

RESEARCH ARTICLE

Taste and mining culture in early modern Spanish worlds

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Abstract

In this article we examine the intertwined relationship between taste and mining culture in early modern Spanish worlds, highlighting descriptions of metals and minerals through which taste appears as an epistemic marker with symbolic dimensions. Drawing on different documents regarding mining practices, mineral vocabulary and metal appreciation in Spain, New Spain, Peru and the New Kingdom of Granada (c.1550–1640), our article contends that knowing minerals through taste in the Spanish worlds was part of a practice engaged with the senses, the body politic and its cosmological order.

In his *Primer nueva coronica y buen gobierno*, the Amerindian chronicler Felipe Guamán Poma de Ayala (1534–1615) created a moralized drawing about the Spaniards' persistent quest for gold in the Andes (Figure 1). In the picture, he represented an apocryphal event in which Greek soldier Pedro de Candía (1494–1542), called 'Español', and the Emperor Huayna Capac (c.1467–c.1525), called 'Inga', are allegedly having the first conversation between a Christian and an Inka in Cuzco. Although this event did not really happen, since Candía's encounter with Inka people was in Tumbes around 1528, the representation has cultural significance. In the drawing, we can read how the Inka asks the Spaniard in Quechua 'Cay coritacho micunqui?', 'Do you eat this gold?' To which the Spaniard answers, 'Este oro comemos', 'Yes, we do eat this gold'. As Guamán Poma highlights in his caption, non-verbal communication was crucial in their meeting, as they exchanged by signs (*por señas hablaron*) their ideas on taste, sense and the meaning of consumption of gold. Presenting gold as an edible matter for Candía was Guaman Poma's satirical way of addressing a cultural strangeness and denouncing the dubious greed-filled obsession of conquistadors for precious metals like gold.¹ This kind of moral statement rejecting the taste for a non-nutritive substance was also relatively usual from a European point of view. Physicians at the time, for instance, would have

¹ Elvira Vilches, *New World Gold: Cultural Anxiety and Monetary Disorder in Early Modern Spain*, Chicago and London: The University of Chicago Press, 2010; Matthew Restall, *Seven Myths of the Spanish Conquest*, New York: Oxford University Press, 2003. On Guamán Poma's work see Rolena Adorno and Ivan Boserup, *Unlocking the Doors to the Worlds of Guaman Poma and His Nueva coronica*, Copenhagen: Museum Tusculanum Press, 2015. To consult the manuscript chronicle see Felipe Guamán Poma de Ayala, *Primer nueva coronica y buen gobierno* (1615), Copenhagen, Det Kongelige Bibliotek, GSK 2232 4°, available at www5.kb.dk/permalink/2006/poma/info/es/frontpage.htm.

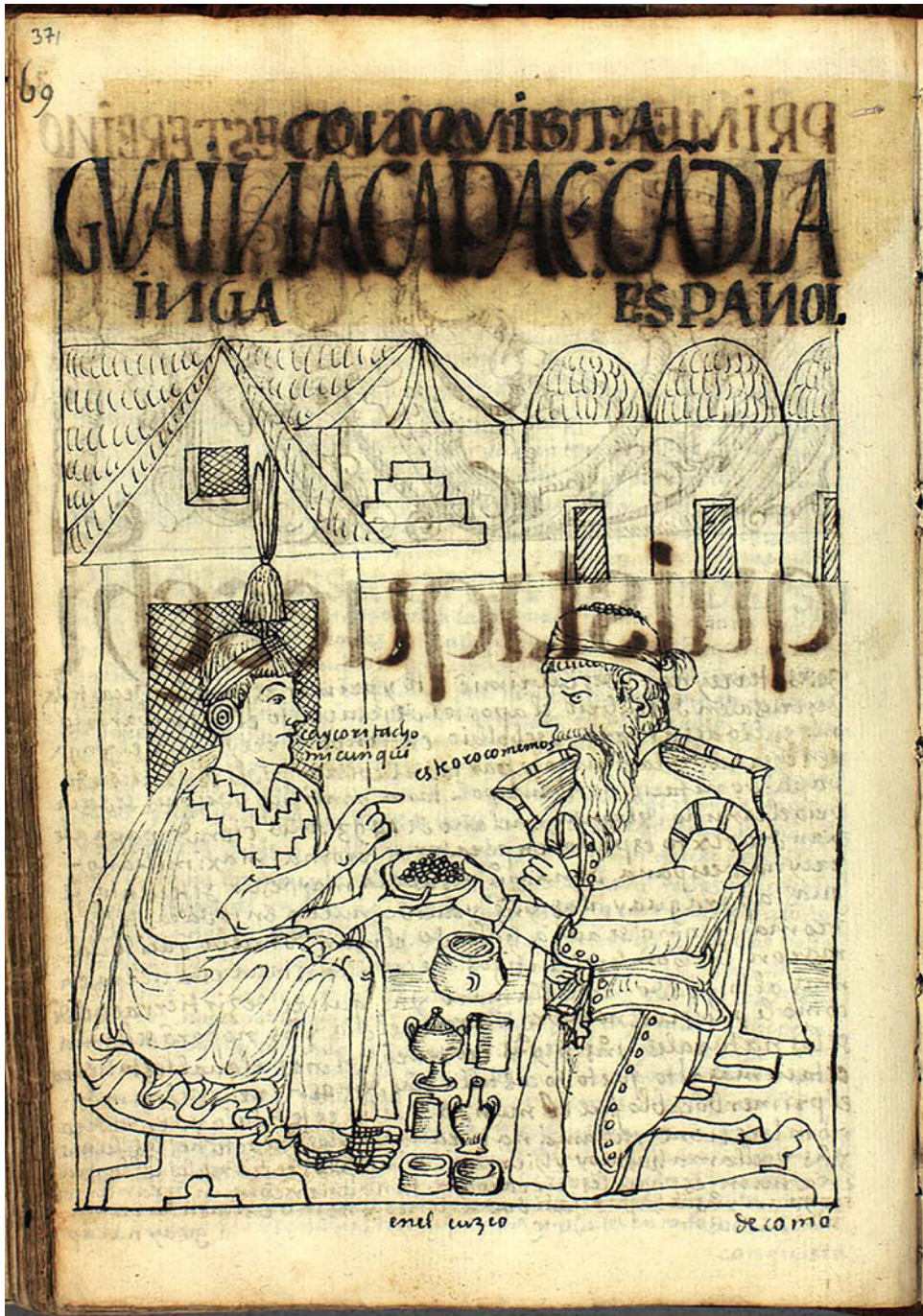


Figure 1. Cay coritacho micunqui? [¿Es éste el oro que comes?] / Este oro comemos. / En el Cuzco / 'Por señas hablaron. Y preguntó al español qué es lo que comía; responde en lengua de español y por señas que le apuntava que comía oro y plata. Y acinab dio mucho oro en polbo y plata y baxillas de oro'. Felipe Guamán Poma de Ayala, *Primer nueva coronica y buen gobierno* (1615), Copenhagen, Det Kongelige Bibliotek, GSK 2232 4°, p. 371v. Available at <http://img.kb.dk/ha/manus/POMA/poma550/POMA0371v.jpg>.

said that this envy of possessing and even eating metals and earth was a symptom of *pica* or *malacia*, a diet disorder consisting in ingesting non-nutritive matter, associated with greed, moral deviance and a lack of judgement.² Therefore the drawing would likely be considered with a (dark) humour by both Inkas and Christians. Nevertheless, beyond satirical criticism, Guamán Poma's image also conveys the symbolic role that taste for mineral matter had for the Spanish social and political body. In early Spanish colonial contexts, the verb *comer* – to eat – and *dar de comer* – to feed – expressed both the political and economic need to receive favours and privileges in exchange of protection and loyalty. With Guamán Poma's drawing, we might say that Spanish expansion and the search for minerals (both metals and precious stones) were, in a way, nutritional endeavours.³ Moreover, it was not a coincidence that gold and silver – the main metals used for coining – were labelled by Spaniards the sweetest metals and, therefore, for the sake of a cosmological homology with agricultural products, they were conceived as the purest, most temperate and most valuable ones.

In this article we contribute to the understanding of the epistemic, social and cosmological functions that taste and smell (inseparable from each other) had in the examination of minerals, particularly metals, in the vast early modern cultural area of the Spanish worlds. Our sources range from metallurgical and mining manuals to chronicles and official accounts for the Spanish Crown. We discuss, on the one hand, the work of scholars like the sixteenth-century polymath Bernardo Pérez de Vargas (c.1530–1580), physician Nicolás Monardes (1493–1588) and the priest Álvaro Alonso Barba (1569–1662), whose treatises on metals were circulated in Spanish, transmitting both colonial and European metallurgical knowledge. On the other hand, we analyse written accounts of chroniclers and royal officers who described the taste of metals such as gold, silver and copper. We have limited our research to the Spanish world's perspective, and we know that more research has to be done regarding African and Amerindian use of taste to assess metals in the colonial context.⁴

2 According to physician Juan Huarte, when the stomach 'falls into a certain infirmity which the physicians call *pica*, or *malacia*, then arise longings after things which man's nature abhorreth: so as they eat earth, coals, and lime with greater appetite than hens or trouts'. Juan Huarte, *The Examination of Men's Wits* (tr. Richard Carew in 1594, ed. Rocío G. Sumillera), London: The Modern Humanities Research Association, 2014, p. 200. According to Covarrubias, alchemists showed this deviance and lack of judgement in their search for drinkable gold: 'Oro potable, cierta invención de alquimistas, que persuaden poderse desatar este metal de manera, que pueda pasar por las vias, y venas, como hace el agua: no creo nada de esto'. Sebastián de Covarrubias Orozco, *Tesoro de la lengua castellana, o española*, añadida por Benito Remigio Noydens, Madrid: Melchor Sánchez, 1671, 127v. Miguel López Pérez, *Historia del oro potable*, Valladolid: Glyphos Publicaciones, 2017. To provide a new interpretation of the intake of mineral matter, new research suggests that for Andean people eating clay before consuming potatoes helped to decrease the toxicity of some tubers. See this news article with links to the scientific papers: Megan Jula, 'The ancient Andean tradition of eating clay may have helped to protect health', *NPR*, 28 November 2017, at www.npr.org/sections/thesalt/2017/11/28/564866619/the-ancient-andean-tradition-of-eating-clay-may-have-helped-to-protect-health (accessed 1 March 2022).

