

la trame de son propre texte, permettant au lecteur de les identifier et d'en suivre les méandres en fonction de sa propre érudition. Partant de la matérialité des pigments extraits à l'état naturel ou fabriqués par des procédés modelés sur les processus naturels, comme certains ocres rouges ou le blanc de céruse, il souligne aussi l'écart toujours plus grand qui s'est établi, pour satisfaire le goût du luxe, entre ces couleurs austères, et de nouvelles couleurs, éclatantes, issues des mélanges sophistiqués de substances provenant de terres lointaines, comme le bleu indigo ou le cinabre indien. Cependant, en insérant dans la première partie du livre 35 dédiée aux pigments, deux passages, sur les peintres et leurs inventions, en particulier dans le modelé des ombres et des lumières, Pline a aussi montré le rôle déterminant du peintre dans l'invention même des couleurs composant sa palette et des mélanges savants qu'il a su en tirer. On a pu également vérifier, à partir d'un passage du *Cratyle*, l'importance des comparaisons établies par Platon entre le créateur des mots du langage, le philosophe ou le législateur avec l'art du peintre (par exemple à propos de la création de la couleur chair), grâce à son expertise dans la technique des ombres et des lumières.¹

Mais le parallèle entre le peintre et l'encyclopédiste va bien au-delà. Plusieurs observations disséminées dans l'*Histoire naturelle* montrent que Pline l'Ancien établit une comparaison entre la réalisation de son projet encyclopédique et le travail des peintres et des sculpteurs célèbres. Dès la préface à Titus, il évoque l'usage par les artistes de signer leurs créations à l'imparfait dans une quête pour parfaire l'œuvre en cours, une quête toujours insatisfaite que la mort vient interrompre.² À la fin de l'excursus sur les peintres au livre 35, Pline reprend le cas des œuvres laissées inachevées, d'autant plus émouvantes qu'on y saisit la pensée même de leurs auteurs.³ Parmi eux figurent Apelle et Nicomaque, cités à la fois par Pline et par Cicéron dans les comparaisons que nous avons étudiées. Comme Sandra Citroni Marchetti l'a bien mis en lumière,⁴ ces passages trouvent dans un développement des *Lois* de Platon (769 a-c) un précédent qui sous-tend le discours plinien, lui-même profondément marqué par la médiation cicéronienne de ce même passage: la comparaison au début du livre 5 du *De Republica* de la république romaine avec une peinture magnifique mais ancienne, dont on n'a pas pris soin de restaurer les couleurs, ni même de conserver «pour ainsi dire les contours» (*extrema liniamenta*).⁵

Il est un point cependant où, au-delà de la matérialité des pigments, l'interprétation des jugements sur l'art de la couleur propre à chaque

¹ Voir *supra* pp. 78-79.

² Plin. NH 1, *praef.* 26-27.

³ NH 35, 145.

⁴ CITRONI MARCHETTI 2011, pp. 31-55; PAPINI 2017; PLATT 2018; ANGIUSOLA 2022, p. 80-86.

⁵ Cic. *Resp.* 5, 1, 2; Plin, NH 1, *praef.* 22.

peintre s'est toujours heurtée à l'obstacle majeur de la perte complète des tableaux célèbres sur lesquels fonder l'analyse. Nous disposons certes d'un ensemble conséquent de peintures murales grecques et romaines susceptibles de nous servir de référence, notamment le corpus des peintures découvertes en Macédoine, en particulier dans la nécropole royale de Vergina, et celui des tombes peintes mises au jour en Méditerranée occidentale, en Grande-Grèce, en Sicile, en Étrurie, à Rome. Elles nous permettent de saisir sur des exemples concrets la multiplicité des techniques picturales en œuvre pour le rendu des ombres et des lumières, et d'identifier aussi le contraste entre une palette aux couleurs éclatantes, florides, et celle d'un coloris plus austère, conforme à l'esthétique privilégiée par Pline. Rien cependant ne nous permet d'approcher davantage les traits spécifiques des œuvres célébrées dans les sources dans leur singularité et leur diversité. Un point ressort cependant fortement de la lecture du livre 35 de Pline l'Ancien, l'importance de l'univers visuel offert par les peintures murales romaines, notamment celles réalisées pour les demeures des personnages éminents puis des membres de la famille impériale depuis la fin de la République jusqu'au début de l'Empire. (FIGS. 6a-b) Réalisées par des peintres le plus souvent anonymes, elles conservent la mémoire de toute une palette de techniques picturales et de couleurs accumulées au fil des siècles, qu'elles mettent à disposition du public. Ce constat peut sembler banal, et pourtant cet examen minutieux, déjà riche en résultats, mériterait sans doute d'être poursuivi en compagnie de Pline l'Ancien.

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THE COLOURS OF GEMSTONES IN PLINY THE ELDER'S *NATURAL HISTORY*, BOOK 37

CHIARA BALLESTRAZZI

ABSTRACT · Pliny the Elder's *Natural History*, Book 37 offers unique insights into the attitude towards precious stones in early Imperial Rome. From a thorough analysis of Pliny's discussion emerges a complex 'semantic system' according to which some gemstones were preferentially meant for specific customers (women vs men) and uses (jewellery or signets), mainly on the basis of their colours and their suitability for engraving. According to ancient science, as living and gendered beings themselves, the sexual dimorphism of gems mirrored that of human beings: pale and watery nuances were suitable for women, while fiery colours reflected the intimate nature of men. The semantics of gemstones are also rooted in the chromatic symbolism of ancient Rome. The green of the emerald pointed to exoticism, otherness, and womanhood, while the red, white, and black striped sardonyx featured the principal colours of Roman tradition. Other gems, like the *sarda*-carnelian, were still linked in Pliny's time with the illustrious Greek past. Further research into material and literary sources, from Pliny to other Roman authors, will provide fresh insights into a class of materials usually very poor in contextual data, and will significantly enrich our understanding of Roman material and chromatic culture.

KEYWORDS · Pliny the Elder, Gemstones, Colours, Gender, Roman Tradition.

1. INTRODUCTION

TOWARDS the end of the *Natural History*, Pliny describes the major artworks of Greek and Roman masters.¹ But Pliny's account of the fine arts is also closely intertwined with the careful description of the natural materials employed by artists. The *Natural History* is in fact a passionate celebration of materials as an expression of the artistry of Nature, and throughout his encyclopaedia Pliny traces the ambiguous and fascinating relationship of human and natural art.²

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¹ Plin. *NH* 33-37.

² Further impetus in this direction is coming from the most recent and promising research into the *Natural History*. See especially ANGUISSOLA, GRÜNER 2020, ANGUISSOLA 2022, and HAUG *et alii* 2022.

Among the myriad of natural products described in the *Natural History*, gemstones were acknowledged by both Pliny and his readers as the masterpieces of Nature's artistry. Within a very reduced volume, gemstones concentrate the majesty of Nature, and by contemplating a single tiny gem it is possible to grasp Nature's grandeur in its totality.

Ut nihil instituto operi desit, gemmae supersunt et in artum coacta rerum naturae maiestas, multis nulla parte mirabilior. Tantum tribuunt varietati, coloribus, materiae, decori, violare etiam signis, quae causa gemmarum est, quasdam nefas ducentes, aliquas vero extra pretia ulla taxationemque humanarum opum arbitrantur, ut plerisque ad summam absolutamque naturae rerum contemplationem satis sit una aliqua gemma.

In order that the work that I have undertaken may be complete, it remains for me to discuss gemstones. Here Nature's grandeur is gathered together within the narrowest limits; and in no domain of hers evokes more wonder in the minds of many who set such store by the variety, the colours, the matter and the elegance of gems that they think it a crime to tamper with certain kinds by engraving them as signets, although this is the prime reason for their use; while some they consider to be beyond price and to defy evaluation in terms of human wealth. Hence very many people find that a single gemstone alone is enough to provide them with a supreme and perfect aesthetic experience of the wonders of Nature.¹

It is for this reason that Pliny devotes the 37th and final book of his encyclopaedia to the detailed description of precious stones. Thanks to their variety, colours, matter, and beauty, gemstones possess an aesthetic autonomy and even a semantic and mimetic potentiality, which, in classical antiquity, distinguished glyptics and jewellery from the so-called 'major arts', namely painting and sculpture.

In fact, with gemstones it was possible to paint. Many ancient texts praise the *ποικιλία* or *pictura* of precious stones,² while engravers cleverly emphasized the pictorial potentiality of gems: glyptic masters employed gems as if they were pigments, by giving semantic value to the natural colours and pattern of the mineral. Red stones could suggest fire and heat, green minerals featured bucolic scenes, blue gems could easily evoke sky and water, purple amethysts were connected to the god of wine Dionysus and his entourage, while spots and veins of variegated minerals sometimes became an integral part of the engraved designs.³ Some engravers even signed their intaglios and cameos borrowing the name of famous painters – like Pamphilus, Nicias, and Apelles (FIG. 1) – or celebrated sculptors – like Phidias, Polyclitus, and Scopas – thus

¹ Plin. *NH* 37.1. Translation by EICHHOLZ 1962, p. 165 with slight modifications.

² See ROSATI 2017, pp. 128, 131 and BALLESTRAZZI 2021, pp. 101-102.

³ Some literary and material examples in BALLESTRAZZI 2021, pp. 102-103.

suggesting an intriguing comparison between their glyptic works and paintings or sculptures.¹ It seems likely that the aesthetic autonomy of precious stones accounts for the absence of any 'history of the art of gems' in Pliny's encyclopaedia and for the apparent lack of specialized Greek scholarly works on glyptics.²

With these assumptions in mind, we should reconsider the importance of materials within ancient glyptics and jewellery. The materiality of glyptics is frequently overlooked by scholars, who have mainly focused on the designs engraved on intaglios and cameos by investigating their political, cultural, and social meanings along with their stylistic and iconographic features.

However, as many written sources from Posidippus' *Lithika*³ onward suggest, the aesthetic and physical characteristics of the mineral matter were also essential to the appreciation of intaglios and cameos and, as Pliny states at the beginning of Book 37, some stones were even withheld from engraving as from a *nefas* against the majesty of Nature.⁴ Pliny and other authors strongly suggest that engraved gems and pieces of jewellery



FIG. 1. Engraved carnelian with a portrait of Demosthenes signed by Apelles inset into a gold ring, 25-1 BC, 1.9 × 1.5 cm. The J. Paul Getty Museum, Villa Collection, Malibu, CA, 90.AN.13. © Getty's Open Content Program.

¹ BALLESTRAZZI 2021, pp. 103-107.

² BALLESTRAZZI 2020 and BALLESTRAZZI (forthcoming).

³ Posidipp. 1-20 AB. Among the very rich and constantly growing bibliography on the *Lithika*, for their material and artistic aspects see especially LELLI 2004; SCHUR 2004; BING 2005; KUTTNER 2005; ELSNER 2014.

⁴ We must be aware that most plain gems did not survive, while engraved gems enjoyed a considerably more favourable fate, as they were handed down and treasured long after the end of Antiquity and the beginning of the Middle Ages: SETTIS 1986, p. 478. However, the rare finds of gems and jewels still *in situ* clearly suggest that plain stones were widely employed in Roman times, and not only in jewellery: e.g., consider the sumptuous array of 415 cabochon gems (peridot, amethyst, garnet, lapis lazuli, green quartz, chalcedony, rock crystal, carnelian, glass, agate-onyx, sapphire, citrine quartz, green beryl, aventurine, aquamarine) that decorated Caligula's palace at the Horti Lamiani in Rome (CIMA 1986).

encrusted with gems were much more than luxurious frivolities: they were invested with crucial symbolic meanings precisely because of their exceptional materiality.¹

In this regard, in the following pages I shall focus on some specific aspects of a broader, albeit preliminary, investigation that I have carried out on the final book of the *Natural History*. My aim was to decode a sophisticated and coherent ‘semantisches System’ of gemstones, to borrow Tonio Hölscher’s seminal definition of Roman art.² Apparently, this ‘system’ was rooted in the physical, chemical, and aesthetic qualities of the minerals themselves. Among them, colour and suitability for engraving were the most important features.³

I can already expect that the Roman ‘semantic system’ of gems that emerges from the *Natural History* is also confirmed by literary sources other than Pliny’s encyclopaedia. Latin literature and poetry frequently deal with pearls and gemstones, which are usually referred to through the cumulative terms *gemmae*, *lapilli*, and *lapides*. Thus, as we shall see, the relatively rare mentions of specific gems should be considered significant, since they are evidence of a deliberate choice rooted in the shared awareness of the meaning of *that* specific mineral in *that* specific context.

2. THE STRUCTURE OF *NATURAL HISTORY*, BOOK 37

In Pliny’s encyclopaedia, hierarchically ordered lists are an important tool to define things, products, and facts. The very structure of Book 37 can therefore offer valuable insights into the uses of precious stones in early Imperial Rome and can also suggest why a specific mineral was preferentially intended for a specific customer.

After a few initial paragraphs devoted to the peculiar ‘art history of gems’,⁴ Pliny lists more than three hundred precious stones, grouped into two main categories.⁵ The first three materials discussed by Pliny – *murrā*, crystal, and amber – enjoy the *auctoritas* of precious stones, although they are not employed for jewellery and seals as gemstones *stricto sensu*.⁶

¹ Cf. LAPATIN 2015, pp. 1-17.

² HÖLSCHER 1987.

³ For insightful discussions of the remarkably sophisticated description of gems’ colours and brightness in the *Natural History* see DE SAINT-DENIS 1971, pp. 221-239 and WHARTON 2020, pp. 291-298.

⁴ Plin. NH 37.2-17, see BALLESTRAZZI 2020, pp. 368-369, 371-374.

⁵ For a thorough discussion of the tricky issue of identifying the precious stones described in ancient sources see THORESEN 2017.

⁶ Plin. NH 37.30: *eandemque omnia haec quam gemmae auctoritatem...*

*murra*¹ and crystal were cut into drinking vessels,² while amber – correctly acknowledged as a petrified resin³ – according to Pliny was useless and appreciated by wealthy *matronae* only for its pointless luxury.⁴

Then, Pliny describes the gems *stricto sensu*, beginning with the most appreciated ones:

nunc gemmarum confessa genera dicemus ab laudatissimis orsi

now I shall discuss those kinds of gemstones that are acknowledged as such, beginning with the finest.⁵

The *gemmarum confessa genera* are further grouped into four main lists: (1) gemstones worn by women⁶ and (2) by men,⁷ (3) gemstones classified by colour,⁸ and lastly (4) a plethora of gems, the *reliquae gemmae*,⁹ for which Pliny resorts to organizing criteria based on the stones' names. A great number of *reliquae gemmae* are listed in alphabetical order¹⁰ and are followed by three little groups of gems named after parts of the body,¹¹ animals,¹² and objects.¹³ Apparently, the *reliquae gemmae* are either minerals that were not (or not anymore) appreciated by Pliny's readers, like the agate,¹⁴ or gemstones which Pliny was not familiar with.¹⁵

On the contrary, the first three groups embrace gemstones that were employed by Pliny's audience. The meticulous descriptions of these minerals and their subspecies, studded with many *exempla* of contemporary luxury, testify to the fact that these gems were part of Pliny's and his

¹ The identification of *murra* on the basis of literary references and extant material artefacts is controversial. For a summary of the various hypotheses, see DEL BUFALO 2016 and THORESEN 2017, pp. 180-181.

