo Marbodeus addit, hac gemma in annulo gestata, securum reddi hominem quocumque; progredientem, his veribus. [quotes Marbode]... Aldrovandi, *Museum Metallicum*, 965.*

¹⁶⁸ See Nicols, *A Lapidary*, pp. 62—70.

¹⁶⁹ Kircher, *Mundus Subterraneus*, VIII, p. 85.

garnet strengthens the heart). Second, a hyacinth, like the beryl, can come in many colors; Marbode mentions that there are red, blue and yellow types. These types were often confused with other gems; for example, the blue hyacinth with the blue sapphire. Riddle suggests that the ancient and medieval sources that Marbode used had identified different kinds of hyacinth.¹⁷⁰ Aldrovandi seemed to be describing a blue transparent stone, but de Boodt was referring to a red or orange hyacinth. Kircher clearly took de Boodt's word on this gem, and therefore also meant the red/orange version of the hyacinth. Lastly, the aspects associated with the garnet and hyacinth are familiar with earlier gems; they treat pestilence, get rid of sadness, and bring honor to the wearer.

VII. What's in a name? The Sapphirus and the Smaragdos

The following are medical and supernatural properties concerning the sapphire in each of the lapidaries:

Marbode	Livens body; unable to be harmed by fraud; overcomes envy; does not allow on to be moved by terror; lets one escape from prison (opening doors and unbinding knots); inclines one to prayers; cools interior of body; prevents perspiration; to cure sores, ground and smeared on with milk; cures headaches; cures defects on tongue. ¹⁷¹
Agricola	None ¹⁷²
De Boodt	Dries the moisture of the eyes; prevents inflammation; helps against dysentery and hemorrhoids; helps blood flow; helps against smallpox and measles (but

¹⁷⁰ Riddle mentions specifically that Pliny might have been using a faint amethyst or a rose quartz, Isidore described a dark blue stone, and Solinus described a transparent sapphire. Marbode, *De Lapidibus*, p. 51.

¹⁷¹ "Its soothing power contentions fierce controls,/ And in sweet concord binds discordant souls;/ Above all others this Magicians love,/ Which draws responses from the realms above:/ The body's ills its saving force allays/ And cools the flame that on the entrails preys./ Can check the sweats that melt the waning force/ And stay the ulcer in its festering course:/ Dissolved in milk it clears the cloud away/ From the dimmed eye and pours the perfect day;/ Relieves the aching brow when racked with pain,/ And bids the tongue its wonted vigour gain" Marbode, *De Lapidibus*, pp. 42—3.

¹⁷² See Agricola, *De Natura Fossilium*, p. 130.

	needs to be applied everyday); protects the eyes from injury; helps ulcers and to heal wounds if powdered with milk; good against poison and pestilence; relieves melancholy; etc. ¹⁷³
Aldrovandi	Dries moistened eyes; prevents inflammation; heals headaches and vision; to look upon a sapphire will defend the eyes from injury and misfortune; if powdered and drunk with milk, will heal internal wounds; when placed in a glass with a spider, the spider will die; etc. ¹⁷⁴
Nicols	Good against feverish distempers; comfortable to the eyes; If worn by an adulterer, the truth will be known; hinders erections caused by Venus; if placed in a glass with a spider, the spider will quickly die, therefore it keeps men chaste; the wearer will keep in favor with princes and with all men; it will pacieth his enemies; free him from enchantments and bonds and imprisonments (will loosen men from prison). ¹⁷⁵
Kircher	"Remedy for the heart; it is said to become dirty when carried by impure men and those given to luxury. Opposes poisons." ¹⁷⁶

First it is important to note that the Latin word, *sapphirus*, actually referred to lapis-lazuli, a dark, non-transparent blue gem. Today, a sapphire is a transparent blue gem; but