3 In the context of conquest, the expression *dar de comer* (to feed) was also used to express the act of land distribution that a good *caudillo* or military leader must do with his soldiers, as recognition and reward for their merits, qualities and feats. In that sense, feeding the soldiers is equivalent to rewarding them with the pillage of conquest. Bernardo de Vargas Machuca, *Milicia y descripción de las Indias*, Madrid: Pedro Madrigal, 1599, Libro 4, 114v–116v. See also Germán Colmenares, 'La aparición de una economía política de las Indias', *Revista Universidad de Antioquia* (1990) 220(59), pp. 3–44, 42.

4 Anthropological evidence gathered across the Americas suggests that Amerindian shamanic communities appraised metals as 'sensorial stimulants whose brilliance, colors, and jingling sounds produce specific states of mind'. This is, for example, the case of materials made of gold-copper alloy (known as *guanín* and *tumbaga*) whose scent and brilliance were related to semen, fire and the sun, and thus associated with fertility, health and power. See the authoritative studies by Nicholas J. Saunders, 'Stealers of light, traders in brilliance: Amerindian metaphysics in the mirror of conquest', *RES: Anthropology and Aesthetics* (1998) 33, pp. 225–52, 230;

We will demonstrate how taste functioned in the production and circulation of metallurgical knowledge: as epistemic marker guided by cultural values. In the first two sections we focus on the place that the subjective and embodied experience of tasting had in knowledge production about minerals, particularly metals. In the last two sections we discuss the extended meaning of mineral taste, revealing its analogical and flexible links with social values and cosmological correspondences. We show that in the Spanish world the taste of minerals was an empirical, sensory practice which served as a cultural reference for the body politic and its natural order. This argument builds on and adds to recent historiography on early modern mining, and on taste as an epistemic practice.

This article brings the anthropological history of the senses and the history of mining into dialogue.⁵ The language of taste, scent and sensory experience is present in the sources of the period we examine in this article, at least those dedicated to vernacular sciences like mining and refining. There are few comprehensive studies of what taste means within the history of mineralogical science and related knowledge. Instead, much of the literature focuses on eighteenth-century engagement with the senses, and how European Enlightenment thinkers developed new ways of scientific information gathering and communication.⁶ By focusing on early modern mining culture in the Spanish worlds, this article suggests that such sense-based ways of knowing were more historically rooted and geographically diverse than the traditional narrative indicates.

The early modern cartography of mining comprises diverse cultural areas such as the Harz mountains and the Ore mountains in Saxony and Bohemia, the Carpathians, the Tyrolean Alps, Iberian sites like Guadalcanal and Almaden, and the vast area along the coast and hinterlands of West Africa. In Spanish America, mining sites were abundant, from gold-mining areas in the extended Caribbean and the New Kingdom of Granada (currently Colombia and part of Venezuela), silver enclaves like Potosi in the Viceroyalty of Peru and Zacatecas in New Spain, and mercury mining in Huancavelica in Peru. The variety of early modern cultures of mining was propitious for the production and exchange of knowledge about minerals and metal transformation. The global mining rush for gold, silver, copper, mercury and iron in the course of the sixteenth century mobilized not only people and transnational markets, but also traditional practices and distinct cultural values employed in the investigation of nature. In a recent study, Tina Asmussen and Pamela O. Long have pointed out the variety of practices of knowledge that were involved in this extractive economy. In their research on mining, they addressed ‘the questions of how culture is mobilized, appropriated, deployed, and linked to the perceptions of nature, experiences of labour, practices of risk, as well as material desires’.⁷ From that vantage

Gerardo Reichel-Dolmatoff, ‘Things of beauty replete with meaning: metals and crystals in Colombian Indian cosmology’, in Peter T. Frust *et al.*, *Sweat of the Sun, Tears of the Moon: Gold and Emerald Treasures in Colombia*, Los Angeles: Natural History Museum Alliance, 1981, pp. 17–33; and Gerardo Reichel-Dolmatoff, *Orfebrería y chamanismo: Un estudio iconográfico del Museo del Oro*, Medellín: Editorial Colina, Banco de la República, 1988. A colonial testimony of the Amerindian sensory skills in identifying metals by smell can be found in ‘Apéndice III: Relación general que se tomó en pública forma y se envió autorizada al virrey en la provincia de los Xarayes, que es en 17 grados sobre el río Paraguay ... donde había llegado el general Nuflo de Chávez ...’, in Marcos Jiménez de la Espada (comp.), *Relaciones geográficas de Indias: Perú*, 2 vols., Madrid: Atlas, 1965, vol. 2, pp. 59–116, 97.

⁵ Inspiration for this connection might be found within the anthropological claim according to which subjective perceptions and sensory experiences are interconnected with social systems. See Constance Classen, ‘Foundations for an anthropology of the senses’, *International Social Science Journal* (1997) 49, pp. 401–12, 401.

⁶ A good example connecting the history of senses, power, the body and the colonial experience in the Americas is the edited volume by Daniela Hacke and Paul Musselwhite, *Empire of the Senses: Sensory Practices of Colonialism in Early America*, Leiden: Koninklijke Brill, 2018.

⁷ Tina Asmussen and Pamela O. Long, ‘Introduction: the cultural and material worlds of mining in early modern Europe’, *Renaissance Studies* (2020) 34, pp. 8–30, 22.

point, historians of knowledge are able to approach mining beyond interpretations dominated by economic and technological utilitarian narratives about the rise of capitalism and the account of progressive mining extraction and chemical innovations. In this article, following such a cultural history of mining and metallurgy, we interrogate the role of taste in the context of the early modern pursuit of mineral knowledge. We contend that the sensory judgement of tasting metals was guided by a flexible cultural frame of reference with cosmological implications.

Since the seminal research produced by historian Peter Bakewell, scholarship on mining and metallurgy in colonial Spanish America has increasingly paid attention to a variety of terms and expectations, as well as labour and belief systems at work in colonial society.⁸ Sensitive to this social and cultural perspective, Allison Bigelow has recently underlined the importance of the multicultural exchange of ideas, terms and naming practices in the Spanish mining worlds in order to grasp the presence of racialized thinking and the contribution of Amerindian and African communities of knowledge. By paying attention to language, Bigelow has shown the ‘ways in which miners throughout the Iberian world understood the animacy of matter and the ability of metallic objects to shape human experiences’.⁹ These are aspects that might be overlooked when trying to outline a progressive or retrospective history of technological and modern scientific progress. Bigelow recalls, for instance, the way in which historian of science Modesto Bargalló in 1969 dismissed the knowledge on metals of Peruvian chroniclers and practitioners. For Bargalló, they ‘played’ with inaccurate galenic humoral terms to describe metals, such as coldness and heat, dryness and humidity, besides other notions like ‘sympathy’ or ‘antipathy’ that did not fit well with what would become the dominant chemical vocabulary.¹⁰ Even though, from the perspective of the present, these terms might seem, at the very least, ambiguous, in a knowledge system dominated by humoral theory they were rather accurate and capacious categories addressing and ordering nature that allowed scholars, miners, chroniclers and people in general to understand mining, mineral ore and their transformation into metallic artefacts. Like Bigelow, many other scholars in recent decades have stressed the significant methodological path according to which paying attention to these humoral concepts, vocabularies and their cultural

⁸ Peter J. Bakewell, *Silver Mining and Society in Colonial Mexico, Zacatecas 1546–1700*, Cambridge: Cambridge University Press, 1971; Bakewell, *Miners of the Red Mountain: Indian Labour in Potosí, 1545–1650*. Albuquerque: University of New Mexico Press, 1984. For studies on early modern Iberian culture of mining and metallurgy see Manuel Castillo Martos, *Minería y metalurgia: Intercambio tecnológico y cultural entre América y Europa durante el período colonial español*, Seville: Muñoz Moya y Monraveta Editores, 1994. Gastón Arduz Eguía ‘Sobre la metalurgia colonial de la plata en Potosí’, in J. Sánchez Gómez and G. Mira Delli-Zotti (eds.), *Hombres, técnica, plata: Minería y sociedad en Europa y América, siglos XVI–XIX*, Seville: Aconcagua Libros, 2000, pp. 105–28; Guillermo Lohmann Villena, *Plata del Perú, riqueza de Europa: Los mercaderes peruanos y el comercio con la Metrópoli en el siglo XVII*, Lima: Fondo Editorial del Congreso del Perú, 2004; Carlos Sempat Assadourian, *Zacatecas: conquista y transformación de la frontera en el siglo XVI: Minas de plata, guerra y evangelización*, México: El Colegio de México, Centro de Estudios Históricos, 2008; Carmen Salazar-Soler and Inés Herrera Canales, ‘Bibliografía minera colonial Hispanoamericana (siglos XV–XIX)’, *Nuevo Mundo Mundos Nuevos*, 2010 (online), at <https://doi.org/10.4000/nuevomundo.59200>; Orlando Bentancor, *The Matter of Empire: Metaphysics and Mining in Colonial Peru*, Pittsburgh: University of Pittsburgh Press, 2017; David Navarette and Lorena B. Rodríguez, *El estudio de la minería latinoamericana: Escalas de abordaje, diversas fuentes y reflexiones teórico-metodológicas*, special issue, *Istor: Revista de historia internacional* (2018) 19, 73; Kris Lane, *Potosí: The Silver City That Changed the World*, Berkeley: University of California Press, 2019; Allison Bigelow, *Mining Language: Racial Thinking, Indigenous Knowledge, and Colonial Metallurgy in the Early Modern Iberian World*, Williamsburg and Chapel Hill: Omohundro Institute of Early American History and Culture, University of North Carolina Press, 2020.

⁹ Bigelow, op. cit. (8), p. 8.