² Pliny refers to *murra capides*, *pocula*, *abaci*, *escaria vasa*, *calices*, *scyphi*, and *trullae* (Plin. NH 37.18-20), then enormous *vasa*, *trullae*, and *calices* carved in crystal (Plin. NH 37.27, 29). While *crystallina* can only be used for cold drinks, *myrrhina* can be used for both cold and hot beverages (Plin. NH 37.26, 30).

³ Plin. NH 37.42-43.

⁴ Plin. NH 37.30. Due to its chemical-physical properties, amber cannot be used efficaciously for signets, and in Roman times this fossil resin was used for figurines, amulets, bulky rings, and luxury spinning and toilette equipment, namely a wide range of small objects related to female use that Pliny would surely have considered useless and expensive trinkets. For a survey of the use of amber in the Roman world, see GAGETTI 2009 and CAUSEY 2011.

⁵ Plin. NH 37.54. Translation by EICHHOLZ 1962, p. 205.

⁶ Plin. NH 37.55-84.

⁷ Plin. NH 37.85-91.

⁸ Plin. NH 37.92-139.

⁹ Plin. NH 37.139-192.

¹⁰ Plin. NH 37.139-185: *per litterarum ordinem*.

¹¹ Plin. NH 37.186: *a membris corporis [...] nomina*.

¹² Plin. NH 37.187: *ab animalibus cognominantur*.

¹³ Plin. NH 37.188-192: *rerum similitudo*.

¹⁴ Plin. NH 37.139: *achates in magna fuit auctoritate, nunc in nulla est*. Cf. MICHELI 2020.

¹⁵ Minimal or no descriptions at all, frequent explanations of the names of the gems, as well as more explicit references to Pliny's sources, are typical of the paragraphs about the *reliquae gemmae*, as opposed to the meticulous discussion of the previous gems.

readers' everyday experience, and the way in which he organizes these *laudatissimae gemmae* offers first-hand insights into their use and social value.

3. GEMSTONES FOR WOMEN, GEMSTONES FOR MEN

As Pliny states, the first gems, the most valuable ones, are those preferred by women:¹ they are, in descending order of value, *adamas*, *margarita*, *smaragdus*, and *opalus*. The description of emeralds 'attracts' that of *berulli*, since *eandem multis naturam aut certe similem habere berulli videntur*.²

A shared peculiarity of these gems seems to be the impossibility for them to be engraved. Diamonds are extremely hard,³ while emeralds feature amazing optic qualities,⁴ and for this reason they are preserved from engraving.⁵ Pearls and opals are of course too brittle to receive any kind of engraving, while beryls, as Pliny observes, are usually cut into a hexagonal shape⁶ suitable for pendants rather than seals. More correctly, we could argue that engravers used to preserve the natural form of their hexagonal crystals.⁷

Conversely, according to Pliny, the next gem, which was popularised by men, was particularly suitable to be engraved and used as a signet:⁸ it is the *sardonyx*,⁹ flanked by its two 'components', the *onyx*¹⁰ and the *sarda*,¹¹ the latter probably corresponding to our carnelian.¹²

¹ Plin. NH 37.85: *hactenus de principatu convenit mulierum maxime senatusconsulto*.

² Plin. NH 37.76: «many people consider the nature of beryls to be similar to, if not identical with, that of emeralds». Translation by EICHHOLZ 1962, p. 225.

³ Plin. NH 37.57: *duritia est inenarrabilis*. Diamonds can be broken up only by goat's blood (Plin. NH 37.59) and, thanks to their hardness, were employed to cut other gems (Plin. NH 37.60).

⁴ Plin. NH 37.62-64. Their deep green is particularly pleasant and refreshing for the eyes, and for this reason emeralds were used by gem engravers to restore their sight (on the healing properties of green objects: TRINQUIER 2002). In addition, emeralds reflect their colour upon the air around them, and so they appear larger when they are viewed from a distance, and thanks to their concave shape they concentrate the vision.

⁵ Pliny deduces the prohibition to engrave emeralds from a 'decree' allegedly issued by Alexander the Great, who forbade any other than the sculptor Lysippus, the painter Apelles, and the gem engraver Pyrgoteles to make his portrait. On this issue, see especially STEWART 1993, pp. 25-41 and BALLESTRAZZI 2020, pp. 368-369, 374, with BALLESTRAZZI 2021, p. 99 and BALLESTRAZZI (forthcoming).

⁶ Plin. NH 37.76.

⁷ A practice also confirmed by material artefacts, such as the gold chain embellished by 35 (preserved) beryls in their natural shape from Crepereia Tryphaena's tomb (second half of the 2nd century AD, Rome, Musei Capitolini, Centrale Montemartini, AC 468).

⁸ Plin. NH 37.85: (gemstones) *de quibus et viri iudicant*.

⁹ Plin. NH 37.85-89.

¹⁰ Plin. NH 37.90-91.

¹¹ Plin. NH 37.91. The *sarda* will be thoroughly described later, among the *ardentes gemmae* (Plin. NH 37.105-106), cf. below, pp. 109-110.

¹² In Pliny's time as now, it is difficult to univocally identify these stones. While the

About the sardonyx, Pliny also states that its use was eminently Roman, and that it was Scipio Africanus who first employed this gem.¹ Since then, the sardonyx enjoyed an extraordinary popularity because it was the only stone which, when engraved as a signet, did not carry away the sealing wax with it.²

This 'gendered' preference for some gems appears to be supported by other Roman authors who deal with precious stones in their literary writings. Many Roman authors describe pearls as *lictos feminae*, to borrow Pliny's expression,³ and the same is true of emeralds. Earrings, necklaces, and *parures* studded with pearls and/or emeralds were by far the favourite ornaments for sophisticated Roman ladies (FIG. 2), who often received them from their lovers and suitors.⁴ Sometimes even men were fond of these jewels: when pearls and emeralds were worn or sought after by men, this was regarded as a disturbing sign of effeminacy. Ambiguous figures like Caesar, Caligula, and Nero betrayed their immoderate passion for pearls,⁵ and Pliny is sincerely shocked at Pompey's portrait rendered in pearls, carried in procession through the streets of Rome on the occasion of the general's triumph over Mithridates.⁶ Emeralds were offered, in addition to sardonyxes, to the young Luperus by a wealthy *matrona* infatuated with effeminate boys (*glabraria*),⁷ while, in Seneca's *Phaedra*, emerald ring stones mark the subversion of Heracles' masculinity at Omphale's court.⁸

Conversely, the sardonyx was actually employed by men: not only, as Pliny states, it was the best gem for signets,⁹ but the sardonyx ring

warm and uniform *sarda* is very likely to correspond to our carnelian, the variegated microcrystalline quartz is quite arbitrarily named 'sardonyx' or 'onyx', as well as 'agate' or 'nicolo', depending on the direction of the coloured bands of each specimen with respect to the engraved device (THORESEN 2017, pp. 178-179).

¹ Plin. NH 37.86: *primus autem Romanorum sardonyche usus est Africanus prior [...] et inde Romanis gemmae huius auctoritas*. Cf. MICHELI 2016, p. 87.

² Plin. NH 37.88: *placuisse in nostro orbe initio, quoniam solae prope gemmarum scalptae ceram non auferrent*.³ Plin. NH 9.144.

⁴ In particular, for pearls: Varro *Men.* 283.2; Hor. *Epod.* 8.13-14; Ov. *Ars* 3.129-130; *Phaedr. App.* 17.3; Sen. *Con. Helv.* 2.5.7; *Ben.* 7.9.4; Plin. NH 9.114, 119-121; 11.136; 13.91; 32.23; 33.40; 37.15; Quint. *Inst.* 11.1.3; Mart. 8.81; 9.2.9; Plin. *Epist.* 5.16.7; Suet. *Iul.* 50.2; for emeralds: Lucr. 4.1126; Prop. 2.16.43; Mart. 11.27.10; Stat. *Theb.* 2.276; for both pearls and emeralds: Hor. *Sat.* 1.2.80; Tib. 2.4.27; Plin. NH 9.117-119; Publil. (?) *apud* Petr. 55.6; Juv. 6.458-459.

⁵ Julius Caesar was exceedingly fond of pearls (Sen. *Ben.* 2.12.1-2; Suet. *Iul.* 45-52) and Caligula and Nero used to encrust with pearls a wide range of objects and furniture (Plin. NH 37.17).

⁶ Plin. NH 37.14-17.

⁷ Mart. 4.28.1-4: *donasti tenero, Chloe, Luperco [...] / Indos sardonychas, Scythas zmaragdus*.

⁸ Sen. *Ph.* 318-319: *natus Alcmena posuit pharetras / et minax vasti spoliū leonis, / passus aptari digitis smaragdus / et dari legem rudibus capillis*.⁹ Juv. 13.138-139.



FIG. 2. Mummy portrait of a woman, 100 AD, encaustic on linden wood, gilt, linen, 48 × 36 × 12.8 cm. The J. Paul Getty Museum, Villa Collection, Malibu, CA, 81.AP.42. © Getty's Open Content Program.

stone was also an indispensable status symbol for the elite classes¹ and was essential to rhetoricians on occasion of their performances.² According to Persius and Martial, sardonyxes were also common birthday gifts for men.³

4. THE GENDER OF GEMS

As we have seen, Pliny's account, along with many other literary sources, mainly dating back to the Imperial Roman period, strongly suggests a gendered preference for different types of precious stones. This is not surprising, given the attitude towards gems in Greece and Rome. In many respects, in classical antiquity stones were considered living beings: some stones and rocks were identified with petrified mythical heroes and heroines, while others were even able to grow, move, weep, and suffer.⁴ However, according to the ancients, gemstones were akin to living beings especially by virtue of their sexuality.⁵ As Pliny states, some gems were even able to fall pregnant and then

deliver baby-stones,⁶ although he does not dwell upon the mechanics of mating within the mineral kingdom. Many ancient authors distinguish male and female specimens within the same typology of gem.⁷ Usually,

¹ Mart. 2.29.2; 11.37.2.

² Pers. 1.16; Juv. 7.143-149.

³ Pers. 1.16; Mart. 10.87.4.

⁴ Cf. MACRÌ 2009; BOARDMAN 2004, pp. 104-109; BARRY 2020, pp. 51-65.

⁵ HALLEUX 1970 and DASEN 2014.

⁶ The *cytis* (namely, 'pregnant stone') seems to be pregnant by another stone, whose presence is revealed by a rattling sound (Plin. *NH* 37.154). The same happens with the *gassinades*, whose pregnancy lasts three months (Plin. *NH* 37.163). The *paeanitis* also becomes pregnant, and for this reason is thought to relieve labour pains (Plin. *NH* 37.180). The female exemplars of the *aetites* were also thought to contain a smaller stone, and for this reason the gem was employed to prevent miscarriage (Plin. *NH* 36.149-151): cf. HALLEUX 1970, p. 24, DASEN 2014, pp. 211-214, and BARRY 2020, pp. 51-53. Thph. *Lap.* 5 seems quite sceptical about the generative power of minerals.

⁷ Cf. HALLEUX 1970 and DASEN 2014, pp. 204-206.

the brilliance and colour of male stones are more intense than those of female exemplars:

καὶ ἄλλαι δὲ ὡς προείρηται πρότερον διαφορὰς ἔχουσαι καὶ συνώνυμοι πρὸς ἀλλήλας. Τοῦ γὰρ σαρδίου τὸ μὲν διαφανὲς ἐρυθρότερον δὲ καλεῖται θῆλυ, τὸ δὲ διαφανὲς μὲν μελάντερον δὲ ἄρρεν. Καὶ τὰ λυγγούρια δὲ ὡσαύτως, ὧν τὸ θῆλυ διαφανέστερον καὶ ξανθότερον. Καλεῖται δὲ καὶ κύανος ὁ μὲν ἄρρεν ὁ δὲ θῆλυς· μελάντερος δὲ ὁ ἄρρεν.

Then there are some (gems) which, as we mentioned before, differ from each other although they share the same name. For instance, there is the 'sard', of which the transparent, ruddier kind is known as the 'female', while the transparent but darker variety is known as the 'male'. The same is true of the lynxurium, the 'female' being the more transparent and the paler. Cyanus also is termed 'male' and 'female', the 'male' variety being the darker.¹

This way, the mineral kingdom closely mirrors the sexual dimorphism of human beings. Aristotle, the *Corpus Hippocraticum*, and many other scientific and philosophical works distinguish men and women on the basis of complexion and skin tone. The different appearance of men and women was believed to reflect their most intimate peculiarities as well as their social behaviour: men are stronger and darker, while women are delicate and pale, their inner nature being characterized by the coldness and humidity of the aquatic element.² It therefore seems no coincidence that the gemstones that adorned female bodies were also characterized by pale, transparent, opalescent or watery colours, or were themselves born in the sea.

5. THE GREEN OF THE EMERALD, THE BLACK, WHITE, AND RED OF THE SARDONYX

The preference for certain typologies of stones seems to be grounded not only in ancient scientific thought, but also in the chromatic symbolism of ancient Rome.

According to both literary and material sources, alongside pearls the women's gem *par excellence* was the emerald (Fig. 3).³ As Pliny states, emeralds embody the quintessence of green,⁴ and the principal typologies of beryl are also green.⁵

¹ Thphr. *Lap.* 30-31. Translation by EICHHOLZ 1965, p. 69. Cf. also Plin. *NH* 37.92 (*carbunculi*); 101 (*sandastros*); 106 (*sardae*).

² On this topic, see SASSI 2001, in particular pp. 1-33. Cf. also EAVERTLY 2013, pp. 83-158.

³ On the many varieties of gems that could be named 'smaragdus' in Graeco-Roman antiquity, see THORESEN 2017, pp. 182-186.

⁴ Plin. *NH* 37.92: *quoniam nihil omnino viridius comparatum illis (i.e. emeralds) virescit*.

⁵ Plin. *NH* 37.76: *probatissimi ex iis (i.e. beryls) sunt qui viriditatem maris puri imitantur*.



FIG. 3. Gold and emerald necklace, 1st-2nd century AD, 33.5 cm. Metropolitan Museum of Art, New York, 21.29.2. © Metropolitan Museum of Art.

Like blue, green played a marginal role within the ideological, religious, and symbolic structure of both Greek and Roman society.¹ For the Romans green was the colour of nature, but sometimes it also conveyed feelings of wildness, novelty, and otherness. It was only from the Imperial age that green complemented the otherwise warm palette of Roman clothing. Despite this chromatic innovation, green remained somehow ambivalent, since it was still perceived as an exotic, extravagant, and rather sinister colour, to such an extent that wearing something green was synonymous with luxury, effeminacy, and eccentricity.

Green was also associated by the Romans with Northern barbarians, who used to dye clothes and other objects green and blue.² Thanks to literary sources we know that green clothes were sought after by wealthy and 'fashion victim' *matronae*³ and, like emeralds, by effeminate men.⁴

Just as green clothes and accessories stood out in stark contrast to the whites, blacks, yellows, reds, browns, and ochres that were ubiquitous in Roman dress code and everyday life, the stunning green of the emerald stuck out against the warm, earthy, and 'traditional' colours of the sardonyx. Pliny describes many typologies of sardonyx,⁵ but its distinctive colours are black, white, and red (FIG. 4). In fact, the sardonyx was usually counterfeited by combining black, white, and red fine stones:

Veras a falsis discernere magna difficultas, quippe cum inventum sit ex veris generis alterius in aliud falsas traducere, ut sardoniches e ternis glutinentur gemmis ita ut deprehendi ars non possit, aliunde nigro, aliunde candido, aliunde minio sumptis, omnibus in suo genere probatissimis.

