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3 The Development of the Iconography of the Laboratory

In the preceding chapters, we focused on the equipment of alchemical laboratories dedicated to the transmutation of metals or production of iatrochemical medicines. The equipment of these laboratories largely overlapped with what one would expect in the workshops of related activities (in the sense of the technologies used, not the goal of production), such as those of assayers or metallurgists, artistic craftworkers, apothecaries, or distillers.

In terms of basic items, the equipment of laboratories was fairly stable, and the development of basic techniques was only gradual.⁶⁷⁴ What evolved were specific types of furnaces, ovens, apparatuses, and vessels.⁶⁷⁵ Some became obsolete and disappeared from laboratories, because the processes for which they were used became uninteresting or easier methods were found. One such example is *kerotakis*, which in Hellenistic alchemy was used for the superficial colouring of metals undertaken as part of the supposed production of the Philosophers' Stone.⁶⁷⁶

According to Sabine Krifka, the stability of laboratory equipment is apparent from the copperplate engraving *Laboratoire dans le Jardin Royale des Plantes* by Sébastien Leclerc I

(1637–1714):⁶⁷⁷ while the interior of the room, with a view of a garden, radically differs from earlier images of a dark and enclosed laboratory (Fig. 236), the technical equipment shows no significant change.⁶⁷⁸ Marco Beretta has made much the same observation regarding the chemical laboratory depicted in the third volume of *l'Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers* (Paris 1763) (Fig. 237):

‘The illustration of a laboratory published in the *Encyclopédie* was undoubtedly a step forward in the form of representation, but the instruments, furnaces, and vessels therein represented were identical to those used in an alchemical laboratory more than two centuries earlier.’⁶⁷⁹

The area of most pronounced change was that of distillation, a crucial laboratory process⁶⁸⁰ that can serve to illustrate some milestones in the development of laboratory techniques. The starting point for the method consisted in one key finding, i.e. the realisation that when a liquid boils, what precipitates on the lid of the vessel is water, not a sample of the entire content of the liquid. The crucial precondition for the technology was the existence of ceramic vessels. Once this principle was known, there

674 Holmes and Levere (2000), p. XI. The ‘changelessness’ of alchemical equipment has also been remarked upon by Schütt (2000), pp. 296–297, and Moureau and Thomas (2022), p. 47.

675 Cf. chapter 2.3.2 Furnaces and Ovens, p. 132.

676 For further detail, see Schütt (2000), p. 19; for one of the most likely reconstructions, see Sherwood Taylor (1976), p. 48. See also Martelli (2011), pp. 291–308.

677 On Leclerc, see Préaud (1983), pp. 73–81.

678 Krifka (2000), pp. 761–762. We also see here a group of scholars who sit and debate around a table, which contrasts with the solitary research of alchemists.

679 Beretta (2000), p. 65.

680 See Forbes (1948).



236. Sébastien Leclerc I (1637–1714), *Laboratory in the Royal Botanical Gardens*, 10 × 24.5 cm, The MET, New York, 41.44.1613.

was a long period of incremental improvement, which came faster in Hellenistic alchemy when it seemed that laboratory investigation might be able to answer questions regarding the composition of matter.⁶⁸¹ The next important milestone came with the discovery of the distillation of alcohol from wine in the mid-12th century, when the earlier apparatus was also improved by the addition of a water cooler. Then came the discovery of nitric acid and *aqua regia* in the early 14th century, which led to a more advanced analytical method (quartation) and a significant broadening of the range of salts that could be prepared. The fact that *aqua regia* can dissolve gold, which had earlier been viewed as ‘immortal’ because it was not affected by common reaction methods, had also a major impact on alchemical thinking. The production of both these acids required a higher quality of materials used for laboratory equipment, and this led to the development of various versions of apparatuses and furnaces⁶⁸² able to produce more fractions of distillate. This required, for

681 For a simplified scheme of development of distillation apparatus, see Sherwood Taylor (1976), p. 45.

682 Taape (2022), pp. 141–169.

example, multiplying the number of differently modified distillation heads and their coolers – thus, we gradually encounter more complex apparatus. Still, there was no change in the main components of a distillation apparatus: a furnace, bath, distillation vessel (cucurbit), still-head (alembic), and receiving vessel. The basic element was an alembic,⁶⁸³ which in its simplest form with one spout⁶⁸⁴ is seen in illustrations that reveal no significant changes from medieval times until late in the 18th century.