¹⁷³ *Qualitate frigida & sicca praedita est Sapphirus, ut caeterae sere omnes gemmae. His facultatibus in pulverem levem redacta, oculorum humiditates exsiccare, inflammationem arcere, & extinguere, collyriis adhibita, aut butyro loto excepta, palpebrisque oblnitis superioribus, potest. Valet etiam pulvis ad omnia alvi prosluvia, ad dysenteriam, fluxum hepaticum, haemorrhoidum, sanguinique reiectiones, si intus sumatutum aqua plantaginis, tormentillae, aut alia his affectibus propria. Integra Sapphirus fronti adhibita haemorrhagia fistit, ac inflammationibus applicata, eas extinguit. In orbiculum redacta pisi magnitudine, ac perpolita, oculis imposita, pulveres, culcies, & quicquid in oculum cecidit aufert, inflammationem sedat, veteraque oculorum vitia omnia aufert, & oculos a variolis & morbillis tutatur. Verum quotidie saepius imponi debet. Si sepius quis Sapphirum contueatur, oculos ab omni iniuria defendet, ac ita tutabitur, ut nihil illis adversi contingere possit. Pulvis etiam exhibitus cum lacte, ulcera interna, ac vulnera sanare perhibetur. Ad cordis corroborationem praestantissimus est, proinde corpus vegetum, membraque principalia integra conservat. Pesti etiam, omnique veneno, febribusque malignis omnino adversatur. Cor laetiscat, cardiacos ac melancholicos affectus quosvis lenit, tollitque. De Boodt, *Gemmarum et Lapidum Historia*, p. 184.*

¹⁷⁴ *Cum hic lapis frigidae, & siccae fit temperaturae, ut caeterae fere omnes gemmae, in puluerem redactus oculorum humiditates exsiccat, inflammationes arcet, collyrijs si adhibeatur. Solo contactu non modo dolorem frontis sanat, sed visionem etiam recreat, oculosque; aduersus quoscumque; affectus praemuni.... Amplius si quis saepius sapphirum intueatur, oculos ab omni iniuria defendet, immo ita tutabitur, ut nihil aduersi illis contingere possit. Deinde hujus pulvis cum lacte haustus ulcera, & vulnera interna sanare traditur. Hinc forte Dioscorides Scorpionum, & Aranearum optime occurrit: nam Aranea vitro inclusa, & orificio vasis sapphyro applicato, breui interire perhibetur. [Then continues to cite from Magnus, Gesner, de Boodt and Marbode]. Aldrovandi, *Museum Metallicum*, pp. 972—3.*

¹⁷⁵ Nicols, *A Lapidary*, pp. 84—5.

¹⁷⁶ Kircher, *Mundus Subterraneus*, VIII, p. 86.

authors like Marbode may have been referring to the opaque lapis-lazuili.¹⁷⁷ By the early seventeenth century, when de Boodt published his lapidary, the sapphire was identified and named a transparent gem; one can see this in de Boodt's chart of gems.¹⁷⁸

The sapphire presents several constant themes; Kircher was the only author to mention clearly that it was good for the heart, but most of the authors listed that the sapphire was good for keeping men chaste, or keeping envy away. Aldrovandi and Nicols included a story that if a sapphire is placed within a cup with a spider, the spider soon dies, thus the reason the gem keeps men chaste. This story does not begin with Marbode, so it may have a later origin, or one that Marbode did not include. Another common trend that is not repeated in Kircher's *Mundus* is that the sapphire can treat ulcers or other internal wounds when drunk with milk (Aldrovandi probably got this from de Boodt). Marbode included a different version, saying that sores could be treated if the sapphire is smeared on the sore with milk. Poison is repeated here, but only by de Boodt and Kircher, again showing that Kircher most likely used de Boodt as his main source for medical properties. However, one theme that is present in de Boodt that Kircher did not mention is that sapphires are good for the eyes; de Boodt and Aldrovandi said the gem helps moistened eyes and prevents inflammation, while Nicols states that the gem comforts them. This could be due to the gem's cooling nature: de Boodt and Aldrovandi both list the sapphire as cold and dry.

As shown above, lapidaries had to make clear which type of *sapphirus* they were referring to; the emerald (*smaragdus*) faced the same problem. As described previously, the status (or views associated with) *smaragdus* changed from antiquity to the early modern period,

¹⁷⁷ Marbode, *De Lapidibus*, p. 41.