¹ For an overview of the Greek and Latin terminology of green, see BRADLEY 2009, pp. 7-9 and PASTOUREAU 2014, pp. 14-26.

² PASTOUREAU 2014, pp. 24-25. For the colours of the Roman dress code, see in particular SEBESTA 1994; OLSON 2008, pp. 11-14; BRADLEY 2009, pp. 178-187; GOLDMAN 2013, pp. 39-69; OLSON 2017, pp. 108-115; LEWELLYN-JONES 2021, pp. 90-99.

³ In particular, an expensive *prasina synthesis* is given on occasion of the Matronalia to a demanding lady by her suitor in Mart. 10.29.3-4.

⁴ For examples of effeminate men and boys as well as *parvenus* wearing green clothes and accessories (HOPMAN 2003, pp. 569-570; GOLDMAN 2013, pp. 55-56, 71-78 and OLSON 2017, pp. 112-124, 141): Petr. 27.2; 28.8; 64.6; 67.4; Mart. 1.96.9; 3.82.5, 11; 5.23.1; Stat. Silv. 2.1.133; Juv. 2.97; 9.50.

⁵ Plin. NH 37.86-89.

To distinguish genuine and false gemstones is extremely difficult, particularly as men have discovered how to make genuine stones of one variety into false stones of another. For example, a sardonyx can be manufactured so convincingly by sticking three gems together that the artifice cannot be detected: a black stone is taken from one species, a white from another, and a vermilion-coloured stone from a third, all being excellent in their own way.¹



FIG. 4. Engraved sardonyx with a lion inset into a gold ring, 1st-2nd century AD, 2.5 cm wide. Private collection. © Christie's 2018.

In opposition to the exotic and green emeralds, and because of its featuring the most traditional Roman colours, the sardonyx naturally became the stone *par excellence* for the signets of Roman men.

Of course, only a more extensive analysis of literary sources, in combination with a focused investigation into contemporary material artefacts, could reveal additional details and even meaningful deviations from this preference for some kinds of stones. But even these first remarks, mainly based on my analysis of Pliny's account, have given consistency to the distinction between gemstones' colours that were meant for women's jewellery and gemstones that were suitable for men's signets, a distinction which seems to rest on both scientific and cultural grounds.

6. 'COLOURED GEMS': GREEKNESS AND EXOTIC FASHION

After women's and men's gems, Pliny describes many stones that fall outside of this binary system based on gender, namely, gemstones recorded according to their colour. In these groups Pliny includes many stones that were in fashion in Hellenistic glyptics and jewellery, before they spread to Rome with the arrival of Greek jewellers and engravers during the late Republic and early Empire.

Among the *ardentes gemmae*, Pliny describes the *carbunculus*, that is, the

¹ Plin. *NH* 37.197. Translation by EICHHOLZ 1962, p. 325. A wonderful pendant featuring a gem made up of the union of three stones – black at the base, white streaked with black in the middle, and white with red shades at the top – is carefully described in Ach. *Tat.* 2.11.3. Apparently, it was not unusual for the Romans to come across counterfeited sardonyxes: Mart. 4.61.6; 9.59.19; 10.87.4.

garnet,¹ and then the *sarda*, that is, the carnelian. The *sarda* had already been mentioned as a component of the *sardonyx*, but Pliny postponed its description till the discussion of red gems. The *sarda*, Pliny observes, is common and, being also praised in the comedies of Menander and Philemon, was the most appreciated gem in ancient times.² Indeed, the σάρδιον ranks among the favourite gems of the Greeks: beside the comedies of Menander and Philemon recalled by Pliny,³ Plato refers to this gem among the λιθίδια [...] ταῦτα τὰ ἀγαπώμενα («our highly prized stones»),⁴ Theophrastus often mentions it as one of the most appreciated gems,⁵ and Posidippus praises an exceptionally large σάρδιον engraved with the Persian king Darius on his chariot.⁶ The *sarda*, Pliny continues, is remarkably suitable for signets,⁷ like some other coloured gems such as the amethyst and the *iaspis*-chalcedony,⁸ while others are not, like the *carbunculus*-garnet⁹ and the *sappirus*-lapis lazuli.¹⁰ Although it is not mentioned in Roman literary sources other than Pliny's encyclopaedia, looking at the material sources it appears that the *sarda*-carnelian is by far the most common gem employed for signets. It was favoured by Italic and Etruscan glyptics, but it was also the material preferred by the great Hellenistic masters who moved to Rome between the late Republic and the early Principate, like Augustus' engraver Dioscurides.¹¹ From Pliny one may infer that, at least for some Roman customers, this material was also able to suggest a nostalgic link with the Greek past, in addition to the engraved devices inspired by Greek masterpieces and the signatures of Greek artists.¹²

¹ A stone frequently employed in Hellenistic jewellery and glyptics: THORESEN 2017, pp. 172-180.

² Plin. NH 37.106: *nec fuit alia gemma apud antiquos usu frequentior – hac certe apud Menandrum et Philemonem fabulae superbiunt*.

³ Some σάρδια are mentioned, together with an emerald, in Menander's *Παιδίων* (PCG VI.2 F 276). Philemon wrote a comedy titled *Σάρδιον* (PCG VII FF 76-77), and this gem could also feature in the *Δακτύλιος* (PCG VII F 20) and/or in the *Αιθόγλυφος* (PCG VII F 41), perhaps a reference to a recognition token or a signet ring used to sign documents (WEBSTER 1953, p. 127).

⁴ Pl. *Phd.* 110d, together with *iaspides* (chalcedonies) and emeralds. Translation by FOWLER 1914, p. 379.

⁵ Thphr. *Lap.* 8; 23; 30.

⁶ Posidipp. 8 AB.

⁷ Plin. NH 37.104-105: *omnia autem haec genera (of carchedonia) contumaciter scalpurae resistent partemque in signo cerae tenent. E diverso ad haec sarda utilissima, quae nomen cum sardonyche communicavit*.

⁸ Plin. NH 37.118. On the identification of the many varieties of *iaspis* described by Pliny see THORESEN 2017, p. 178.

⁹ Plin. NH 37.95.

¹⁰ Plin. NH 37.120. On the identification of this gem, see THORESEN 2017, p. 171.

¹¹ E.g., out of seven known intaglios signed by Dioscurides, as many as six are carnelians, the other being an amethyst: BALLESTRAZZI (forthcoming).

¹² BALLESTRAZZI 2020, pp. 366-367, 380-382 and BALLESTRAZZI (forthcoming).

The same seems to be true of the other 'coloured gems'. Although these gems are seldom or never mentioned in literary sources, some of them are relatively frequently found among jewels and signets from museum and private collections or archaeological excavations. While the gems listed by colour seem to be alien to the Roman 'gendered system', they obey another significant cultural dichotomy, that between Greece and Rome. As a matter of fact, in Pliny's time these gems apparently still evoked an aura of exoticism and Greekness.¹

7. 'IMPROPER' AND COUNTERFEITED GEMS

The gems employed for signets and jewels are of course only a side of the Roman 'system' of precious minerals, and we should also take account of the primary distinction traced by Pliny between the *gemmarum confessa genera* and the precious minerals that, while enjoying *eandem [...] quam gemmae auctoritatem*, are not acknowledged as such. Although Pliny does not offer any explicit clarification, as I have previously noted² it seems clear that this dichotomy rested on the fact that *murra*, crystal, and amber, while being as attractive, expensive, and in high demand as gems, were not engraved and used as seals, nor were they set in pieces of jewellery as were the gemstones belonging to the *gemmarum confessa genera*.

As we will see with regard to a special class of green and blue glass gems,³ Pliny's account of precious minerals, when compared with material evidence and other literary sources, can also reveal some unexpected issues, which have been overlooked by scholars so far. This also seems to happen, for example, with the second 'improper gem' described by Pliny, namely, crystal or transparent quartz.⁴ While amber was actually unsuitable for signets,⁵ archaeological evidence seems to contradict Pliny's implicit statement that crystal did not belong to the *gemmarum confessa genera* employed for jewellery or seals, since transparent quartz was among the minerals from which signets were made. Pliny carefully describes the peculiarities of crystal while extensively criticizing the contemporary passion for crystal vessels and table equipment.⁶ Nevertheless, he does not include crystal among the *gemmarum confessa genera*, nor does any transparent stone appear among the principal gems grouped by colour.

¹ These differentiations could be further developed by comparing the colours of the 'traditionally Roman' gem (sardonyx) and 'exotic' gems (emerald, amethyst, garnet, etc.) with the pigments employed in painting, especially considering the thorny distinction between *colores austeri* and *colores floridi* drawn by Pliny in Book 35 (NH 35.30, 50) and its aesthetic and moral implications. On colours and pigments in Book 35, see A. Rouveret's discussion in this volume.

³ Below, p. 116.

⁵ See above, p. 103, note 4.

² Above, pp. 102-103.

⁴ Plin. NH 37.23-29.

⁶ Plin. NH 37.29.

Rather, according to Pliny's account, crystal was mainly employed to produce fakes of translucent coloured gems, like beryls and emeralds.

Quin immo etiam exstant commentarii auctorum – quos non equidem demonstrabo – quibus modis ex crystallo smaragdum tinguant aliasque tralucentes, sardonychem e sarda, item ceteras ex aliis; neque enim est ulla fraus vitae lucrosior.

And furthermore, there are treatises by authorities, whom I at least shall not deign to mention by name, describing how by means of dyestuffs emeralds and other transparent coloured gems are made from rock-crystal, or a sardonix from a sard, and similarly all other gemstones from one stone or another. And there is no other trickery that is practised against society with greater profit.¹

For ethical reasons Pliny firmly refuses to record any dyeing technique, but many of them survive recorded in the so-called *Stockholm Papyrus*, a collection of recipes dating to the 4th century AD but relying on earlier texts, which lists more than seventy procedures for producing imitation gems, alongside recipes for metal alloys and textile dyes.²

The many methods for counterfeiting gems usually have two operations in common.³ First, a transparent mineral – crystal, selenite (namely, moonstone) or topaz – needs to be 'opened up' thanks to a compound of alum and vinegar. The transparent gem is then dipped into a dyeing solution, a mixture of a colourant ground with olive oil or resins, to obtain imitation beryls, rubies, amethysts, sapphires, pearls, and many other stones, even if most of the recipes are for imitation emeralds. Subjected to experimental tests,⁴ it seems that the procedures described in the papyrus can effectively produce convincing imitation stones, as is repeatedly assured by the recipes themselves.⁵ Since crystal was used to imitate translucent coloured gems, one might argue that it was less valued than the stones for whose imitation was so largely employed.

No specimen of imitation gems crafted from crystal survives, although we cannot exclude that a few among the surviving crystal gems have lost that coloured patina which was produced through the procedures described. Even though not predominant, crystal was employed for gems

¹ Plin. NH 37.197. Translation by EICHHOLZ 1962, p. 325-327. Cf. also Plin. NH 37.79: *Indi et alias quidem gemmas crystallum tinguendo adulterare invenerunt, sed praecipue berullos*. On crystal and fake gems in the *Natural History*, see CROWLEY 2020.

² On the papyrus see HALLEUX 1981, pp. 110-151 (for the recipes on gemstones, see pp. 113-133) and CALEY, JENSEN 2008, in particular pp. 47-88.

³ For a detailed description of the dyeing procedures known in antiquity, see BOL 2014a.

⁴ BOL 2014a, pp. 116-119 and BOL 2014b. For the dyeing of gemstones in antiquity see LAPATIN 2015, p. 127, note 26 with bibliography.

⁵ Cf. e.g. P.Holm. 17 (HALLEUX 1981, pp. 115-116); P.Holm. 48 (HALLEUX 1981, p. 124); P.Holm. 52 (HALLEUX 1981, p. 125); P.Holm. 75 (HALLEUX 1981, p. 130).

and signets, and some extremely fine exemplars do survive.¹ Should we therefore consider these gems just faded imitation emeralds or beryls?

Possibly, the discrepancy between Pliny's account and archaeological evidence could be connected with the fluctuating appreciation that crystal enjoyed in ancient times. Indeed, while Theophrastus lists crystal among precious stones, namely, the stones «from which little signets are cut»,² in his most polemic *lithikon* Posidippus strenuously complains that, although beautiful and transparent, crystal was not valued by his foolish contemporaries because it was not as rare and small as gems.³ Perhaps, it was precisely the fact that crystal was found in large blocks⁴ that made its acknowledgement as a gem rather controversial.⁵ I am sure that a thorough analysis of the differences between *lapides* and *gemmae* in the *Natural History* would also offer some interesting insights in this respect.⁶

These few preliminary remarks about rock crystal are just an example of the complex and fascinating issues that Pliny's account may reveal upon careful consideration.⁷

8. FURTHER DEVELOPMENTS

Albeit limited, the evidence discussed so far has allowed me to delineate the material, scientific, aesthetic, and cultural underpinnings of the use and appreciation of precious stones in Roman culture. Future research on this topic should also aim at determining the geographical and chronological frames of the 'semantic system' of gems which I am sketching in this essay. My preliminary studies in these directions already point to

¹ See for instance the celebrated crystal with the bust of Athena signed by Eutyches, son of Augustus' engraver Dioscurides: Berlin, Antikensammlung FG 2305, ZWIERLEIN-DIEHL 2007, pp. 119-120, 415, Tav. 102, Fig. 468. See also BALLESTRAZZI 2020, pp. 376-377, Fig. 14.

² Thphr. *Lap.* 30: ἐξ ὧν δὲ τὰ σφραγίδια ποιεῖται καὶ ἄλλαι πλείους εἰσὶν [...] ἔτι δὲ καὶ ἡ κρύσταλλος καὶ τὸ ἀμέθυσον, ἅμφω δὲ διαφανῆ.

³ Posidipp. 16 AB. On the epigram, see especially PETRAIN 2005, pp. 332-340 and BELLONI 2016.

⁴ A remarkably huge specimen was dedicated in the Capitol by Livia, and other capacious crystal vessels are known to Pliny: Plin. *NH* 37.27.

⁵ Apparently, Theophrastus acknowledges rarity and smallness among the principal distinctive characteristics of gemstones: Thphr. *Lap.* 8; 24; 26; 27; 29; 33; 34; 35.

⁶ Although an explicit definition of *gemma* is missing from Book 37, it seems that both natural shape and size, as well as use and social prestige, are involved in the implicit definition of *gemmae* as opposed to *lapides*, the latter described in Book 36.

⁷ I am confident that a thorough examination of some passages of Book 37 will also provide some additional clues to the much-debated material identity of *murra* (cf. above, p. 103, note 1), while Pliny's statements about the passion of Roman women for amber and its 'uselessness' need to be further investigated on the basis of both literary sources and material evidence.

interesting conclusions, which will certainly deserve further investigation.

From a geographical and cultural viewpoint, I expect that this 'system' will prove to be eminently Roman and quite different from the Greek attitude towards gems. For example, Pliny and other authors mention emerald signets belonging to male rulers of the Greek world, like Polycrates of Samos,¹ Alexander the Great,² and Ptolemy IX.³ This strongly suggests that within that cultural frame emeralds were not meant only for women's ornaments as they were in Rome.