Advance in technologies of metal smelting and assaying was linked to experimentation that required the application of high temperatures in a systematic and controllable way, and there were improvements connected with the use of newly discovered mineral acids and fluxes. All this required highly resistant crucibles, because without them such work could not be conducted.⁶⁸⁵ Glassmaking also under-

683 The term ‘alembic’ over time came to designate the whole distillation apparatus; see Thomas and Moureau (2022), p. 65.

684 There also existed alembics with two or three spouts; see chapter 1.2 Alchemy and Its History, p. 24.

685 Crucibles from Hesse were highly valued. They



237. Benoit Louis Prévost (1735–1804) and Louis-Jacques Goussier (1722–1799), 'Chemical Laboratory', 39.3 × 25.7 cm. Denis Diderot and Jean Le Rond d'Alembert, *L'Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers*, vol. III.

went a major shift; while in Roman times glass had one general chemical composition, the Middle Ages and early modern period saw the development of many different types of glass composition, including glass with different geographical origins.⁶⁸⁶

In this chapter we shall focus on the equipment of alchemical laboratories from the perspective of changes in the ways in which they were depicted. In this context it should be borne in mind that depictions could have both an instructive and descriptive potential. The ways in which laboratories were represented determined the instructive and documentary potential of such images, which depended not just on artistic quality but also on their relationship to the text in which they occurred. Synergy between text and image was an important advance in all areas of the application of pictures and their reproduction in print as an instrument of education. In the medieval

were produced in the same manner for several centuries; see Martín-Torrés (2007), pp. 161–162.
686 Burnett, Calvet, and Bayley (2022), p. 112.

period, images of the equipment of laboratories were confined almost exclusively to alchemical manuscripts, but book printing brought about crucial change. Laboratory equipment first found its way into printed books about distillation, editions of Pseudo-Geber's works, and subsequently, on a much higher level, into the literature on mining and assaying by three key authors: Biringuccio, Agricola, and Ercker. Later medical and alchemical works by other authors often drew on these.

Depictions of alchemical laboratories, and of the equipment itself, thus overlapped with those that documented equipment used in related areas of activity. At the same time, however, they were an integral element of the complex historical phenomenon of alchemical iconography as part of the history of natural sciences and visual culture of the medieval and early modern periods in the western world. The development of the depiction of alchemical laboratories must therefore be situated in this primary context and then compared with the more general development of technical illustrations at the time.

3.1 An Overview of Alchemical Iconography

Alchemical iconography refers to a specific mode of instructional transmission of ideas concerning natural sciences, philosophy, and medicine, in which the emphasis was usually on the meaning (i.e. the content), while the formal and artistic aspects were secondary. This iconography was an important part of alchemical literature not so much by its quantity as by its originality.⁶⁸⁷ The study of alchemical iconography was pioneered in the 1930s by Gustav Friedrich Hartlaub,⁶⁸⁸ but focused works on the subject began to appear during the 1960s, with the important contributions of Jacques Van Lennep,⁶⁸⁹ Barbara Obrist,⁶⁹⁰ Lyndy Abraham,⁶⁹¹ and Jorg Völlnagel.⁶⁹² Important collections of iconographic material are also to be found in the books of Stanislas Klossowski de Rola⁶⁹³ and Arthur Greenberg.⁶⁹⁴ In the past four decades, a large number of studies have focused on iconography in the works of Heinrich Khunrath, Michael Maier, George Ripley, and many others.⁶⁹⁵

687 As Marco Beretta emphasises, this was an aspect in which alchemy was clearly different from the emerging chemistry, which was poor in imagery: 'In the history of chemistry, depictions of locations of experimentation have never been as rich as in the 17th century.' Beretta (2000), p. 57.

