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DOI

[10.1007/978-3-319-96379-2_1](https://doi.org/10.1007/978-3-319-96379-2_1)

Publication date

2019

Document Version

Final published version

Published in

Gems in the Early Modern World

[Link to publication](#)

Citation for published version (APA):

Bycroft, M., & Dupré, S. (2019). Introduction: Gems in the Early Modern World. In M. Bycroft, & S. Dupré (Eds.), *Gems in the Early Modern World: Materials, Knowledge and Global Trade, 1450-1800* (pp. 1-32). (Europe's Asian Centuries). Palgrave Macmillan.
https://doi.org/10.1007/978-3-319-96379-2_1

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CHAPTER 1

Introduction: Gems in the Early Modern World

Michael Bycroft and Sven Dupré

Are there diamonds in Brazil? There was no straightforward answer to this question in the eighteenth century, despite the fact that, as we now know, diamonds were discovered in the mountainous region of Serro do Frio in the 1720s. The discovery is usually associated with a man named Bernardo Fonseca Lobo, who claimed credit for the discovery in a petition to the Portuguese crown.¹ But Lobo claimed to have made the discovery in 1723, five years before he showed the diamonds to the Portuguese Governor of Brazil. A plausible explanation for the delay is that Lobo had taken five years to identify the stones as diamonds. At any rate, that was the view of Sylvestre Garcia do Amaral, a lapidary from Lisbon who claimed to have made this identification before anyone else, in 1727. Amaral may have identified the stones by sight or, more reliably, by attempting to cut them on a rotating iron wheel sprinkled with powdered

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 648718).

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M. Bycroft, S. Dupré (eds.), *Gems in the Early Modern World*, Europe's Asian Centuries, https://doi.org/10.1007/978-3-319-96379-2_1

emery. As early modern lapidaries knew from daily experience, emery cuts ruby, sapphire, and rock crystal but not diamond.

Amaral was probably not (as he claimed) the first to identify the stones as diamonds, but he was right to stress his expertise as a lapidary. Raw diamonds are rough and cloudy, like pieces of translucent gravel, easily confused with the rock crystal that was being dug up and traded in Serro do Frio in this period. Even experienced traders took their precautions: a Huguenot merchant in Lisbon received stones from Brazil in the late 1720s, sent to him by a former servant who wanted “to know what they were”; the merchant sent the specimen to a London firm and learned that they were “good and handsome diamonds.” Expert judgements such as this one ensured that Brazil supplied most of the world’s diamonds for the rest of the eighteenth century. Analogous judgements were made on a



Fig. 1.1 “View of Negroes [sic.] washing for diamonds at Mandanga on the River Jigitonhonha in Cerro do Frio Brazil,” from Thomas Mawe, *Travels in the Interior of Brazil*, 2nd ed. (London, 1822). Image credit: Library of Congress/Internet Archive

daily basis throughout the century. One of the earliest illustrations of the diamond mines in Brazil, from the early nineteenth century, shows a line of black slaves bent over a riverbed, each overseen by a white man whose job is to appraise the minerals turned up by the digger at his feet (Fig. 1.1).

By mid-century, Brazilian diamonds were a reality for numerous merchants, slaves, mine owners, and lapidaries. But there remained a great deal of uncertainty about the origin and quality of the new stones. In a book published in 1751, the London jeweller David Jeffries went so far as to say that there was no such thing as Brazilian diamonds and that diamonds labelled as such were in fact from India. He claimed that merchants in Lisbon started selling their Indian diamonds as “Brazilian” ones when the king of Portugal banned the trade in diamonds with India; to lend plausibility to the fake name, these merchants maintained that Brazilian diamonds were inferior to Indian ones. The result of this de-valuation was a surplus of cheap diamonds that had depressed the diamond trade in London and threatened the livelihoods of merchants and gem-cutters in the capital. Jeffries hoped that his treatise would reverse this trend by exposing the ruse of the Portuguese traders and providing clear rules for determining the quality, and hence the price, of raw diamonds. Now, the price of a raw diamond depends on how much material must be removed when it is faceted, which in turn depends on the desired cut. So Jeffries went into great detail about the types of cut that were then in fashion and the procedures for executing these cuts. His book ends with a set of line drawings of diamonds of different sizes and cuts; Jeffries urged his genteel readers to use these drawings as templates for estimating the size and hence the price of their own diamonds.²

Jeffries’ book went through numerous editions and translations, but his conspiracy theory did not convince everyone. “All jewellers agree,” a French naturalist wrote in 1779, “that the Brazilian diamond is somewhat softer, lighter and less perfect than the Oriental one.” Scientists at the Royal Society of London and the Paris Academy of Science weighed in on the dispute, distinguishing Brazilian diamonds from Indian ones on the grounds of density, crystal structure, refractive index, and electrical conductivity. In doing so, they made use of newly discovered properties of gems (such as refractive index) and of new techniques for measuring old properties (such as the hydrostatic balance for measuring density). These scientists found their specimens where they could: an English scientist weighed a set of diamonds obtained from the East India Company; one of his French counterparts weighed diamonds from the crown jewels. The

differences these men detected were aesthetic as well as technical. The French naturalist Georges Buffon cited a note from the ambassador of the Holy Roman Empire: “Oriental diamonds have greater hardness, fire and brilliance than those from Brazil...An experienced eye is never mistaken.”³

The case of Brazilian diamonds illustrates the main themes of this volume. Firstly, the past can be fruitfully studied from the point of view of *materials*, in this case precious and semi-precious stones. The material properties of gems—their size, shape, and hardness; their varieties and sub-varieties; and the way they respond to the edge of a file or the light of a candle—made a difference to the way they interacted with humans. Secondly, gems are best studied from several different angles at once. The history of Brazilian diamonds could be written by an art historian, a cultural historian, a history of science, a historian of technology, or an economic historian, and for this reason, the history of precious stones is best written by a team that combines all these specialties. In merging these sub-disciplines, we are especially interested in exploring the role of *knowledge* in the history of gems, whether the knowledge involved in telling a ruby from a piece of coloured glass, in cutting a diamond into facets, or in explaining why emeralds occur in North Africa and South America but not in France or China. The third theme is the acceleration of the *global trade* in gems between 1450 and 1800 and in particular the integration of Europe and Europeans into that trade. This integration is nicely symbolised by the jewel shown on the front of this book, an eighteenth-century *tika*, or forehead ornament, set with green and red stones (possibly emeralds and rubies), and with shivers of diamond and pearls. Made in Surat, the most important port city at the north-west coast of India, the jewel travelled via channels connected to the Dutch East India Company to the stadholderly collection in the Dutch Republic.⁴ Global trade is the backdrop for the 11 chapters in the volume, each of which sheds light on the connections between the art, science, technology, and trade of these unusually mobile and versatile materials. Though most of the chapters take Europe as their starting point, most of them do not end there; together they range across Eurasia, as did the maps, networks, and commodities they examine. In the rest of this introduction, we summarise existing knowledge about gems in the early modern world before expanding on the three themes outlined in this paragraph.

1 THE GLOBAL GEM TRADE AND EUROPE

What does it mean to say that Europe and Europeans became integrated into the global gem trade in the early modern period? The history of the diamond trade, the most well-documented branch of the gem trade in this period, suggests the following answers.

