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Article abstract

This article examines the practice of producing factitious gems as described in Nityanātha's Jewel Mine of Mercury (Rasaratnākara), a thirteenth to fifteenth-century alchemical work written in Sanskrit. It queries how this practice fits within the Indian alchemical discipline and explores its possible connections with other artisanal crafts.

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Making Gems in Indian Alchemical Literature

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In this article, I will examine the practice of producing factitious gems as described in Nityanātha's *Jewel Mine of Mercury* (*Rasaratnākara*, henceforth *Jewel Mine*), a thirteenth to fifteenth-century alchemical work written in Sanskrit. The practice of producing gems is unusual for the Indian alchemical tradition with only few references to it found in its literature. Here, I will query how the *Jewel Mine* presents this topic and fits it into its larger alchemical programme. An analysis of the substances and applied procedures will serve to situate the relevant recipes within the Indian alchemical tradition and within a wider milieu of artisanal knowledge.

1 THE SOURCE

The *Jewel Mine* is one of the key works of the Indian alchemical discipline. The works associated with this discipline variously call their subject "the doctrine of mercury" (*rasavāda*), "the discipline of mercury" (*rasaśāstra*), and "the knowledge of mercury" (*rasavidyā*). As these names suggest, the methods and aims of Indian alchemy centre on the uses of mercury, in particular on the making and application of mercurial elixirs. This is also the focus of much of the *Jewel Mine*'s contents, which draw heavily on earlier alchemical works, such as the tenth-century *Treatise on the Heart of Mercury* (*Rasahṛdayatantra*) by Govinda, the anonymous eleventh- to twelfth-century *Ocean of Mercury* (*Rasārṇava*), and the twelfth- to thirteenth-century *Crest Jewel of the Lord of Essences* (*Rasendracūḍāmaṇi*) by Somadeva. There are also numerous references to ayurvedic works and authorities, as well as to Śaiva Tantric medical texts, such as the *Higher Qualities in the Time of Action* (*Kriyakālaguṇottara*).[1]

1 On the references to other alchemical works, as well as to ayurvedic and other works, see HIML: vol IIA, 659–660. See Slouber 2007: 2, n. 2 on the difficulties of translating the title *Kriyakālaguṇottara* appropriately.

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The *Jewel Mine* consists of five parts:

1. The section dedicated to mercury (*Rasakhaṇḍa*)
2. The section dedicated to the lord of essences, i.e., mercury (*Rasendrakhaṇḍa*)
3. The section dedicated to the doctrine (*Vādakhaṇḍa*, also "to the learned": *Vādikhaṇḍa*, or "to extraordinary knowledge and powers": *Ṛddhikhaṇḍa*)
4. The section dedicated to elixirs and tonics (*Rasāyanakhaṇḍa*)
5. The section dedicated to utterances of power (*Mantrakhaṇḍa*)

The first section of the *Jewel Mine* is very similar in content to the oldest of the Sanskrit alchemical works. It describes the various ways in which mercury and a range of auxiliary substances are processed for their formulation into elixirs. The second section is dedicated to medical treatment with mercurials, a topic briefly introduced in the *Crest Jewel of the Lord of Essences* (*Rasendracūḍāmaṇi*) by Somadeva, but treated much more extensively here.[2] The twenty chapters of the third section cover a range of topics, including the initiation of the alchemical student, the set up of the laboratory and its inventory, the materials used in alchemical operations, the transmutation of metals into gold or silver, and the eighteen-step alchemical programme for making and applying elixirs.[3] Chapter nineteen of this section introduces a topic not found in earlier alchemical works: It describes how to make factitious gems and other imitation products, such as fake sandal, camphor, musk and saffron; how to make ink, incense and perfume, and how to magically increase the yield of grains. This is the chapter we will examine more closely here. The fourth section describes the final formulation of mercurial elixirs and their application in elixir regimen. This section parallels the final chapters of the *Heart of Mercury* and the *Ocean of Mercury*, though it also includes a section on a kind of alchemical pilgrimage in Srisailam, which is not featured in the latter works – but is referenced in the ca thirteenth-century *Root of Bliss* (*Ānandakanda*). Finally, the last section of the compendium, the *mantrakhaṇḍa*, is dedicated to the "six acts" (*ṣaṭkarma*) of magic.

2 CHAPTER NINETEEN OF THE JEWEL MINE'S VĀDAKHAṆḌA: FISH BLACK (*MATSYAKAJJALA*)

As described above, chapter nineteen is somewhat of an outlier of the *Jewel Mine*'s section dedicated to doctrine (*Vādakhaṇḍa*), and indeed the whole compendium. The chapter begins with this statement:

2 The medical section deserves further study. Meulenbeld (HIML: vol IIA, 654–655) provides a summary of its contents. Unfortunately, this summary is based on the 1940 edition by Jīvrām Kālidāsa (HIML: vol IIA, 663), which seems to have added dozens of chapters to the *Rasendrakhaṇḍa* that are not found in the extant manuscripts. See Wujastyk 1984 on the chapters transmitted in the manuscripts.