688 A collected edition of his studies, see Hartlaub (1991).

689 Van Lennep (1965, 1966, 1985).

690 Obrist (1982, 2003, 2007).

691 Abraham (1998).

692 Völlnagel (2004, 2012).

693 Klossowski de Rola (1997a, 1997b).

694 Greenberg (2007).

695 To list just a selection of works, let us mention Peter Forshaw's studies on Khunrath, Jennifer M. Rampling's work on George Ripley, a commented edition of Michael Maier's *Atalanta fugiens* edited by Tara Nummedal and Donna Bilak (<https://furnaceandfugue.org>, accessed 10 October 2022), and the project *Matthäus Merian d.Ä. und die*

Historians have so far reached no agreement on the typology of alchemical iconography, but the suggestions that have been made do not differ much in principle. Mino Gabriele suggests a division into three categories: technical drawings of laboratory equipment, geometrical compositions including various tables and schemes, and finally figurative allegorical and symbolic compositions.⁶⁹⁶ Jennifer Rampling has also formulated a threefold division, but one that is somewhat differently conceived. In her first category, she includes technical drawings of laboratory equipment, in the second alchemical images *sensu proprio*, i.e. those that clarify or evoke various aspects of the 'art' (from simple schemes all the way to complicated figural depictions), and in the third category, she places 'depictions of alchemy' that describe alchemical practice but need not be the work of alchemists (for instance, a wide range of Dutch and Flemish genre paintings). The boundaries between these categories are naturally not set in stone.⁶⁹⁷ A similar division, but with one additional category, has been proposed by Sven Limbeck, who speaks of 1) technical drawings, 2) diagrams, 3) portraits, and 4) allegories.⁶⁹⁸ Peter Forshaw distinguishes six categories of alchemical iconography: 1) illustrations of laboratory equipment (furnaces, vessels); 2. bestiary (dragons, lions, frogs, birds); 3. religious analogies (the passion and resurrection of Christ, coronation of the Virgin Mary, and Adam and Eve); 4. mythological analogies (such as Apollo and Diana, Venus and Mars, Vulcan); 5. geometric diagrams; and 6. glyphs or *notae* depicting cosmic principles (e.g. the four elements) or

Bebilderung der Alchemie um 1600, edited by Berit Wagner (<https://merian-alchemie.ub.uni-frankfurt.de>, accessed 10 October 2022). For recent synthetic studies on alchemical iconography, see Rampling (2022) and Bilak (2022).

696 Gabriele (1997), pp. 29–33.

697 Rampling (2022), pp. 150–151.

698 Limbeck (2014), p. 239.

alchemical substances and processes.⁶⁹⁹ This division differs from the previous ones in dividing figural depictions into three separate categories and adding a separate category of alchemical signs. Of all the approaches to classification outlined above, the closest to ours is the system proposed by Mino Gabriele. Here we shall not go into the issue of depictions of alchemical workshops as part of genre painting, because that is dealt with in a separate section.⁷⁰⁰ At this point, we shall focus only on images created within the alchemical context.

The threefold division of alchemical images is closely linked to their semantic character, which is associated with different strategies for sharing and transferring the knowledge presented in those depictions. In principle, the first class of images are those supposed to impart information to the reader by a direct visual message concerning the depicted object. This was often the case with alchemical furnaces, vessels, and instruments, where the visual impression made by the object was not supposed to differ between the author of the drawing and the reader, and the subject of the drawing referred only to itself. This type of illustration was the most frequent type of depiction in alchemical manuscripts, ranging in size from small diagrams inserted into the text or in the margins all the way to pictures taking up the larger part of a page.

A semantically more complex class consisted of geometric schemes, often filled with or supplemented by text, which on varying levels of abstraction were supposed to evoke in the reader's mind a significantly wider range of meanings and interactions.⁷⁰¹ Typical examples of this category are what were

known as *rotae*, i.e. compositions consisting of medallions grouped in a circle and related to a central motif or grouped in concentric circles. Some of these followed up on early medieval models, for instance from the *Etymologiae* of Isidor of Seville.⁷⁰²

In contrast to drawings of alchemical equipment, which were related almost exclusively to laboratory practice, these schemes dealt above all with alchemical principles, the conditions of alchemical work, the substances it used, and correct methods. In the Platonic sense, these geometric figures expressed the mathematical laws in accordance with which the cosmos had been constructed. This made such images valuable objects of intellectual contemplation.