From a chronological perspective, apparently the Roman 'semantic system' of gems did not survive Late Antiquity, when a new 'symbolic system' was codified. In particular, it seems that the Plinian 'women's gems' were reserved to the emperor:⁴ pearls and emeralds – alongside blue 'hyacinths' – marked a wide range of liturgical equipment, jewellery conferred to high-ranking courtiers, and even mosaic walls and ceilings of churches and basilicas as imperial gifts.⁵

In addition, I am convinced that a careful examination of any attestation of specific gems in poetry and literature would not only improve the decoding of the Roman 'semantic system' of gems, but also offer a key to the passages in which writers and poets such as Persius, Martial, and Juvenal deal with gems with the aim of characterizing situations and literary characters.

Furthermore, the investigation of literary sources should be constantly combined with a focus on material artefacts. The occasional archaeological findings of pieces of jewellery, as well as the depictions of women wearing their favourite *parures*, such as the celebrated Fayum mummy portraits,⁶ could provide further evidence of women's preference for certain minerals rather than others, and of what were considered the most fashionable combinations of gems at a given time. As for the engraved gems, some important data could also come from the frequency of certain iconographies in relation to specific minerals,

¹ According to Hdt. 3.40.41 and Paus. 8.14.8, Polycrates' famous signet was an emerald engraved by Theodorus of Samos, set into a gold ring. See BALLESTRAZZI 2020, pp. 367-368 and BALLESTRAZZI (forthcoming).

² Plin. NH 37.8 refers to Alexander's portraits on emeralds engraved by Pyrgoteles: see above, p. 104, note 5.

³ After much hesitation, Lucullus accepted from Ptolemy IX a portrait of the king engraved on an emerald: Plut. *Luc.* 3.

⁴ The Eastern Roman emperor Leo I (reign 457-474) even issued an edict forbidding the use of 'pearls', 'emeralds', and 'hyacinths' to anyone, while reserving these gems for the emperor himself: *Cod. Iust.* 11.12. See SPIER 2012, pp. 18-19.

⁵ Cf. the many examples from written and material sources discussed by BEGHELLI 2017, pp. 236-247.

⁶ Cf. WALKER *et alii* 1997.

with an eye always kept on the chronological and geographical coordinates of an artefact.

Surely, valuable insights into the use of precious stones in Rome could also come from gems employed in contexts other than jewellery and glyptics. The exceptional hoard of precious stones from the Horti Lamiani,¹ for example, features many of the principal gems described by Pliny, including some stones that are only seldom employed in Roman glyptics and jewellery, like the *topazus*-peridot,² which Pliny lists among the *viridantium genera*,³ or the *sappirus*-lapis lazuli, belonging to the *caeruleae* gems.⁴ Few are instead the specimens of *sarda*-carnelian, the most common gem for engravings. Apparently, cases like this confirm that some kinds of gemstones were predominantly employed in specific contexts, sometimes even regardless of their availability, value, or ease of engraving.

Most likely, the decoding of this semantic language of Roman gemstones will provide new and unexpected keys to the interpretation of a class of materials usually very poor in contextual data, and it will remarkably enrich our approach to ancient gemstones. In addition to, and in combination with, iconography and stylistic features of the designs engraved on intaglios and cameos, the choice of the material itself should also be taken into account in connection with the identification of who commissioned and used the gems. This applies both to material gems from archaeological excavations or historical collections and to gems described in literary sources. In fact, thanks to the specific minerals set in the jewellery of Roman ladies and engraved as signets for Roman men (and women) we could even identify gender, political and cultural aspirations, or the tastes of their owners.⁵

However, we must be aware that, as Pliny observes, the rigour of this 'semantic system' was troubled by the whims of individuals who, if sufficiently prominent, could also promote new and lasting fashion trends. In this regard, Pliny records that the emperor Claudius wore both sardonyxes and emeralds, a combination apparently still in fashion at the time of Martial.⁶

¹ See above, p. 101, note 4.

² THORESEN 2017, pp. 186-189.

³ Plin. *NH* 37.107-109.

⁴ Plin. *NH* 37.119-120.

⁵ Of course this 'semantic system' based on gender and tradition could also coexist with other criteria grounded in the healing and magical potential of gems, even regardless of the possible presence of magical inscriptions or engravings (see NAGY 2015, pp. 206-211 for an insightful definition of 'magical gems'). On the material semantics of amulets and magical gems, especially by virtue of their colours, see MASTROCINQUE 2011 and BECKMAN 2017 with further bibliography.

⁶ Mart. 4.61.6-8.

Hactenus de principatu convenit mulierum maxime senatusconsulto. Minus certa sunt de quibus et viri iudicant; singulorum enim libido pretia singulis facit praecipueque aemulatio, velut cum Claudius Caesar smaragdus induebat vel sardonyches.

Up to this point there is agreement as to which stones are supreme, the question having been largely settled by a decree of our Women-councillors of State. There is less certainty regarding the stones about which men too pass judgement. In the case of men, it is an individual's caprice that sets a value upon an individual stone, and, above all, the rivalry that ensues. A case in point is that of the Emperor Claudius, when he took to wearing emeralds or sardonyxes.¹

The acknowledgement of the material semantics of Roman gems could also disclose some unexpected issues. A promising case-study is that of a large group of Augustan glass intaglios which reproduce the pattern of the sardonyx by juxtaposing the specific colours of women's gems: their combination of blue and green bands alternating with thinner white stripes does not match the design of any natural mineral (FIG. 5). These gems raise doubts about the traditional assumption that glass gems were used as imitations of much more expensive natural minerals. Although Pliny himself recalls glass imitations of many stones² and mentions the *vitreae gemmae e volgi anulis* when describing the pigment *anulare*,³ the manifest artificiality of these blue and green gems demonstrates that the use of glass was not limited to the imitation of more precious minerals. Like the unusual combination of sardonyxes and emeralds brought into vogue by Claudius, it seems likely that this unnatural pattern also conveyed a specific meaning and was meant for particular customers, who probably did not employ these gems as signets, as residual traces of gold leaf in the device of many specimens suggest. Only a careful analysis of the engraved devices could suggest the category of Romans for which these gems were designed, and whether this peculiar pattern was invested with a particular symbolic meaning.

¹ Plin. NH 37.85. Translation by EICHHOLZ 1962, pp. 231-233 with slight modifications.

² Pliny records glass imitations of crystal (Plin. NH 37.29), opals (Plin. NH 37.83), *carbunculus*-garnet (Plin. NH 37.98), *callaina*-turquoise (Plin. NH 37.112), *iaspis*-chalcedony (Plin. NH 37.117), *leucocrisius* (Plin. NH 37.128).

³ Plin. NH 35.48: *fit et ipsum e creta admixtis vitreis gemmis e volgi anulis, inde et anulare dictum.*

9. CONCLUSIONS

In this essay, I have offered some tentative conclusions about the Roman 'gem code' and the symbolic meanings of the most appreciated precious stones. Many issues touched upon here need further analysis, and various strands of research will combine to provide deep insights into the Roman semantics of precious stone and the symbolic language of colours. My ongoing work underlines the fact that any investigation in this direction should embrace a wide chronological span and be constantly supported by a strongly multidisciplinary approach which considers both literary and material sources. I am confident that even the preliminary results presented here suggest new and promising research paths and urge us to recalibrate our current methodological approaches to ancient gemstones. In offering this contribution to the history of colour and to the due rehabilitation of the 'minor arts', I hope to have demonstrated the importance of considering the materiality and colours of precious stones alongside and in combination with the traditional foci of glyptic studies.

★

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FIG. 5. Two-piece cast glass gem inset into a bronze ring, second half of 1st century BC, 1.6 × 1.1 cm. The J. Paul Getty Museum, Villa Collection, Malibu, CA, 85.AN.370.83. © Getty's Open Content Program.

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PIGMENTS GIVING MORE THAN COLOUR: THE CASE OF LEMNIAN EARTH OR MILTOS

EFFIE PHOTOS-JONES

ABSTRACT · This paper focuses on a statement first made by Dioscorides (*De Materia Medica*, v 97) in reference to a renowned mineral medicinal, *Lemnian Earth* (LE) or *Lemnian Miltos* (LM). Dioscorides stated that ‘goats’ blood’ must have been added to the earth, to make it red and unstaining, but this comment of his became a source of some ‘concern’ to later authors, like Galen; it meant that LE was a prepared rather than a natural material, and further, one prepared in a rather unconventional way. LE was used for a variety of ailments but mainly against poison ingested or injected (by venomous snakes). To our knowledge there are no samples of LE dating to antiquity but the Pharmacy Museum of the University of Basel has samples dating to a much later period (16th-18th century CE), when LEs circulated under a variety of colours (white/grey/yellow/red) rather than just red. Chemical and mineralogical analysis of a select number of samples, combined with DNA sequencing of their microbial load revealed the presence of the fungal species *Talaromyces* (previously identified as part of the *Penicillium* family). Therefore, it is suggested here that microorganisms, like fungi, and their associated (red) pigmenting organic compounds (secondary metabolites) might have been the source of the colour red, and not ‘goats’ blood’. Fungal-derived pigments are used widely as food colorants today. In seeking evidence, within the documentary record, for the deliberate introduction of a fungal load I highlight a comment by Galen that LE was mixed with wheat and barley. Had that grain been ‘mouldy’, it could have easily provided the source for *Penicillium*. Dioscorides’ comment may appear, at first, innocuous and of little consequence to the study of ancient pharmacology, focused as it is on plant-derived bioactive substances. Yet, minerals and rocks constitute circa 10% of the Dioscoridean *pharmacopoeia*, and the synthetic ones a much smaller subset. Therefore his ‘off-the-cuff’ remark may have the potential to shed light on possible ancient biotechnological practices, currently little appreciated and/or understood.

KEYWORDS · Lemnos, Galen, Lemnian Earth, *Lemnian Miltos*, *fungi*, Secondary Metabolites.

1. SETTING THE SCENE

THE subject of this paper is the mineral medicinal of the Greco-Roman world, called *Lemnian Earth* (LE) or *Lemnian miltos* (LM) or *Lemnian*

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sphragis, *Lemnian sealed earth* (cf. the Latin *Terra sigillata*), renowned in antiquity for the healing of wounds that ‘were slow to heal’ and as a cure ‘against poison’, whether ingested or acquired from snake bites. The island of Lemnos is situated in the North-eastern Aegean and the locality of its extraction (greater Kotsinas, on the North coast) forms part of a landscape steeped in local myth and archaeological remains (8th-6th century BCE town of Hephaistias) (Figs. 1a, b). Over the last twenty-five years myself and my colleagues have taken an active interest in the closer investigation of this mineral medicinal and the landscape it derived from.

On the geological front, our work has focused on the assessment of the clay sediments¹ and the water from the local springs;² the latter is thought to have played an integral part in the preparation of LE in the post-medieval period.³ On the archaeological materials analysis front, our work has been based on the chemical and mineralogical characterisation of LE samples in the collection of the Pharmacy Museum of the University of Basel (16th-18th century) as well as the DNA sequencing of their microbial (fungal, bacterial) load (Figs 2a-c). Also analysed, and belonging to the same collection, were three samples of *Terra Silesia* (Silesian Earth, hereafter SE) from Central Europe of contemporary date (Figs. 2d-f).⁴

Why has this mineral medicinal been so intriguing to us? First, on account of the strong belief in its efficacy spanning millennia, from antiquity to the modern era. Second, on account of the comments of 19th century chemists who analysed the LE in use at the time and decreed that there was nothing special about it («it is absolutely certain this ‘soil’ contains no therapeutic properties»).⁵ Third, Dioscorides’ comment (*De materia medica*, v 97) mentioned above, namely that they must have added goats’ blood to make the earth red and unstaining; if they did not do that, what did they actually add to that earth that was neither dye nor pigment and yet turned it red?

While chemical and mineralogical analysis could easily corroborate (or not) the observation that LE may have been ‘just a clay’, the issue of the colour (red) and how it was acquired was more problematic. As far as antiquity was concerned, LE/LM was always red. Further, that red colour should not stain. The combination of the two requirements, *i.e.*, to be red and unstaining, excluded the presence of common mineral pigments, like iron oxides or plant-derived dyes. Dioscorides was the first to put forward the suggestion that something different (for example goats’

¹ HALL, PHOTOS-JONES 2008; PHOTOS-JONES *et alii* 2012; PHOTOS-JONES, HALL 2011.

² PHOTOS-JONES *et alii* 2016.

³ HALL, PHOTOS-JONES 2008; TOURPTSOGLOU-STEFANIDOU 1988.

⁴ CHRISTIDIS *et alii* 2020.

⁵ TOURPTSOGLOU-STEFANIDOU 1988, p. 506.



FIG. 1a. Map of the North Aegean with Lemnos in the centre; FIG. 1b. the island of Lemnos with the broader archaeological landscape associated with the extraction of the Lemnian Earth, in the north of the island, highlighted.



FIGS 2 a, b, c. Three samples of Lemnian Earth in the collection of the Pharmacy Museum of the University of Basel (after fig. 1, CHRISTIDIS *et alii* 2020). From left to right: 700.4, 700.17, 700.18



FIGS 2 d, e, f. Three samples of Terra Silesia in the collection of the Pharmacy Museum of the University of Basel (after Fig 1, CHRISTIDIS *et alii* 2020). From left to right: 703.1, 703.2, 703.3.

blood) was added to the natural clay, but it was Galen who endeavoured to resolve the ambiguity of the addition of goats' blood: «Now, I had once read in the works of Dioscorides and others that the Lemnian earth was mixed with goats' blood, and that it is out of the mud resulting from this mixture that the priestess used to mould and stamp the so-called Lemnian seals». ¹ Galen goes on to state that he had a great desire to see for himself the process of mixture, the *summetria tes mixeos* (συνμετρία τῆς μίξεως) or the proportions of blood to earth. After watching the ceremony, he adds: «I thought well to inquire whether there was no tradition of goats' blood being mixed with the earth. All who heard this question of mine laughed, and they were not mere chance individuals, but people well informed about the whole history of the locality as well as in other matters». ² Having consulted with them, he concluded that no blood was added. Further, so convinced was he of the Lemnian *sphra-*

¹ Galen, *De simplicium medicamentorum facultatibus*, IX 2 in KÜHN 1826, p. 171, ll. 1-4. Translation by BROCK 1929, p. 193.

² Greek text in KÜHN 1826, pp. 173, ll. 16-174, l. 1. Translation by BROCK 1929, p. 194.

gis' / *miltos*' useful properties that he adds: «I had no hesitation myself in testing the medicine, and I took away twenty thousand seals» (δισμυρίας λαβὼν σφραγίδας).¹

As FIGS 2a-c suggest, in later periods, LE came under different colours. Georgius Agricola, the 16th-century authority on all natural materials mined and/or extracted and the acknowledged 'father' of modern mineralogy, states that «they (the pieces of LE) were yellowish and sealed with Ottoman letters».² To our knowledge, there are no dated LE *sphragides* from antiquity. Further, and as already mentioned, only a very small data set exists regarding the technical characterisation of LEs of later date.

In this paper I will propose that LE acquired its coveted and long-standing reputation (from early antiquity to late 19th-early 20th century) based on two different but ultimately related reasons: (a) the subtle and 'under-the-radar' method of its preparation, and (b) the complex way it was rendered pharmacologically active. Of the two, I will address only the former, *i.e.*, its manufacture, and only to the extent that present state of research allows me to do so. I am referring to 'manufacture' because I can see no other way the clay acquired a red colour, which did not stain, without deliberate additions/alterations of the natural material.