¹⁰ Modesto Bargalló, *La amalgamación de los minerales de plata en hispanoamérica colonial*, México: Compañía Fundidora de Hierro y Acero de Monterrey, 1969, p. 221.

background is fundamental to avoiding oversimplifications and gaining access to the role played by taste in the early modern Spanish mining culture.¹¹

In this article, we address the question of how the language of taste made sense of metals and minerals in the Spanish worlds. This question is framed by a broader interrogation of how subjectivity, and particularly sensory experience in the Spanish worlds, knotted networks of expectations and produced understandings and explicative frameworks about metals. In the aftermath of the work of scholars like Lorraine Daston, Peter Galison and Steven Shapin, subjectivity is increasingly playing a major historiographical role as it gives us the opportunity to deflate present-day retrospective objectivity narratives, and to assess alternative epistemic virtues and other scientific selves in action in early modern times.¹² In that regard, in this article we aim to highlight that the witness of senses and the observation and description of mineral particulars were authoritative in Spanish sixteenth- and seventeenth-century accounts of mining and metallurgy. As Ralph Bauer has recently shown, Spanish cosmographers, natural historians and philosophers, as well as imperial knowledge institutions such as the office of the royal chronicler of the Indies, the Casa de Contratación (House of Trade), and the Consejo de Indias (Council of the Indies), built on the empirical programme of medieval Christianized alchemical tradition, which ignited sensory curiosity to shed light on the secret works of mineral nature and indigenous metallurgic technologies in the extended Caribbean and the Andes.¹³ We will take into account the presence of such alchemical Christian tradition in the assessment of metals and minerals. During that period, Spanish America was the main source of silver, gold and emeralds for the world economy.

Prospecting, extracting and transforming metals and precious stones were part of an imperial project in which members of the royal bureaucracy, clerics, scholars, miners and practitioners from different cultural traditions were involved as knowledge agents. Taste had its place within this context of bullion production and knowledge making. As we will argue, knowing metals through taste was a subjective experience modulated and tuned by a variety of cultural analogies. Although the sources we will present did not propose a fixed taxonomy of the taste of metals, our article will underline that taste was guided by cultural frames of reference such as the vocabulary of food,

11 See, for instance, Carmen Salazar-Soler and Frédérique Langue, 'De huaira a malacate: una historia cultural a partir del vocabulario minero en América española (siglos XVI–XIX)', in Rossana Barragán and Seemin Qayum (comps.), *El siglo XIX: Bolivia y América Latina*, Lima: IFEA, 1997, pp. 373–39; Pilar Díez de Revenga Torres, 'El color de los minerales: ¿cuestión lingüística o técnica?', *Revista de investigación lingüística* (2004) 7(1), pp. 91–104; Mary Money, *Oro y plata en los Andes: significado en los diccionarios de Aymara y Quechua. Siglo XVI–XVII*, La Paz: CIMA, 2004. Allison Bigelow, 'Incorporating indigenous knowledge into extractive economies: the science of colonial silver', *The Extractive Industries and Society*, (2015) 3(1), pp. 117–23.

12 Lorraine Daston and Peter Galison, *Objectivity*, New York: Zone Books, 2007. Steven Shapin, 'The sciences of subjectivity', *Social Studies of Science* (2012) 42(2), pp. 17–184; Shapin, *Changing Tastes: How Things Tasted in the Early Modern Period and How They Taste Now*, Uppsala: Salvia Småskrifter, Tryck Wikströms, 2011.

13 Ralph Bauer, 'The crucible of the tropics: alchemy, translation, and the English discovery of America', in Jaime Marroquín Arredondo and Ralph Bauer (eds.), *Translating Nature: Cross-cultural Histories of Early Modern Science*, Philadelphia: University of Pennsylvania Press, 2019, pp. 171–87; and Bauer, *The Alchemy of Conquest: Science, Religion, and the Secrets of the New World*, Charlottesville and London: University of Virginia Press, 2019. For an historiographical survey on Spanish alchemy and the empirical grounds of early modern Iberian science see Julio Sánchez Gómez, 'Magia, astrología y ocultismo entre los mineros del siglo XVI', *Studia historica: Historia moderna* (1988) 6, pp. 339–50; Mar Rey Bueno, 'La Mayson pour Distiller des Eaües at El Escorial: alchemy and medicine at the court of Philip II, 1556–1598', in Teresa Huguet-Termes, Jon Arrizabalaga and Harold J. Cook (eds.), *Health and Medicine in Habsburg Spain: Agents, Practices, Representations*, London: The Wellcome Trust Centre for the History of Medicine, 2009, pp. 26–39; Antonio Sánchez, 'The "empirical turn" in the historiography of the Iberian and Atlantic science in the early modern world: from cosmography and navigation to ethnography, natural history, and medicine', *Tapuya: Latin American Science, Technology and Society* (2019) 2(1), pp. 317–34.

temperature and texture, and the analogies related to nobility, baseness, utility and nourishment. This cultural frame enabled them to gather and to communicate sensory knowledge of metals.

Knowing metals through the senses

The Earth, as the servant of man, what fruit it produces, what smells, what flavours, what juices! What colors does it not engender!

Fray Luis de Granada (1583)¹⁴

Tasting mineral ore was advised for gaining knowledge about metals and finding clues for veins to be mined. ‘He who professes the art of metals does not judge as exempt any diligence that may give him greater knowledge’ (‘El que professa el arte de los metales no juzgue por escusada diligencia ninguna que pueda ocasionarle su mayor conocimiento’). For that reason, the practitioner should use his taste, ‘which discovers the purity of metals, as well as smelling does’ (‘no da menor noticia de la pureza, o mezcla de la tierra la experiencia del gusto, que el sentido del holfato’).¹⁵ This is how, in the book *Arte de los metales*, Alvaro Alonso Barba, an Andalusian cleric and mining expert writing from the Imperial Villa of Potosí, advised using taste and smell in order to learn about and access the realm of mineral matter. First published in Spanish in 1640 – translated into English in 1670 as *The Art of Mettals*¹⁶ – the book rapidly became known in the Atlantic world for its detailed descriptions of the *cazo* or *cocimiento* process which improved the method of mercury amalgamation in order to refine silver ore in a more profitable manner. The process consisted of heating crushed silver ore with salts and mercury in copper *cazos* or large pans.¹⁷

Barba’s book on the art of metals crystallizes the Spanish American exchange of mining ideas, values and technologies between Andean indigenous communities, African people and European colonizers.¹⁸ To codify such diverse mining practices and expectations towards metals for his transatlantic audience, Barba builds on the alchemical, mining and metallurgical tradition developed in medieval Europe and, above all, in the sixteenth

14 Fray Luis de Granada, *Introducción del símbolo de la fe*, Madrid: Imprenta Real, 1583, primera parte, Capítulo IX, p. 28: ‘La tierra, como sierva del hombre, ¡qué frutos produce, qué olores, qué sabores, qué zumos! ¡Qué colores no engendra! ¿Quién podrá explicar cuánta sea su fertilidad, cuántas sus riquezas, especialmente si consideramos cuántas diferencias de metales se sacaron de ella cinco mil años antes de la venida de Cristo, y cuántos se han sacado después acá, y se sacarán hasta la fin del mundo, llegando los hombres, como dijo aquel poeta, hasta las sombras del infierno, y persiguiendo el oro y la plata, por más que se esconda en las entrañas de la tierra?’

15 Álvaro Alonso Barba, *Arte de los metales, en que se enseña el verdadero beneficio de los de oro y plata por azogue*, Madrid: Imprenta del Reyno, 1640, 3v.

16 Álvaro Alonso Barba, *The first book of the Art of Mettals*, tr. Edward Montagu, 2 vols., London: for S. Mearne, 1670–4.

17 Among the studies on Barba see Josep M. Barnadas, *Álvaro Alonso Barba: Investigaciones sobre su vida y su obra (1569–1662)*, La Paz: Biblioteca Minera Boliviana, 1986; Carmen Salazar Soler, ‘Álvaro Alonso Barba: teorías de la Antigüedad, alquimia y creencias prehispánicas en las ciencias de la tierra en el Nuevo Mundo’, in Berta Ares and Serge Gruzinski (eds.), *Entre dos mundos: fronteras culturales y agentes mediadores*, Seville: CSIC, 1997, pp. 269–96. Carmen Salazar-Soler, ‘Reflexiones en torno a la noción de procesos de americanización a partir de la historia de la minería colonial peruana’, *Nuevo Mundo Mundos Nuevos* (2020), at <https://doi.org/10.4000/nuevo-mundo.79251>; Tristan Platt, ‘La alquimia de la modernidad: Los fondos de cobre de Alonso Barba y la independencia de la metalurgia boliviana (1780–1880)’, *Anuario: Archivo y Biblioteca nacionales de Bolivia* (1999) 5, pp. 37–102.

18 For an overview of this exchange see Kris E. Lane, ‘Africans and natives in the mines of Spanish America’, in Matthew Restall (ed.), *Beyond Black and Red: African–Native Relations in Colonial Latin America*, Albuquerque: University of New Mexico Press, 2005, pp. 159–84; Allison Bigelow, ‘La técnica de la colaboración: redes científicas e intercambios culturales de la minería y metalurgia colonial altoperuana’, *Anuario: Estudios Bolivianos, Archivísticos y Bibliográficos* (2012) 18, pp. 53–77.

century by metalworkers, gunners, preachers, physicians and alchemists such as Ulrich Rülein von Calw (1465–1523), Vannoccio Biringuccio (1480–1539), Georg Agricola (1494–1555), Benvenuto Cellini (1500–71) and Johannes Mathesius (1504–65).¹⁹ However, despite its connection to European mining culture, Barba's treatise occupies a particular place, since it condenses New World experience and, therefore, testifies to transcultural transfers and dialogues with the mineral knowledge of colonial subaltern groups. Within this alchemical and metallurgic tradition, it is important to refer to Bernardo Pérez de Vargas, an earlier Spanish author and polymath. We know little about the life of Pérez de Vargas, except that he produced *De re metallica* (1569), a text that drew upon but also expanded the earlier *De re metallica* (1556) of the German humanist and metallurgist Georg Agricola. Pérez de Vargas's work thus served to popularize, in the Spanish-speaking world, Agricola's earlier codification of German vernacular mining practices.²⁰

Both Pérez de Vargas's and Barba's treatises dealt not only with techniques to find, extract, melt and refine metals, but also with natural-philosophical examinations, popular stories and scholarly synthesis on the nature, classification and generation of metals. Barba's and Pérez de Vargas's texts have many theoretical similarities to explain the genesis of metals, such as a mixture of humoral theory, meteorological four-elements theory, and their use of the mercury-sulphur principle to describe metallurgical transformations. Instead of putting forward astrological forces as the cause of the origins of metals, as did medieval authors such as Albertus Magnus (c.1200–80), they provided explanations based on a hot-and-cold *virtud mineral* ('mineral virtue') whose heat would penetrate and mix earthy and humid matter, and whose cold would harden it. This tenet followed Aristotelian meteorological theory, according to which metals would spawn and grow in the earth like plants, fuelled by subterranean heat and exhalations. Metals were treated as composite matter, formed by the action of the elemental qualities: hot, cold, dry and humid.²¹