One can find both these categories of image in related types of technical literature and in the literature on natural sciences, while the third category of alchemical images, i.e. the figural allegorical and symbolic depictions, are specific to alchemical iconography.⁷⁰³ Allegorical or symbolic images can certainly be found in abundance in other contemporary manuscripts, but the alchemical ones differ in their level of inventiveness and often their bizarre quality. They were a medium in which alchemical procedures could be dramatized.⁷⁰⁴ In many cases, they are in effect a concentrate of proliferating analogical relations that is intended to start a complicated game with the reader's intellect and imagination, in which the search for the intended message resembles a journey through a labyrinth built from an

699 Forshaw (2020), p. 1.

700 See chapter 4.3 The Depiction of the Alchemist in a Laboratory in Genre Painting, p. 422.

701 'Some of the earliest alchemical diagrams also borrow from visualization techniques developed in other branches of scientific or philosophical inquiry sometimes adapted to include figurative elements.' Rampling (2022), pp. 153–154.

702 Rampling (2013), p. 65.

703 According to Barbara Obrist (2003), p. 134: 'Verbal and pictorial similes in alchemical documents may be divided into two main groups: analogies, on the one hand, and diverse rhetorical forms of figurative speech – allegory, metaphor, enigma – on the other. While the basic function of analogies is to help finding unknown terms and to name them, the other category of similes relates to persuasion, clarification, and simple comparison. This division, however, merely indicates major tendencies.'

704 Rampling (2022), p. 152.

excess of meanings. There can be no doubt that this highly original kind of symbolism mirrored the developed imagination of the people who created it.⁷⁰⁵

This part of alchemical iconography adopted and reinterpreted a wide range of motifs only loosely connected with natural sciences.⁷⁰⁶ They were taken from both secular and religious sources, from ideas on agriculture or medicine, all the way to motifs from Christian iconography, including some theological concepts such as the Holy Trinity.⁷⁰⁷ From the 16th century onwards, mythological themes also begin to appear in alchemical iconography. Interpretation of alchemical iconography thus requires not only a knowledge of the history of nature cognition and the history of chemistry and technology, but a familiarity with other areas of the culture of the period, such as astrology and astronomy, medicine, poetry, mythology, and heraldry.

The principles of this complicated way of communicating alchemical knowledge were transposed into iconography from textual alchemical allegories and metaphors.⁷⁰⁸ From

705 Various thoughts on the role of imagination in hermetic sciences, in addition to alchemy and especially to magic, appear in literature mainly in the 15th and 16th century. Paracelsus and his followers, who considered imagination to be an important element of human creative powers, played a significant role in the shift of attention to imagination and its powers. See Koyré (2006), pp. 88–92; Pagel (1982), pp. 121–125; Godet (1982), pp. 35–42.

706 The extent of this ability to adopt and adapt various pictorial motifs led some scholars to posit a particular lack of originality in alchemistic iconography; cf. Elkins (1992), pp. 21–26, and Kahn (1995), pp. 47–51.

707 This covers in effect all phenomena and symbols which were allegorised also in other areas of medieval culture, such as metaphors and personifications, things (fauna, flora, minerals, architecture, etc.), secular events and rituals (conflict, wedding), dreams and visions, and the like; see Limbeck (2014), p. 244.

708 'Medieval alchemical images often closely relate to the texts and evoke the metaphors and

the outset, they reflected the special status of alchemy as a secret science following in the footsteps of hermetic and gnostic conceptions of being. Since the time represented by the writings of Pseudo-Democritus, alchemy was considered a divinely revealed science that could be comprehended only via initiation, which was supposed to endow the alchemist with a transformative power of divine origin.

In the late Middle Ages, this conception found a capable interpreter in the person of Petrus Bonus, who around 1330 wrote a treatise entitled *Margarita Pretiosa Novella* (Precious New Pearl). According to Bonus, alchemy has a double nature: a natural, and a supernatural or divine one.⁷⁰⁹ The latter provides the *raison d'être* for its allegorical expression in both words and images: it was necessary to treat divine mysteries in a manner analogous to the Bible, with its parables and allegorical stories.⁷¹⁰ The alchemical art therefore speaks via analogies.⁷¹¹ This was partly a matter of the protection of alchemical secrets, which

analogies encountered in the texts.' Rampling (2022), p. 161.

709 This double nature of alchemy is related to the double nature of the Philosophers' Stone: 'Bonus describes the *lapis naturalis* (obtained by sublimation) as a product which is not yet perfect, though it may become so when adjoined (by fixation) to the occult and divine lapis. Since this process depends for its realization upon free divine revelation, it transcends natural laws and appears to be a true miracle.' Cristiani (1973), p. 170.