3 See HIML: vol IIA, 655–657 for a more detailed outline of the contents of this section's chapters.

> संसारे सारभूतं सकलसुखकरं सुप्रभूतं धनं वै तत्साध्यं साधकेन्द्रैर्गुरुमुखविधिना वक्ष्यते तस्य सिद्ध्यै ।
>
> रत्नादीनां विशेषात्करणमिह शुभं गंधवादं समग्रं ज्ञात्वा तत्तत् सुसिद्धं ह्यनुभवपथगं पावनं पण्डितानाम्॥ १ ॥
>
> In the world of rebirth, very abundant wealth is indeed the most excellent thing, producing all pleasures; that is to be attained by lords of *sādhakas*. According to the method from the mouth of the teacher, specifically the manufacture of jewels, etc., and the auspicious lore of perfumery is related here for the purpose of attaining it. For, having understood everything, those various things are easily attained, being in the direct experience [and] purifying for wise ones.[4]

The chapter continues with a series of formulations for creating gems (verses 1–40). These formulations stand on their own and do not seem to be integrated into a larger alchemical programme of making mercurial elixirs. The uses of the factitious gems are not discussed anywhere in or outside this chapter and indeed, there is even little elsewhere on the uses of gems in the *Jewel Mine*.

The gems to be created include rubies (*padmarāga*), sapphires (*indranīla*), emeralds (*marakata*), garnets (or zircons: *gomeda*), topazes (*puṣparāga*), and blue sapphires (*nīlamāṇikya*), as well as coral and pearls.[5] It bears noting that, to my knowledge, none of the recipes for producing these gems are found in any other Sanskrit alchemical work. The sixteenth-century *Nectar Mine Light on Mercury* (*Rasaprakāśasudhākara*) is the only other alchemical work to feature recipes for making pearls and coral, but it does not include any recipes for the other gems.[6]

In the *Jewel Mine*, all recipes for gems, apart from those for coral and pearls, make use of a dye whose recipe is described in verses 2–5ab. This dye is called "fish collyrium" or "fish black" (*matsyakajjala*). In the following, I will examine the fish black-based recipes in detail. This is the recipe for fish black:

4 Translation of *Rasaratnākara Vādakhaṇḍa* 19.1 by McHugh (2012:197). All other translations my own unless otherwise indicated. McHugh discusses the chapter's artificial aromatics (sandalwood, camphor, musk, and saffron), with a detailed analysis of the recipe for artificial sandalwood.

5 It should be noted that the exact identification of any substance named in premodern sources, including gems, can be problematic. Here, the range of gems that might be categorized as rubies, etc. may not correspond to modern categorizations. In the case of garnets (or zircons: *gomeda*), topazes (*puṣparāga*), and blue sapphires (*nīlamāṇikya*), the identification and thus translation is particularly uncertain. See also Wojtilla 2009 for a discussion of the difficulties in identifying various gems.

6 This article will not examine the recipes for producing coral or pearls, but see the reconstruction of parallel recipes in the *Nectar Mine Light of Mercury* (*Rasaprakāśasudhākara*) and the correspondences and differences to the *Jewel Mine*'s recipes in Wujastyk 2021*a*,*b* (on coral) and Wujastyk 2021*c* (on pearls).

चतुर्गुणेन तोयेन लाक्षां पिष्ट्वा तु तद्द्रवैः ।
वस्त्रपूतं शतपलं गृह्य मृद्भाण्डगं पचेत् ॥२॥
मृद्वग्निना पादशेषं जातं यावच्च तस्य वै ।
क्षिपेत्पलं पलं चूर्णं सर्जितंकणलोध्रकम् ॥३॥
किंचित्पच्यात्ततः शीतं काचकूप्यां सुरक्षयेत् ।
स्थूलमत्स्यत्वचं पच्याद्दिवारात्रं जलेन तत ॥४॥
घनीभूतं समुतार्य ख्यातोऽयं मत्स्यकज्जलम् ।

> Rub lac with four times its amount of water; take 4,8 litres[7] of this liquid, filtered through a cloth, and boil it in an earthen vessel on low heat, until a fourth of it remains. Add 48 g each of powdered natron, borax, and lodhra (Symplocos racemosa Roxb.). Heat it a bit. Then, once it has cooled down, pour it into a glass bottle. Cook the skin of a fat fish for a day and night with this water. When it has thickened, remove it. This is known as "fish black".[8]

The preparation of the dye happens in several steps. The first is to extract the dye from the lac resin. Lac, or stick lac, as it is called in its unprocessed state, is the secretion of lac insects, of which the most commonly cultivated is *Kerria lacca*. The secretion of lac insects consists of dye and wax or resin. The dye can be extracted from the wax by boiling the stick lac in water and filtering out the wax. This is the first step in the *Jewel Mine*'s recipe for fish black. Lac has a long-established use as a red pigment in textile dyeing and painting on the Indian subcontinent, while lac wax seems to have been employed as a coating for paint pigments.[9]

Lac wax does not dissolve in water. However, it can be dissolved if borax or sodium carbonate are added, which allows for more dye to be extracted from

7 The rendering of one *pala* as 48g or ml is approximate: I am guided by Srinivasan (1979) in my translation of measurements here. Srinivasan (1979: 94) equates one *pala* with between 46–51 grams.

8 I use the edition of the *Vādakhaṇḍa* by Shastri (*Rasaratnākara*) throughout. Given the problems with Śāstri's edition of the *Rasendrakhaṇḍa*, there is some doubt about the text of the *Vādakhaṇḍa* in this edition. I have not been able to compare its contents against manuscript readings. The single manuscript of the *Rasaratnākara* with a *Vādakhaṇḍa* section accessible to me at present (MS Kathmandu NAK 5-7760, filmed as A965/5 by the NGMCP), only gives the verses 33–137 of chapter nineteen of the *Vādakhaṇḍa*, starting with a recipe for making coral. However, the recipes for gems are found in verses 1–32. The relevant folios of this section (folios 170–174, which include part of chapter eighteen as well) are missing.