Regarding the senses, both Pérez de Vargas and Barba mentioned their role when prospecting, distinguishing and describing mineral matter.²² As Bigelow asserts, before the advent of spectrometre technologies, 'miners sorted and named metals using data they gathered from their senses'.²³ Earlier we quoted how Barba advised that whoever professes the art of metals must use and exercise the senses to learn and increase mineral knowledge. Even though 'the true knowledge of what species the metal is, depends upon the essaying of the mineral ore' ('el verdadero desengaño consiste en el ensaye de las venas'), Barba and Pérez de Vargas still considered the senses the initial,

19 For an example of the culture of mining and the arts of metals in sixteenth-century Europe, see Tina Asmussen (ed.), *The Cultural and Material Worlds of Mining in Early Modern Europe*, special issue of *Renaissance Studies* (2020) 34; Pamela O. Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*, Baltimore: Johns Hopkins University Press, 2011; Pamela H. Smith, 'Vermilion, mercury, blood, and lizards: matter and meaning in metalworking', in Ursula Klein and Emma Spary (ed.), *Materials and Expertise in Early Modern Europe: Between Market and Laboratory*, Chicago: The University of Chicago Press, 2010, pp. 29–49. Michael Cole, 'Cellini's blood', *Art Bulletin* (1999) 8(2), pp. 215–35.

20 Bernardo Pérez de Vargas, *De re metallica: en el cual se tratan muchos secretos del conocimiento de toda suerte de minerales*, Madrid, 1569. See Manuel Bermúdez Méndez, 'Apuntes acerca de Bernardo Pérez de Vargas y su obra literaria', *Isla de Arriarán* (2006) 28, pp. 121–41.

21 Alexander Warren Dym, 'Alchemy and mining: metallogenesis and prospecting in early modern mining books', *Ambix* (2008) 55(2), pp. 232–54; John Norris, 'Early theories of aqueous mineral genesis in the sixteenth century', *Ambix* (2007) 54(1), pp. 69–86; Norris 'The mineral exhalation theory of metallogenesis in pre-modern mineral science', *Ambix* (2006) 53(1), pp. 43–65.

22 Like Shapin, we consider that gustation and olfaction cannot be worked separately, because in our sources, almost all the time, they are considered related and complementary. Steve Shapin, 'The taste of wine: towards a cultural history', *Rivista di Estetica*, n.s. (2012) 51, pp. 49–94, 51.

23 Bigelow, op. cit. (8), p. 262.

unavoidable way to know mineral matter.²⁴ While an assayer or mint officer ultimately tested the quality and nature of mineral ore with the assistance of fire and with weight and measuring tools, miners, prospectors, *cateadores* (dowsers) and *baquianos* (local experts) used their set of sensory skills to pick up signs and clues in the landscape and among the ore they collected.²⁵

As Warren Dym has shown for German areas, early modern mining culture was expressed and lived in an outdoor setting, in mountainous landscapes, through forests and rivers: mining practitioners were like hunters and diviners, seeking concrete, experienceable traces of the hidden bounty of the earth.²⁶ Similar realities can be found in Spanish mining and metallurgical culture, where people were acquainted with practitioners coming from German areas, or with experts like a *zahorí*, an interpreter of the landscape who was able to find hidden sources of water, metals and treasures through sensory signs.²⁷ Additionally, in the Andean colonial context, the *cateadores* (a Hispanized term from Quechua *çatticcayani*, having fallen inside a deep thing, and *çattita*, a wise man who understands through experience and is versed in all things) were skilled people who knew how to search for and find hidden mines.²⁸ Barba described their sensory acuity in the following terms: ‘to look in mountains for veins of hidden metals, using the indexes and signs of the veins, which they who are called *cateadores* know from experience in this exercise’.²⁹

Among the senses involved in mineral and metallurgical knowledge, sight was for Barba the most reliable (‘el más cierto desengaño de los sentidos’).³⁰ He reduced all minerals to eight colours – white, black, grey, blue, green, yellow, red, purple – and their mixtures. As Allison Bigelow has highlighted, Barba also based his rather intricate taxonomy of silver ores on three racialized colour differences taken from colonial vocabulary: *pacos* (from Quechua *ppaqu*, reddish silver ores), *negrillos* (‘little black ones’, for black silver ores) and *mulatos* (mulattos, for silver ores between the black and red categories).³¹ With sight, miners could also discern particular forms in plants or cliffs surrounding a vein, or also perceive from a distance glittering signals indicating mineral soils and precious metals,

24 Barba, op. cit. (15), 24r.

25 In order to *reducir a arte* the variety of assessments and opinions based on taste and sensory judgements, since 1570 the Spanish legal system was careful in its need to homogenize a *ley de pureza* (law of purity) for gold and silver by establishing a unified way of assaying, measuring and weighing precious metals for all kingdoms. The debate around this issue was exposed by the royal assayer Juan de Arfe y Villafañe, *Quilatador de la plata, oro, y piedras, conforme a las leyes reales*, Madrid: Guillermo Drouy, 1598.

26 Warren A. Dym, *Divining Science: Treasure Hunting and Earth Science in Early Modern Germany*, Leiden: Brill, 2011.

27 German miners in the Americas began to arrive early on, from the sixteenth century. A good example is the arrival of fifty German miner masters who were sent to Venezuela to find gold and silver mines using their ingenuity (*industria*) and knowledge (*saber*). See ‘Contratación de Carlos V con Enrique Ehinger y Gerónimo Sailer, por la cual les concede la conquista y colonización de Venezuela’, quoted in Nectario María, *Los orígenes de Maracaibo*, Madrid: Universidad de Zulia, 1959, pp. 427–428. On *zahorís* see Héctor Strobel del Moral, ‘La rabadomancia en la Nueva España: Práctica, apología y ridiculización’, *Relaciones: Estudios de Historia y Sociedad* (2019) 40(160), pp. 123–53. Regarding the good esteem Phillip II had for *zahoríes* see David Goodman, *Power and Penury: Government, Technology and Science in Philip II’s Spain*, Cambridge: Cambridge University Press, 1988.

28 Bigelow, op. cit. (8), p. 233.

29 *Memorial de Álvaro Alonso Barba al Rey*, 1662, quoted in Barnadas, op. cit. (17), p. 222: ‘Buscar por los cerros las betas de metales encubiertas, por los indicios, y muestras dellas, que conocen por experiencia los que por este exercicio llaman cateadores’.

30 Barba, op. cit. (15), ‘De los colores de todos los metales’.

31 Barba, op. cit. (15), 39v, ‘Del conocimiento de los metales y diferencias’. On mineral colours see Díez de Revenga Torres, op. cit. (11). For the racial thinking infused in Barba’s classification see Allison Bigelow, ‘Transatlantic Quechuañol: reading race through colonial translations’, *PMLA* (2019) 134(2), pp. 242–59.

like vapours or particular glow effects in hills and forests.³² But, as the sight could be fooled, especially inside the mines, it was necessary to involve all sensory practices that could reveal the secrets of the earth, such as touching, tasting and smelling.

Similar to what Pamela H. Smith has argued for places such as Central Europe, sensory perception of landscape shaped the practical knowledge of Spanish early modern mining.³³ Through sight, smell, taste and touch miners could gather clues to determine the kind of soils, the characteristics of the mineral ore and the place where a metal could be found.

Tasting minerals

Smell was considered appropriate for determining the nature of specific materials. In his *De re metalica*, Pérez de Vargas analyses the taste and smell of metals together, since, on the one hand, smell is understood as a consequence of taste ('el olor es secuela del sabor y manera de rastro suyo que deja') and, on the other, one can better determine and know a taste through the vaporous odours of ores and melted metals.³⁴ Additionally, according to medical humoral theory, smell and taste were signs of hot and dry qualities in matter, and were supposed to be less noticeable in cold and humid things.³⁵ In fact, taste is as related to smell as to touch, since taste can also be described with temperature and texture perceptions. This was the case for the taste of metals, since a hot metal like copper was accounted as having a harsher taste than mercury, which was considered a cold metal with imperceptible taste. As we will see in this section, the taste of metals was associated with neat oppositions or structuring polarities between fetid and nice odours, hot and cold temperatures, sharp and soft textures.

For both Barba and Pérez de Vargas, the variety of odours arising from the soils makes mineral nature an admirable thing to be known. They refer to several experiences and procedures in which tasting and smelling mineral ore were involved. For instance, a common experience among Andean miners was to smell pieces of mineral ore that they did not recognize, acknowledging the epistemic potential of this sense.³⁶ Although the general judgement was that mineral matter tended to have bad taste and smell, miners knew that rare prerogatives in their art could be found. In fact, the clays from Nata in Panama, Estremoz in Portugal and Malacca in East India were judged as having a pleasant fragrance. Good smell (*olor bueno*), of high esteem (*de admiración*), as well as exhalations with a gentle and peaceful warmth (*calor apacible*) were credited among Spanish miners as sign of potential richness of rocks and soils ('señal de riqueza que tienen sus piedras, o tierras').³⁷ For Barba, certain gold and silver mines did not stink – something that Bernardo Pérez de Vargas had stated too – and these mines could even have a nice smell. For instance, following Georg Agricola, Barba wrote that in the Saint Sebastian mine, in Marienburg, there used to emanate such a sweet smell that Prince Henry of Saxony thought it was similar to the exotic scents from India he was acquainted with, which made him dream about the smell of Paradise.³⁸ Barba validated this anecdote with his own Andean experience of the good scent of some silver ores in Peru: 'a gentle

32 Barba, op. cit. (15), 23v: 'Dan los colores de los cerros indicio no pequeño de si tienen o no minerales en sus entrañas'.

33 Pamela H. Smith, 'The codification of vernacular theories of metallic generation in sixteenth-century European mining and metalworking', in Matteo Valleriani (ed.), *The Structures of Practical Knowledge*, Cham: Springer, 2017, pp. 371–92, 376.

34 Pérez de Vargas, op. cit. (20), 24v, 25v.

35 Miguel Martínez de Leache, *Discurso farmacéutico sobre los cánones de Mesue* (ed. María Paula Ronderos Gaitán), Bogotá: ICANH, 2010 [1652], p. 153.