Firstly, it does not mean that the trade was merely local before 1450 or that it excluded the lands west of the Nile and the Don. On the contrary, a map of diamond trade routes between 100 BC and 300 AD takes in the length, if not the breadth, of Eurasia. From their origins on the Indian subcontinent, diamonds travelled to China via modern-day Sri Lanka and Thailand; they travelled north as far as the Ural mountains; and they travelled west via the Red Sea and the Persian Gulf to the port cities of the Mediterranean.⁵ The flow of diamonds from India to the Mediterranean slowed after the fall of the Roman Empire, but it never ceased altogether and it thickened from the thirteenth century onwards. As early as the eighth century, Venetian traders were buying gems in Aleppo and Alexandria and bringing them to Pavia, where their buyers included agents sent by Charlemagne. In the tenth century, gems were mentioned in a treaty settled between Greeks and the Muslim rulers of Aleppo. In the thirteenth century Venice set up trade missions in Aleppo and Alexandria, and the importance of gems to these missions is shown by treaties concluded between Venice and the Muslim rules of Egypt and Syria between 1238 and 1353. A merchant's handbook written in Europe in about 1490 describes the flourishing trade of diamonds out of Venice on the eve of European landfall in India and Brazil. The author refers to diamonds bought by Venetians in the Near East and then sent west from Venice, the cut diamonds going to Lisbon and Paris and uncut diamonds to Antwerp.⁶

This trade was transformed by the arrival of Europeans in South America in 1492 and by their arrival in the Indian Ocean by sea in 1498. The most obvious consequence of these voyages was the physical proximity of Europeans to diamond mines and to the merchants who frequented them. Europe no longer relied for its diamonds on the Persian and Arab middle-men who had controlled most of the gem trade through the Levant since antiquity.⁷ They were now able to purchase diamonds at the mines themselves or at trading centres with a direct link to the mines, notably Goa and Madras. At its peak early in the sixteenth century, Goa was the largest market for precious stones in Asia, and although the best of the diamonds sold there probably went to the agents of local rulers,

many also found their way to Europe. According to an Italian visitor in this period, it was easy to find “a Portuguese merchant, well skilled in that trade, to make a small purchase in diamonds on one’s behalf, they being cheap at Goa.” The sea route from Goa to Lisbon had the advantages of security, ease of transport, and freedom from taxation and regulation.⁸ By the second half of the seventeenth century, these advantages had shifted from Portuguese Goa to English Fort St. George; the latter went on to become “the most important Indian diamond centre for most of the eighteenth century.”⁹ The immediate causes of this shift were, firstly, the arrival of Jewish merchants in London from the 1650s onwards and, secondly, the opening up of the English diamond trade with India, first to officials of the East India Company (1650) and then to anyone prepared to share their profits with the Company (1644).¹⁰

The early modern period saw not only better access to existing sources of diamonds but also fresh access to sources that had previously been unconnected to Europe. The first new sources were from the Far East. The island of Borneo had supplied China with diamonds since ancient times, but very few of these specimens reached Europe before the arrival of English, Dutch, and Portuguese adventurers in the region in the sixteenth century. The English traveller Ralph Fitch may have bought some of them: his account of his travels in South East Asia in the period 1583–1591 shows that he had a commercial interest in gems and that, while in Mulacca, he saw diamonds that had been found in “an Iland among the Javas,” probably a reference to Borneo.¹¹ Two decades later, agents of the Dutch East India Company were making regular purchases of Borneo diamonds from their base at Batavia.¹² Much more important for the global trade in gems, and for the place of Europeans in that trade, was the discovery of diamonds on the other side of the Pacific Ocean. At first, Brazilian diamonds were mined by opportunistic merchants or goldminers. Over time, the Portuguese crown tightened its grip on this activity, establishing a monopoly on the mining of Brazilian diamonds in 1739 and a monopoly on their distribution from Lisbon in 1753. For the first time, a major world source of diamonds came under the direct control of a European power.¹³

Along with greater access to the sources of diamonds came a dramatic increase in the quality and quantity of diamonds flowing into Europe. The increase in quality is attested by the collections of European dukes, kings, and princes, many of which contain specimens that are famous for their size and splendour and that first entered European treasuries in the early

modern period. A typical example is the “Pitt diamond,” also known as the “Regent’s diamond,” a stone that was (according to the most likely story) bought in Madras in 1701 by a director of the East India Company and former diamond merchant, Thomas Pitt, before being sold to Philippe II soon after he became the Regent of France in 1715.¹⁴ The increased quantity is indicated by business records, such as those of the English East India Company (which imported 92,000 pounds worth of diamonds in 1698) and of the company that owned the crown monopoly on diamond mining in Brazil (which extracted over 50,000 carats per year for much of the eighteenth century).¹⁵ To these figures we must add the many diamonds that entered Europe by unofficial means, whether in the pockets of private travellers, in the cargo of contraband ships, or in the cabins of unscrupulous officials of the Dutch and English East India Companies. According to one estimate, half of all Brazilian diamonds entering Europe in the eighteenth century had not passed through the hands of the merchants who owned the official monopoly on this trade. In the words of one historian, “jewel trading must surely have constituted one of the greatest semi-visible, half-clandestine economic activities of the early modern period.”¹⁶

The flow of diamonds did not stop at the main European trading centres of Lisbon, London, Antwerp, and Amsterdam. A web of merchants and travellers connected these centres to other European cities. Paris is a case in point. This city rarely enjoyed direct access to the global diamond trade—Jean-Baptiste Tavernier’s lucrative voyages during the reign of Louis XIV were the exception rather than the rule—but it was well-stocked with diamonds through the seventeenth and eighteenth centuries. As early as the 1590s, Henry IV employed jewellers of Flemish and Portuguese origin to purchase stones from Lisbon, London, Antwerp, and Amsterdam; later rulers continued this tradition, especially Cardinal Mazarin and Louis XIV.¹⁷ Beyond the royal sphere, goldsmiths and lapidaries in Paris were supplied by several trans-European diamond networks. The Hellemens family had an agent in Paris sometime around 1600; the Huguenot jeweller Jean Chardin retained contacts in Paris after he fled to England in 1681; two other Huguenot merchants, Paul Berthon and Peter Garnault, left France after the Revocation of the Edict of Nantes in 1685 and sent diamonds back to France from their new home in Lisbon.¹⁸ As diamonds moved eastwards to Paris, they also moved down the French social hierarchy. In fifteenth-century France, diamonds had been the preserve of royalty and nobility. By the start of the eighteenth century they were widely

owned by clerks, notaries, merchants, and artisans, as shown by a 1701 document in which the shopkeeper's guild of Paris implied that *half* of their trade in diamonds was with these groups and the other half with people of noble birth.¹⁹ Diamonds became available to commoners elsewhere in Europe at roughly the same time: in Hamburg at the end of the seventeenth century, diamond jewellery replaced gold chains as must-have items for the wives of successful shopkeepers.²⁰

None of this implies that the integration of Europe into the global gem trade was smooth or one-sided. The diamond commodity chain was tangled, rusty, and often bloody. Diamond mining was a form of drudgery made worse by the brutality of rulers and colonialists. Diggers in mines in India risked being crushed by falling earth or (if they dared to sell the diamonds they found) being beaten to death by their overseers.²¹ The bulk of the labour at Brazilian mines in the eighteenth century was done by slaves, of which there were at least 2000 working in the mines at any one time, most of them from West Africa.²² Diamond trading, too, was a risky business, especially when it involved travelling long distances with a cargo of precious stones—the Flemish merchant Jacques de Couttre took 25 armed retainers with him on one of his trips from Goa to inland diamond mines.²³ In both mine and market, Indian diamonds were dominated by non-Europeans. The local rulers who controlled the diamond mines on the subcontinent claimed the largest diamonds for themselves; they also sustained the gem trade by sending their agents to buy specimens at emporia such as Goa.²⁴ Hindu and Muslim merchants in India were not merely intermediaries between mine owners and Europeans but were entrepreneurs in their own right; some of them built wide commercial networks that extended into Arab and Persian territories and that made life difficult for European merchants in India.²⁵ Successful transactions in the diamond trade were complicated cross-cultural events that unfolded over a period of months or even years. An exchange of Mediterranean coral for Indian diamonds, for example, could take two to three years to complete and involve the coordinated activity of Jewish merchants in Livorno, Catholic agents in Lisbon, and Hindu merchant-brokers in Goa.²⁶

Diamonds were not the only gems whose trade was transformed by the commercial extension of Europe into the Americas and the Indian Ocean. Pearls and emeralds followed a similar pattern to diamonds, though with notable differences of chronology and geography. Pearl fisheries are more numerous and widespread than diamond mines, with the result that pearls have been traded and consumed on a large scale since antiquity. Europe is

no exception—pearls occur naturally on the British Isles and on the Continent, and the world’s most illustrious pearls have long been those of the Persian Gulf, nearer to hand for Europeans than the diamond mines of India.²⁷ European voyages of discovery nevertheless had a dramatic effect on the trade. In the New World, Europeans encountered pearls as early as Columbus’ third voyage of 1498, four decades before they captured the emerald mines of Colombia and more than two centuries before the discovery of diamonds in Brazil. In the Old World, the Spanish and Portuguese were “in control of all the principal pearl fisheries” by the end of the sixteenth century, at a time when Europeans controlled no diamond mines whatsoever. The result was a flood of pearls into Europe that left a heavy cultural deposit, whether in the plays of Shakespeare, the essays of Montaigne, or the jewellery sported by noble men and women in painted portraits.²⁸