9 See Kramrisch 1928: 15–16 on mentions of lac pigment in the *Saṃyutta Nikāya* and the *Abhilāṣitārtha Cintāmaṇi*, as well as the use of lac resin for coating the pigments.

Figure 1: Fish black (*matsyakajjala*). © Andrew Mason.

the wax.[10] The *Jewel Mine*'s recipe features the addition of borax and natron, i.e., sodium carbonate, to the dye mixture. However, note that the recipe prescribes filtering the lac and water mixture *before* the natron and borax are added. This means that their function for the dye must be a different one.

There is a third ingredient that is added to the mixture along with the borax and natron: the lodhra tree (*Symplocos racemosa, Roxb.*). The bark of this tree has a range of medicinal uses that are already attested in the earliest of the Indian medical works. More relevantly, the bark has also traditionally been used as a mordant in textile dyeing, especially for dyeing fabrics with red dyes like lac or Indian madder.[11] Lodhra fixes the colour, but also gives it a greater vibrancy. And both borax and natron can also be used as mordants in textile dyeing processes, each contributing further to the colour fastness of the dye and its colour intensity. When you add these ingredients to a lac dye and water mixture, the colour of the dye noticeably changes: The addition of natron changes the brown-red of the lac to a deep purple-red, as does the addition of borax. Lodhra brings about a more pinkish red. All three together result in a deep burgundy dye.[12] The final ingredient of the fish black is fish skin, or more specifically, the skin of a fat fish (*sthūlamatsyatvacam*), which is boiled "for a day and night" in the dye. Boiling fish skin produces two products: fish oil and fish glue, a gelatinous substance that dries crystal hard. Fish glue is a traditional wood working glue, and also has a long history as an artist's material in Europe as well as in Asia.

10 See Hatchett 1804: 196–201 on the various methods for further dissolving stick lac (or seed lac, i.e., lac that has undergone some first processes of cleansing).

11 See Crill 2015: 33 on the use of lodhra as a mordant with red dyes in textile processes.

12 I observed these changes in colour in an experiment reconstructing this recipe.

One of its uses was as a binding medium, holding particles of pigment together to firmly attach paint to the surface of parchment. This use was also known to the Chinese from at least the T'ang dynasty (seventh to tenth century CE), particularly for stabilizing ink on various surfaces.[13]

Gelatin (including, at least theoretically, fish gelatin) can also be used in textile dyeing processes to improve the dyeability and colour strength of fibres. Pretreatment of textiles with gelatin leads to higher dye absorption as well as improved colour fastness.[14] Thus, the inspiration for this ingredient may derive from textile dyeing techniques, but may also be connected to painting techniques.

The dye produced from these ingredients is a dark red, thick, and viscous liquid, which is then applied with or without other ingredients to stones to create the appearance of the various gems.[15] That is, with one exception, the text actually refers to this process as *producing* the gems, rather than imitating them.[16]

3 MAKING RUBIES

The first recipe (verses 5cd-6) is for rubies, and here, only mahua oil is added as an ingredient to the basic fish black dye:

> एतत्कर्षद्वयं तस्याः काचकूप्यां विनिक्षिपेत् ॥५॥
> वर्षोपलास्तु तेनैव लालयित्वा सुपाचिते ।
> मधूकतैलमध्ये तु क्षणं पक्त्वा समुद्धरेत् ।
> जायन्ते पद्मरागाणि दिव्यतेजोमयानि च ॥६॥
>
> Pour 24 grams[17] of this into a glass bottle. Roll "rain-stones" (varṣopala) around in this. When they have been well-heated, Heat them briefly in mahua oil. Then remove them. They become divinely radiant rubies.

The so-called "rain-stones" (*varṣopala*: usually "hailstones") are also featured in the recipes for the other gems.[18] This is the only place in the *Jewel Mine*

13 See Thompson 1956: 58–59 on the use of gelatin and fish glue as binders in European medieval painting. Sze (1959: 67–68) briefly describes the use of animal glues, including fish glue, as a binder for ink in seventeenth-century Chinese painting and calligraphy. Also see Winter 1984: 117 on fish glue as a painting medium in a ninth-century Chinese work. I have not been able to find a premodern Indian source on the use of fish glue in painting.

14 Hassabo et al. 2022: 128.

15 For a reconstruction of this recipe, see Wujastyk 2023*a*.

16 The exception is the recipe for blue sapphire (verses 15–16), which states that the stones will resemble blue sapphire rather than that blue sapphire is produced. See below for the translation of the passage.

17 This is an approximate measurement based on the idea of one *pala* equating four *karṣa* (Srinivasan 1979: 106), using the average 48g for one *pala*.