36 Barba, op. cit. (15), 2r. See also note 4 above.

37 Barba, op. cit. (15), 2r.

38 Barba, op. cit. (15), 2r.

smell comes out of the mines of metals which are called *Pacos*'.³⁹ But this was rare: in most cases, metals had a bad smell and a bad taste because of their distempered complexion and their mixture with sulphur and other 'mineral juices'.⁴⁰ Fetid-like animal excrement, pestilential, causing death, thick, upsetting and similar to a 'cellar full of must, when it is boiling, with a serious and heavy stench' ('bodega llena de mosto, cuando está hirviendo, grave y pesado'): those were usually the kind of smells miners had to perceive and take care of, because they could be signals of mortal vapours.⁴¹ Barba tells different stories in which bad smells and poisonous exhalations had killed indigenous miners and made work impossible, forcing them to abandon such locations.

Like modern geologists who still lick or taste rocks and mineral ores to better appreciate their properties, Barba recommended the 'experience of taste' in order to have full notice about the 'purity or mixture of the soil': 'The curious miner ought to make trial by tasting'.⁴² The learned priest in Potosí emphasized that since all minerals are commonly dry and hot, bad-tasting earth can be taken as a good sign for the existence of metals in underground. In that regard, polymath Pérez de Vargas also underlined the fact that, because of the presence of sulphur, all mineral tastes were more or less salty and acute (*agudo*), while smells were generally fetid. However, despite the fact that all metals had a degree of bitter acrimony, the taste difference between them was so clear that gold and silver were considered sweet and with less stench because they did not have as much 'malign mixture of sulphur' as other metals ('la mezcla de malicia de azufre').⁴³ Therefore – Pérez de Vargas emphasized – we must understand that, although some minerals might be called sweet, they rather stink and have a bitter (*amargo*) taste. Mineral sweetness was, then, a relative term in a line of bad and not too bad smells and tastes.⁴⁴

Over the centuries, thinkers have put forward divergent assessments of the epistemic value of taste. For Aristotle, the senses of taste, smell and touch were understood as not capable of discovering the true nature of things, when compared with sight and hearing.⁴⁵ But since the thirteenth century at least, as Charles Burnett showed years ago, this was far from being unanimously agreed upon at the time. In late medieval manuscripts like the *Summa de saporibus*, taste had acquired pre-eminence and superiority, as the adequate sense for true knowledge, because it was able to transcend superficiality – a capacity that other senses would lack.⁴⁶ Spanish physician Juan Huarte de San Juan (1529–88) provided a nice case to understand such a sensorial *paragone*. A person with sharp sight, Huarte suggested, is rarely bewildered by things with very different aspects, but when many things are similar – and such was the case of mineral ores – to perform right discernment gets harder:

39 Barba, op. cit. (15), 2v: 'Apacible olor es el que echan de sí las minas de los metales que llaman *Pacos*'. The Quechua *paco* referred to a vast array of silver ore with ferruginous gangue. See Bigelow, op. cit. (8), 272–89.

40 Barba, op. cit. (15), 2v, 21v: 'Los demás géneros de metales huelen por la mayor parte mal, o por su natural destemplaza, o por la mezcla de azufre, caparrosa, o otros jugos, que casi siempre tienen'; 'No tienen buen olor, ni buen sabor generalmente los metales, por la sulfareidad que a todos acompaña'.

41 Barba, op. cit. (15), 3r

42 Barba, op. cit. (15), p. 11.

43 Pérez de Vargas, op. cit. (20), 25r. *The Simpsons* made a quick approach to this subject in Episode 619, 'The Serfsons', Season 29 (2017). In this episode Homer stated the idea that gold is sweet and lead has a disgusting taste.

44 Pérez de Vargas, op. cit. (20), 25v: 'Y debese entender que aunque se llaman dulces de sabor algunos metales que siempre son hediondos. Pero dulce se dice el que acrimonia y hedor tiene'.

45 Aristotle, 'On the soul', in *The Complete Works of Aristotle*, 2 vols. (ed. J.)Barnes, Princeton, NJ: Princeton University Press, 1984, vol. 1, pp. 641–92, 672.

46 Charles Burnett, 'The superiority of taste', *Journal of the Warburg and Courtauld Institutes* (1991) 54, pp. 230–8; Massimo Montanari, *Il riposo della polpetta e altre storie intorno al cibo*, Bari: Laterza, 2010, p. 98.

if we set before [someone with] a sharp sight, a little salt, sugar, meal, and lime, all well pounded and beaten to powder, and each one severally by itself, what should he do who wanted taste [*que careciese de gusto*], if with his eyes he should be set to discern every of these powders from other without erring ...? For my part I believe he would be deceived.⁴⁷

For early moderns like Huarte, there were at least six different tastes, although other authors would enumerate ten or even eleven. These were catalogued in a sort of line range or latitude – to use a term common to galenic thinking – between fetid and peaceful smells, hot and cold temperatures, and sharp and smooth textures, enabling tastes to keep a relational and contiguous order between them. Here we list the most common order in which tastes are explained by Spanish and New World physicians with the type of food they associated it with: acrid (*acre*), also called acute (*agudo*) or mordant (*mordaz*), like the taste of garlic and chilis; bitter (*amargo*), like almonds and lupins or *altramuces* or *chocos*; salty (*salado*), like chickpeas; astringent (*astringente*), for some authors also called austere (*austero*) and acerbic (*acerbo*), like *capulín* (*prunus salisifolia*) and acorns; vinegary (*avinagrado*) or sour (*agrio*), like vinegar and lemon; fat (*graso*), like lard, although some authors did not consider it a taste, but a consistency or tactile aspect; sweet (*dulce*), like honey; insipid (*insípido*), like pure water, which, however, was contested as a taste.⁴⁸ Beyond the realm of expertise, this rough classification of taste was a shared knowledge, and people in general understood the rules, meanings and mechanisms to apply it in their everyday life. For example, in his itinerary through the Caribbean and the northern Andes, the Florentine merchant Galeotto Cei (1513–79) was able to distinguish the different properties of cultivated and wild guava thanks to their special taste: the latter was astringent and, therefore, it was appropriated to provoke constipation and treat looseness of the bowels during a tropical journey. Another example can be found in the testimony of chronicler and natural historian Gonzalo Fernández de Oviedo (1478–1557), who stated that adequate guavas recommended for constipation were those that were not ripe, because of their astringency.⁴⁹ Taste was presumed as a way of knowing: people could rely on it, since their tongue could tell them what the world was like.

For medical practices, identifying the taste of food and medicines with a certain degree of precision allowed healers to know their properties and elemental qualities and, by extension, to determine their appropriate use for a particular human complexion, the treatment of an ailment, the right time of the year for their consumption, or the best way to include it in a diet, among other variables.⁵⁰ In contexts of traveling, commerce, warfare and cultural encounters, taste could be of great use for early modern Spaniards. Besides distinguishing themselves from others through their ideas about what was socially distasteful and avoidable, the global expansion of European monarchies compelled Christians to test their preferences and palates. Taste was then exerted to decipher the virtues of novel plants and mineral particulars present in different *materia medica* and foodstuffs which challenged their taxonomic models and their

47 Huarte, op. cit. (2), p. 173.

48 For tastes in early modern Spanish authors see Jerónimo de Ayala, *Principios de cirugía: Tratados de cirugía* (ed. María Paula Ronderos Gaitán), Bogotá: ICANH, 2009 [1724], pp. 169–72; Martínez de Leache, op. cit. (35), pp. 157–88; Jean-Louis Flandrin, 'Assaisonnement, cuisine et diététique aux XIVe, XVe et XVIe siècles', in Jean-Louis Flandrin and Massimo Montanari (eds.), *Histoire de l'alimentation*, Paris: Fayard, 1996, pp. 491–509, 500; Allen J. Grieco, *Food, Social Politics and the Order of Nature in Renaissance Italy*, Florence and Milan: Villa I Tatti, Officina Libraria, 2019, p. 130.

49 Galeotto Cei, *Viaggio e relazione delle Indie (1539-1553)*, Rome: Bulzoni, 1992, p. 28; Gonzalo Fernández de Oviedo, *Historia general y natural de las Indias*, 5 vols., Madrid: Atlas, 1992. vol. 1, p. 259.

50 Grieco, op. cit. (48), pp. 110–16.

gustation.⁵¹ Physicians, artisans and practitioners of mining and metallurgy were certainly efficient at identifying and naming the tastes, nature and virtues of edible and non-edible matter in order to inscribe it within their bodies of knowledge and ways of living.⁵²

Like food and medicines, minerals also had tastes to examine, although with less diversity. Almost all minerals were salty (*salados*) and bitter (*amargos*), depending on how much sulphur they contained. Even though, in our sources, there is no explicit attempt at a systematic mineral taste classification, the period actors themselves judged and acted following the polarities or oppositions between hot and cold (temperature), sharp and smooth (texture), or fetid and agreeable (odour). At one extreme, we should locate the powerful stench of sulphur, the hottest and most acrid mineral. At the other extreme, we can situate mercury as the most humid and cold one. Associated with sulphur, and often accompanying copper and iron, Barba says that ‘rock-alum’ is ‘mightily astringent’ (*virtud de constreñir*), and ‘copperas’ (copper sulphate, vitriol or, for Barba, *caparrosa*) ‘has a biting taste, with a sour and astringent quality’ (*mordicante al gusto, áspera y constrictiva*).⁵³ Given its cold and moist nature, Pérez de Vargas affirms that it is difficult to perceive the taste of lead and tin – soft metals.⁵⁴ Copper and iron, as they were classified as hot, could be directly recognized by their acrid, acute (*agudo*) or bitter (*amargo*) taste.⁵⁵ Silver and gold, as the most tempered metals, were credited as being the sweetest.⁵⁶ Gold was at the pinnacle of taste: ‘Gold smells and tastes well, by reason of its most excellent temperature; or at least, it neither smells nor tastes ill.’⁵⁷

Even though the taste of minerals and metals could be placed somewhere between the polar ranges of hot–cold, agreeable–fetid, smooth–sharp, they were also movable thanks to human agency or due to their specific underground origin. Ultimately, the transformation and variability of mineral matter were the main pursuit of alchemy and metallurgy. According to humoral theory, all bodies and mixtures have a complexion that could change by altering their inner heat or humidity. Climate, nutrition, exercise, emotions and ageing were, for instance, means by which persons could undergo changes in their complexion.⁵⁸ As well as foodstuffs, metals could be altered and transformed by means

51 Rebecca Earle, *The Body of the Conquistador: Food, Race and the Colonial Experience*, Cambridge: Cambridge University Press, 2012. For an example with plants see Šebestian Kroupa, ‘Georg Joseph Kamel (1661–1706): a Jesuit pharmacist at the frontiers of colonial empires’, doctoral thesis, University of Cambridge, 2019. Gregorio Saldarriaga, ‘Taste and taxonomy of native food in Hispanic America: 1492–1640’, in Rafael Climent-Espino and Ana M. Gómez-Bravo (eds.), *Food, Texts, and Cultures in Latin America and Spain*, Nashville: Vanderbilt University Press, 2020, pp. 76–98.