¹⁷⁸ De Boodt, *Gemmarum et Lapidum Historia*, p. 22. Therefore, Kircher is also focused on the transparent sapphire, since he copied de Boodt's chart. Kircher also describes physical properties as blue and clear (*gemma coerulea & disphana est*). Kircher, *Mundus Subterraneus*, VIII, p. 86.

due to discoveries of emeralds in the New World. However, the emerald's given medical properties did not change as shown below:

Marbode	It is used to foretell the future; increases power of persuasive words; when hung around the neck, it drives away harsh fever and can cure epilepsy; improves eyesight; prevents plague; holds in check furious emotions. ¹⁷⁹
Agricola	Soothes eyes, but does not cure them (Pliny); any lewd act is dangerous to the <i>smaragdus</i> (will shatter on certain circumstances); combats epilepsy; kings and priests hang it on the necks of boys in order to expel epilepsy. ¹⁸⁰
De Boodt	Helps blood flow and keep dysentery in check; takes out poison; takes away plague; if hung around the neck of boys, will protect them from epilepsy; as a ring it also prevents epilepsy. ¹⁸¹
Aldrovandi	Keeps blood and dysentery in check; takes out poison; helps the heart; takes away plague and fever; many believe if hung around the necks of boys, it will protect them from epilepsy; as a ring it also prevents epilepsy; when applied to abdomen, will take away dysentery; if hung around the neck, drives away night terrors. ¹⁸²

¹⁷⁹ "Of mighty use to seers who seek to pry/ Into the future hid from the mortal eye. Wear it with reverence due, 'twill wealth bestow/ And words persuasive from thy lips shall flow, The stone itself or living spirit fired./ Hung round the the neck it cures the ague's chill,/ Of falling sickness, dire mysterious ill;/ It hues so soft refresh the wearied eye,/ And furious tempests banish from the sky;/ So with chaste power it takes the furious mood/ And cools the wanton thoughts that fire the blood." Marbode, *De Lapidibus*, pp. 44—5.

¹⁸⁰ Agricola, *De Natura Fossilium*, p. 126.

¹⁸¹ *Smaragdus ut omnes gemmae, frigidae & siccae est temperaturae, ob id omnem alvi sanguinisque fluxum, & praecipue dysenteriam ebibitus fistit, teste Avenzoare, nec resert an a mordaci humore, an a veneno ortum habuerit. Propinantur ad venena, dysenteriam, alvi que fluxum, sex grana in pollinem redacta cum aqua aliqua cordiali, ut tormentillae, acetosae, nymphaeae, vel boraginis. Quibus haustis extemplo aeger, si venenum sumpserat, cordis anxietates, animique defectus patitur: quos si exerit sudor & somnus, liberatur 10 horarum spatio. Eadem dosi sumptus, venenatis morsibus, animaliumque puncturis, pesti, febribusque pestilentibus medetur. Inter amuleta praecipue commendatur Smaragdus. Nam si e puerorum collis pendeat, eos ab Epilepticis paroxysmis tutari creditur; digitis etiam gestatus comitalem morbum impedire omnes authores afferunt, eamque habere facultatem, ut si morbus ita vehemens fit, ut superari a gemma non possit, eam in partes diffringi, itaque vel tollere morbum, vel frangi quasi pugnando a potentiori devictam. De Boodt, *Gemmarum et Lapidum Historia*, 198-9.*

¹⁸² *Smaragdus ut omnes aliae gemmae, frigidi, & sicci est temperamentis. Idcirco omnes alui, sanguinisque; fluxiones, & praefertim dysenteriam haustus in aliquo liquore cohibet, ut Auenzoar attestatur. Neque refert an affectus ob acrimonia humoris, an a veneno originem traxerit. In affectibus venenatis ad pondus lex, vel octo granorum in aqua Tormentillae, Acetosae Nymphaeae, vel Boraginis exhibetur; quandoquidem Patiens, si venenum sumpserit, illico cordis anxietates patitur, & sudore oborto, decem horarum spatio,*