18 That is, verses 8, 10, and 11 apparently read *varṣotpala* (rain-lotus?) rather than *varṣopala*.

that they are mentioned and their identification is uncertain. Unless these are joke recipes, we can probably assume that *varṣopala* does not denote hailstones here. Hellwig (2009: 157, n. 301) suggests this must be a translucent stone, rather than hail. To my knowledge, the only other work which mentions *varṣopala* as a kind of stone is the *New Examination of Gems* (*Navaratnaparīkṣā*). The relevant passage reads as a shorter and somewhat garbled version of the *Jewel Mine*'s recipes for producing gems and does not aid in identifying *varṣopala*.[19]

A number of translucent stones, such as rock crystal (quartz), or topaz, were known in medieval India. Indeed, when it comes to rubies, there is an old connection to rock crystal (*sphaṭika*): Varāhamihira's sixth-century *Great Collection* (*Bṛhatsaṃhitā*) tells us that there are three kinds of rubies:[20]

> सौगन्धिककुरुविन्दस्फटिकेभ्यः पद्मरागसंभूतिः
>
> सौगन्धिकजा भ्रमराञ्जनाब्जजम्बूरसद्युतयः
>
> कुरुविन्दभवाः शबला मन्दद्युतयश्च धातुभिर्विद्धाः
>
> स्फटिकभवा द्युतिमन्तो नानावर्णा विशुद्धश्च
>
> Rubies are produced from spinel, corundum, and rock crystal.[21] Those produced from spinel have the lustre of bees, collyrium, lotus, or plum juice.[22] Those produced from corundum are variegated, of

19 See Finot 1896: 177–178 for the parallel passage on making gems in the *New Examination of Gems*. Neither the author nor the date of this work have been identified, though Finot (1896: XII–XIII) speculates that the author mentioned on one of the manuscripts, a Somabhūbhuja, may be king Someśvara, the author of the *Mānasollāsa* (MS London BL IOLR 1568). The other manuscripts, however, mention a Nārāyaṇapaṇḍita as the author. According to Finot, the Bikaner MS (MS Bikaner Anup 3820), which refers to Nārāyaṇapaṇḍita, also states that the passage on gems is a section of a compilation called *Smṛtisāroddhāra*. Also see Wujastyk (2023*b*) on the differences between the *Jewel Mine*'s version and that of the *New Examination of Gems*.

20 Chapter 82. 1–2 (*Bṛhatsaṃhitā*: 639).

21 The identification of *saugandhika* as spinel and *kuruvinda* as corundum relies on Mookerji's understanding of the terms (*Rasa-Jala-Nidhi*: vol 3, 202), which may be anachronistic. They may also refer to sulphur and cinnabar, respectively. Bhaṭṭotpala's commentary (*Bṛhatsaṃhitāvivṛti*: vol 2, 886) on the verse gives "specific minerals" (*dhātuviśeṣau*) for them, i.e., does not classify them as gems (*ratna*).

22 Finot's translation gives jambu and myrrh for *jamburasa*. Reading them as separate terms rather than as a compound is certainly possible. The identification of *rasa* is often uncertain, with multiple possibilities. Myrrh is perhaps a better possibility than the alternative of quicksilver, since the latter doesn't seem to fit the list in terms of its colour (Finot 1896: 72). I assume the items in the list are associated with a range of reddish-browns to purple. *Bhaṭṭotpala*'s commentary (*Bṛhatsaṃhitāvivṛti*: vol 2, 885–886) on this passage seems to read *jamburasa* as a compound, though perhaps as referring to the sap of the plum tree rather than to the juice of its fruit. It also specifies that the items are of a reddish colour (*lohitavarṇa*). On *jambu* as jamun or black plum rather than rose-apple, see Wujastyk 2004.

Figure 2: Various translucent stones: quartz, selenite, calcite, topaz. © Andrew Mason.

> low lustre, and permeated with minerals. Those produced from rock crystal are full of lustre, of various colours, and pure.

Given that the *Jewel Mine*'s recipe states that it will *produce* radiant rubies, rather than produce something that merely looks like rubies, starting off with a related gem would seem to make sense. We may also note that recipes for making factitious gems in Greco-Egyptian recipe literature, specifically in the ca fourth-century Stockholm Papyrus, describe applying various dyes to rock crystal, though other translucent stones may have also been used.[23]

Pliny the Elder already noted in his first-century *Natural History*, that: "(t)he people of India, by colouring crystal, have found a method of imitating various precious stones, beryls in particular".[24] In the same work, he said the following about rock crystal:[25]

> It is a diametrically opposite cause to this that produces crystal, a substance which assumes a concrete form from excessive congelation. At all events, crystal is only to be found in places where the winter

23 See Caley 2008: 86. In her reconstruction of the Stockholm Papyrus' recipe for making factitious emeralds, Bol (2014*b*) used a variety of translucent stones, including quartz, selenite, and topaz. The methodology applied in the procedures described in the Stockholm Papyrus is different from that of the *Jewel Mine*, in that the application of the dye is preceded by a technique for "opening" stones, but the basic procedure of applying a dye with a binding agent to stones is parallel. The Stockholm Papyrus features two recipes for preparing rubies (recipes 19 and 31), both using crystal. See Caley 2008: 53 and 56, respectively.

24 Book 37, chapter 20, on the eight varieties of beryl (*Natural History*: vol 6, 415). See also Wojtilla (2009: 40) on the subject of Pliny mentioning fake gems from India.

25 Book 37, chapter 9 (*Natural History*: vol 6, 394).

> snow freezes with the greatest intensity; and it is from the certainty that it is a kind of ice that it has received the name,[26] which it bears in Greek. The East, too, sends us crystal, there being none preferred to the produce of India.