52 To see how physicians, scholars and practitioners described food in Spanish America see Juan de Cárdenas, *Problemas y secretos maravillosos de las Indias compuesta por el doctor Juan de Cardenas, médico*, México: Museo Nacional de Arqueología, Historia y Etnología, 1913 [1591]; Juan Méndez Nieto, *Discursos medicinales*, Salamanca: Universidad de Salamanca, Junta de Castilla y León, 1989 [1607]; José de Acosta, *Historia natural y Moral de las Indias*, Madrid, 1608.

53 Barba, op. cit. (15), 5r–6r.

54 Pérez de Vargas, op. cit. (20), 24v–25r. Because of their coldness, in Renaissance Italy, sometimes a phial of mercury or a piece of lead was used to temper hot wines. Grieco, op. cit. (48), p. 136.

55 Among other Spanish American products with an acute taste there were chilis and cocoxihuitl, and with an acute smell was guava skin. Francisco Hernández, *Quatro libros de la naturaleza, y virtudes de las plantas, y animales que están recebidos en el uso de medicina en la Nueva España ... traducido, y aumentados muchos simples, y compuestos y otros muchos secretos curativos, por Fr. Francisco Ximénez*, México: viuda de Diego López Davalos, 1615, 72r, 82v; see also Cei, op. cit. (49), p. 28.

56 Pérez de Vargas, op. cit. (20), 24v–26r.

57 Barba, op. cit. (15), 21v: ‘Aunque el oro huele, y sabe bien, por su excelentissimo temperamento, o por lo menos no sabe ni huele mal’.

58 Earle, op. cit. (51).

of fire.⁵⁹ However, although technical means were capable of altering the taste of metals, their taste could also differ from one place to another. According to Spanish royal chronicler Juan López de Velasco (c.1530–98), his informants from Río de la Plata provinces had written to him that their copper was sweet (*dulce*).⁶⁰ In a different account from late 1560s, Juan de Echagoyan, a former judge of Santo Domingo, wrote that La Española copper was vinegary, but that it could be sweetened.⁶¹ The same process of turning copper into a sweeter metal appeared again in 1621 in a proposal made by the *regidor* of Jerez (Spain) Manuel Gaytán de Torres to the Spanish Crown for the exploitation and refining of copper mines in Venezuela.⁶² Therefore copper could move by human agency in the polarity of taste, from acrid or bitter (hot) to vinegary (less hot) and to sweet (tempered). In his journey through Spanish America during the 1660s, the Syriac priest Elias al-Mûsili described that when silver ores were too earthy or cold, miners and assayers were able to temper them by adding copper, but if they thought they were too hot, they would add lead to make it sweeter.⁶³ This capacity of taste to identify the properties of metals is significant, since it confirms that taste was an epistemic marker and was used to assess and project processes of alloying, refining and assaying metals.

As Pamela H. Smith has argued, ‘the polar oppositions of Aristotelian qualities – hot, dry, wet, and cold – were a fundamental structuring framework for all knowledge – practical and otherwise – in early modern Europe’, as well as in Spanish America, we should say.⁶⁴ As we have seen, although there was not an explicit system for the variety of metal tastes where mobility was the rule, we want to suggest that they were employed as sensory and epistemic markers within the polarities of hot and cold, fetid and agreeable, and sharp and smooth. This taste polarity enabled early modern people in the Spanish worlds to determine material properties, potential metallurgic transformations and the relative value of minerals and metals, going from acrid and bitter taste to sweet and insipid; from the most harsh, hottest tastes of copper, iron and sulphur (with salty, bitter and acrid tastes), to the most humid and cold tastes of mercury, tin and lead granted as less sapid. Silver and gold were put in the middle and most valuable place, as fat, sweet, temperate metals. Taste was therefore an operative way to understand, describe and transform the metals.

Waters, metals and geographical descriptions

Aside from metallurgical and the mining treatises, it is difficult to find references to the taste of minerals and metals. The tacit nature of knowledge based on taste is an explanation for this scarcity. On the mining ordinance (*ordenanzas mineras*) – a gubernatorial

59 Massimo Montanari, *La comida como cultura*, Gijón: Trea, 2006, p. 50.

60 Juan López de Velasco, ‘Demarcación y división de las Indias’, in *Colección de documentos inéditos: relativos al descubrimiento, conquista y colonización de las posesiones españolas en América y Oceanía sacados en su mayor parte del Real Archivo de Indias*, 42 vols., Madrid: José María Pérez, 1864–1871, vol. 15, pp. 409–539, 524.

61 ‘Relación de la isla Española, enviada al rey D. Felipe II por el licenciado Echagoian, oidor de la Audiencia de Santo Domingo’, in *Colección de documentos inéditos*, op. cit. (60), vol. 1, pp. 9–35, 14.

62 Manuel Gaytán de Torres, *Relación y vista de ojos que don Manuel Gaytán de Torres, veintiquatro de la ciudad de Jerez hace a su Magestad en el Real Consejo de las Indias, por comisión que para ello tuvo de las minas de cobre que ay en las Serranías de Cocorote, provincia de Venezuela*, Granada: Antonio Moreno Martín, 1968 [1621], Segundo artículo, ítem 10, 3r: ‘Y fundido el metal [cobre] de primera fundición, se ha de llevar a otra casa de sesenta pies de largo donde se ha de afinar y adular con otro ingenio’/‘Melted the copper for the first time, it must be taken to another house of sixty feet long, where it should be refined and sweetened’.

63 Elias al-Mûsili, *An Arab’s Journey to Colonial Spanish America: The Travels of Elias al-Mûsili in the Seventeenth Century* (tr. from the Arabic and ed. Ceasar E. Farah), New York: Syracuse University Press, 2003, p. 60.

64 Smith, op. cit. (33), pp. 386–7.

regulation that almost every jurisdiction promulgated through the modern age in the Hispanic world⁶⁵ – the taste of minerals was not even mentioned, because the ordinance was made for ruling the ownership and exploitation of the mines, not for discovery or analysis. Fernández de Oviedo did not mention the use of taste for metalworks, even though he wrote a detailed description of the search for and mining of gold.⁶⁶ In the *Cartas annuas* of the New Kingdom of Granada, the Jesuits did not record information about this subject, nevertheless they did mention how gold mining was done in the province of Antioquia.⁶⁷ The few references beyond metallurgic treatises we have found so far are related to the connection of waters and metals. Interestingly, as we will see, tasting water was an indirect way of gaining and communicating knowledge about the presence and properties of metals in specific places.

Here again, Barba opens the way: metals ‘communicate to water their qualities and virtues’ (‘comunican a las aguas sus calidades y virtudes’). When they get in touch, he explains, waters receive the ‘very subtle spirits of metals’ (‘espíritus sutilísimos del metal’). From that communicative principle, says Barba, a variety of flavours, odours, colours and medicinal properties can be found in streams and springs.⁶⁸ Barba also describes several workshop experiences in which metals communicate their taste to water. Any sort of ore, he says, would imbue its taste easily in a glass of water, and the infusion will go even faster if it is boiled twice: afterwards one can taste it and discern with certainty the taste of the minerals.⁶⁹ This experience turned out to be for him the best way to know whether alum and copperas or vitriol were present in the pieces of ore he wanted to refine: the acrid or sour taste of water would be a clear sign of the presence of those sulphurous minerals.⁷⁰ Bernardo Pérez de Vargas also recognized this indirect method of finding or identifying metals by tasting water. In the case of copper, for instance, he described how this mighty metal infused underground waters that pass through its veins, turning them into a bitter, deadly and abominable liquid. His advice: do not try to drink wine in a glass made of copper.⁷¹

Records coming from the *Relaciones geográficas de Indias* inform us on how civil authorities in Spanish America described the mineral taste of their rivers and streams. These records are privileged sources for understanding how the use of sensory knowledge of metals through smell and taste was also present in people who did not exert mining or metallurgic practices. The *Relaciones geográficas* were conceived by the Spanish Council of Indies in the 1570s and 1580s as an attempt to standardize the natural, historical and political descriptions of Spanish kingdoms through a fifty-item questionnaire composed by royal cosmographer and chronicler Juan López de Velasco (1530–1598). This administrative and epistemic project for the *entera noticia* (‘whole description’) of the New World united local agents in the Indies with collection and calculation centres

65 Miguel Molina Martínez, ‘Legislación minera colonial en tiempos de Felipe II’, in *XIII Coloquio de Historia Canario-Americana; VIII Congreso Internacional de Historia de América*, 1998, pp. 1014–29, available at <http://coloquios-canariasamerica.casadecolon.com/index.php/CHCA/article/view/8201> (accessed 30 May 2021).

66 Fernández de Oviedo, op. cit. (49), vol. 1, pp. 159–65.

67 ‘Letras anuas de la viceprovincia de Quito y el Nuevo Reino de los años de 1608 y 1609’, in José del Rey Fajardo and Alberto Gutiérrez (eds.), *Cartas anuas de la provincia del Nuevo Reino de Granada, años 1604 a 1621* Bogotá: Pontificia Universidad Javeriana, 2015, pp. 189–256, 246

68 Barba, op. cit. (15), 60r–60v.

69 Barba, op. cit. (15), 3v: ‘Imprímense fácilmente los sabores de las tierras en el agua pura, si en algún vaso se detienen juntas, y más si se les ayuda con el calor del fuego; dándoles uno o dos hervores y probándola después, juzgará el gusto la mezcla o jugo que contiene’.