Emeralds were less abundant than pearls but more widely travelled and more specific to Europeans. The global trade in emeralds began in earnest in the 1560s, when the Spanish crown seized control of emerald mines in Muzo, an inland region of present-day Colombia, not without butchering and enslaving the local people. The trade flourished in the following 80 years, thanks to the freshness of the mines, the quality of the stones compared to their Old World equivalents, and the demand for the stones in the Old World, especially among Muslim rulers in South Asia. European merchants helped to satisfy this demand by shipping the stones from the heart of the New World to the heart of the Old, usually via European gem-trading centres such as Lisbon, London, Antwerp, and Amsterdam. By 1600, Europeans trading across South Asia were using Colombian emeralds to buy diamonds from Golconda, rubies from Burma, and other sought-after Eastern stones.²⁹ With Spanish control of Colombian emeralds, the gem trade became truly global in scope.

Other species followed different paths to diamond, pearl, and emerald and involved Europeans in different ways. The turquoise trade was dominated by Central Asian empires throughout the early modern period, when nearly all the world’s high-quality turquoise came from mines near the town of Nishapur, then part of the Safavid empire. Turquoise, and information about turquoise, reached Europe in increasing quantities over the period, but the stone remained an exotic curiosity in Europe rather than a consumer good that transcended social boundaries.³⁰ As for coral and amber, no voyages of discovery were required to obtain these stones, which had been found on the doorstep of Europe since antiquity, in the

Mediterranean and Baltic seas, respectively.³¹ Different gems had different itineraries, a point to which we shall return at the end of this introduction. But enough has been said to raise the question of how European culture was shaped by its entry into the trade in major species of gem in the early modern period.

2 GEMS IN EARLY MODERN ART, SCIENCE, AND TECHNOLOGY

The growth of the global gem trade was accompanied by changes in the way gems were cut, polished, appraised, consumed, classified, and understood. The crucial technological change in Europe was the development of cutting, the art of slicing through a gem in a plane to create one or more artificial faces. Related arts had existed since antiquity in India and the Islamic world as well as in the Mediterranean region; these arts included piercing, engraving, and polishing gems, which had been carried out with techniques such as abrasives and hand-powered wheels.³² In Europe in the Middle Ages, however, stones were generally left with their natural shape, whether this was rough or regular; some polishing and smoothing was done as a finishing touch, but nothing more. The first clear evidence of diamond cutting in Europe dates from the first decade of the fifteenth century.³³ Detailed descriptions of the cutting process appeared from the sixteenth century onwards, showing vices and solders for holding the diamond in place, metallic disks against which the diamond was ground, and hand-powered systems of wheels and belts for driving the disk.³⁴ As the skills of lapidaries increased, so did their level of organisation. Communities of cutters and polishers appeared in Venice, Bruges, Antwerp, Amsterdam, and London, roughly in that order; some of these communities formed their own guilds, such as the Antwerp guild of diamond- and ruby-cutters (formed in 1582) and the Paris guild of lapidaries (1584).³⁵ The history of diamond cutting was intertwined with that of other stones, such as rock crystal, rubies, sapphires, and emeralds. The Parisian guild created in 1584 included crystal-cutters, pearl-piercers, and engravers of hard stones such as agate and lapis lazuli, as well as diamond-cutters.³⁶

With the invention of cutting came the proliferation of different kinds of cuts, a topic that straddles art history and the history of technology. The evolution of diamond cuts can be traced in paintings, apprenticeship records, inventories of major treasuries, and in surviving examples. The

table cut, made by removing the upper and lower apices of an octahedral diamond, appeared as early as the end of the fourteenth century; the brilliant cut, an elaboration of the table cut in which each face is divided into multiple facets, emerged in the latter part of the seventeenth century. Yet, early modern cuts were defined less by these two developments than by the sheer variety of new cuts, each shaped by the whims of patrons, the ingenuity of artisans, the ebb and flow of fashion, and the availability of raw diamonds of different shapes and sizes. A modern authority on the topic describes no less than 21 different types of early modern brilliant.³⁷

In addition to the proliferation of cuts, art historians have documented the richness of early modern jewellery collections and mapped variations in taste across time and space. In the specialised history of jewellery, typically tied to objects in museum collections, the courtly appetite for jewels and gems is particularly well documented. Two prominent examples are the Victoria and Albert Museum in London and the Green Vault in Dresden.³⁸ Already in the fifteenth century, gems were highly valued at the Burgundian court; inventories show that they were prized possessions of the dukes of Burgundy.³⁹ In France, the royal passion for diamonds reached its peak in the person of Louis XIV, who owned 12 million livres worth of diamonds by the time of his death in 1715, most of which he wore at a reception of a Persian ambassador in the previous year.⁴⁰

The growth of extravagant royal collections was accompanied by a range of subtler changes in the way gems were set, worn, and displayed and in the types of gems favoured by consumers. Some of these changes were in step with wider developments in European art. “Baroque” pearls were popular in the Renaissance; later they gave their name, and their bold irregular shape, to an entire artistic movement. Early in the eighteenth century, brilliant-cut diamonds found a natural home in the glittering interiors of rococo Paris. Later in the century, natural crystals became common in French mineral collections at the same time that simple geometric forms gained popularity in painting, sculpture, and architecture.⁴¹ Other changes appear to have been specific to gems. The abundance of diamonds in British jewellery in the mid-eighteenth century has more to do with the burgeoning trade in diamonds from Brazil than with a general stylistic change. The evolution of gem settings in the fifteenth and sixteenth centuries—from bowl-shaped hollows, to settings made of petal-shaped foils, to the use of enamel on the setting—is equally immune to a generic explanation. The winds of fashion baffled even contemporaries. The French jeweller Pierre de Rosnel, writing in the middle of the seven-

teenth century, was at a loss to explain why hyacinth had declined in value since antiquity.⁴²

Gems were also caught up in the new ways of understanding nature that emerged in early modern Europe. These innovations grew out of the medieval tradition of writing “lapidaries,” lists of precious and semi-precious stones with short descriptions of each.⁴³ Between 1500 and 1800, the lapidary tradition was transformed under the pressure of the new science, especially the mechanical philosophy of Pierre Gassendi and René Descartes, the experimental programmes pursued at the Royal Society of London and the Paris Academy of Sciences, the chemical analyses carried out in connection with German and Swedish mines, and above all, the rise of thorough-going classification schemes in natural history.⁴⁴ By 1800, the lapidary had fallen from favour as a literary genre, replaced by books on the newly minted sciences of crystallography, mineralogy, and geology, and by articles scattered through learned journals on everything from the quantity of chromium in emeralds to the refractive index of rock crystal. The decline of the lapidary reflected the decline of the “gem” or “precious stone” as a natural kind. The authors of medieval lapidaries defined their subject-matter generously to include everything from diamonds and rubies to agate and toadstone. The category narrowed from 1500 onwards, with naturalists excluding opaque stones such as jasper and turquoise, organic matter such as pearls and amber, soft stones such as rock crystal, and even (in the case of Georges Buffon) emerald. Despite these mutations, the category was remarkably long-lived. Only at the very end of the eighteenth century did naturalists start to say that the terms “gem” and “precious stone” refer not to a natural kind but to an arbitrary collection of objects brought together by the aesthetic preferences of human beings. For most of the period covered by this book, “gem” and “precious stone” were at once natural categories and aesthetic and commercial ones.