Perhaps this identification of crystal as a kind of ice or "congealed" water explains the use of the term "hailstone" (*varṣopala*) for the stones used in the *Jewel Mine*'s recipes. However, I have not found any parallel explanation of the formation of rock crystal (*sphaṭika*) in premodern Sanskrit works.

Kauṭilya's *Treatise on Statecraft* (*Arthaśāstra*) lists crystal (*sphaṭika*) as one of the precious stones to be received into the treasury. Here, the text notes that "(a) clear crystal may have the color of a Mūlāṭī flower, resemble a cool shower, or be a sunstone".[27] The Sanskrit rendered as "resemble a cool shower" is *śītavṛṣṭiḥ*. As Olivelle (2013: 530) notes, the term "cool shower" may be the name of a gem, in the same way as "sun-stone" (*sūryakānta*), perhaps equating to "moon-stone" (*candrakānta*), which is a variety of crystal mentioned in various Indic lapidaries.[28] This term, *śītavṛṣṭiḥ*, is the closest we get to the *Jewel Mine*'s *varṣopala*, which we can thus perhaps understand as the equivalent of the moonstone variety of the rock crystal. At the same time, we should keep in mind that the *Jewel Mine* does mention rock crystal in other contexts, but calls it *sphaṭika*, not *varṣopala*.[29]

The *Garuḍapurāṇa* features a long chapter on rubies.[30] It uses the same terms as the *Great Collection* (*Bṛhatsaṃhitā*), differentiating between rubies derived from spinel (*saugandhika*), corundum (*kuruvinda*), and rock crystal (*sphaṭika*).[31] The text describes rubies of the rock crystal (*sphaṭika*) variety as endowed with all good qualities, reflecting and refracting the rays of the sun.[32] It also describes the range of colours rubies display, stating that rubies can have the colour of vermillion, red or blue lotus, saffron or lac resin (*lākṣārasa*).[33] It is the latter that I would like to emphasize here, since the *Jewel Mine*'s recipe uses lac. Thus, following the idea of rubies being produced from rock crystals in nature, with a colour resembling lac, the *Jewel Mine*'s recipe could be understood to emulate natural processes.

The final ingredient of the *Jewel Mine*'s ruby recipe is mahua oil. The stones have been rolled in the dye and are now immersed in oil. It is unclear how long

26 Bostock and Riley (*Natural History*: vol 6, 394, n. 50) note that the term used for crystal is κρύσταλλος, from κρύος "cold."

27 Translation of *Arthaśāstra* 2.11.32 by Olivelle (2013: 123).

28 See, for example, the *Navaratnaparīkṣā* on *sphaṭika* varieties (Finot 1896: 167).

29 A keyword search for *sphaṭika* in the Digital Corpus of Sanskrit (Hellwig 2019–) brings up three passages in the *Rasaratnākara*: *Rasendrakhaṇḍa* 8. 83 and 85 and *vādakhaṇḍa* 13.43. It should be kept in mind, however, that the edition of the *Rasendrakhaṇḍa* is unreliable.

30 I.70 (*Garuḍapurāṇa*: vol. 1, 232–235).

31 I. 70.6 (*idem*, p. 233).

32 I. 70.9 (*idem*).

33 I. 70.8 (*idem*).

Figure 3: Quartz crystal dyed with fish black and coated with mahua oil. © Andrew Mason.

the stones must be placed in the dye, as the text merely prescribes that they must have been "well-heated" (*supācite*) before they are "briefly" (*kṣanam*) heated in the mahua oil. The function of the oil is not explained. Here, there is no link to textile dyeing techniques. The use of oil is paralleled in the recipes for imitating gems in the Stockholm Papyrus, though there, the pigment is directly mixed with the oil and then used to coat the stones rather than being a separate layer following the initial dyeing.

In painting, oil can be used to create a glaze, providing both protection for the pigment and a sheen to the painting.[34] Presumably, the idea in the *Jewel Mine*'s ruby recipe was to give the imitation ruby an extra gleam. Why mahua oil is required specifically, rather than any other oil, is not clear. Perhaps this is simply due to its wide availability on the Indian subcontinent, though the same argument could be made for a variety of other oils. This last step of coating the dyed stones with mahua oil is reiterated in the next recipe for making sapphires. The recipes after that just mention that the stones should be cooked as before, which could include their coating with oil, but may also not. Notably, the *Garuḍapurāṇa* (I.70.24) mentions appearing to be smeared with oil, or losing its lustre when rubbed as a sign of a fake ruby, pointing to a history of imitation jewels coated with oils.[35]

34 See Bol (2014*a*: especially page 126) on the use of oil-and-pigment-based paint glazes in medieval Europe to create the impression of shining jewels on paintings. Here, the glaze for imitating gems in paintings used the same materials as for imitating gems described in the Greco-Egyptian recipes books and later artisan's handbooks derived from them. I have not been able to find information on parallel techniques in Indian painting, which seems to have used water or resins for making paints rather than oils (see

4 THE OTHER GEMS: SAPPHIRE, EMERALD, GARNET, TOPAZ, AND BLUE SAPPHIRE

These are the recipes for the other gems:

SAPPHIRE

नीलीचूर्णं पलैकं तु पूर्वकूप्यां तु तद्द्रवम् ।
तद्द्रवं द्विपलं चूर्णे क्षिप्त्वा सर्वं विलोलोयेत् ॥ ७ ॥
क्षिप्त्वा वर्षोपलांस्तेन पूर्वतैलगतान्पचेत् ।
इन्द्रनीलानि तान्येव जायन्ते नात्र संशयः ॥ ८॥

48 g of indigo powder. And that liquid in the aforementioned bottle.