710 The theological principle of exegesis and figurative language of Biblical prophesies and parables were always treated by alchemical writers as an analogy to 'philosophical language'; see Rampling (2022), p. 165.

711 'Ita quod scientia ista nihil dimisit, quin ad se detraheret, et sibi componeret: Neque est hoc inconueniens, quoniam omnia quae sunt, et quae non sunt, ars ista divina sibi pro terminis suis assumet, et loquitur de omnibus secundum analogiam in suis libris, et omnes aliae de ipsa hoc idem possunt, tam philosophia, et quam Astrologia, et quam Geomantia, et quam ars imaginum, ut dicit Balgus in Turba philosophorum...' Bonus (1546), fol. 53r.

were not to be publicly presented, but was also a way to test the ability of anyone who tried to comprehend alchemy, since to do so required the divine gift, that is, illumination of the mind. Neophytes had to prove that they had the gift and could grasp the message of the depictions, despite the intentional intricacy and obscurity: 'The cryptic secrecy serves, then, to verify the presence of illumination in true initiates, and to guarantee the possession of the alchemical secret among a limited group of initiates assembled by divine choice.'⁷¹²

According to Bonus, another reason for using metaphorical speech was that alchemy deals with hidden forces, which are outside the domain of the senses. These arcana can nonetheless be elucidated by analogies, and so by observation and correct understanding of the apparent qualities of bodies one can arrive at an understanding of their invisible nature. Using Aristotelian terminology, we can say that an observation of the accidental form can guide us to an understanding of the substantial form.⁷¹³ Bonus claims that during some key phases of the Great Work, one must add a substance that cannot be perceived by the senses but only grasped by the mind. This is how he speaks, for instance, about adding a hidden Stone, which will ensure a fixation of the spirit and soul at the end of sublimation.⁷¹⁴ In another place, he calls this active ingredient 'secret sulphur', which can be made apparent in the Great Work only by extraordinary

skill.⁷¹⁵ What then follows is a rather typical demonstration of various modes of symbolisation:

'It is the sulphur of the Sages, their stone and divine sulphur. It is a secret sulphur, thanks to which all things are made into gold and celebrated. It is the shadow of the Sun, a clot of mercury, which coagulates all that is liquid and transforms it into its nature. It is that which flies with flying things and remains with that which remains ... it is the gold of philosophers ... a quintessence, *sal armoniacum*, *acetum philosophorum*, *aes* and body, earth, which is called the mother of elements, into which all elements are transformed ... philosophers call it a little world, because it is like a person a little world, which resembles all things and takes part in them.'⁷¹⁶

Bonus shows here that in a symbolic matrix conceived in this way anything can be compared with anything else on the basis of analogy between the Great Work and the world, i.e. between the micro- and macrocosm. But that is not all: there is yet another way of hiding secrets (*arcana*) and complicating the situation still further, which is a sort of mirror-image counterpart to this extensive approach to symbolism. Specifically, different things are often just one thing, so that the body, the soul, and the spirit of the Stone are merely different

⁷¹² Cristiani (1973), p. 175.

⁷¹³ Obrist (1982), p. 51. Later, in the 16th century, this conception evolved into the theory of signatures, which played an important role in Paracelsus's teaching and was systematically developed by Oswald Croll in his *De signaturis internis rerum* (1609). See Hlaváček and Žemla (2020).

⁷¹⁴ 'Aut ex parte fixationis et permanentiae animae et spiritus in fine sublimationis, et hoc fit per adiectionem lapidis occulti, qui sensu non comprehenditur, sed intellectu solum per inspirationem, vel revelationem divinam, aut per doctrinam scientis.' Bonus (1546), fol. 38v.

⁷¹⁵ 'Et hoc sulphur occultum sit manifestum in magisterio artis cum maxima sapientia.' Bonus (1546), fol. 101r.