All these developments—in technology, the decorative arts, fashion, and the sciences—were shaped by the accelerating global trade in gems. The connections were not straightforward. There was no formula for converting an abundance of gems into a new machine for cutting them, a new method of setting them, or a new theory for explaining them. But connections existed nonetheless. European cutters worked for Asian consumers, with raw diamonds arriving in Europe and being sent back East once they were cut. Some European lapidaries worked in Asia itself, such as the Portuguese cutters who set up shop in Goa, or the Antwerp-born cutter and polisher Abraham de Duyts, who spent more than a decade in the

service of the Mughal emperor Shah Jahan.⁴⁵ In the 1660s, the Safavid emperor Shah ‘Abbas II worked closely with the French jeweller Jean Chardin to design and purchase jewellery for his own use.⁴⁶ Meanwhile, at courts in Europe, the abundance of raw material meant that royal artisans could experiment with new cuts without risking the wrath of their patrons: the lapidary who cut the “French Blue” for Louis XIV may well have honed his skills on the 1000 other diamonds that Jean-Baptiste Tavernier delivered to the king at the same time as the famous blue stone.⁴⁷ Novelty could emerge from scarcity as well as abundance: there is some evidence that the rose cut was invented by lapidaries in Antwerp who tried to achieve the visual effect of table-cut diamonds with the flat pieces of raw diamond they received from their more prosperous counterparts in Amsterdam.⁴⁸ The transfer of an artistic style from one culture to another is notoriously hard to track, all the more so in the case of rare and customised objects such as early modern jewels. Art historians have nevertheless been able to show that the techniques of filigree and enamelling entered Mughal jewellery through Portuguese artisans active in Goa. An influence in the opposite direction can be detected in, for example, the gem-setting technique used in a jewel first recorded in 1619, in the inventory of Maximilian III, Archduke of Austria.⁴⁹

In the lapidary tradition, one of the mechanisms that converted a global trade in gems into new ideas about gems was the travel narrative. At the beginning of the fifteenth century, when Jan van Eyck painted the Fountain of Life surrounded by a canal filled with crystal clear water and precious stones seemingly randomly scattered in this little stream on the central panel of the Ghent Altarpiece, the origins of gems were shrouded in mystery (Fig. 1.2). Following Augustine’s commentaries on the book of Genesis, medieval theologians, natural philosophers, and travel chroniclers believed that precious stones grew in Paradise and were carried by four paradisaical rivers spreading them over the Earth. The source of these rivers, and thus earthly Paradise, was invariably thought to be in the East. A famous twelfth-century chronicle, the Letter of Prester John, widely disseminated the idea of the location of the Garden of Eden in India and of precious stones as indicators of the proximity of earthly Paradise. Perhaps the most read travel chronicle up to the sixteenth century, written by John Mandeville at the end of the fourteenth century, presented India as the land of plenty, especially with respect to spices and gems.⁵⁰ These ideas coloured the expectations of Europeans arriving in the Americas and the Indian Ocean in the sixteenth century.⁵¹

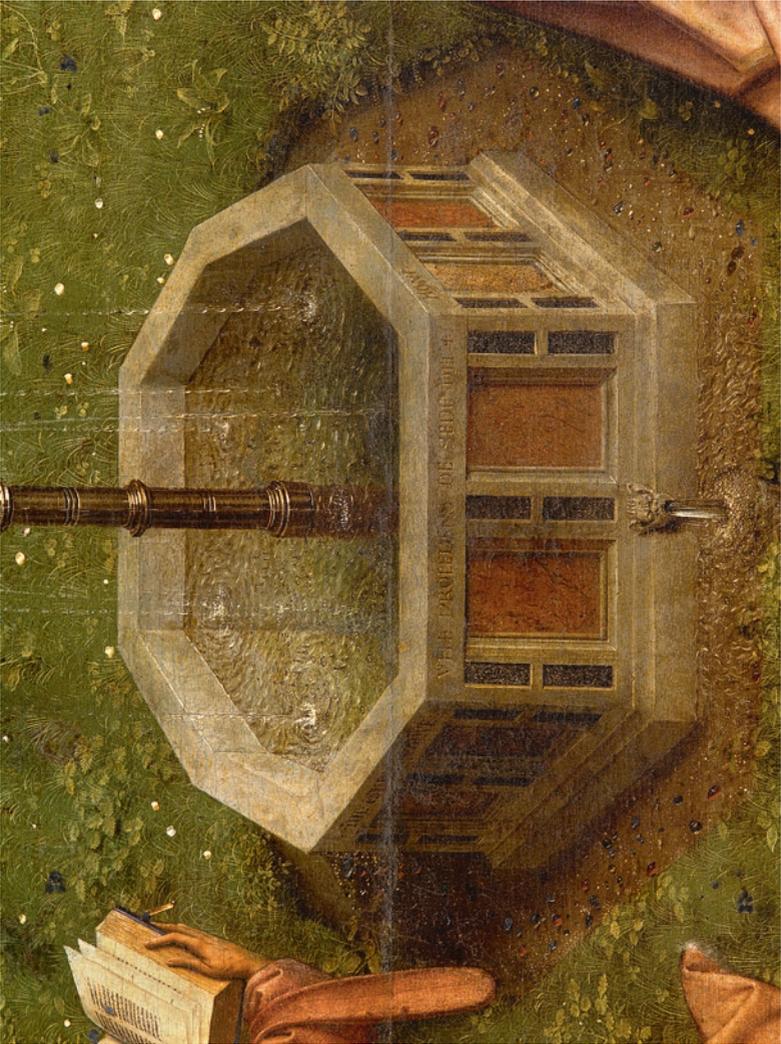


Fig. 1.2 Jan Van Eyck, "Adoration of the Lamb" (Central Panel, Detail), Ghent Altarpiece, 1432, Saint Bavo's Cathedral

Some of these travellers wrote their own chronicles, and in doing so they greatly increased the scope and accuracy of European ideas about foreign gems. At the beginning of the sixteenth century, Duarte Barbosa, who circumnavigated the world with Magellan, brought together a great deal of first-hand knowledge about the trade, technology, and localities of gems in the Indian Ocean. At the end of the same century, Jan Huygen van Linschoten did the same for a Dutch audience in his *Itinerario*. The genre culminated with Jean-Baptiste Tavernier's account of his travels in Persia and India, published at the behest of his patron Louis XIV in 1676. The data gathered by merchants and other travellers eventually found their way into treatises on the natural history and natural philosophy of gems, such as those written by the Prague physician Anselmus Boethius de Boodt and the English experimenter Robert Boyle.⁵² The impact of global trade on the lapidary tradition, like its impact on technology and decorative arts, was complex and indirect. These subtle but significant connections are one of several themes of this volume.

3 MATERIALS, KNOWLEDGE, AND GLOBAL TRADE

As the footnotes to the previous two sections show, there are large bodies of literature on the early modern gem trade and on early modern jewellery, and a smaller but growing literature on the science and technology of gems in the same period. The basic aim of this volume is to enrich this literature by gathering between two covers a set of original research papers on early modern gems. But we also have grander ambitions, the first of which is to integrate the various sub-disciplines under which gem history is usually written—art history, economic history, history of science, history of medicine, and history of technology. Collected volumes that cover all these aspects of gems do exist, but they tend to be made up of chapters that are each dedicated to only one of those aspects. Books dedicated to one or other aspect usually have something to say about the other aspects—books on early modern jewellery usually refer to the discovery of diamonds in Brazil, for example—but these interdisciplinary remarks tend to be marginal to the books' main purpose. We have learnt a great deal from such books and from a pair of recent monographs on early modern gems that have pioneered a more interdisciplinary approach to the topic.⁵³ But we believe the current literature gives only a partial answer to some crucial questions. These questions include the one that opens this introduction—how did early modern people verify reports about the existence of new

deposits of gems in distant lands?—as well as an array of other questions addressed in this volume. What difference did the perceived geographical origin of gems make to their value? What role did information about the geological locations of gems play in ideas about how gems are formed in the Earth? How did merchants settle on definitions of the types of gems that interested them, on terms for the types they defined, and on tests for distinguishing one type from another? And how did jewellers and lapidaries make use of written information about gems—their prices, localities, geometry, and so on—that proliferated in an age of increasing global travel and communication?