Having added 96 g of that liquid into the powder, one should stir it all. Having added the "rain-stones" in the aforementioned oil, one should heat them with it. These will undoubtedly become sapphires.

EMERALD

मञ्जिष्ठां तालकं नीली समचूर्णं प्रकल्पयेत् ।
काचकूप्यां स्थितैर्द्रावैः सर्वमेतत् सुलोलयेत् ॥९॥
वर्षोपलांस्तु तेनैव सिक्त्वा पच्याच्च पूर्ववत् ।
सर्वे मरकतास्तेन समीचीना भवन्ति वै ॥१०॥

One should mix evenly ground Indian madder, orpiment, and indigo. All this should be well-stirred with the liquids in the glass bottle. Having soaked the "rain-stones" with this, one should heat it as before. Through this, they all truly become whole emeralds.

Kramrisch 1928: 16). The third recipe for "diamond-coating" (*vajralepa*) described in Varāhamihira's *Great Collection* (chapter 57, verse 7, *Bṛhatsaṃhitā*: 502), which consists of a mixture of the horns of the cow, the buffalo, and the goat, donkey hair, buffalo and cow skin, and some herbal juices may be understood to constitute a kind of glaze, though *vajralepa* is usually understood to be a kind of cement used for the construction of walls in temples and palaces, and fixing images on temple walls. See also Kramrisch 1928: 16–17 on *vajralepa* as described in the *Viṣṇudharmottara*, where it is described as a foundation for painting.

35 विजातिलिङ्गाश्रय एव भेदः (…) स्नेहप्रदिग्धः प्रतिभाति यश्च यो वा प्रघृष्टः प्रजहाति दीप्तिम्. See also Garbe 1882: 19 (Sanskrit text) and 73 (translation into German) on the description of how to evaluate genuine rubies in Narahari's *Rājanighaṇṭu*: माणिक्यं कषघर्षणे 'प्य् अविकलं रागेण जात्यं जगुः – They call it a genuine ruby when there is no impairment of colour when it is scraped or rubbed.

GARNET (OR ZIRCON)

मञ्जिष्ठायाः कषायेण पेषयेन्मत्स्यकज्जलम् ।
वर्षोत्पलांस्तु तेनैव सिक्त्वा पच्याच्च पूर्ववत् ॥ ११ ॥
गोमेदानि तु तान्येव प्रवर्तन्ते न संशयः ।

Rub the fish black with an extract of Indian madder. Having soaked the "rain-stones"[36] with it, one should heat it as before. These turn into garnets without doubt.

TOPAZ

पिष्ट्वा तालकतुल्यं तु जलैके रसकुङ्कुमम् ।
तन्मध्ये चाष्टमांशं तु क्षिपेन्मत्स्त्योत्थकज्जलम् ॥ १३ ॥
तत्सर्वं पाचयेद्याममवतार्य सुरक्षयेत् ।
वर्षोपलांस्तु तेनैव सिक्तान्पच्याच्च पूर्ववत् ।
भवन्ति पुष्परागास्ते यथा खन्युत्थितानि च ॥ १४ ॥

Having ground an equal amount of orpiment and myrrh (?) and saffron in one part water, one should add eight parts of the fish black to that. One should let all that be heated for three hours. Having set it aside, one should store it well. And the "rain-stones" are soaked with it and one should heat it as before. These will become topaz like those excavated from a mine.

BLUE SAPPHIRE

नीलीचूर्णस्य तुल्यांशं क्षिपेन्मत्स्योत्थकज्जलम् ।
बीजकाष्ठं च तुल्यांशं जले स्थाप्यं दिनावधि ॥ १५ ॥
तत्सर्वं पाचयेद्याममवतार्य सुरक्षयेत् ।
वर्षोपलांस्तु तेनैव सिक्तान्पच्याच्च पूर्ववत् ।
नीलमाणिक्यसदृशास्ते भवन्ति न संशयः ॥ १६ ॥

Add an equal amount of indigo powder to the fish black, and an equal amount of red sandalwood[37] placed in water for a day. Let all that be

36 The text reads *varṣotpala* (rain-lotus) instead of *varṣopala* here, but I assume that the latter is the correct reading.

37 The identification of *bīja* as red sandalwood or Indian kino (*Pterocarpus marsupium* Roxb.) is uncertain. However, this tree's bark is used for textile dyeing and can produce yellow and deep red colours. See the Botanical Survey of India (Botanical Survey of India 2023: sub P. marsupium). It is also featured under the name *raktacandana* in alchemical works (for example, *Rasaratnasamuccaya* 10.88) as part of the "red group" (*raktavarga*) of substances, used for dyeing (*rañjana*) alchemical products.

> heated for three hours. Having set it aside, one should store it well. And the "rain-stones" are soaked with it and one should heat it as before. These will undoubtedly become similar to blue sapphire.