In the sections that follow I first draw a brief outline of the ancient sources. The narrative is mainly Galen's and I illustrate it, on a step-by-step basis, and as it unfolds, with one graphic illustration (FIG. 3). Then I present a summary of our published data on the technical characterisation of archaeological samples of LE (and of SE) from a much later period when similar practices may or may not have been followed. I suggest that the colour changes in Galen's LE might have been caused by fungal presence in the grains; in other words, that the wheat/barley may have been partly rotting. This hypothesis arose out of our 'discovery' of fungi (of the *Penicillium* family) in the LEs of the later periods. Did the Christians follow the same ritual of blessing as the priestess of Artemis? We do not know. But some fungi are known to produce colourful molecules and if present they could have coloured clays as well.

2. LEMNIAN EARTH IN ANTIQUITY: KEY SOURCES

In the mind of the ancient Greeks and in the context of Greek mythology, the island of Lemnos in the Northern Aegean was perhaps best known for two main 'events': (a) the slaughter of Lemnian men by their women folk because they deserted them in favour of the Thracian

¹ Greek text in in KÜHN 1826, p. 174, ll. 6-7. Translation by BROCK 1929, p. 193.

² MACGREGOR 2013.

women! and (b) Philoctetes' cure of his bite by a poisonous snake with Lemnian Earth.

LE is first mentioned as Lemnian *miltos* in the 4th century BCE by Theophrastus (*On Stones*, 52), together with Kean, Cappadocian /Sinopic earths (identified as red earths or *miltos*). *Miltos* was one of the many reds known already from the Mycenaean period (Linear B tablets) and was the name given to a red pigment iron oxide from the north Cycladic Island of Kea and/or Sinope (Cappadocia, Turkey). *Miltos*, at least of the Kean variety, has now been identified as naturally occurring very fine, almost industrial grade, iron oxides.¹ Kean and Sinopic *miltos* stained red, and as such they were used as a pigment by builders and artists as well as for the painting of boats. Recently our research group has demonstrated that Kean *miltos* would have been more than a means of decorating boats, and instead could have acted as an antifouling agent, on account of trace amounts of metals (Pb, Cu, Sn) but also active microorganisms.²

In the 1st century BCE, Vitruvius describes LE as a natural pigment (*On Architecture*, 7.7.15). Pliny (1st century CE) identifies it as a pigment as well as, more importantly, a medicine. Moreover, in his *Natural History* Pliny refers to LE as *Terra Lemnia*, *Terra Rubricata*, *Terra Sigillata* or *Lemnia Rubrica*, and he mentions LE in three books (*NH* 28.24; 29.33 and 104; 35.14) as a particularly efficient antidote against poisons and snakebites. It is quite clear that in Pliny's mind LE was (only) red since it compared it with Sinopis (*sinopic miltos*) and *minium* (*NH* 35.14).

Dioscorides (1st century CE) describes Lemnian Earth as extracted from a tunnel-like aperture in Lemnos, and «mixed with goats' blood»; it was an «uncommonly effective antidote for deadly poisons when drunk with wine» and «against the stroke of venomous animals and for their snake bites» (*De materia medica*, v 97),³ thus restating, the reference to Philoctetes' cure. The implication, therefore, is that LE could be taken internally (with wine) rather than simply applied as a poultice, externally.

As mentioned, it is Galen following his second visit to Lemnos in the late 190s CE,⁴ who gives an insightful account of LE's properties and of its extraction and processing in chapter 2 of the ninth book of his work *On the Properties of Simple Drugs* (*De simplicium medicamentorum facultatibus*),⁵ a "required reading" for those interested in the history of this 'medicine'. Before tackling the issue of LE, Galen begins by defining what is 'earth' (γῆ/ge), saying that Greeks commonly give this name to all material

¹ PHOTOS-JONES *et alii* 1997.

³ Translation by BECK 2011, p. 380.

⁵ KÜHN 1826, pp. 169-176.

² PHOTOS-JONES *et alii* 2018.

⁴ NUTTON 1973, pp. 158-171.

... which, put into water, becomes at once liquefied and turns into mud (πηλός/*pelos*). That used in agriculture [by the farmers] has certain varieties, a fat and sticky kind being quite dark in colour, while another kind, not fatty, but more friable, is called white clay (potters' earth) (ἄργιλος/*argil(l)os*), this having a whitish tint. These are the extreme varieties, and the other earths are between them, approaching either the one or the other.¹

Galen is clearly stating that there is a whole range of materials that could be classified as earths; at one end of that range is the earth that farmers routinely work with. This earth feels/looks greasy (λιπαρά/*lipara*), it is sticky (γλίσχρος/*glischros*) and it is also dark in colour (μέλαινα τὴν χροάν/*melaina ten chroan*). At the other end is a white earth more friable/crumblily and without grease; all earths are capable of 'dissolving' in water and this property distinguishes them from other natural materials. When farmers' earth is wetted, it becomes a mud called *pelos*. The importance of working with wet earth (πηλός/*pelos*) as opposed to dry earth is repeatedly highlighted, as is the fact (see below) that when the *pelos* is being worked it needs to be totally immersed in water.

LE and its three varieties belong to the first category of earths, their varieties being defined on the basis of application. It is also clear that LE cannot be considered as potters' clay (ἄργιλος/*argil(l)os*). Indeed, Galen continues: «One is the above-mentioned sacred earth, which nobody touches but the priestess. A second kind is the real red earth (μίλτος/*miltos*), mainly used by builders. The third is that which removes dirt, and which can be used, if desired, by those who wash linen and clothes (*fullers*)». ² Fullers' earth is identified as smectite/montmorillonite clay. ³ The ritual of the preparation of the *Lemnian sphragis* is described by Galen in the passage below:

The priestess collects this, to the accompaniment of some local ceremony (μετά τινος ἐπιχωρίου τιμῆς/*meta tinos epichorion times*), no animals being sacrificed, but wheat and barley being given back to the land in exchange (ἀντιδιδόμενων τῷ χωρίῳ/*antididomenon toi chorioi*). She then takes it to the city, mixes it with water so as to make moist mud, shakes this violently and then allows it to stand. Thereafter she removes first the superficial water, and next the greasy part of the earth (λιπαρόν τῆς γῆς/*liparon tes ges*) below this, leaving only the stony and sandy part at the bottom, which is useless. She now dries the greasy mud (λιπαρὸς πηλός/*liparos pelos*) until it reaches the consistency of soft wax; of this

¹ KÜHN 1826, p. 168, ll. 10-18. I have used Brock's (1929) translation of the relevant passages in Galen; comments/additions are in italics.

² Greek text in KÜHN 1826, pp. 170, ll. 14-171, l. 1. Translation by BROCK 1929, p. 192.

³ ROBERTSON 1986.

she takes small portions and imprints upon them the seal of Artemis; then again she dries these in the shade till they are absolutely free from moisture.¹

In another passage that follows the above and of equal significance is Galen's observation that the priestess 'stuffed into' the earth (ἐμβάλλουσα τῇ γῇ/*emballousa tei gei*) some quantity of wheat and barley; she also did «other» unspecified things in accordance with the local ritual (κατὰ τὸν ἐπιχώριον σεβασμόν/*kata ton epichorion sebasmon*), and then transported the earth and wheat/barley to the town/ temple in a carriage.² In the passage quoted above, Galen refers again to the *epichorios time* (ἐπιχώριος τιμή), viz. the local custom; accordingly, the priestess, having depleted the land of its earth, appears to be giving something valuable back to it (wheat and barley), (ἀντιδιδόμενων τῷ χωρίῳ/*antididomenon toi chorioi*), perhaps in the hope of returning to it, its health-giving powers. Setting aside our interpretation of the priestess' intentions, what can be deduced from her actions is that, this was no casual sprinkling of clay with some grain but a deliberate act of mixing the clay with wheat and barley, the latter in considerable quantities (κρίθων ἀριθμόν/*krithon arithmon*).³

Sprinkling or mixing with wheat and barley could not have been seen as anything but innocuous additions to the clay. However, what remains conspicuously absent is any reference to the issue of the colour red. Galen set sail to be present during the days when the priestess was actively involved in the extraction of LE and to clarify the issue of the addition (or not) of goats' blood. He declares himself satisfied that no goats' blood was added but he does not disclose if anything else was added; or how the earth became red. We can only assume that this was a deliberate move from his part and perhaps instrumental in him sailing away with 20,000 seals.

FIG. 3 gives a graphic illustration of the priestess' 'ritual' as she worked her way through what would have been a well-designed manufacturing process (see caption to FIG. 3); also the potential (colour) changes in the λιπαρὸς πηλός. It suggests that what may have been added was not goats' blood but rather 'something' in the wheat and barley, namely a fungal growth. It is almost certain that this fungal growth would have been readily recognised by all (see below reference to *euros*). Whether they would want to report its presence, is a separate issue. The symbol of Artemis was a goat, hence the stylised stamp on the pellet.

¹ Greek text in KÜHN 1826, pp. 169, l. 11-170, l. 4. Translation by BROCK 1929, p. 192.

² KÜHN 1826, p. 173, ll. 12-16.

³ KÜHN 1826, p. 173, l. 13. I would like to thank Prof Vivian Nutton for offering added insight into the priestess' actions and indeed the editors of this volume for carefully debating this point.

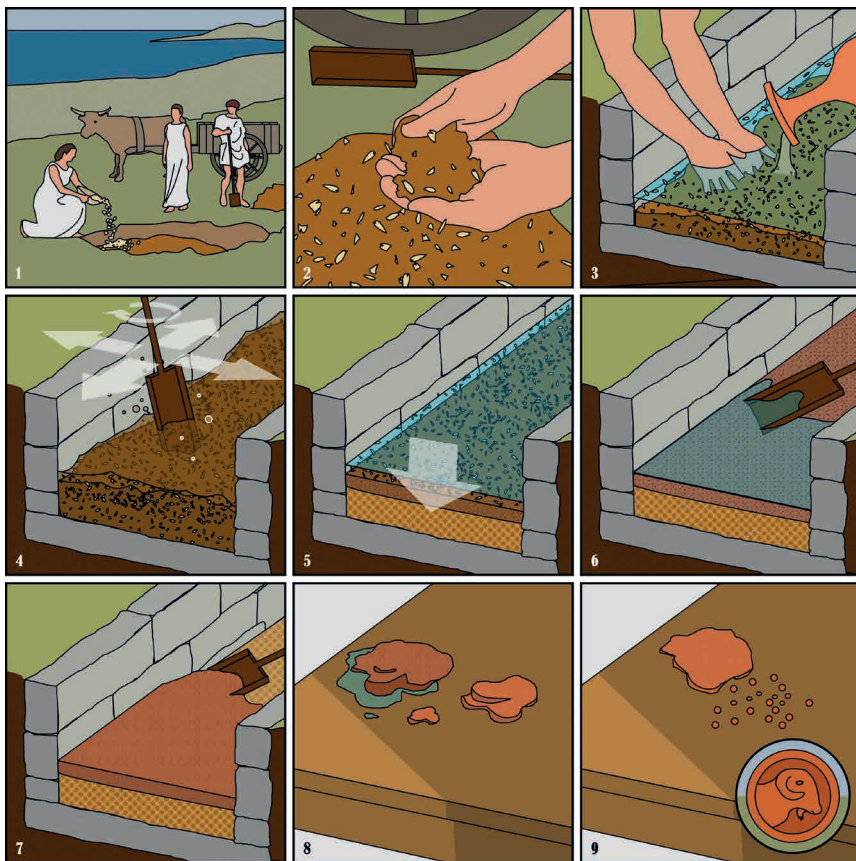


FIG. 3. **Images 1, 2:** priestess is on site and 'blessing' the pit with wheat and barley 'according to the local custom'. **Images 3, 4:** priestess is at the 'temple' making '*pelos*' after pouring water in a 'vat' and mixing vigorously earth with water. Wheat and barley get thoroughly mixed in the *pelos* but given their light weight they are likely to float in the water layer. Some will be trapped in the coarse sediment at the bottom. **Image 5:** a settling period follows whereupon the *liparos pelos* consisting of fine clay-sized particles separates from the water and the coarse grained sediment (sandy and silty material) below it. **Image 6:** water (top) layer is removed to reveal a *liparos pelos* whose colour is 'different' from that of the original earth; this colour change is due to the hypothesised release of fungal pigmenting biomolecules (secondary metabolites) because of (rigorous) stirring but possibly other (environmental) reasons as well. The latter may include changes in the pH of the water as a result of the presence of clays in the vat. **Image 7:** select removal of *liparos pelos* and disposing (not shown) of the coarse layer below. **Images 8, 9:** controlled drying of the *liparos pelos*, both prior to and after shaping and stamping it into pellets; stamp: a goat's head, the goat being the symbol of the goddess Artemis. © Analytical Services for Art and Archaeology (Ltd).

3. LE: THE TECHNICAL ANALYSES SO FAR

Having put forward a suggestion for an alternative source of colourant for the LE and in Galen's time, I now present a summary of our work on LEs of later periods. As can be seen from TAB. 1, except for the white LE, which consists primarily of dolomite and could have possibly been a fake (many fake LEs were purported to be circulating in the markets of Central Europe at the time), the composition of the other two LEs consists of a mixture of kaolinite and smectite/montmorillonite with illite, hematite, titanium oxide and quartz. The red sample (FIG. 2b) has ca. 5% iron oxide. The red SE (FIG. 2e) has ca. 7 % hematite, and it stains like the red LE.¹ Samples 700.19 and 700.20, natural clay sediments, from the locality of the extraction are also included.² They contain not only hematite but also alunite (see 700.19). Given the small number of both geological and archaeological samples analysed, the results regarding 'typical' composition for LEs can only be suggestive, rather than conclusive.

	703.1 yellowish SE	703.2 red SE	703.3 white SE	700.4 white LE	700.17 red LE	700.18 grey LE	700.19 natural red clay	700.20 natural clay
Dolomite	nd	nd	nd	65	nd	nd	nd	nd
Kaolinite	31	88	67	17	37	nd	69	1
Smectite/Montmorillonite	nd	nd	nd	nd	nd	66	nd	35
Quartz	33	nd	26	8	18	7	nd	21
Opal-CT/Cristoballite	nd	nd	nd	nd	nd	nd	4	nd
Illite	28	nd	6	10	41	18	nd	13
Anatase	1	5	0	nd	nd	nd	nd	nd
Albite	nd	nd	nd	nd	nd	nd	nd	13
Alunite	nd	nd	nd	nd	nd	9	23	nd
Biotite	nd	nd	nd	nd	nd	nd	nd	nd
Calcite	nd	nd	nd	nd	nd	nd	nd	8
Chlorite	nd	nd	nd	nd	nd	nd	nd	9
Hematite	nd	7	nd	nd	4	nd	2	nd
K-feldspar	7	nd	nd	nd	nd	nd	nd	nd

TAB. 1. Mineral composition (key phases) determined by X-ray diffraction of the six earths discussed here (adapted from table 1, in CHRISTIDIS *et alii* 2020); nd = not detected.

DNA sequencing of the post-medieval samples of Lemnian and Silesian earths gave interesting results (see TAB. 2). Three fungal species were identified, namely *Talaromyces*, *Penicillium* and *Aspergillus*. All three belong to the larger family of *Trichocomaceae* of the Eurotiales phylogenetic order.³

¹ CHRISTIDIS *et alii* 2020, table 1.