Each of these questions cuts across disciplines. Each of them is also a question about knowledge, about how people find things out. These questions bring to mind learned traditions such as natural history and natural philosophy, but they take us well beyond the library and the lecture hall. They take us into the mines and seabeds where gems were found, the markets where they were bought and sold, and the workshops where they were cut, polished, and mounted. They are eminently practical questions, ones that had to be answered before gems could be wrought by human hands and traded for a profit. To take one example, there was a constant concern with fake stones across Europe since at least the thirteenth century. Goldsmiths often used imitation stones to set in jewels and bejewelled objects, such as the Westminster Retable.⁵⁴ Medieval guild statutes for goldsmiths forbade or regulated the use of fake stones in jewellery (especially rings) and other forms of goldsmiths' work.⁵⁵ For example, the mercers of Paris were forbidden to use fake pearls (and also Scottish pearls, obtained from fresh-water mussels in Scottish rivers) as cheap substitutes for oriental pearls. By 1355, the new statutes of the Paris goldsmiths' guild forbade the use of crystal (beryll) cut to resemble diamonds. In Venice, a new ordinance of the later 1280s forbade goldsmiths to make imitations of natural stones or to enhance a natural stone by tinting it. The very first document concerning the Antwerp diamond trade, dated 1447, is a proclamation against the sale of false stones. It concerned diamonds, rubies, sapphires, and emeralds and proclaimed that it was punishable to produce, process, trade, or pawn false stones.⁵⁶ This constant concern with false stones indicates that their counterfeiting was common and widely practiced. The response from artisans and naturalists was to propose a growing number of tests for telling real stones from fake ones, from the straightforward (scratching the stone with a file) to the recondite (weighing the stone in air and water to determine its density). The evolution of

these tests is a topic that falls between the cracks of a range of historical sub-disciplines. Like the other questions of knowledge dealt with in this volume, it is ripe for interdisciplinary treatment.

The other two key terms in this volume—materials and global trade—have become a popular combination in recent years. Adopting the categories of “social lives” and “cultural biographies” of things (from the work of respectively Arjun Appadurai and Igor Kopytoff), a conglomerate of art historians, historians of science and technology, and historians of consumption have used the trajectories and itineraries of “things” and objects as a window on to global history.⁵⁷ Most recently, Daniela Bleichmar, Paula Findlen, Anne Gerritsen, and Giorgio Riello, among others, have shown that motion—in the elementary sense of movement through space and in the richer sense of movement from one culture to another—helps to make objects what they are. The motion of objects is integral to what they mean to different people along their travels around the globe.⁵⁸ The study of material culture opens up “spaces of global interactions”; in the words of Anne Gerritsen and Giorgio Riello, objects embody “the material interconnectedness of the early modern world.”⁵⁹

This book is a contribution to the global history of things and objects. However, it stands out from existing literature in this area by its focus on materials rather than things or objects and by its choice of gemstones as a material. We draw upon recent work by anthropologists, historians of science, and art historians, who have studied a range of materials, from ink to lapis lazuli, with a view to finding out how they were made, consumed, and understood, and how humans imbued them with meaning.⁶⁰ Among early modern materials, gems are distinctive for their wide dispersion and high status. They were widely dispersed because they were portable, desirable, and rare and because of the difficulty of imitating them by artificial means. They travelled widely because they *had* to travel in order to move from mine to market and because they were *easy* to transport in the declared cargo of galleons and caravans as well as (more often) in the pockets and orifices of intercontinental smugglers. In this sense, gems were an exemplary early modern good. But in another respect, they were unusual. Unlike porcelain, tea, and printed cotton, they were very expensive, impossible to manufacture on a large scale, and they had been known as luxuries in ancient Greece and Rome.⁶¹ They were “old” rather than “new” luxuries—or rather, they were an old luxury that took on a new life in the early modern world.

4 THIS VOLUME AND BEYOND

The 11 chapters in this book are organised into 3 parts on motion, value, and skills, respectively. The chapters are grouped by theme rather than by discipline or region; within each part, they are organised as nearly as possible in chronological order. The first part sets the scene by describing how gems moved around the early modern world, how they were set in motion, and how they were pulled together in the course of their travels. We begin with Hugo Crespo's study of the contents and dispersal of the Ceylonese royal treasury in the middle of the sixteenth century. An inventory of the treasury drawn up by a Portuguese official gives us a remarkably detailed account not only of the contents of the Ceylonese crown jewels—including their price, weight, and the identity of the gems they contained—but also of the fate of these jewels after they were seized by the Portuguese viceroy in Ceylon. Next, Christina Anderson follows the paths of gems in a different way by surveying the commercial network of the Hellemens family, a merchant family of Flemish origin whose concerns included diamonds, rubies, and emeralds. With agents in Venice, Paris, Lisbon, Goa, and Constantinople, the Hellemens network illustrates the vast distances travelled by gems as well as the complexity of their movements and the difficulty of sustaining these movements over a long period of time. Finally, Claire Sabel links up a source of gems at one end of Eurasia with a sink of gems at the other end of Eurasia. The source was the ruby and sapphire mines in Siam and Pegu; the sink was the English natural philosopher Robert Boyle. The philosopher was especially interested in coloured gems and in the terrain in which they were found, information that was newly available in Restoration London in the form of travelogues written by Europeans with first-hand experience of the Asian gem trade. The vigour of the gem trade in London meant that Boyle could observe rubies being cut and speak to people who had observed diamonds being taken from the mine, all without leaving the capital.

What drove these complicated transfers of materials? What did people see in gems, how did they see it, and how did the things they saw in a gem depend on where the gem came from? The five chapters in Part II supply some answers to these questions about the value of gems. Anna Grasskamp explains why coral was valued by artists in Ming China: because it was a powerful symbol, an object that connoted foreignness, the marine world, and processes of transformation, and because these features were compatible with traditional Buddhist iconography. The result was the hybrid

works of art that Grasskamp analyses against the backdrop of the increased availability of Mediterranean coral to Chinese collectors in the late Ming period. Next, Michael Bycroft notes that the notion of “foreignness” was present in European mineralogy in the form of the distinction between “Oriental” and “Occidental” gems, where the former term connoted hardness, beauty, and high value. This distinction entered natural history treatises in the sixteenth century; a study of one such treatise (Boodt’s *Gemmarum et lapidum historia*) suggests that the distinction was due in part to changing ideas about how gems were distributed around the globe. The relationship between the value of gems and their classification is also the theme of Marcia Pointon’s chapter. Whereas Bycroft focuses on a naturalist and on gems in general, Pointon focuses on merchants and collectors and on one category of gem, the lasque. Like “Oriental” gems, lasques were defined in part by where they came from, in part by their physical properties (especially their shape), and in part by their degree of perfection. Pointon emphasises the variability of the category: “lasque” meant different things to different people at different times. Variability is also the theme of Marieke Hendriksen’s chapter on the decline of lapidary medicine in eighteenth-century Holland. There is no doubt that this decline occurred, but it occurred earlier in academic medicine than it did in practical pharmacy. This discrepancy can be explained by the fame of individual physicians such as Herman Boerhaave and by persistent consumer demand for gem-based remedies.

Hendriksen’s chapter is a reminder that raw gems were not usually valued for their own sake but only after being ground into a paste or set in a necklace (in the case of medical stones) or after being cut, polished, and mounted in precious metals (in the case of jewellery). The skill involved in these processes is the subject of the final set of chapters. Taylor Viens describes the making of the Mughal style in the lapidary arts. This style was the result of a convergence of artisans from different ethnic groups who each made a distinctive contribution to the whole, as can be seen on objects such as the gem-studded falcon that Viens analyses in detail. Viens emphasises the persistence of tradition and the sensitivity of lapidaries to the hardness of gems. These themes recur in the next chapter, where Marjolijn Bol considers descriptions of the polishing process written down by Europeans between the twelfth and sixteenth centuries. These accounts show that European lapidaries had a detailed knowledge of the polishing process well before the introduction of diamond faceting into Europe in the fourteenth century. This knowledge concerned the relative hardness of

different gems, the abrasives and lubricants that were suitable to different gems, and the order in which these substances should be applied to any given gem. Karin Hofmeester surveys the diamond industry in Europe after the introduction of faceting, paying particular attention to printed texts that contained practical advice on the polishing process and on the gem trade in Europe and elsewhere. Some of these texts were probably used by artisans and merchants; many of them attest to the global orientation of their authors, whether in the sources of their data or the commercial interests of their intended audience. Finally, Marlise Rijks employs the concept “process appreciation” to account for the interest in the manipulation of gems and the production of counterfeited gems in early seventeenth-century Antwerp. In the early modern period, the making processes employed by artisans were elevated to a higher status and became appreciated by scholars and collectors alike. Process appreciation in relation to gemstones also implied the scientific interest in the natural origins of gems, which, as Rijks argues, was often understood analogously to artisanal making processes.