Nicols	Good against poisons; Good to "recreate" the fight; will break if it touches the skin of an adulterer. ¹⁸³
Kircher	Opposes poisons; cures diarrhea, and all blood flows; helps epileptics. ¹⁸⁴

The first property that Kircher listed was that the emerald could help the wearer resist poison; it is a property that is repeated in all the lapidaries after de Boodt.¹⁸⁵ Epilepsy is also common throughout all the lapidaries except Nicols'. Besides Kircher and Marbode, a story is included that states that kings (and sometimes priests) would hang emeralds from the necks of boys or have them wear a ring with an emerald in order to stave epilepsy off. Since Marbode does not include this specific story (though he does state that in general when hung around the neck or as a ring it can prevent epilepsy) it must have originated elsewhere. Agricola stated the following concerning this theory:

It combats epilepsy as though it were a deadly enemy until it either overcomes the lesser power of the disease or is overcome by a greater power. In the former case the stone remains whole and intact but in the latter case it is fractured into many small pieces. For this reason kings and priests suspend it from the necks of boys and wear it in rings in order to test whether it will have the power to expel this horrible disease.¹⁸⁶

This is a clear example that shows how gems were used in a (expensive) test of trial and error. Epilepsy was a feared disease that was common enough.

liberatur. Ha ea dem ratione icribus Animantium venenatarum, necnon febribus pestilentibus, & malignis medetur.

*Inter amuleta Smaragdus potissimum magnificatur: nam si de puerorum collo pendeat, eos ab Epilepsiae paroxismo tueri creditur. In annulo etiam gestato comitalem morbum impediri omnes Authores affirmant. Ori inditus haemorrhagiam coercere tradunt. Si ventri applicetur, dysenterias omnes, teste Antonio Guainerio, instar miraculi, auferri dicunt. Item de collo pendulus nocturna terriculamenta arcet, & febrem hemitriteam tollit. Memoriam etiam firmate, necnon visum reficere, & recreare affirmant. Quid simile a Marbodeo scribitur hunc in modum. [quotes Marbode] Aldrovandi, *Museum Metallicum*, p. 975.*

¹⁸³ Nicols, *A Lapidary*, pp. 95—6.

¹⁸⁴ Kircher, *Mundus Subterraneus*, VIII, p. 86.

¹⁸⁵ Coincidentally enough, de Boodt's lapidary is the first listed here that includes the "new world" emeralds. Whether the theme of poison is due to the new gems or not is not clear either way.

¹⁸⁶ Agricola, *De Natura Fossilium*, p. 126.

Conclusions

The contents of Book VIII and XII, with their attention to gems makes clear the importance in Kircher's *Mundus Subterraneus* and their connection to his Geocosm. Kircher included ideas, theories, images, and general information from previous authors, mainly from de Boodt. De Boodt's influence is easily identified though the language and theories Kircher chose, specifically when it came to the medical uses of gems. This dependence led to inconsistencies as when Kircher specifically claimed that Paracelsus was one of the charlaten alchemists. Following de Boodt, Kircher included Paracelsus and his ideas, especially concerning theories on salt and sulphur. Another specific example is that Kircher and de Boodt were the only authors to call the diamond "a gem of reconciliation." However, Kircher also used other sources to write his sections on gems, including Aldrovandi's images as well as similar references to Aldrovandi's medical uses. Since Aldrovandi also relied heavily on de Boodt, the extent of his influence on Kircher remains unclear. Marbode, the medieval writer, is quoted and used not only by Kircher, but by the other authors as well. Agricola's text on gems and Nicols' English lapidary may also have had some influence, but there are no clear indicators in the *Mundus*.