The recipes for the other gems follow the same format as that for rubies, but add further ingredients to the dye, such as indigo, madder, orpiment, saffron, and red sandalwood. Again, all these pigments were widely used in textile dyeing, as well as in painting. Madder is even mentioned as a textile dye in several alchemical works.[38] Lac, saffron, madder, and red sandalwood are further featured in various alchemical works as belonging to the "red group" (*raktavarga*) of substances applied in alchemical cleansing, dyeing, and transmutation processes.[39] Orpiment plays quite a large role in alchemical processes in its own right, but is not listed in the yellow group (*pītavarga*) of dyes.[40] The red and yellow groups of substances are utilized for cleansing substances as well as for colouring metals in alchemical processes. Indigo is used to cleanse sapphire (Hellwig 2009: 488), the very gem it is used to create. However, madder, saffron, and red sandalwood are not employed for the cleansing of gems.

In any case, the application of these pigments here in the recipes for making gems is clear: They are used as dyes. Indigo for blue gems; a combination of Indian madder (= red), orpiment (= yellow), and indigo (= blue) to create a green dye for green gems, etc. Using the fish black, which delivers a red tint, as a base for all of these is a little puzzling in the case of gems that should have a blue or green colour. Notably, the dye for emeralds also contains Indian madder, which also delivers a red hue: It is difficult to see how a mixture of two reds, yellow and blue would create the green expected for emeralds. Wujastyk (2023*b*) showed that the dye produces an appropriate colour for rubies. Perhaps experiments with the other recipes would also confirm that the other mixtures of pigments produce the expected colours.

5 REFLECTIONS

The recipes for making (imitation) gems in the *Jewel Mine*'s nineteenth chapter of the *Section Dedicated to Doctrine* (*Vādakhaṇḍa*) are an unusual addition to the work. There are no parallels in earlier Sanskrit alchemical works and the recipes are also not integrated into the *Jewel Mine*'s larger alchemical scheme focused on the uses and applications of mercury. This is also true for the other

38 According to Hellwig (2009: 357), the *Rasaratnasamuccaya* (3.62) mentions madder as a textile dye which is fixed with alum as a mordant. The *Rasendracūḍāmaṇi* (11.49) mentions this as well.

39 See Hellwig 2009: 321 on the red group and its applications.

40 The different alchemical works offer different versions of the yellow group of dyes. None of them include orpiment. See Hellwig 2009: 301.

recipes of the nineteenth chapter, almost all of which are concerned with producing substitute or imitation substances.

The *Jewel Mine* is a collection of sections of older works, including non-alchemical ones. This particular section may have been adopted from a currently unknown lapidary. However, a comparison with its one parallel in such a lapidary, the *New Examination of Gems* (*Navaratnaparīkṣā*), shows the *Jewel Mine*'s version to be both more comprehensive as well as more systematic in its composition, and the *New Examination of Gems*' reading to be defective. The only conclusion we can draw from this at present is that the *New Examination of Gems* was not the source for the *Jewel Mine*'s recipes.

The *Jewel Mine*'s recipes seem to draw on techniques and materials from textile dyeing, and perhaps to a lesser extent, on painting techniques. There are also parallels in methods with those described for making factitious gems in Greco-Egyptian recipe literature, especially concerning the possible use of quartz as the base stone that gets dyed. However, the Greco-Egyptian recipes also display substantial differences in their methods used for applying pigments, as well as in their choice of pigments, so that a direct transfer from Greco-Egyptian techniques to the Indian ones seems unlikely. Pliny's mention of gem imitations from India point to a long history of Indian techniques for faking gems that precedes the *Jewel Mine*'s recipes by more than a thousand years.

We do not hear much of imitation gems in Sanskrit literature more broadly, though, as we have seen, several works describe ways of differentiating between real and fake gems. However, a story in the *Ocean of Stories* (*Kathāsaritsāgara*) centres on the use of imitation gems (*kṛtrimamāṇikya*): In the story of the confidence tricksters Śiva and Mādhava, the protagonists use a chest of imitation jewellery to trick their mark into giving them money.[41] The duped person eventually tries to sell one of the ornaments in the market and finds out that they are fake:[42]

> Then the merchants, who were connoisseurs in jewels, said, after examining it: "Ha! The man who made these sham jewels was a clever fellow, whoever he was. For this ornament is composed of pieces of glass and quartz with various colours and fastened together with brass, and there are no gems or gold in it."

The story offers no explanation of how the confidence tricksters got (or made?) the imitation jewels. However, note how the ornaments are said to be composed

41 Tawney and Penzer 1924: vol 2, 175–183. I would like to thank the anonymous reviewer who pointed this story out to me.

42 Tawney and Penzer 1924: vol 2, 182. Sanskrit text, *Kathāsaritsāgara* 5,1.178–179 (p. 113 of the ed.): तत्रैतद्रत्नतत्त्वज्ञाः परीक्ष्य वणिजोऽब्रुवन् । अहो कस्यास्ति विज्ञानं येनैतत्कृत्रिमं कृतम् ॥ ५,१.१७८ ॥ काचस्फटिकखण्डा हि नानारागोपरञ्जिताः । रीतिबद्धा इमे नैते मणयो न च काञ्चनम् ॥ ५,१.१७९ ॥.

of coloured pieces of glass and quartz (*kācasphaṭikakhaṇḍā hi nānārāgoparañjitāḥ*): We might add glass to our possible contenders for *varṣopala*. Note also the implied admiration for the craftsmanship that went into making the counterfeit ornaments. This could be understood as a reference to artisanal knowledge and an implied art of forgery. The latter does not, however, seem to be specifically associated with alchemy.