The chapters in this volume cover a lot of ground, but we cannot say that we have left no stone unturned. Future research in this area will cover new regions and periods, make new comparisons, and examine new stones. Three quarters of the chapters in this volume focus on Europe and its connections with other parts of Eurasia. Yet, the themes of materials, knowledge, and global trade are (obviously) not specific to Europe, and nor are they specific to Eurasia or the period 1450–1800. China, like Europe, is poorly endowed with deposits of major gemstones such as ruby, sapphire, emerald, and diamond, and yet these stones have made their way to the Middle Kingdom since at least the first century AD.⁶² A map of pearl sources referred to in Chinese texts before 1500 runs from Java in the south to Manchuria in the north and from Mecca in the west to Japan in the east.⁶³ In the Islamic world, the lapidary tradition flourished from at least the tenth century, and some of the treatises in this tradition contained precise measurements of the density of gems at a time when such measurements were unknown in Europe.⁶⁴ The appetite for gems at the Ottoman court in Istanbul, and the Mughal court in seventeenth-century India, was at least as great as that in their European counterparts—from 1590, there were three separate treasure rooms for precious stones, jewels, and gold at the Mughal court.⁶⁵ There are many studies of the gem trade, jewellery, the lapidary arts, and the classification of gems that deal with the Islamic and Asian worlds. But this literature, like its European equivalent, would benefit from the interdisciplinary approach taken in this volume.

Although we focus on connections between different regions of the world, gems lend themselves just as well to comparative study, since they have been treated in remarkably similar ways by geographically disparate cultures. The idea that pearls are formed from raindrops was present in India in 600 BC, Rome in the first century AD, Baghdad in the tenth century AD, and England in the seventeenth century. The decorative use of pearls—including the practice of drilling them for the purpose of running a thread through them—developed independently in the Americas and Eurasia by the end of the first millennium AD. In the fourteenth and early fifteenth centuries, rubies and gold became a highly prized combination at courts across Eurasia.⁶⁶ Some of these parallels are no doubt due to connections—textual, diplomatic, and commercial—between different parts of the world. But they also hint at the power of objects to draw, by virtue of their bare material properties, a common response from different cultures.

The response so drawn depends on the material properties in question, and since different gems have different material properties, it follows that different gems have different histories. Some of these histories are largely unwritten. Historians are yet to do for rubies, for example, what Kris Lane has done for emeralds. They are yet to examine the numerous early modern sources relating to rubies and draw them together in a single study that merges the histories of art, trade, and technology. Unlike diamonds, rubies were widely imitated in coloured glass, and unlike emeralds, they were found in Asia but not in the Americas. Their capacity to glow in the dark made them a staple of natural philosophical treatises. And the subtle differences between ballas rubies, spinel rubies, and sapphires were a perennial puzzle for merchants and taxonomers. Like the other stones covered in this volume, rubies are an excellent subject for historians interested in materials, knowledge about materials, and the place of both in global trade.

NOTES

1. This paragraph and the following one are based on Tijn Vanneste, “Diamonds in South America,” from an unpublished book manuscript, and on a manuscript transcribed by Tijn Vanneste and communicated to the authors. The manuscript is from Archives du Ministère des Affaires Étrangères (Paris), Mémoires et Documents, Portugal (vol. 2), p. 340.
2. David Jeffries, *A Treatise on Diamonds and Pearls* (London, 1751), esp. 65–87. For an inventory of later editions of this treatise, see John Sinkankas,

- Gemology: An Annotated Bibliography* (Metuchen, NJ: Scarecrow Press, 1993), vol. 1, 511–13.
3. J. Demeste, *Lettres au Dr Bernard sur la chymie, la docimasia, la cristallographie, la lithologie, la minéralogie et la physique en general* (Paris, 1779), vol. 1, 407–9 (“tous les joailliers”, crystal structure, electricity). John Ellicot, “A Letter from Mr. John Ellicot, F. R. S. to the President, concerning the Specific Gravity of Diamonds”, *Philosophical Transactions of the Royal Society of London* 43 (1744): 468–72, esp. 470 (East India Company diamonds). Georges Buffon, *Histoire naturelle des minéraux*, vol. 4 (1786), 266 (crystal structure, refractive index, ambassador). Mathurin-Jacques Brisson, *Pesanteur spécifique des corps: ouvrage utile à l’histoire naturelle, à la physique, aux arts et au commerce* (Paris, 1787), 62–4 (several crown jewels).
 4. Pauline Lunsigh Scheurleer, “Twee oosterse sieraden uit de stadhouderlijke verzameling”, *Bulletin van het Rijksmuseum* 44 (1996): 15–26. Our thanks to Suzanne van Leeuwen, curator at the Rijksmuseum, for informing us about the history of the collection.
 5. Godehard Lenzen, *The History of Diamond Production and the Diamond Trade* (Barrie & Jenkins Ltd, 1970), 36–7 (Red Sea and Persian Gulf to Mediterranean), 39–40 (Ural mountains), 41 (China via Sri Lanka and Thailand), 42 (map of diamond trade routes in antiquity).
 6. *Ibid.*, 61 (merchant’s handbook), 62 (thirteenth-century trade), 83 (thirteenth- and fourteenth-century trade).
 7. *Ibid.*, 37–8. Cf. George Winius, “Jewel Trading in Portuguese India in the XVI and XVII Centuries”, *Indica* 47 (1988): 15–34, on 33.
 8. Winius, “Jewel Trading”, 22 (importance of Goa), 24 (local rulers), 23 (“Portuguese merchant”), 16, 22–3 and 29 (advantages of Goa-Lisbon route). João Teles e Cunha, “Hunting Riches: Goa’s Gem Trade in the Early Modern Age”, in *The Portuguese, Indian Ocean and European Bridgeheads: Festschrift in Honour of Prof. K.S. Mathew*, ed. Pius Malekandathil and T. Jamal Mohammed (Lisbon: Fundação Oriente, 2001), 269–303, on 290 and 295 (size of Goa market at its peak), 281, 291 (freedom of Portuguese trade), 291–6 (brief regulation of Portuguese trade).
 9. Vanneste, 47, cf. Gedalia Yogev, *Diamonds and Coral: Anglo-Dutch Jews and Eighteenth-Century Trade* (Leicester: Leicester University Press, 1978), 70.
 10. Yogev, chap. 5, cf. Vanneste, 45–7.
 11. Ralph Fitch, “The Long, Dangerous, and Memorable Voyage of M. Ralph Fitch”, in Richard Hakluyt, *The Principal Navigations Voyages Traffiques and Discoveries of the English Nation* (Cambridge: Cambridge University Press, 1903 [1599]), vol. 5, 465–505, on 498–9. Cf. Bruce Lenman, “England, the International Gem Trade and the Growth of Geographical