When compared to the other lapidaries, it is clear that Kircher did not include all the details and properties that he could have, especially as seen by his lengthy chart in Book VIII. For example, in the case of the sapphire, de Boodt, Aldrovandi, and Nicols elaborated on the sapphire's use in healing the eyes. Kircher did not include this aspect in his chart. Rather he listed that the sapphire can help the heart, can be destroyed by impurity, and that it resists poisons. For the most part, Kircher summarized what the other lapidaries claimed (as with the topaz for example). This contributes to the claim I make that the purpose of Kircher's lapidary is

very different than those others presented here. Instead of focusing on the gem properties and classifications of types, locations, uses, and worth, Kircher summarized this information which could be found elsewhere. Rather, he focused on the scientific characteristics of gems- their chemical makeup and experiments that demonstrated properties and origins. There is some evidence that Kircher did not believe in the virtues of gems; one example is in the case of the diamond, where he states that "it is taken up as a drug, for caustic strength, one says the gem carries reconciliation, courage and firmness, but wrongly, as we have said elsewhere." But nonetheless, he listed the medical and supernatural uses of gems because other authorities have done so. When compared with these other lapidaries, his focus was not on labeling gems and clarifying species, but his *Mundus Subterraneus* was meant to be an encyclopedia of sorts. The information was also meant to clarify the ways in which the geocosm worked to produce these gems.

These descriptions also reveal more about the early modern world that Kircher lived in. First, as seen with the example of what Kircher stated about the ruby ("a noble antidote"), gems were for the wealthy. Most people did not have access to being able to use gems to heal their illnesses. There is no doubt then that wealthy people from antiquity, the middle ages, and the early modern period saw themselves as special for being able to own precious gems. It was most likely a common thought that they saw gems as being more likely to cure themselves when compared to using herbs and other common ingredients. Amulets, rings, and milk with gem powder (sapphire) were for the upper class alone, and indeed for those able to read the books of these authors. The collectors, such as Kircher and Aldrovandi, also fit into this wealthy class because of their ability to collect and protect gems within their museums of natural, mechanical

and supernatural objects. It was their job to classify not only one gem from another, but gems from stones, fossils, marbles, and other minerals.

Secondly, by looking at the diseases mentioned in these lapidaries, one can see what diseases people were concerned with. Melancholy, epilepsy, poisonings, and the plague appeared treatable by using multiple gems. Melancholy was the disease of royalty; it was associated with princes and queens and was bound up with the intellect and the artistic personality, but it was also tied to depression.¹⁸⁷ Another disease, epilepsy was feared as much as melancholy.¹⁸⁸ Poison was a constant threat, whether if it was due to animal, plant, or bug bites, or due to the worry of being poisoned by another. Plague and pests again were a constant threat in early modern Europe. It is evident here that this was a concern since before Marbode, as he told of gems that could protect from the plague (the *smaragdus*); but it became more prominent in the lapidaries as time went on which reflects the fact that Europe had been visited by plagues and pests constantly since the breakout of the Black Death in the mid-fourteenth century.

Besides these common diseases (as well as dysentery, eye infections, and hemorrhoids), there are a variety of more “supernatural” cures listed with the medicinal instructions. Dispersing night terrors, protecting or raising ones status, fighting drunkenness, and driving away demons were listed multiple times for several gems. The reader is also given more specific stories, such as if a real diamond is put on the top of a woman without her knowledge it will make her sleep— if she is faithful to her husband it will cast her in his embraces, but she will

¹⁸⁷ For more on melancholy, see H.C. Middlefort, *Mad Princes of Renaissance Germany* (Virginia: University of Virginia Press, 1994) and Robert Burton, *The Anatomy of Melancholy* (New York: New York Review of Books, 2001).

¹⁸⁸ For a general history of epilepsy, see Owsei Temkin, *The Falling Sickness: A History of Epilepsy from the Greeks to Modern Neurology* (Baltimore: John Hopkins Press, 1945).

turn away if she is unfaithful (Nicols) — or how the sapphire lets one escape from prison by opening doors and unbinding knots (Marbode, Nicols). Historical examples are sometimes used, as with the story Nicols told of Cardanus who claimed he cured Ceaser Palavicinus of a fever and another noble man of melancholy with the Topaz.¹⁸⁹ These tales of superstition were included amongst the medicinal ones, which show the thin line between the medical and the supernatural even in the late seventeenth century. Whether the authors believed all these virtues could be influenced is unclear. Agricola probably least of all believed in these virtues, due to the fact that he often did not include medical or supernatural virtues in his lapidary. As stated previously, Kircher was also skeptical, but included them nonetheless.¹⁹⁰