² CHRISTIDIS *et alii* 2020.

³ See the Wikipedia entry on *Trichocomaceae* at: <https://en.wikipedia.org/wiki/Trichocomaceae>.

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Talaromyces used to be classified under the *Penicillium* species but now is treated independently.

sample	<i>Talaromyces</i> sp	<i>Penicillium</i> sp	<i>Aspergillus</i> sp
703.1 yellowish SE	nd	X *	X
703.2 red SE	nd	nd	nd
703.3 white SE	nd	nd	nd
700.4 white LE	nd	nd	nd
700.17 red LE	X	likely	likely
700.18 grey LE	X	X	nd

TAB. 2. Fungal load in three of the six earths analysed. X refers to ‘present’. X* refers to *Penicillium* sp type different to that of 700.17; nd = not detected. (adapted from table 2 in CHRISTIDIS *et alii* 2020).

As TAB. 2 demonstrates, only two of the three LEs have a fungal load. The dolomite-rich white LE (700.4) has no fungal load and, as mentioned, is compositionally different to the other two; it may not have originated from Lemnos. The red LE contains *Talaromyces* and likely *Penicillium* and *Aspergillum*; the red Silesian earth carries no fungal load. Both are iron rich, meaning that the original clay (from Silesia or Lemnos) was either hematite-rich or that hematite was subsequently added to it. The Silesian white earth contains a different type of the *Penicillium* species as well as *Aspergillus* species. The two sets of earths are contemporary; they also show some overlap in the species of fungi present. This raises the question of possible contamination post-manufacture and/or during storage.

How can we be confident that the fungal load was acquired during manufacture and not during their long history of acquisition and/or storage as artefacts in museum collections? There is presently no definitive answer to this question. Fungal spores like those of *Penicillium* with their characteristic blue and green colour are ubiquitous but, for their growth, they require the presence of an organic substrate as a food and energy source. What that food source would have been while in storage and away from an organic substrate is difficult to assess.

Fungi produce organic compounds, primary and secondary metabolites, important for their survival. The former are responsible for reproduction and growth; the latter for communication and defence and as a means of survival within a specific ecological setting. There are many strains of the *Talaromyces* and *Penicillium* species which contain yellow/orange/red secondary metabolites.¹ It has been shown that pH (ca. 5-7) and temperature (ca. 24°C) are optimum conditions for the generations of red

¹ MORALES-OYERVIDES *et alii* 2020.

secondary metabolites by a particular strain of *Penicillium*.¹ Microbially derived colorants were used in the past in the East and are used increasingly by the food industry today; also as pharmaceuticals, since many are bioactive (displaying antibacterial/ antifungal/ antioxidant) properties.² I argue that, given their properties as food colorants, had they been generated in antiquity, they could have been used as ...earth colorants, as well!

4. FURTHER COMMENTS AND CONCLUDING REMARKS

The story of the extraction and preparation of LE has for long been 'read' as a ritual process carried out under a religious authority, Christian or pagan whether in antiquity or in the post-medieval period. Emphasis has been placed on the day of the extraction of the earth, be it on the 6th of May in antiquity or the 6th of August in later periods.³ Yet it is clear that, in reference to antiquity, it is the events following the extraction (*i.e.*, what the priestess did once the load of grain-with-earth was carried to the temple) that is of interest to us; with regards to the later periods, it may be the events preceding the extraction and taking place over the whole year that might be of interest.⁴ In the 4th century BCE, Lemnos was a major producer of grain (wheat and barley) with as much as 30 % of its landmass dedicated to the cultivation of barley.⁵ Hesiod writes that harvest of grains took place when «the Pleiades rose to the east», namely in May.⁶ That date seems to coincide with the time of the extraction of LE in antiquity (on the 6th of May), *i.e.*, the time of harvest when grains would have been fresh and plentiful.

The ancient sources make it clear that only a few clay-rich geographical localities, mainly in the islands of the Aegean, were associated with medicinal earths (Dioscorides, *De Materia Medica*, v).⁷ For the majority there is little reference to their colour. This was not the case with *Lemnian milto*s. Since there is no reference to any specific pigment or dye added and the only pointer to another component being added is the grain used by the priestess, I suggest the source of colour *could* be associated with *that* grain and more specifically, a fungal growth *within*. Did the priestess choose to add mouldy grain, in the first place? Did the grain become mouldy as it was placed with the earth in the vat where it was stirred 'violently' and for days?

As for the first question and with regards to mouldy grain, I come now to the issue of *euros* (εὐρώς) which first came to our attention in

¹ MENDEZ *et alii* 2011.

² RAO *et alii* 2017.

³ HALL, PHOTOS-JONES 2011; TOURPTSOGLOU-STEFANIDOU 1988.

⁴ HALL, PHOTOS-JONES 2011, fig. 62, p. 94.

⁵ GARNSEY 1985, p. 68.

⁶ THIBODEAU 2016, p. 523.

⁷ See Samian, Eretrian, Kimolian, Melian earths as well as *Ampelitis* and others; HALL, PHOTOS-JONES 2011; PHOTOS-JONES *et alii* 2015.

association with a white composite ‘mineral’ formed on the lead metal plate in the course of making *psimuthion* (ψιμύθιον, synthetic cerussite or lead carbonate).¹ *Euros* is translated as mould, dank decay but also as putrid wetness, ὑγρότης σεσηπιῖα (*hugrotes sesepeuia*).² On the issue of mouldy wheat (*eurotion sitos*/εὐρωτιῶν σίτος)³ but also mouldy bread (*arton... eurotionton*/ἄρτων ... εὐρωτιώντων)⁴ as well as mouldy wicker work!,⁵ we can only assume that antiquity was well aware of such processes of decay, as a state of becoming of organic matter, under particular conditions, rather than a microorganism.

There is certainly no mention by Galen to ‘mouldy grain’ whatever its source. The hypothesis that the grain added might have been mouldy has to remain exactly that, a hypothesis. Although the presence of fungi in some LEs of later periods is a fact, their source cannot be ascertained. So where do we go from here? Laboratory-based experiments is the next step. Simulating what the priestess may have done *i.e.* by growing fungi in the presence of clays can verify whether the clays can change colour or not. It is important to establish which conditions exactly induce the fungi to release their secondary metabolites. Presently the dosage (*krithon arithmon*) is unknown. Galen notes that a lot of barley was needed/added, but how much is required to change the colour of clay? Changing of the colour of clay did not merely serve as an exercise in aesthetics (a visual effect). It must have signalled the conversion of a simple clay to a therapeutic one. Our research is ongoing.

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¹ PHOTOS-JONES *et alii* 2020; see Theophrastus, *On Stones*, 56.

² See Timaeus the Sophist, *Platonic Lexicon*, ε 58, s.v. Εὐρώς· ὑγρότης σεσηπιῖα, ed. VALENTE 2012, p. 142.

³ See, e.g., John of Damascus (?), *Sacred Parallels*, ed. MIGNE 1857-1866, vol. 95, 1493, l. 53 (εὐρωτιώντα σῖτον).

⁴ See, Eustathius (?), *Commentary on the Hexameron*, ed. MIGNE 1857-1866, vol. 18, 792, ll. 26-27 (σάκκους ἄρτων ξηρῶν καὶ εὐρωτιώντων).

⁵ Euripides, *Ion*, 1393 (εὐρώς τ’ ἄπεστι πλεγμάτων).

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A FEW REMARKS ON THE RELATIONSHIP BETWEEN MATERIALS, TECHNOLOGY AND COLOUR EXPERIENCE IN ANCIENT GREECE

MARIA MICHELA SASSI

ABSTRACT · This paper begins with the observation that in ancient Greek literary and philosophical tradition as well as in painterly practice colour is perceived as pertaining to the nature of the object itself and almost being one with it. It then considers the relationship between Greek painterly practice and philosophical accounts of colour(s), arguing that the philosophers show a substantial lack of interest in the painters' practices. Dyeing technology also seems to be of little interest to colour theorists, who seem more focused on the visual effect of colours than on the behaviour of pigments and dyes. However, as I ultimately suggest with an anthropological turn of the discourse, referring to dyeing practices may be helpful to understand the intriguing predominance of the white/black/red triad both in the scientific explanations and in the Greek chromatic vocabulary.

KEYWORDS · Colour(s), Ancient Greek Painting, Ancient Greek Colour Theories, Ancient Greek Chromatic Vocabulary, Dyeing, Colour Symbolism.

1. INTRODUCTION

I WOULD like to begin with the famous fragment by the visionary poet and philosopher Empedocles of Akragas (*fl.* 450 BCE), who describes the combination and decomposition of the four natural elements by the forces of Love and Hate by means of a vivid analogy with the variegated work that painters do by using only a few pigments:

As when painters color many color-hued (*poikillosin*) sacrificial offerings,
Both men, by reason of their skill, very expert in their art (*amphi technēs*),
They grasp many-colored pigments (*poluchroa pharmaka*) in their hands,
Then, having mixed them in harmony, the ones more, the other less,
Out of these they compose forms similar to all things,
Creating trees, men, and women,
Wild beasts and birds, water-nourished fish,
And long-lived gods, the greatest in honors:

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In this way may your mind not succumb to the error that it is from elsewhere
[scil. than from the four elementary roots]

That comes the source of all the innumerable mortal things whose existence
is evident,

But know this exactly, once you have heard the word of a god

(Frg. 23 Diels-Kranz, Trans. Laks-Most).¹

This text offers some food for thought, starting with a consideration of the Greek term used to define the pigments: *pharmakon*. This term means both curative remedy and poison: therefore, a substance endowed with active power, and one that often comes along with enchanting songs.² One may find here a most enlightening indication of that material sense of colour that is the main feature of the chromatic experience throughout the ancient Mediterranean world – in fact, while I will focus in my paper on the Greek side of this topic, I will also make comparisons here and there with the cultures of the Ancient Near East insofar as my knowledge allows.

In the first section of my paper, I will observe that, as far as we understand, in the ancient Greek literary and philosophical tradition as well as in painterly practice colour is perceived as being inherent to the object and almost one with it. In the second section, I will address the relationship between Greek painterly practice and philosophical reflections on colour: I will argue that, in spite of Empedocles' attractive parallel between the mixing of elements in the cosmos and the painters' use of pigments, the ancient accounts on the emergence of all the colours from a limited set of basic hues reveal a substantial lack of interest in, and even rejection of, the painters' practices. Dyeing technology, too, garnered little interest from ancient colour theorists, with a few significant exceptions. However, as I will finally show in the third section, referring to dyeing practices may be extremely helpful to investigate the highly debated issue of the apparent restriction of the Greek colour vocabulary (and the theories on colour mixing) to a limited number of basic colours.

2. A PHENOMENON OF MATTER AND LIGHT

I will not dwell on the constantly flourishing research on Greek polychromy, except to bring to the fore what I believe to be the most sig-

¹ LAKS, MOST 2016, p. 403.

² Cf. FARAONE 2010 who comments on the passage in Plato's *Charmides* (156e-157a) where Socrates promises to cure the young man's headache by applying a *pharmakon* (in this case, a magic healing leaf) along with an incantation (Gr. *epode*, properly a 'melody of accompaniment').

nificant conclusion that can be drawn from the numberless technical reconstructions of the use of colour on the basis of preserved traces of pigments on stone and bronze sculptures, buildings, terracottas, and wall paintings. It cannot be underestimated that in recent decades we have been able to capture the ancient artists' search for a rich and vibrant chromatism capable of enhancing the emotional and symbolic associations evoked by the materiality of the painted object. This conclusion applies to the Archaic period, when a taste prevailed for strong colours (think for instance of the blue mane of the lion statue from Loutraki, ca. 550 BCE, at the Ny Carlsberg Glyptotek, Copenhagen), as well as to the Classical and Hellenistic periods, when the artists increasingly focused on chiaroscuro effects for the purpose of more naturalistic representations, thus gradually favouring the use of pastel colours (think of the Vergina frescoes) and gilding.¹ This search for brightness is similar to that found in other artistic cultures from the ancient Near East (e.g., the Mesopotamian one) to Mesoamerica (e.g., the Maya).² Here I would like to focus on the fact that in ancient Greece, just like in the other cultures mentioned, the same preference for the sensual dimension of brightness also exists in the colour vocabulary.

A brief look at the Homeric language will show that the description of the chromatic effect of an object goes hand in hand with the enhancement of the brightness of its surface, for example in the description of a beautiful woman's complexion, for which the adjective *leukos* is often used, which inevitably combines the connotation of white with a connotation of splendour (the term *leukos* comes from the same etymological root as the Latin *lux*). Even more significant is the case of an adjective such as *chruseos* (golden), directly formed on the name of gold (*chrusos*), which primarily evokes the precious matter of an object (be it an artifact or the hair of a god), but at the same time emphasises its impact on the eye of the internal observer – as well as on that of the ancient listener and of the modern reader. The combination of the haptic sense of texture and the impression of luminosity often occurs in the use of other adjectives derived from metal nouns such as *chalkeos* (bronze) and *argureos* (silver). One should add *kuaneos*, which indicates a dark blue with bright

¹ The contributions to this volume of Brecoulaki, Verri and Brinkmann, Koch-Brinkmann provide richly updated accounts of the technical difficulties of reconstructing the original colouring and problematize the conclusions that can be derived from it. See in general ROUVERET *et aliae* 2006; STAGER 2016; ØSTERGAARD 2018; BRINKMANN, KOCH-BRINKMANN 2020. For the Loutraki lion see above Brinkmann-Koch Brinkmann, p. 42; for the Vergina frescoes see above Rouveret, pp. 79-80.

² Cf., respectively, THAVAPALAN 2019a, esp. pp. 38-41, 119-122 and THAVAPALAN 2019b; HOUSTON *et alii* 2009.

reflections, derived from *kuanos*, a material not easy to identify.¹ All in all, the world of epics is a world of metals that are materials both for goldsmithery and sumptuous buildings (such as the doors of Alkinoos' palace in Hom. *Od.* 7.88) and for the construction of offensive and defensive weapons (bronze being the most important). These metals connote wealth and prestige through their sheen.²

These observations surround a problem with a long history, that is, the notion of colour among the ancient Greeks. This problem was first brought up by Johann Wolfgang von Goethe, who pointed out in his *Farbenlehre* (1810) the peculiar fluidity and oscillation of the Greek colour terminology. Goethe remarked, for example, that the area of yellow is not clearly delimited by red on one side and blue on the other, nor that of red by yellow and blue, while purple fluctuates between red and blue, tending sometimes to scarlet, others to violet. A few examples should suffice here. The term *xanthos* covers the most diverse shades of yellow, from the bright yellow of the blond hair of Homeric heroes to the reddish blaze of fire (Bacchylides, *Ep.* 3.56 and *Frg.* 4.65 Snell-Maehler). On the other hand, the meaning of *chloros*, etymologically linked to the name of the grass (*chloe*) and used to qualify the colour of plants (in this case with a nuance of freshness and brightness), can also touch on pale yellow (when describing the pallor dictated by emotion, as in the famous fragment of Sappho, 31.14 Lobel-Page), if not a brighter yellow, so much so that it often occurs from Homer onwards as an attribute of honey (which is *xanthon* in Simonides, fr. 593 Page). For red there is indeed *eruthros*, a term very specific and perhaps the only one in the Greek language that corresponds to a well-defined zone of the spectrum. But much more frequent are the adjectival formations of the root *phoinik-* (*phoinix*, *phoinikeos*, *phoinikoeis*) to designate a vivid red; these adjectives can trespass into the area of

¹ The high value assigned to objects made of *kuanos* in Homeric descriptions suggests that it was a rare material, such as the lapis lazuli stone, from which a deep blue pigment was produced. However, bright reflections might also be given off by objects of azurite or coloured with Egyptian blue, due to the presence of copper in both of these materials. There is archaeological evidence that Egyptian blue, called *ku-wa-no* in Linear B texts, was produced in Mycenaean Greece; it became much more abundant in later centuries throughout the Mediterranean area. Cf. HALLEUX 1969; THAVAPALAN 2019a, pp. 363-366. From a broader perspective, WARBURTON 2016 makes the important point that nouns of precious materials contributed to the emergence of abstract colour terminology based on texts from Mesopotamia, Egypt and Mycenaean Greece.