70 Barba, op. cit. (15), 41r.

71 Pérez de Vargas, op. cit. (20), 25v.

in Europe.⁷² The questionnaire was received in every town and city, and local authorities should answer them with the help of the most experienced people who could know some of the answers, because of their training or their antiquity in the place. Since the *Relaciones geográficas* were based in very specific questions, they enabled people to verbalize ideas and practices that were part of everyday tacit knowledge.

We have gathered different answers from several parts of the continent to provide a quick and wide perspective on how descriptions of mineral taste were made, starting with the taste of waters. In Guatemala, in the provinces of Verapaz and Zacatula, it was reported that some waters coming from the mountains were *gruesas* – which is thick, raw: hard waters – because they were not warmed by the sun, while others were ‘terrible, for they pass, I think, through veins of iron or something ill and of bad flavour’.⁷³ In other records coming from New Galicia, New Spain and Quito there were references to the water that runs through deposits of gold or silver: in those two cases, the waters were judged as *buenas, sanas* and *delgadas* – good, healthy and thin: light waters.⁷⁴

Following the same indirect method of tasting metals through the water, Franciscan chronicler Fray Pedro Simón (1574–1628) wrote in his *Noticias históricas* (1626) about the quality of water as a sign of gold mines in the Paeses province, by the Magdalena river: ‘To what it seemed to me, and to others more trained than me who also agreed, when I was in the province of these Indians, there were good signs of gold mines in many parts, as the delicate [*delicadas*] and healthy [*saludables*] waters showed it’.⁷⁵ In a context of Spanish expansion and colonial settlement, this first-hand testimony is exemplary because it explicitly states that good waters could be true signs of undiscovered and very much desired gold.

In the examples we have shown in this section, the adjectives used by common people for the water that runs through gold and silver veins were ‘good’, ‘healthy’ and ‘thin’ (light). The informants and the chronicler did not use ‘sweet’, as metallurgic practitioners would do. However, this might be explained by the fact that informants were oriented towards the healthy conditions of their inhabited environment, while miners and artisans were describing the temper of their ore and metalworks. Additionally, the principle of light waters is that they are sweet, even if they are not properly sweet as sugar (sweetness, as we have already said, was also a relative term that meant temperate). Moreover, good water was supposed to be ‘without colour, smell or flavour, and must be seen by the sun’,

72 Arndt Brendecke, *Imperio e información: Funciones del saber en el dominio colonial español*, Madrid and Frankfurt: Iberoamericana, Vervuert, 2012; María M. Portuondo, *Secret Science: Spanish Cosmography and the New World*, Chicago: The University of Chicago Press, 2009.

73 ‘Relación de las provincias de la Verapaz y Zacatula distrito de Guatemala’ [1574], in René de Acuña (ed.), *Relaciones geográficas siglo XVI: Guatemala*, México: UNAM, 2017, e-pub: ‘Y algunas destas [aguas] son terribles, por pasar, según creo, por venas de hierro o de otras cosas graves y de mal sabor’. A similar argument can be found in ‘Apéndice VI: Carta dirigida al rey por el licenciado Diego García de Palacio, tocante a las provincias de Guazacapan, Los Izalcos, Cuzcatlan Y Chiquimula’, in Acuña, op. cit.; and ‘Relación del pu[eb]lo de Amatlan, de la Real Corona’, in Acuña op. cit.

74 ‘Relación de las villas de San Martín y Llerena y su partido’ [1585], in René de Acuña (ed.), *Relaciones geográficas siglo XVI: Nueva Galicia*, México: UNAM, 2017, e-pub; ‘Relación de la ciudad y provincia de Quito’ [1570–1], in Pilar Ponce Leiva (ed.), *Relaciones histórico-geográficas de la Audiencia de Quito (siglos XVI y XVII)*, 2 vols., Quito: Malka/Abya-Yala, 1992, vol. 1, p. 97; ‘Relación de la ciudad de Zamora 1570–1571’, in Ponce, op. cit., vol. 1, pp. 99–111, 102; ‘Descripción de la ciudad de San Francisco de Quito’, in Ponce op. cit., vol. 1, pp. 187–221, 194. ‘Relación general de las poblaciones españolas del Perú hecha por el licenciado Salazar de Villasante’, in Jiménez de la Espada, op. cit. (4), vol. 2, pp. 121–146, 127, 142.

75 Fray Pedro Simón, *Noticias históricas de las conquistas de Tierra Firme en las Indias Occidentales*, 7 vols., Bogotá: Banco Popular, 1981, vol. 5, p. 229: ‘A lo que a mí me pareció y a otros que se las entendía más, cuando estuve en la provincia de estos indios [paeses], no había malas muestras de minas en muchas partes, como lo mostraban sus aguas tan delicadas y saludable’. For gold mines around the Darién river see vol. 6, p. 493.

because its heat tempers the water and makes it digestible, less raw, and healthier.⁷⁶ Therefore the lack of a specific taste in the water was a sign of quality. For the same reason, metals like silver and gold were also credited as purifiers of water for their temperate and ‘sweet’ quality, in contrast with other metals like copper or iron.⁷⁷ In the *Relaciones geográficas* we have chosen, the association of thin, temperate and healthy waters with the good nature of metals uncovers a cosmological analogy with symbolic effects that gives us the occasion for a final consideration on the taste of metals in the Spanish worlds.

The cultural and cosmological breadth of mineral taste

Let us finish this analysis by stressing the natural-philosophical and symbolic dimensions of mineral and metal tasting through the exemplary cases of gold and iron. As we have seen, the good taste of gold and silver was explained from the minimal quantities of sulphur in their composition. While gold was described as having the best and purest taste, iron was assessed as having a bad, acrid taste because it was mixed with more sulphuric minerals. Pérez de Vargas described its nature as a ‘bastard metal’ (‘metal bastardo’) made of an ‘earthy, thick and strong substance’ (‘de una sustancia terrestre, gruesa y fuerte’), associated with decay and instability by the rustiness it could engender (‘cría orín y herumbre’).⁷⁸ The famous Sevillian physician Nicolás Monardes (1508–88) described this traditional opposition in his *Diálogo del hierro, y de sus grandezas* (1574): ‘gold is made from clean and pure origins, which makes it splendid, radiant and beautiful, and iron, made of coarse and impure origins, is ugly, black and dark’.⁷⁹ The assumed opposition between gold and iron based on its externalities and sensory qualities projected a hierarchical logic rich in cosmological analogies and symbolic consequences. However, given the benefits of iron in daily life and the excesses committed for the spell of gold, early moderns like Monardes challenged such categorical opposition and, by extension, stressed the limits of assessing metals through taste, as well as the expectations and belief systems that this way of knowing could generate. By revealing the functioning – and ironical conversion – of this hierarchy, we will outline the cosmological correspondences and variations that the tastes of metals could entail.

As Allen J. Grieco has shown, during late the medieval and early modern periods the classification of the vegetable world was derived from Albertus Magnus’s canon; in this classification there were five distinct categories: (1) trees, shrubs and bushes that produce fruit; (2) grains; (3) herbaceous plants; (4) plants with edible roots; and (5) the acrid group

⁷⁶ Juan Sorapán de Rieros, *Medicina española contenida en proverbios vulgares de nuestra lengua: Muy provechosa para todo genero de estados, para philosophos y médicos, para theologos y juristas, para el buen regimiento de la salud y mas larga vida*, Madrid: Martín Fernández Zambrano, 1616, p. 272: ‘sin color, olor, ni sabor, y ha la de ver el sol’. Girolamo Manfredi, *Libro llamado El porque, provechosissimo para la conservación de la salud, y para conocer la phisonomia, y las virtudes de las yerbas. Traduzido de Toscano en lengua Castellana*, Alcalá: en casa de Juan Iñiguez de Lequerica, 1587, 37v.

⁷⁷ As Pedro Simón recalls it, gold and silver glasses temper the wine: ‘estando prevenidas muchas mucuras de chicha y totumas en qué bebería, que es el vaso más a propósito que se ha hallado para este brebaje, porque así como el vino es su propio vaso el del oro o la plata, para la aloja, cerveza y sidra el de vidrio, para el agua el de la tierra sin vidriar, para el chocolate, atole y pinole, el coco, así para la chicha, guarapo y masato son vasos acomodados las totumas’. Simón, op. cit. (75), v. 5, p. 571.

⁷⁸ Pérez de Vargas, op. cit. (20), 37r.

⁷⁹ Nicolás Monardes, *Primera, segunda y tercera partes de la historia medicinal de las cosas que se traen de nuestras Indias occidentales que sirven de medicina; tratado de la piedra bezar, y de la yerba eucerconera; Diálogo de las grandezas del hierro y de sus virtudes medicinales; tratado de la nieve y beber frío*, Seville: Alonso Escribano, 1574, 162v: ‘ser el oro hecho de sus principios limpios y puros, por donde es lucido, resplandeciente y hermoso, y el hierro, por ser hecho de principios gruesos e impuros feo negro y obscuro’. Monardes’s description might have an echo in visual representations of Van Leeuwenhoek and Blankaart when they drew pointy particles to visualize acrid tastes.

of garlic, onions, leeks and shallots. Generally, it was thought that natural products with better taste – the sweetest – were those generated by trees, and then, in a descending scale, the rest. The worst taste was acrid. According to this perspective, proximity with the ground was considered negative and less valuable. Consequently, taste for certain foodstuffs could have social assumptions. In the vegetable scale, fruit from trees were worthy of the nobility, while the last group, garlics and onions, was assumed to be suitable for peasants. Additionally, it was thought that the best fruit to harvest were those at the top of trees, because the sap that nourished them was already filtrated and less earthy, unlike the sap received by fruits located at the lowest parts of plants.⁸⁰ Fruit that moved away from the ground and closer to the sun was usually preferred because of its improved flavour. Analogically, it was also supposed that, according to a vernacular astrological correspondence – also developed by Albertus Magnus and the Christianized alchemical tradition – the sun and other celestial bodies, with their rays, heated and penetrated the element of earth, modifying it and creating metals in its entrails.⁸¹ Even though sixteenth- and seventeenth-century scholars like Pérez de Vargas, Monardes and Barba disavowed this astrological explanation for the origins of metals, associations between metals and astral bodies were still frequent, especially when appraising metals. In the corpus of the *Relaciones geográficas* we find cases in which the informants explained that the presence of gold in their territories was due to the effect of the sun.⁸² In this manner, gold was considered the most perfect among metals for its correspondence with the sun, the value of silver compared to the splendour of the moon, while iron received the influence of Mars. These analogies between metals and celestial bodies were also carried to a social level. Gold and silver, for their temperate nature, sweetness, purity and shininess, were adequate for noble matters, whereas the ill complexion of iron was suitable for lower, but profitable, deeds related to the mechanical arts and peasant work.