This is the only Indic story I know in which someone is duped with fake gems, though there may, of course, be others. The *Jewel Mine* itself gives no explanation for how the created gems were meant to be used other than its general statement about creating wealth at the beginning of the chapter. In its eleventh chapter, the sixteenth-century *Nectar Mine Light on Mercury* (*Rasaprakāśasudhākara*), mentions several times that its alchemical gold and silver are "suitable to be sold in the market" (*haṭṭavikrayayogyaka*).[43] It does not say the same for its gems, i.e. pearls and corals. In all three cases, the recipes speak of producing or improving gold or silver, rather than producing something resembling these metals. There is no further commentary on the uses of the products.

This again opens the question of the nature of alchemical products and factitious gems in particular. To put it distinctly: Did alchemists consider factitious gems, i.e., artificially created gems, as equal to, or the same as natural ones? In other words, do the recipes in the *Jewel Mine* describe transmutation, or imitation? Are the produced gems "real" or "fake"?

As mentioned above, almost all of the *Jewel Mine*'s recipes speak of *producing* the gems, with some of the basic ingredients possibly linking to their natural formation. This would suggest that alchemists were attempting to emulate natural processes and therefore to create "natural" products. However, the *Jewel Mine* itself does not offer any theory of the formation of gems (or any other substances). In fact, the *Jewel Mine* generally does not prominently feature gems in its alchemical operations and also does not independently describe their features, so that we don't have any data that lets us compare the characteristics of natural and factitious gems.[44]

What about the cases in which products are described as "similar" (*sadṛśa*) to the natural product? Do these give us a clue about ontological differences? Here again, the *Jewel Mine* does not offer an analysis. It is perhaps notable that it does not apply the term "*kṛtrima*" (artificial), which was used in the tale from the *Ocean of Stories* for the fake jewels. Indeed, it appears that "*kṛtrima*" is generally not applied to alchemical products in any of the Sanskrit alchemical works.[45]

43 *Rasaprakāśasudhākara* 11.41: (gold), 57 (gold), and 99 (silver).

44 The work does feature the use of diamonds, however, and *Rasaratnākara*, *Vādakhaṇḍa* 9.123–131 describes the use of diamonds, rubies, and sapphires for making an elixir.

45 This statement is based on a keyword search for "*kṛtrima*" in the Digital Corpus

The alchemists never admit that they might be producing counterfeits or fakes, or that products that are "similar to" a natural product are in any way inferior.

The question of authenticity has already been raised by McHugh (2012: 198) in his discussion of artificial sandalwood and other aromatics in this very chapter of the *Jewel Mine*:

> This text and others like it raise the issue of the place of authenticity in medieval Indian culture. This text does not in any way present these methods as a shameful necessity, and, indeed, it praises them as allowing one to attain the most important goal in the realm of rebirth. Similarly, the perfumery texts that provide instructions on the manufacture of artficial aromatics do so with no mention of practicing this art in secrecy. Although it was important to be able to evaluate the quality and origin of aromatics and gemstones, nevertheless, we should not assume that all artifice was seen as a bad thing in this culture. I suggested that the cooling wood produced by this method might arguably be counted as a type of *candana* in the broadest sense of the word. I should note that today we draw a distinction between synthetic versus natural, authentic versus fake, as well as fake versus artificial. Synthetic rubies and synthetic camphor are chemically identical to natural ones[46]—they are real (rubies and camphor) but not natural. If we understand the *candana* manufactured by the method given was considered to be a type of *candana* by virtue of its cooling nature, then perhaps the best term for this is "synthetic *candana*." In certain contexts, it may be useful to have a cheap artificial/synthetic or heavily adulterated version of the "real" thing that shared some of the same essential qualities [....]
>
> Although the sophisticated *vidagdha* might not want to wear artificial aromatics, and the medieval king might not want to fill his treasury with fake sandalwood, there is no reason why there could not have been markets for artificial versions of rare and costly aromatics in medieval India, just as there are today.

Note the idea of a synthetic product that is simply considered a different type of a substance. Wujastyk (2021*c*) discussed the possibility that pearls made from fish eyes[47] may have been considered an alternative kind of pearl. However, we

of Sanskrit (Hellwig 2019–) and is therefore limited to the contents of works represented there. The exception to this rule is a kind of silver derived from lead that is defined as *kṛtrima*, found, for example, in the *Rasendracūḍāmaṇi* 14.29 and then also in later works that cite the *Rasendracūḍāmaṇi*.

46 This statement is only true for modern synthetic rubies: the factitious rubies of the *Jewel Mine*'s are not chemically the same.

47 Described in *Rasaratnākara*, *Vādakhaṇḍa* 19.23–28 and in *Rasaprakāśasudhākara* 11.131–133.

should note that we do not find a category of manmade (*kṛtrima*) gems as an acceptable alternative to natural gems in any of the known Indian lapidaries. And the story from the *Ocean of Stories* presents a fairly unambiguous position on imitation jewels. And yet, one can easily imagine a less wealthy part of the population being interested in imitation jewellery, just as costume jewellery is popular today.

To my knowledge, there are currently no archaeological finds of imitation gems in India. A targeted search might reveal some and thus throw light on their makers, the techniques used for creating them, and their applications and consumers. However, to return to the alchemists' aims in making artificial gems and other products: If acquiring great wealth was the driving concern in their endeavours, then producing cheap imitation jewels for the poor would not seem the best way to go about it. In the absence of more decisive source materials, we will have to leave the question open as to how alchemists used their products and indeed, even whether they were able to successfully produce what they described in their literature.

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