Finally, the geocosm is an important over-arching theme throughout the entire book, and is evident in books VIII and XII as well. Kircher defined the geocosm as a macro/microcosmic system in the preface to Book VIII, comparing the interior of the earth to a mother's body and womb or comparing the functions of a furnace to the power of the center of the earth. All of these are material, corruptible things, but their connections to the heavens and God are real for Kircher. God as the Divine Architect created the *Spiritus Architonius* which is the force behind the petrification of fossils and the creation of stones. This same power creates gems and their colors and forms as first argued by de Boodt, but is discussed in much more detail by Kircher throughout Book VIII with his experiments. Kircher's information on gems is not presented simply as a lapidary like de Boodt's, or as a book of chemical recipes in order to tell the audience how to change common stones to precious ones. It is also not a museum catalogue like

¹⁸⁹ Another example of a persisting historical story from de Boodt is of a large garnet of Emperor Rudolf II; and the same story is repeated in Aldrovandi, Nicols, and Kircher.

¹⁹⁰ However, as Martha Baldwin argues Kircher did believe the snakestone had the power to remove poison. In the experiment that Baldwin explores, Kircher had a dog bit by a poisonous snake and by merely touching the snakestone to the dog, the stone stuck to the dog until the poison was removed, and the dog was reported to be healed after. See Baldwin, "The Snakestone Experiments," pp. 394—418.

Aldrovandi's *Museum metallica* as it is clear that Kircher is not trying to advertise the Collegio Romano because he included examples of stones from multiple collections. Kircher's section on gems is distinctive in providing the reader information on categorizing gems, theories on their process of creation, and experiments to prove his theories. He also includes popular stories about gems (the twelve gems of the Bible) and superstitious properties associated with them even though he clearly does not believe in these virtues. With all these different ways of looking at gems and their place in the geocosm, Kircher was writing an encyclopedia, providing the reader with everything on gems he knew. Gems, like fossils, are an important part of Kircher's geocosm: though some terms and theories such as the *Spiritus Architectonicus* are repeated from his sections on fossils and his ideas on the importance of sulphur and salt is again stated in his chapters on alchemy and chemistry, he combines them to share his understanding of the science of gems.

Bibliography

Primary Sources:

Agricola, Georgius. *De Natura Fossilium*. Translated by Mark Chance Brandy and Jean A. Brandy. Menasha, Wisconsin: George Banta Publishing Company, 1955.

Aldrovandi, Ulisse. *Musaeum Metallicum*. Bononiae: Typis Io. Baptistae Ferronij, 1648.

Boyle, Robert. *An Essay About the Origine and Virtues of Gems*. Ed. George W. White. New York: Hafner Publishing Company, 1972.

De Boodt, Anslem Boéce. *Gemmarum et lapidum historia*. Lugduni Batavorum, ex officina Ioannis Maire, 1647.

Della Porta, Giambattista. *Natural Magick*. London: Printed for J. wright, 1669.

Kircher, Athanasius. *Mundus Subterraneus*. Amsterdam: Apud Joannem Janssonium & Elizeum Weyerstraten, 1665.

--- *Physiologia Kircheriana Experimentalis*. Amstelodami: Ex officinâ Janssonio-Waesbergiana. 1680.

Marbode of Rennes. *De Lapidibus*. Ed. John M. Riddle. Trans. C.W. King. Wiesbaden: Franz Steiner Verlag GmbH, 1977.

Nicols, Thomas. *A Lapidary: or, the History of Pretious Stones, with Cautions for the Undeceiving of All Those That Deal with Pretious Stones*. Cambridge: Thomas Buck, 1652.

Secondary Sources:

Abbri, Ferdinando. "Alchemy and Chemistry: Chemical Discourses in the Seventeenth Century." *Early Science and Medicine* 5, no. 2 (2000): 214-226.