In the complex web of cultural associations in the early modern Spanish world, the analogies of the sunshiny gold prompted by the sense of taste were abundant. For Barba, for instance, another reason for gold having a good taste was its fatty complexion.⁸³ This connection with a fat quality had sense in the scale of taste because sweet and fat were adjacent flavours.⁸⁴ By means of analogical thinking, connections between sweetness and fatness gave gold a symbolic place within dietetic thinking, according to which

80 Grieco, op. cit. (48), pp. 195 and 201.

81 Early modern alchemical images depicting this process are exemplary studied in M.E. Warlick, 'Picturing nature in alchemical images', in Arthur Versluis et al., *Esotericism, Religion, and Nature*, Minneapolis: North American Academic Press, 2010, pp. 255–76.

82 'Relación de la Isla Española', op. cit. (61), p. 14: 'Este oro las aguas lo bajan de las sierras y montes peladeros, y dan con él en los ríos grande o pequeño polvo, en el estado en que el sol lo tenía criado, y alguno va adelante con la corriente y arena, y otro queda hecho polvo entre la arena, y otro en pedazos arrimados a las piedras que la corriente no puede llevar adelante'. On this natural speculation connecting the heat of the sun and the generation of minerals in the tropical Spanish America see Nicolás Wey-Gómez, *The Tropics of Empire: Why Columbus Sailed to the Indies*, Cambridge, MA: MIT Press, 2008.

83 Barba, op. cit. (15), 17r.

84 Italian cosmographer Giuseppe Rosaccio (1530–1620) also employed the polarity of tastes –from sweet to acrid – and confirmed the contiguity between sweet and fat: 'il zapore è una qualità gustabile causata dall'humido, digertito nel secco terrestre per virtù del Sole, ò del Fuoco, e perche questo humore diversamente si mescola, e si cuoce con il secco, per questo si fanno anco diverse specie di sapori trà i quali sono li estremi trà il dolce, e l'amaro, e trà il dolce e l'acuto, e trà l'amaro e l'acuto, onde se il zapore si accosta più al dolce, si chiama grasso, & se si accosta più all'acuto si chiama salso, e se più all'amaro si dice sapor pontico'. Giuseppe Rosaccio, *Il medico del dottore in Filosofia, et Medicina & Osservatore de'Motti Celesti. Libro tre. In questo primo si tratta della Nobiltà & Eccellenza dell'Astrologia*, Venice: Pietro Farri, 1621, p. 124.

the most nutritious foodstuffs were fat and sweet.⁸⁵ Besides, from late medieval times, fat (*graso*, *pingüe* or *untuoso*) had strong symbolic links with wealth, and was synonym for abundance, copiousness and fertility.⁸⁶ In that sense, we might say that gold was the best nourishment, perhaps not for the human body, but for the social body.⁸⁷ As Guamán Poma's satirical drawing conveys, gold fed the early modern Spanish body politic (Figure 1).

Despite the fact that metals could be invested with a high or low hierarchy according to their specific place within the polar range of tastes, metals could also receive different meanings when assessed from other points of view, such as from the benefits they offer to humans. In Monardes's *Diálogo del hierro, y de sus grandezas* the symbolic and cosmological associations derived from the taste of metals were questioned. The sulphur-and-mercury theory about the origins of metals gave Monardes the opportunity to assert that iron ore was not only generated from the same physical principles as gold and silver, but that it was actually the most excellent ('el más excelente') of metals, 'because iron is more useful and necessary than all the other metals' ('porque del tenemos más aprovechamientos y más necesidad que de todos los demás').⁸⁸ The doctor in Monardes's dialogue affirms that the zeal for gold and silver has created scarcity and overrated prices in the Spanish world. Instead, iron appears as a reminder of the abundant, cheap and useful means provided by nature and fashioned in sundry ways by human ingenuity, not only for its role in the making of tools, but also for its medicinal properties treating ailments. For Monardes, the sense of utility can be taken as the shifting point and limit to taste as an epistemic and symbolic marker for metals. Dissociated from the values conferred by taste, gold shows its dark side in the greed and plunder it yields, while iron shows its splendor in all the help it gives to labour and the maintenance of life. Monardes questioned the idea that metals could be appreciated by the external forms gathered by the senses. He moved away from straightforward analogies, and preferred to go beyond the values associated with the colour black, rustiness and the acrid flavour. Instead, from an ironical or paradoxical appraisal, he conceived of iron as the actual gold. For Monardes, iron was the best metal because of its multiple uses – a remedy for melancholy and infertility, and a matter used in navigation for exploring new lands. Even though it was not of the most precious complexion, its practical functions had more weight than its composition. As historian Antonio Manuel Hespanha has stated about the juridical order in the early modern Iberian world, less perfection and subordination did not imply less dignity, but only a specific place in the order of Creation. Therefore each entity was supposed to play its role in the social and natural order adequately and honourably, according to its nature.⁸⁹ In that sense, the values of usefulness and cooperation underlie Monardes's paradoxical appraisal of iron's dignity and his rejection of the overrated taste

⁸⁵ De Cárdenas, op. cit. (52), p. 122; Hernández, op. cit. (55), 96v. Both texts have the common source of natural historian and *protomedico* of New Spain Francisco Hernández (c.1514–87).

⁸⁶ Likewise, in the Italic peninsula, in Florence, the gentry were known as *il popolo grasso*, while Bologna was known as *la grassa*, because of its abundance and richness. Massimo Montanari, 'Bologna "la grassa": La construcción de un mito', in Massimo Montanari (ed.), *El mundo en la cocina: Historia, identidad, intercambios*, Buenos Aires: Paidós, 2003, pp 173–88, 174; *Diccionario de autoridades*, v.v (1737).

⁸⁷ People could consume metal as part of medical prescriptions, such as tiny parts of gold and silver. In those cases, metals were not contemplated as nourishing food, but as *materia medica*, since they were prescribed to alter the body without becoming corporal substance. Girolamo Manfredi, *Liber de homine: Libro del perche*, 1497, 1v. Royal assayer Juan de Arfe y Villafañe says that even if eaten, and unlike other metals, gold is never poisonous: 'ni comiéndose es ponçonofo, como otros metales, antes para muchas enfermedades es medicina'. Arfe y Villafañe, op. cit. (25), 76r.

⁸⁸ Monardes, op. cit. (79), 163v.

⁸⁹ Antonio Manuel Hespanha, *Imbecillitas: As bem-aventuranças da inferioridade nas sociedades da Antigo Regime*, São Paulo: Annablume, 2010, p. 55.

for gold and silver: 'Iron is profitable for agriculture and country labours: to benefit estates and ... things so necessary and beneficial for everyone, since the arts of the countryside support and sustain all the states of the world'.⁹⁰

According to their taste, metals could assume a network of cosmological and symbolic values entailing a hierarchy. But the taste conferred on a specific metal was neither a determination of its meaning nor certainly the only way to understand it. From the perspective of utility and ethical considerations of a good life, metals were assessed differently, as Monardes proposed with his appraisal of iron. By considering the cosmological breadth of the taste of metals we have pointed out both its potential and its limits.

Conclusion

In this article we have examined the role of taste in Spanish understanding of metals during the sixteenth and seventeenth centuries. References to tacit knowledge entailing tasting metals are not abundant in historical sources. In mining and metallurgic treatises, sight, measurement and assaying methods were preeminent for recognizing, classifying and describing mineral matter. However, our analysis has shown that through taste it was possible to gain access to other forms of knowledge about metals. The language of taste was mainly structured by an Aristotelian and galenic vocabulary of elemental qualities and humoral differences. The fact that discussions of the taste of metals and minerals appeared mostly in metallurgic and mining treatises implies that it was the subject of a training process and a specialized knowledge that could be obtained in practice. Practitioners like Andean assayers, miners, *zahoríes*, *cateadores* and *baquianos* would have had to use their refined palate in order to better grasp particularities and differences. Naming and describing mineral tastes enabled them to gather sensory clues in the landscape (like tasting waters to determine the presence of metallic veins), discern the composition and properties of mineral matter, and envision potential transformations in the metals they worked with. Indeed, taste was as useful for knowing as for making. Tasting and assigning taste to metals oriented human ingenuity on how to transform them through the force of heat and the mixture with other metals, as happened in the case of food and cooking. Taste was granted as a rather reliable way of knowing in the Spanish worlds.

Although mineral and metal taste had a resemblance with everyday ways of naming foodstuffs, it was applied in a relative sense. The taste of copper was deemed acrid or bitter, but it was not bitter as an almond; gold was sweet, but never as sweet as sugar, and so on. Barba and Pérez de Vargas insisted that all metals were fetid and rather sharp to the taste. The different tastes of metals, from sweet to acrid, should then be understood as an effort to inscribe mineral stuffs within the polarity of temperature (hot-cold), texture (soft-sharp) and smell (peaceful-fetid), with the aim of organizing and discerning their subtle particulars and their technical potentials. This operation necessarily mobilized evocations of and associations with symbolic values of taste and distaste, social distinctions between nobler and lower metals, natural-philosophical comparisons with plants and humans, and cosmological thinking on matter.

In this article, we have been able to show how, in the vast geography of early modern Spanish culture, the subjective and embodied knowledge of mineral taste was mediated by moral and social considerations on the body politic, and validated by cosmological

⁹⁰ Monardes, op. cit. (79), 164v: 'Aprovecha asimismo el hierro para la agricultura, y labores del campo ... cosas tan necesarias y provechosas para todos, pues el oficio del campo sustenta y sostiene todos los estados del mundo'.

correspondences. Knowledge provided by taste conferred sundry symbolic values that reinforced the cultural significance of metals, even when not straightforwardly connected with mining, metallurgy or alchemy. However, such a wider framework of taste triggered irony and criticism from persons like Nicolás Monardes and Felipe Guamán Poma de Ayala: taste for metals could be scorned as overrated when refined palates did not consider utility and good life in their judgements.

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