² SASSI 2014. Cf. GRAY 1954 for the in-depth historical reconstruction, based on rich archaeological documentation, of the availability of the different metals and of the relative processing techniques in the centuries preceding the composition of the poems (which took place at a time when silver and gold were rare imported products).

xanthos (so much so that we find *phoinissa* as an epithet of the flame in Pind. *Pyth.* 1.24), or they can indicate a darker hue when describing the blood shed from a wound (e. g., Hom. *Il.* 23.717), in an implied connection with the word *phonos*, which means killing. Dark red, on the other hand, is often indicated by the term *porphureos*, whose meaning (assuming a presence of blue) can extend to purple (and in this sense is synonymous with *halourghes*).

From an accurate analysis of linguistic usage Goethe acutely concluded that the Greeks had little interest in exact colour differentiation; a claim which he thought was confirmed by scientific accounts on the nature of colour and the colour range offered by Greek thinkers from the Presocratics onwards. In fact, the early Greek thinkers as well as Plato and Aristotle shared a pattern whereby all colours arise from the mixing of a limited set of primary colours; moreover, this set is determined by the opposites of white (*leukos*) and black (*melas*), which stand on the two poles of light and dark. This conception is at the antipodes of Newton's, who had demonstrated through his experiment with the prism that different colours (seven in number) are generated by the decomposition of the beam of white light according to different degrees of refraction that can be defined with mathematical precision (1671-1672). But Goethe sides with the ancients, as he fully shares their approach to colour vision as a global psychological experience; he even plays this approach against the abstraction of Newton's theory.

The second crucial stage of our story is hallmarked by William E. Gladstone, a great Homerist as well as a leading politician of his time. In a seminal chapter devoted to the chromatic landscape of the Homeric poems in his *Studies on Homer and the Homeric Age* (1858), Gladstone remarked a high frequency of black and white notations and, at the same time, of words that denote an imperfect discrimination of prismatic colours, as well as a strong sensitivity to light impressions. In particular, he denounced the vagueness of the designations of green and blue.

According to Gladstone the term *chloros*, with its connotation of fresh clearness, is not adequate to define the notion of green – this notion, in fact, is better conveyed by the prosaic word *prasinos* (leek-green, light green), which first appears in Plato's and Aristotle's accounts. Blue, on the other hand, is expressed either in a shade so dark as to be confused with black in the adjective *kuaneos*, or, in a lighter shade often indistinguishable from light green or grey, and often disturbingly gleaming, in the adjective *glaukos*. What is more, *glaukos* is used of a number of objects of the most disparate colours: olives, vine leaves, grass, and certain kinds of eyes which tend to see better at night like those of nocturnal ani-

mals, such as owls (*glaukes*): famously, *glaukopis* ('with light owl eyes') is the epithet of the goddess of war, Athena.¹

The absence of a term for pure blue to indicate the colour of the sea or sky in fine weather is the most problematic fact to emerge from Gladstone's survey. In Homer the sky may be large and wide (*Il.* 4.497, 3.364), starry (*Il.* 4.444), of iron or bronze (*Il.* 17.42, 15.329: an allusion, perhaps, to the shining fixity of the stars), but it is never blue. On the other hand, the adjectives of the sea, even when connected with chromatic sensations, do point to the shimmering (so *glaukos* in *Il.* 16.34) or the movement of the waves. The two connotations of light and movement merge, for example, in the epithet *porphureos* (*Il.* 1.482, 16.391, 21.326), in which the synesthetic effect is provided by the association with the verb *porphurein* ('to sway, to stir', cf. Gr. *phurein* and lat. *fervere*);² or in the epithet *oinops* (*Il.* 5.771 or *Od.* 1.183) which assigns to the sea the aspect of wine, in the sense that it shimmers and wavers like the wine poured into the large craters on the occasion of the symposium—in fact, the root *-op* alludes to the general visual impression rather than to the colour.³

All subsequent scholarship had to deal with these and other special features of the Homeric colour vocabulary, all the more so since numerous lexical overviews have demonstrated that the Homeric model came to characterise the language of Greek poetry (and not only that) throughout the Archaic and Classical periods and beyond. Of course one has to take into account the stylisation of literary tradition with respect to the ordinary language as well as the numberless ways in which the literary genre, the specific context and the author's subjectivity influence the choice of certain colour designations rather than others. Nevertheless, it seems undeniable that the enduring emphasis on brightness over hue must reflect a widespread sensitivity to glowing and shifting colours which is also attested by the data of polychromy.⁴

It is worth noting that, despite the convergence of his survey with Goethe's, Gladstone's conclusions run in the opposite direction. As a matter of fact, Gladstone finds the Greek chromatic lexicon *inadequate* with respect to Newton's classification of colours, which he takes as normative. Moreover, Gladstone claims that such inadequacy is due to the

¹ DEACY, VILLING 2002.

² FERRINI 1999-2000.

³ Cf. IRWIN 1974, pp. 28, 202-203.

⁴ IRWIN 1974; GRAND-CLÉMENT 2011; GRAND-CLÉMENT 2016. Of course, where technical precision was required, Greek writers were quite able to discriminate hues and nuances, and in describing them they creatively resorted to several compound terms and a wealth of prefixes and suffixes. This was the case with physicians, for whom colour was crucial in evaluating symptoms such as the aspect of the patient and the humours revealed in expectoration, urine, and evacuations: cf. e.g. VILLARD 2002.

ancient Greeks belonging to an evolutionary stage in which the retina was not fully developed and therefore was sensitive to brightness rather than to precise discrimination of hues. Of course, the idea that the physiology of visual perception has evolved in the history of mankind, which became extraordinarily popular in the positivist climate of the second half of the 19th century, is now fully outdated. During his time, however, Gladstone's diagnosis marked the beginning of a trend in scholarship focusing on the place of the Greek lexicalization of colours in the general framework of the development of world languages. I shall come back to this story later, as I prefer for now to develop the significant issue raised by Goethe about the ancient scientific theories on colours.

3. THEORY AND PRACTICE

On the whole, Greek philosophers too seem to assume the materiality of colour in their theories, seeing colour as an inherent property of things. In fact, as I argued a few years ago, one can attribute to them a 'pre-theoretical' concept of colour that coincides with that of our everyday experience, in which the colours of the objects around us offer us the most immediate means of orienting ourselves in the world.¹ This 'natural' concept of colour is clearly the opposite of the one developed in modern science and philosophy from Galileo onwards, which gained unbeatable strength from Newton's discovery; according to the latter concept, colour is a secondary quality, *i.e.* a mere product of our perceptive activity, variable from subject to subject.

It is worth noting that in the last few decades a rich and sophisticated debate has arisen in what has become a veritable branch of philosophy, the philosophy of colour, between defenders of the subjective nature of colour and supporters of its inherence to objects; furthermore, and significantly for our purposes here, scholars in the latter group sometimes like to engage with theoretical stances held by Greek philosophers, such as Empedocles and Aristotle.² Yet I prefer here to focus on the issue of the Greek theorists' identification of primary colours, that is to say those from whose mixing all other colours are derived. One might expect that they selected as primary colours red, yellow and blue, by analogy with what is to us the most obvious experience of processing pigments: namely, while red, yellow and blue can be obtained without mixing other pigments, all the colours of the spectrum can be obtained from variously combining them (yellow + red = orange, yellow + blue = green, blue + red = violet). We learn instead from Theo-

¹ SASSI 2009.

² SASSI 2022.

phrastus' writing *On the Senses* that Empedocles identified white and black as simple colours corresponding perhaps to the elements fire and water, respectively,¹ while Democritus, who traced the chromatic variety to the refraction of light through different atomic aggregations on the surface of things, extended the list to red and *chloron* (a green that is certainly lighter and brighter than *prasinon*, the latter being included by Democritus among the secondary colours: Theophr. *De sens.* 73-78, in 68 A 125 Diels-Kranz). According to Plato in *Timaeus*, the basic colours are white, black, red and bright (*lampron*, *Tim.* 68a).² It may not be surprising that white and black play a prominent role in these accounts, as they correspond to the intuitively important principles of light and darkness. Nevertheless, it is certainly striking that the more extended lists of basic colours found in Democritus and Plato include red plus either *chloron* or *lampron*, but not the pure blue that was ubiquitous in the painting practice of the time.

Aristotle's explanation of colours moves along similar albeit more articulate lines. He still highlights the basic polarity of black and white, which combine to produce a series of distinct colours according to the various proportions of light (*leukon/xanthon*) and dark (*melan/phaion*) in the mixture: red (*phoinikoun*), green (*prasinon*), dark blue (*kuanoun*), violet – clearly ordered on a scale of increasing darkness (*halourgon*; Aristot. *De sensu* 4.442a20-25). His account of the rainbow in Book 3 of *Meteorology* is consistent with this notion. In it, Aristotle explains the rainbow as a reflection of our sight (which moves as a sort of straight line) from the cloud of air condensed in minute rain drops and thus working as a mirror for the sun at the other end; therefore the three colours seen in the rainbow, namely red (*phoinikoun*), green (*prasinon*) and violet (*halourgon*), are due to the brightness of the sun being weakened as it is reflected through moister (*i. e.* darker) parts of the cloud (*Meteor.* 3.4, see esp. 374b 25-35).

I would like to address at this point the issue of the relation between theory and practice of colours in ancient Greece. At the start of his account of the meteorological phenomena caused by reflection, including halos, mock suns and rods, Aristotle had noted, interestingly but obscurely, that “precisely” (*hapē*) red, green and violet are “more or less” (*schēdon*) the only colours painters do not produce by mixing pigments (*Meteor.* 3.2, 372a 5-9). If it is understood here that the painters have “more or less just” red, green and violet available in their natural state, here Aristotle aims to find confirmation in the painting practice of the

¹ As it has been carefully demonstrated by IERODIAKONOU 2005a.

² Cf. IERODIAKONOU 2005b.

above colors' special status within the range of intermediate colours.¹ However, that "more or less" shows that Aristotle is all but sure about the kinds of pigments the painters might consider to be fundamental in their practice. As a matter of fact, ancient Greek painters do not seem to have had a notion of 'primary colours' in the same way that red, blue and yellow would emerge in the practice of mixing pigments from the late Middle Ages onwards. Greek painters had plenty of pigments – red, green, violet as well as yellow and blue – obtained from processing both organic and inorganic substances.² Moreover, according to a widespread view, painters from Antiquity to the early Middle Ages did not even work the colours on a palette, but applied them directly onto the material support by juxtaposing and/or overlapping the pigments rather than mixing them.³ In fact, the ever growing evidence offered by archaeological research is bringing to light a variety of traditions which make such generalisations about execution techniques extremely fragile.⁴ Be that as it may, it remains that direct observation and/or description of painterly practice did not have any influence on Greek colour theories. The philosophers preferred to think about the overall visual impression of coloured objects generally assuming that brightness is essentially provided by white, that a warm glow stems from red, and perhaps that there is a

¹ My tentative reading of this passage, based on emphasizing the meaning of *haper* and *shedon*, is different from another, more widespread interpretation according to which Aristotle aims at emphasising that painters are not able to obtain the 'nobler', natural colours of the rainbow by mixing their pigments (GAGE 1993, pp. 31-32; SHAPIRO 1994, p. 603). Not by chance Alexander of Aphrodisias, who embraces this interpretation, is clearly embarrassed in defending Aristotle's statement. For Alexander is aware that *phoinikoun*, *prasinon* and *halourges* are natural (*autophueis*) colours respectively obtained from cinnabar (*kinnabari*) or dragon's blood (*drakontion*), malachite (*chrusokolla*), and *ostreion*; hence he is committed to let Aristotle say that those same hues, when painters try to produce them artificially (*skeuasta*) by mixing other pigments, are worse than the natural, brighter ones (Alex. Aphr. In Arist. Mete. p. 161, ll. 1-15 Hayduck).

² Cf. KAKOULLI 2009.

³ Cf. SHAPIRO 1994, esp. pp. 606 ff., mentioning John Gage's research.

⁴ I am grateful to Hariclia Brecoulaki for raising this point in the discussion that followed my paper at the conference as well as to Giovanni Verri for clarifying it to me *per litteram*. Brecoulaki and Verri's contribution to this volume too should be considered in this regard. Among other things, the very passage of Alexander of Aphrodisias mentioned at n. 1 above seems to prove that mixing 'our' primary colours was common painting practice at least in the 2nd century AD. For he says that red (*phoinikoun*) can be produced by mixing talc (*koupholithos*) and purple (*porphureos*), green (*prasinon*) from deep blue (*kuanoun*) plus yellow (*ochron*), violet (*halourgon*) from deep blue (*kuanoun*) plus red (*phoinikoun*; Alex. Aphr. In Arist. Mete. p. 161, ll. 5 ff. Hayduck). What is more, Alexander rightly observes the phenomenon nowadays known as 'subtractive synthesis', i.e., that with the kinds of mixing he mentions comes an increasing loss of brightness.

shade of blue in black – remember that the prized colour named *kuaneon* indicates a shimmering dark blue.¹

It seems worthwhile now to consider some statements more or less explicitly directed against painting practice. Plato refuses in the *Timaeus* to define the dosing of the ingredients of a certain colour when explaining the production of *xanthon* from mixing unspecified quantities of *lampron*, *eruthron*, *leukon*, and similarly for the production of *kuanoun* from the addition of *lampron* to *leukon* and *melan* (*Tim.* 68b, 68c). Aristotle, too, does not specify the proportions in which black and white come together in the different colours, limiting himself to generically distinguishing those with the most pleasant effect (such as *halourgon* and *phoinikoun*), the result of a simple numerical ratio, from those in which the ratio is not determined (*De sensu* 3, 439b 30, cf. 440a 13, b 18).² Aristotle also refuses to explain chromatic phenomena by the model of the superimposition of colours, which he finds both in the practice of painters and in certain meteorological phenomena. He says that painters, in order to represent an object far away, lay one colour on top of a more vivid one, just as the sun, which is *leukos* in itself, appears red when seen through fog or smoke. Aristotle prefers instead to think that in remote vision a complete fusion of black and white takes place (*De sensu* 3.440a 7, a 31, b 1).