- Knowledge from Columbus to James I”, in *Renaissance Culture in Context: Theory and Practice*, ed. J. R. Brink and William F. Gentrup (Brookfield, VT: Aldershot, 1993), 86–99, on 93–4.
12. Vanneste, *Global Trade and Commercial Networks*, 45.
 13. *Ibid.*, 50–7.
 14. François Farges, “Les grands diamants de la couronne de François I à Louis XVI”, *Versalia* 16 (2014): 55–79; Bernard Morel, “Les diamants des monarchies européennes”, in *Diamants: au coeur de la terre, au coeur des étoiles, au coeur du pouvoir*, ed. Hubert Bari and Violaine Sautter (Paris: A. Biro, 2001), 237–93.
 15. Yogev, *Diamonds and Coral*, 102 (EIC). Vanneste, “Diamonds in South America”, table entitled “Diamond Production in Brazil.”
 16. Yogev, 120 (unofficial Brazilian diamonds). Winius, “Jewel Trading”, 15.
 17. Michèle Bimbenet-Privat, *Les orfèvres et l’orfèvrerie de Paris au XVIIe siècle* (Paris, 2002), vol. 1, 93–6 (Henry IV), 106–7 (Mazarin); vol. 2, 396 (Mazarin), 414 (Louis XIV).
 18. Karin Hofmeester, this volume (Hellemens). Vanneste, *Global Trade and Commercial Networks*, 48 (Chardin), 100, 140–2.
 19. Archives Nationales, T/1490/18, p. 846r.
 20. Yogev, *Diamonds and Coral*, 89.
 21. Both phenomena were observed in 1612 by the Flemish merchant Jacques de Couttre: Winius, “Jewel Trading”, 20.
 22. Vanneste, “Diamonds in South America”, 12–13.
 23. Winius, “Jewel Trading”, 28n31.
 24. *Ibid.*, 24 (agents in Goa).
 25. Vanneste, *Global Trade and Commercial Networks*, 43–4.
 26. The example is drawn from Francesca Trivellato, *The Familiarity of Strangers: The Sephardic Diaspora, Livorno, and Cross-Cultural Trade in the Early Modern Period* (Yale University Press, 2009), chap. 9. For other examples of cross-cultural exchange in the early modern diamond trade, see Vanneste, *Global Trade and Commercial Networks*, esp. chap. 3.
 27. Robin A. Donkin, *Beyond Price: Pearls and Pearl-Fishing: Origins to the Age of Discoveries* (American Philosophical Society, 1998), 28 (map 1), 62 (map 15).
 28. *Ibid.*, chaps. 9 and 10, esp. 276–80 (cultural references), 280 (Montaigne quoted; “in control”), 314–14 (Columbus and pearls).
 29. Kris E. Lane, *Colour of Paradise: The Emerald in the Age of Gunpowder Empires* (Yale University Press, 2010), 27 (inferior Old World emeralds), 52–9 (seizure of Muzo mines), 81 (1580–1640 zenith of global emerald trade), chap. 4 (merchants and shipping), 129–30 (emeralds for rubies), 135–8 (emeralds for diamonds). Cf. on emeralds in Goa, Cunha, “Hunting Riches”, on 292.
 30. Arash Khazeni, *Sky Blue Stone: The Turquoise Trade in World History* (Berkeley, CA: University of California Press, 2014), 13, chaps. 2 and 4.

31. On coral and amber in the works of Pliny, see Bycroft's chapter in this volume, Sect. 1. On early modern amber, see Rachel King, "Whose Amber? Changing Notions of Amber's Geographical Origin", *Kunsttexte.de/Ostblick* 2 (2014): 1–22. On the reciprocal trade in diamonds and coral, see Yogeve, *Diamonds and Coral*, 102–9; and Trivellato, *Familiarity of Strangers*, chap. 9.
32. Jack Ogden and Michael Spink, "Techniques of Construction and Decoration in Islamic Jewellery", in Michael Spink and Jack Ogden, *The Art of Adornment: Jewellery of the Islamic Lands: Part One* (Nour Foundation, 2013), pp. 87–8; Jack Ogden, *Jewellery of the Ancient World* (London, Trefoil Books, 1982), pp. 143–50.
33. Fritz Falk, "The Cutting and Setting of Gems in the 15th and 16th Centuries", in *Princely Magnificence: Court Jewels of the Renaissance, 1500–1630*, ed. Victoria and Albert Museum (London: Debrett's Peerage and Victoria and Albert Museum, 1980), 20–6, on 20. Cf. Fritz Falk, *Edelsteinschliff und Fassungsformen im späten Mittelalter und im 16. Jahrhundert. Studien zur Geschichte der Edelsteine und des Schmucks* (Ulm: Verlag Wilhelm Kempter KG, 1975). Falk's earliest dates for the invention of faceting (certainly 1406, possibly 1381) are over a century earlier than the date (1538) given by an earlier authority, namely Lenzen, *Diamond Trade and Production*, 71–81.
34. P. Grodzinski, "The History of Diamond Polishing", *Industrial Diamond Review* 1, Special supplement (1953): 1–13.
35. Karin Hofmeester, "Shifting Trajectories of Diamond Processing: From India to Europe and Back, From the Fifteenth Century to the Twentieth", *Journal of Global History* 8, no. 1 (2013): 25–49, on 34–9 (Venice, Antwerp, Amsterdam, London). Lenzen, *Diamond Trade and Production*, 71–81 (Bruges, Paris, Antwerp). René de Lespinasse, *Les métiers et corporations de la ville de Paris*, vol. 2 (Paris, 1892), 82 (creation of Paris guild). There was also a diamond-cutting guild in Venice before 1582: Salvatore Ciriaco, "Diamonds in Early Modern Venice: Technology, Products and International Competition", in *History of Technology*, vol. 32: *Italian Technology from the Renaissance to the Twentieth Century*, ed. Anna Guagnini and Luca Molà (London: Bloomsbury, 2014), 67–86, on 71–2.
36. *Recueil des statuts, ordonnances, réglemens et privilèges, accordez en faveur des marchands orfèvres jouailliers de la ville & fauxbourgs de Paris* (Paris, 1688), 584.
37. Falk, "Cutting and Setting", 20 (fourteenth-century table cuts). Herbert Tillander, *Diamond Cuts in Historic Jewelry: 1381–1910* (London: Art Books, 1995), 130–68 (brilliant cuts).
38. On the V&A Museum's collection, see the catalogue in *Princely Magnificence: Court Jewels of the Renaissance, 1500–1630* (Debrett's

- Peerage Limited in association with the Victoria and Albert Museum, 1980). On the Green Vault, see Christine Nagel, *Schmuck der sächsischen Kurfürsten um 1600: Untersuchung zum Umgang mit Schmuck und dessen Funktionen im Rahmen fürsterlicher Repräsentation und Kommunikation* (Berlin: dissertation.de, 2009). On European court jewels in general, see the following recent surveys: Diana Scarisbrick, Christophe Vachaud, and Jan Walgrave, *Brilliant Europe: Jewels from European Courts* (Brussels: Mercatorfonds, 2007); Morel, “Diamants des monarchies européennes.”
39. Brigitte Buettner, “Precious Stones, Mineral Beings: Performative Materiality in Fifteenth-Century Northern Art”, in *The Matter of Art: Materials, Technologies, Meanings, ca. 1250–1600*, ed. Christy Anderson, Anne Dunlop, and Pamela H. Smith (Manchester University Press, 2014), 205–22.
 40. Ina Baghdiantz McCabe, *Orientalism in Early Modern France: Eurasian Trade, Exoticism and the Ancien Regime* (Oxford, 2008), 231–43, 255, cf. 187, 257–9.
 41. Baroque pearls: Donkin, *Beyond Price*, 264, 268, 276, citing Peter Stone, “Baroque Pearls”, *Apollo* 67 (1958): 194–9, 69 (1959): 33–7, 107–12. Etymology of “baroque” as an art movement: Kerry Downes, “Baroque”, in *The Oxford Companion to Western Art*, ed. Hugh Brigstocke (Oxford University Press, 2001), retrieved 19 Feb 2018, www.oxfordreference.com. Rococo diamonds: Hans Sedlmayr and Hermann Bauer, “Rococo”, in *Encyclopedia of World Art* (New York: MacGraw Hill, 1966), vol. 12, 230–74, on 239. Neo-classical crystals: Emma Spary, “Capturing and Interpreting Crystals in French Collections, 1760–1800”, presentation at Victoria and Albert Museum, 12 April, 2016. Cf. Diana Scarisbrick, *Jewellery in Britain, 1066–1837: A Documentary, Social, Literary and Artistic Survey* (Wilby: Michael Russell, 1994), 252 (baroque-rococo-neo-classical sequence in British jewellery).
 42. Scarisbrick, *Jewellery in Britain*, 233–4 (diamonds in Britain). Donkin, *Beyond Price*, 276 (baroque pearls). Pierre de Rosnel, *Mercure Indien* (Paris, 1667), vol. 2, 29.
 43. The medieval lapidary tradition is summarised in Frank D. Adams, *The Birth and Development of the Geological Sciences* (Baltimore, MD: The Williams & Wilkins Company, 1938), chap. 4. Cf. Joan Evans and Paul Studer, *Anglo-Norman Lapidaries* (Paris: Champion, 1924). On the lapidary tradition in the sixteenth century, see Lynn Thorndike, *A History of Magic and Experimental Science* (New York: Columbia University Press, 1923–1958), vol. 7, 298–324.
 44. On these developments and the ones described in the next paragraph, see Michael Bycroft, *Gems and the New Science: Craft, Commerce and Classification in Early Modern Europe*, unpublished book manuscript.