Baldwin, Martha. "Alchemy and the Society of Jesus in the Seventeenth Century: Strange Bedfellows?" *Ambix* 40, part 2. (July 1993): 41-64.

---- "The Snakestone Experiments: an Early Modern Medical Debate." *Isis* 86, No. 3 (September 1995): 394-418.

Cohen, Saul B. ed. *The Columbia Gazetteer of the World*. 2nd ed. 3 volumes. New York: Columbia University Press, 2008.

- Findlen, Paula. *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy*. Berkeley: University of California Press, 1994.
- "The Last Man Who Knew Everything... or Did He?: Athanasius Kircher, S.J. (1602-80) and His World." *Athanasius Kircher: The Last Man Who Knew Everything*. Edited by Paula Findlen. New York: Routledge, 2004.
- Godwin, Joscelyn. *Athanasius Kircher's Theatrum of the World: The Life and Work of the Last Man to Search for Universal Knowledge*. Rochester, VT: Inner Traditions/Bear, 2009.
- Gould, Stephen Jay. "Father Athanasius on the Isthmus of a Middle State: Understanding Kircher's Paleontology." *Athanasius Kircher: The Last Man Who Knew Everything*. Edited by Paula Findlen. New York: Routledge, 2004.
- Hirai, Hiro. "Kircher's Chymical Interpretation of the Creation and Spontaneous Generation." *Chymists and Chymistry: Studies in the History of Alchemy and Early Modern Chemistry*. Edited by Lawrence M. Principe. Sagamore Beach: Watson Publishing International LLC, 2007.
- Hoover, D.B. *Topaz*. Oxford: Butterworth-Heinemann Ltd., 1992.
- Jaffé, David. "Aspects of Gem Collecting in the Early Seventeenth Century, Nicholas-Claude Peiresc and Lelio Pasqualini," *The Burlington Magazine* 135, no. 1079 (Feb., 1993). 103-120.
- Lane, Kris. *Colour of Paradise: The Emerald in the Age of Gunpowder Empires*. New Haven: Yale University Press, 2012.
- Marshall, Peter. *The Magic Circle of Rudolf II: Alchemy and Astrology in Renaissance Prague*. New York: Walker & Company, 2006.
- Nummedal, Tara E. "Kircher's Subterranean World and the Dignity of the Geocosm," *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher*. Edited by Daniel Stolzenberg. Stanford: Stanford University Libraries, 2001.
- Rowland, Ingrid D. "Athanasius Kircher, Giordano Bruno, and the *Pansperma*," *Athanasius Kircher: The Last Man Who Knew Everything*. Edited by Paula Findlen. New York: Routledge, 2004.
- Sinkankas, John. *Emerald and Other Beryls*. Radnor, Pennsylvania: Chilton Book Company, 1981.
- *Gemology: An Annotated Bibliography*. 2 Volumes. Metuchen, N.J.: The Scarecrow Press, Inc., 1993.
- Torrey, Harry Beal. "Athanasius Kircher and the Progress of Medicine." *Osiris* 5 (1938). 246-275.

Thorndike, Lynn. ed. *The Sixteenth Century*, vol. 6 of *The History of Magic and Experimental Science*. New York: Columbia University Press, 1941.

Thorndike, Lynn. Ed. *The Seventeenth Century*, vol. 7 of *The History of Magic and Experimental Science*. New York: Columbia University Press, 1941.

Waddell, Mark A. "Magic and Artifice in the Collection of Athanasius Kircher," *Endeavour* 34, no. 1 (2010) 30-34.

Webster, Charles. *Paracelsus: Medicine, Magic and Mission at the End of Time*. New Haven: Yale University Press, 2008.

Webster, Robert. *Gems: Their Sources, Descriptions and Identification*. Washington: Butterworths, 1962.

Yamada, Toshihiro. "Kircher and Steno on the "geocosm," with a Reassessment of the Role of Gassendi's Works." *Geological Society of America Special Papers* 411 (2006): 65-80.