Evidence of the philosophers' reluctance to look at the painters' practice may be provided *e contrario* by the fact that Democritus seems to have drawn some of his observations from the field of metallurgy – which sounds like a confirmation of the social relevance of metal creations, whose preciousness was enhanced by the material's chromatic effects.³ Theophrastus reports that he traced back the quality of redness to the same kind of atoms as heat, *viz.* spherical, but larger, taking as proof the fact that we become red when we are heated, as do other things when they are inflamed, and, more interestingly from this angle, that iron turns red when it is brought to incandescence (Theophr. *De sens.* 75). Furthermore, Democritus believed that «golden and copper-colour and all such tones ... come from white and red, their brilliance being derived from the white (*leukon*)», and the «most beautiful colour» results by adding small concretions of *chloron* (light green) to a metallic colour (*De sens.*

¹ I prefer to explain the philosophers' stance by their lack of epistemological interest in the practice of pigments rather than by a supposed secrecy of painters' ateliers. That there was no such secrecy is demonstrated by Eva Keuls' enlightening study of technical vocabulary and metaphors of painting vastly displayed in Plato's dialogues (KEULS 1978) – not to mention, when it comes to (much) later periods, Alexander's passage cited above, p. 145 nn. 1 and 4.

² Cf. SORABJI 1989.

³ Cf. *supra*, pp. 139-140. Another, later, witness of such relevance is Pausanias (cf. JOCKEY 2020, esp. pp. 133-142), but examples could multiply.

75). Such a remark might hint to a process in which some sulphurous solution or compound was used, as the atomist explains *prasinon* (leek green) as a compound of *chloron* and *porphuroeides* (composed on its turn of white, black and red) and specifies that sulphur colour (*to...theion*) is «of this character with a dash of brilliance» (*De sens.* 77).¹

Democritus shows indeed a significant propensity for empirical observation, which he might have extended to the field of dyeing. As a matter of fact, Theophrastus attributes to him the notion that woad blue (*isatis*), a colour produced from a plant with this name (Lat. *Isatis tinctoria*) is a mixture of deep black (for the most part) and green, and leek green is in turn a mixture of purple and woad blue (*De sens.* 77). However, it is unclear whether Democritus might have ever seen green tones to emerge in the course of a production process of the woad hue, or the other way around. Anyway, whatever the accuracy of his remarks on this specific point, Democritus was alone, or almost, in his attempt (albeit hesitant) to base his account on experimental knowledge.²

On one hand, the generalized reluctance to take into account not only painting but also dyeing practices is part of the anti-experimental tendency of ancient science.³ On the other hand, and more specifically, I believe that colouration techniques are outside the horizon of the theorists because painting as well as dyeing are aimed at imposing colour *over* things; on the contrary, the philosophers, while being variously sensitive to the aesthetic effect of coloured artefacts, are more interested in *natural* colours, namely, in those which convey the essence of things.

I would be tempted to suggest, if anything, that there is a not accidental correspondence between the three colours most often cited by philosophers as basic (white, black and red) and those most used in vase painting in the Archaic and Classical periods.⁴ Not only was vase painting present in the daily life of the Greeks much more pervasively than sculptures or monumental decoration; but one may also surmise that the red of the terra cotta that stands out in both white-figure and black-figure pottery could be perceived as more 'natural'. I mention this hypothesis, albeit

¹ For this hypothesis, admittedly speculative, cfr. SASSI 2014. Theophrastus' translations are from STRATTON 1917.

² While Empedocles seems to have paid attention both to melting metals (fr. 92 Diels-Kranz) and mixing dyes (fr. 93), the lack of the original context prevents us from inferring anything further. The Peripatetic treatise *De coloribus*, in accordance with its empirical approach, often and extensively refers to dyeing processes, but for the sole purpose of highlighting the porous structure of the dyed objects and the continual changing of colours in nature ([Aristot.] *Col.* 793a 23-b2, 794a 16-b 11, 795b 10-21, 797a 2-8).

³ On the crucial issue of the role of experiments in ancient Greece, cf. at least the seminal essay by LLOYD 1964.

⁴ See the overview provided by WEHGARTNER 2002.

speculatively, because I am about to tackle the last question I stated at the beginning, namely, the relevance of the white/black/red triad in the Greek (and not only Greek) chromatic vocabulary.

4. WHITE, BLACK AND RED EVERYWHERE: YET HOW, SPECIFICALLY?

In order to fully understand the Greek experience of colour, it is crucial to go back to the issue of chromatic vocabulary. In section 1, I remarked that throughout ancient Greek poetry colour descriptions aim to emphasize brightness (a feature shared with ancient polychromy) rather than to distinguish precise hues. Moreover, the areas in which most colour terms are concentrated in the Homeric poems are those of white, red and black, which continue to be dominant even as the lexicon becomes increasingly richer throughout the literary tradition with the addition of nuances in the areas of yellow, green and blue. In section 2, we saw that Greek colour theories share both the emphasis on luminosity and the limitation of the colour palette, whereas the painters' search for luminous effects is accompanied by an increasingly broad and free use of pigments. As it has been noted in other ancient cultures as well, there is often a contrast between the simplicity of the linguistic/cognitive code and the richness and variety of painterly practice. The latter can be explained in terms of aesthetic needs varying according to the fruition contexts, the changing styles and the material history of pigment production.¹ What happens in the languages is more obscure; let us therefore reprise the history of scholarship on colour terms where we left it.

From Gladstone onwards, the problem of the Greek chromatic lexicon has been the subject of constant interest of scholars, both classicists and non-classicists, within the broader framework of the discussion on the development of language in general and its relation to knowledge. Within this framework, two fundamental directions can be distinguished for the sake of simplicity. On the one hand, in the field of linguistics, it has been argued that the classification of colours in all human societies has evolved from the linguistic expression of a few basic colours (universally assumed) towards progressively broader lists – the Greeks and other ancient cultures, but also traditional societies, would represent a 'primitive' stage, if no longer from the perceptual point of view, at least from the linguistic-cognitive point of view. On the other hand, the irreducible diversity of the ways in which each specific culture frames the

¹ BAINES 1985 makes this fundamental point for ancient Egyptian colour terminology and believes that it must also apply to other non-industrialized societies. His words, «color is more easily painted than talked about» (p. 289), can certainly be true for ancient Greece as well.

world of experience has been insisted upon, especially when it comes to colour taxonomies around the world.¹

While this second, relativistic model prevailed in the first half of the 20th century at the same time as the newborn anthropological science was flourishing, it was challenged around the half of the century in the linguists' perspective. I am referring to the book *Basic Color Terms* by Berlin and Kay (1968), who reaffirmed the notion that the naming of colours follows a universally valid evolutionary pattern from a small number of basic terms (that can be translated across languages). Berlin and Kay relied on their analysis of 98 languages: for twenty or so languages on first-hand information from native speakers living in the San Francisco area, for the rest on published sources or communications from linguists, ethnologists, or scholars of ancient languages. They thus reconstructed a series of eleven basic colour categories from which in each language derive eleven terms (or fewer), which appear according to a temporal sequence, necessary and common to all societies, articulated in seven stages. The first stage (present in all languages) sees the emergence of white and black; in the second, red appears; in the third, green or yellow; in the fourth, the term green or yellow, whichever of the two was missing in the previous stage; in the fifth, blue appears; in the sixth comes brown; in the seventh, in no particular order, finally violet, pink, orange and grey appear.

In all languages, in other words, the starting point would be represented by the distinction between light and darkness (which verbalises the most elementary physiological response to the luminous stimulus), followed by the identification of the different colours, starting from red, according to decreasing degrees of visual impact, or salience, and, correspondingly, of an increasing distinction between hues. The last stage, represented in the survey by the situation of contemporary English, is that reached in a fully industrialised society in which the artificial production of colours, fuelled by the demands of fashion or advertising design, has gone hand in hand with the development of colorimetric systems capable of covering an ever wider range of colours, often distinguished by a trademark – think of the particular 'blue' trademarked by Tiffany, which thanks to this association has become synonymous with luxury and elegance.

As a matter of fact, Berlin and Kay were grossly mistaken about the Greek lexicon, since they limited themselves to the Homeric language, with no first-hand knowledge of ancient Greek. Thus they placed Homeric Greek in the third stage, characterised by four basic colours (white, black, red, yellow), because they mistook *chloros* for yellow; moreover, they placed terms such as *porphyreos* or *polios*, well present in Homer, in

¹ LLOYD 2007.

the last stage of their development scheme. However, as I have repeatedly noted, the vocabulary of archaic and classical Greek does indeed tend to favour a limited number of colours, and the hypothesis that this has to do with the greater salience of certain colours rather than others deserves attention. More generally, Berlin and Kay's book, after an initial phase in which it provoked strong negative reactions from anthropologists advocating cultural relativism, initiated a new phase of studies, be they linguistic, linguistic-anthropological, or philological, in which the evolutionary hypothesis has been thoroughly put to the test.

Among other things, as far as ancient languages are concerned, the prominence of the white/black/red triad has been reiterated not only for Greek, but also for Indo-European languages such as Sanskrit, Ancient Egyptian, and Akkadian.¹ But here it is worth dwelling above all on the thoughts of anthropologists, who more often than not provide scholars of the ancient world with the most valuable tools. In fact, it was Marshall Sahlins (1976) who finally admitted that the linguistic definition of a hue tends to be determined in every culture by the saliency of the colour, namely, by its capacity to catch visual attention. This would explain why red, the most salient colour, is generally the first to be defined as hue, followed by yellow, green, and, less often blue; on the contrary, green and blue, being less salient colours, are usually perceived for their brightness before being (slowly) focused as hues.

Sahlins, on the other hand, tempered this universalistic statement with a relativistic reminder when he noted that the emotional, social, religious associations of white, black and red indeed change from one civilisation to another. Let us now take for example the survey of the Ndembu society (Central Africa) in Victor Turner's seminal book *The Forest of Symbols* (1967), whose chapter 3 is devoted to *Color Classification in Ndembu Ritual*. Turner first remarks that white, red and black are colours for which the Ndembu possess primary terms and that «blue cloth ... is described as "black" cloth, and yellow and orange objects are lumped together as "red"». ² Then he infers from their presence in initiations and life-crisis rites a chain of symbolical associations of white to milk and semen (perceived as vital fluids of maternal and paternal origin, respectively), red to blood (whose meaning is ambivalent in relation to life and death), black to earth (linked to death). Dominique Zahan (1974) explained the dominance of the white/black/red triad among the Bam-

¹ Cf., respectively, SHIELDS 1979; BAINES 1985; THAVAPALAN 2019a; add at least SCHOLEM 1974 for the Torah and Talmud (where, remarkably, blue, *tekhelet*, appears with equal importance); BOLTON 1978 for modern Southern Peru; WARBURTON 2002 for ancient Egypt; KEYSER 2018 for a general survey in the perspective of the history of alchemy.

² TURNER 1967, p. 60.

bara of the Niger valley and the Mbay of Chad in terms partially different, but equally significant to us. On the one hand, he traced this dominance back to the ease with which black and white are extracted from the earth, while red is linked to metal forging or plant extracts. On the other hand, he observed that the energy of these colours, when released and materialised in dyed clothes, is able to create a social code. In this picture, white connotes joy, black sadness, and red (because of its rarity) the authority of the tribe chief, the only one worthy of wearing garments the colour of blood, the liquid that brings life but is also spilled in war.

On the basis of this comparison, let us now turn to the Greek world. First, we can observe that the symbolic associations conveyed by the triad are different: white and black are linked to life and death, respectively, thanks to connection of light to life and darkness to death that is characteristic of the cultures of the ancient Mediterranean area; moreover, blood is often characterised as dark red (e.g., *phoinikoun*, *porphureon*) or black (*melan*) because of its close link with death – the fact that terms denoting red can shift into black is a further example of the fluidity of the Greek chromatic vocabulary.¹ However, Zahan's study can provide us with a helpful indication of how the particular perceptual salience of a colour can be enhanced by the material mode of production and the various symbolic values it can evoke. Particularly enlightening is the case of the adjective *porphureos*, a term closely linked to the idea of movement (*porphurein*),² but also to a specific dyeing material (purple or *porphura*, a Phoenician discovery soon transplanted in Greece), adaptable to a wide range of shades of red, capable of extending into the blue zone (when used for the luminous reflections of the sea wave) up to and including violet – a category that we would expect, according to Berlin-Kay's scheme, only at a final stage. Therefore, the broad range of nuances covered by the term *porphureos* is not a fact of generic indefiniteness. Its polysemy is instead linked to the technology of purple production in the ancient world: several dyes, from yellow to scarlet red to blue-violet, could be obtained from the juice secreted by several species of murex, mixing them in various ways and stopping the process of photochemical exposure (or eventual

¹ GRAND-CLÉMENT 2016 has an excellent chapter on the 'symbolic triad' (pp. 342-395; on blood colours, pp. 349-352); specifically on the emotional value of colours in ritual contexts, cf. GRAND-CLÉMENT 2020.

² Cf. *supra*, p. 142. The paper by GAMBASH, PESTARINO, FRIESEM in «Technai», 13, 2022, offers a fresh examination of the production and diffusion of purple dyeing throughout ancient Mediterranean. Notice in particular (p. 95) that traces of purple probably belonging to the robe of the deceased have been found in a 2nd-millenium BCE tomb in Cyprus. Cf. also BRØNS, DROß 2018 on the significance and diffusion of purple garments in the Mediterranean world from the 4th century BC to the 4th century AD. On purple garments as status symbol in the Oriental world since 1500 BCE, see BOGENSPERGER 2015.

boiling) at certain points. The frequency with which the term occurs in archaic and classical poetry and its connotations of preciousness can also be explained in this connexion: purple was a particularly precious colour, especially in the darker varieties, obtained from undiluted juice, of which a single mollusc provided very few drops. A rich network of symbolic values has grown out of these 'infrastructural' conditions. The adjective *porphyreos*, in that shade of dark red that well describes the colour of blood (Il. 17.360 f.) or death (e.g., Il. 5.83), is also suitable for expressing the fear aroused by contact with the powers of the underworld: purple, disturbingly, is the carpet that Clytemnestra spreads before his spouse, the king Agamemnon, returning from the Trojan war just to find death by his wife in his luxurious mansion (Aesch. Ag. 910, cf. 957 and 959).¹

We can finally conclude that dyeing technology was already advanced enough in Greek culture to produce the nomenclatorial complexity that is only proper to modern industrialised societies according to Berlin and Kay's model. These observations would be enough for us to treat as mere 'fast lanes' what Berlin and Kay conceive of as rigidly consequential phases in every culture. An objection to my argument could be that these terms remain linked to the material of production and therefore do not reach the level of abstraction that allows them to be defined 'basic'.² I would reply that precisely on this point the chromatic experience of the Greeks (as well as that of the Babylonians and the Egyptians) shows that it cannot be mapped onto Berlin&Kay's grid.³ Too varied are the symbolic and aesthetic associations with which colours are loaded in the world of the Greeks, inhabited by statues and monuments and brightly coloured garments and vases, for them to ever be willing to detach themselves from a natural, concrete concept of colour.

I am pleased that my conclusions resonate with what Shiyanthi Thavapalan highlighted in the opening chapter of these proceedings: that is, the Greek case confirms that in the ancient classical world, just as in all traditional societies, cultural practices shape the symbolic associations and thus the vocabulary and the science of colours.

★

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¹ GRAND-CLÉMENT 2016, pp. 328-339; GRAND-CLÉMENT 2020, pp. 248-254.

² This is the objection ONIGA 2007 addressed to the stance I took *contra* Berlin and Kay in SASSI 1994. For a comprehensive and balanced assessment of the BK hypothesis, cf. LYONS 1995.

³ Cf. MC NEILL 1972; CONKLIN 1973.

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