45. Hofmeester, “Shifting Trajectories”, 33 (Duyts). Cuhna, “Hunting Riches”, 293 (stones cut in Europe), 295 (European cutters in Goa).
46. Khazeni, *Sky Blue Stone*, 110.
47. Farges, “Grands diamants”, 64.
48. Annelies De Bic, “The Paradox of the Antwerp Rose: Symbol of Decline or Token of Craftsmanship?”, in *Innovation and Creativity in Late Medieval and Early Modern European Cities*, ed. Karel Davids and Bert De Munck, 269–93 (Surrey, England: Ashgate, 2014), 279–80. Cf. Tillander, *Diamond Cuts*, “Introduction.”
49. Nuno Vassallo e Silva, “Jewels for the Great Mughal: Goa a Centre of the Gem Trade in the Orient,” *Jewellery Studies* 10 (2004): 41–51, on 47 (Maximilian III), 49–50 (filigree and enamelling).
50. Marjolijn Bol, “Gems in the Water of Paradise: The Iconography and Reception of Heavenly Stones in the Ghent Altarpiece”, in Christina Currie, Bart Fransen, Valentine Henderiks, Cyriel Stroo and Dominique Vanwijnsberghe, eds., *Van Eyck Studies: Papers presented at the Eighteenth Symposium for the Study of Underdrawing and Technology in Painting, Brussels, 19–21 September 2012* (Leuven: Peeters Publishers, 2017), 34–48.
51. Bruce Lenman, “England, the International Gem Trade and the Growth of Geographical Knowledge from Columbus to James I”, in *Renaissance Culture in Context: Theory and Practice*, ed. Jean R. Brink and William F. Gentrup (Brookfield, VT: Ashgate, 1993), 86–99.
52. On Boyle, see the chapter by Sabel in this volume. On Boodt, see the chapter by Bycroft in this volume, and Sven Dupré, “The Art of Glassmaking and the Nature of Stones: The Role of Imitation in Anselm De Boodt’s Classification of Stones,” in *Steinformen: Natura – Materia – Artificio*, ed. Maurice Sass, Iris Wenderholm and Isabella Augart (Berlin: De Gruyter, forthcoming).
53. These two books are Lane, *Colour of Paradise* and Marcia Pointon, *Brilliant Effects: a Cultural History of Gem Stones and Jewellery* (New Haven and London: Yale University Press, 2009).
54. For examples of imitation and fake gems, see Marjolijn Bol, “Coloring Topaz, Crystal and Moonstone. Factitious Gems and the Imitation of Art and Nature, 300–1500”, in *Fakes!? Hoaxes, Counterfeits and Deception in Early Modern Science*, ed. Marco Beretta and Maria Conforti (Sagamore Beach: Science History Publications, 2014), 108–29, on 124–8, discussing the imitation gemstones set on the Westminster Retable, ca. 1250; Hazel Forsyth, *The Cheapside Hoard: London’s Lost Jewels* (London: Museum of London, 2013), 68–76. The Cheapside Hoard includes counterfeit balas rubies (red dyed rock crystal) and a jewel with red and green pastes (glass). See also Anne-Françoise Cannella, *Gemmes, verre coloré, fausses pierres précieuses au Moyen Age. Le quatrième livre du Trésorier de Philosophie*

- naturelle des pierres précieuses* de Jean d'Outremeuse (Geneva: Librairie Droz, 2006).
55. The following examples are discussed in Ronald W. Lightbown, *Mediaeval European Jewellery with a Catalogue of the Collection in the Victoria & Albert Museum* (London: Victoria and Albert Museum, 1992), 11–22.
 56. Iris Kockelbergh, Eddy Vleeschdrager and Jan Walgrave, eds., *The Brilliant Story of Antwerp Diamonds* (Antwerp: Ortelius, 1992), 29.
 57. *The Social Life of Things: Commodities in Cultural Perspective*, ed. Arjun Appadurai (Cambridge, 1986), especially Igor Kopytoff, “The Cultural Biography of Things: Commodization as Process”, 64–91. For itineraries, see especially *Mobility, Meaning and Transformations of Things. Shifting Contexts of Material Culture Through Time and Space*, ed. Hans-Peter Hahn and Hadas Weiss (Oxford: Oxbow Books, 2013).
 58. *Objects in Motion in the Early Modern World*, ed. Daniela Bleichmar and Meredith Martin, special issue of *Art History* 38, no. 4 (2015); *Early Modern Things: Objects and Their Histories, 1500–1800*, ed. Paula Findlen (New York and London: Routledge, 2012); *The Global Lives of Things: Material Culture in the First Global Age*, ed. Anne Gerritsen and Giorgio Riello (New York and London: Routledge, 2015).
 59. *Writing Material Culture History*, ed. Giorgio Riello and Anne Gerritsen (Bloomsbury, 2015), 113.
 60. Tim Ingold, “Materials against Materiality”, *Archaeological Dialogues* 14 (2007): 1–16; Ursula Klein and Emma C. Spary, *Materials and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago: University of Chicago Press, 2010); Ann-Sophie Lehmann, “The Matter of the Medium: Some Tools for an Art Theoretical Interpretation of Materials”, in *The Matter of Art: Materials, Technologies, Meanings 1200–1700*, ed. Christy Anderson, Anne Dunlop, and Pamela H. Smith (Manchester: Manchester University Press, 2015), 21–41.
 61. For new luxuries, see among other works, *The Spinning World: A Global History of Cotton Textiles, 1200–1850*, ed. Giorgio Riello and Prasanna Parthasarathi (Oxford: Oxford University Press, 2009); Marcy Norton, *Sacred Gifts, Profane Pleasures: A History of Tobacco and Chocolate in the Atlantic World* (Ithaca: Cornell University Press, 2008); Maxine Berg, *Luxury and Pleasure in Eighteenth-Century Britain* (Oxford: Oxford University Press, 2005).
 62. Craig Clunas, “Precious Stones and Ming Culture, 1400–1450,” in *Ming China: Courts and Contacts, 1400–1450*, ed. Craig Clunas, Jessica Harrison-Hall, and Luk Yu-Ping (London: British Museum, 2016), 236–44, on 238–9.
 63. Donkin, *Beyond Price*, 204 (map 24).

64. Examples are treatises by al-Biruni (973–1048) and al-Khazini (fl. c. 1115–c. 1130). On these treatises, see respectively Mariam Rozhanskaya and B. A. Rosenfeld, “On Al-Biruni’s Densimetry”, in *Annals of the New York Academy of Sciences* 500, no. 1 (1987): 403–17, and H. Carrington Bolton, “The Book of the Balance of Wisdom”, *Chemical News* 34, no. 872 (1876): 59–62. On early modern Persian treatises on gems (*javahirnama*), see Khazeni, *Sky Blue Stone*, chap. 2.
65. Gül Irepoglu, *Imperial Ottoman Jewellery: Reading History through Jewellery* (Istanbul: BKG, 2012); Siebenhüner, Kim, *Die Spur der Juwelen. Materielle Kultur und transkontinentale Verbindungen zwischen Indien und Europa in der Frühen Neuzeit* (Cologne-Weimar, 2018); *The Jewels of India*, ed. Susan Stronge (Bombay: Marg Publications, 1995); *Goieielli dall’ India: dai Moghul al Novecento* (Milan: Galleria Ottavo Pisano La Rinascente, 1996).
66. Donkin, *Beyond Price*, 1–8 (raindrops), 306–7 (pearls in Americas). Clunas, “Precious Stones and Ming Culture”, 240–1.

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