⁷¹⁶ 'Et hoc proprie est sulphur philosophorum et lapis eorum et sulphur divinum. Et hoc est sulphur occultum cum quo omnia deauratur et decorantur. Hoc est umbra solis et coagulum argenti vivi coagulans omne liquidum et in suam naturam convertens. Hic est qui cum volantibus volet, et cum quiescentibus quiescit... et est aurum philosophorum... quinta essentia... est sal armoniacum, et acetum philosophorum, et eas et corpus, et terra quae dicitur mater elementorum, ad quam convertuntur omnia elementa... a philosophis minor mundus dicitur, quia sicut homo dicitur minor mundus quia in eo omnium rerum similitudo et participatio reperitur.' Bonus (1546), fol. 101v.

aspects of the same and according to these aspects, sages call them by one name or different names. The meaning of each word therefore depends above all on the context in which it is used. Michael Maier suggests some of the pitfalls of this principle when noting that ‘allegorical speech is hard to understand in itself and the cause of much going astray from the right path, when we use the same words for different things and different words for the same thing’.⁷¹⁷

In this context, alchemical symbolism, both textual and pictorial, acquires values analogous to those attributed to dreams in Freud’s psychoanalytical theory; it becomes the ‘royal road’ to understanding sacred entities that cannot be immediately accessed by the senses.⁷¹⁸ An alchemist deals with something that cannot be seen but can be grasped via various visual manifestations of the substance that is being

717 Maier (1618a), p. 54. Let us add that Libavius strongly opposed this manner of interpretation, writing: ‘Lime is a magisterium formed by calcination, ash is the result of burning, and both belong to a certain substance, although the names are sometimes changed and variously modified by mystical philosophers, who are in their own way bursting with metaphors and allegories. On top of that, during the treatment of the stone, anything is called by any name as long as it resonates with some sort of similarity. But we do not want to follow this path ... It is a peculiarity of mystical teaching, where one can use any expression or name of an earthly thing to refer to the magisterium of the Stone and its parts.’ Libavius (1606), *Commentariorum Pars prima*, pp. 9, 85; Meitzner (1995), pp. 74, 86.

718 ‘The function of allegories as a special form of alchemical imagery goes much deeper than a mere intention to hide. It is best explained by the Christian conception of symbol as a “manifestation of the sacred”. In a symbol, the material and spiritual reality is not linked by substitution but in reality. In this sense, the sacraments as a symbolic mediation of Divine grace are symbols par excellence. In a sacrament, the immanent and the transcendent world meet. Alchemists adopted this understanding of symbols and used the language of symbols as a tool for understanding God’s creation.’ Limbeck (2014), pp. 244–245.

processed. Alchemists investigate a large quantity of symbolic depictions, which they come to understand once they find what connects them, and this is a link that can be strengthened by relationship with the text. But such links are far from obvious. Indeed, texts often do not comment on the illustrations at all. As Jennifer Rampling notes, this discontinuity between the text and the pictures is especially obvious in the treatises *Aurora consurgens* and *Buch der Heiligen Dreifaltigkeit* (Book of the Holy Trinity) but also in later treatises, such as *Donum Dei* and the *Ripley Scroll*.⁷¹⁹

This is also why one cannot unambiguously articulate the meaning of such images and reduce them to particular concepts. The searcher must interpret them and then try to comprehend them in their mutual relations, where they jointly form both the riddle and its solution.⁷²⁰ This is a type of alchemical symbolism that we encounter in the most sophisticated part of alchemical literature, in works considered as representing the ‘traditional corpus’ of alchemical literature.⁷²¹ In many texts, however, metaphors and allegories serve merely as cover names (‘Decknamen’)⁷²² in the context of much less complex semantic relationships. Their purpose is mainly to refer to certain chemical substances using names different from those commonly used.⁷²³ In this role, then,

719 Rampling (2022), pp. 174–175.

720 Sherwood Taylor therefore even argued that alchemical depictions express the nature of alchemy better than books or recipes do; see Sherwood Taylor (1958), p. 158.

721 See Alleau (1968), pp. 595–596.

722 The German term ‘Decknamen’ is now often used also in texts of historians of sciences written in other languages. It was coined by Julius Ruska. See Ruska and Wiedemann (1924), pp. 17–36; cf. also Newman (1998c), pp. 104–106.

723 Even just the language of alchemy was hiding much, although not necessarily on purpose, because the composition of compounds was unknown. Nevertheless, the Decknamen were supposed to hide the meaning of the expression fully, so that one would not be able to deduce it from the context.

they are conventional signs whose semantic link to the referent is given by an *a priori* code.

With regard to artistic technique, alchemical iconography developed in two directions. The first was that of line drawings and illuminations, which started to appear in manuscripts in western Europe in the second half of the 13th century. The second is that of engravings, which appear in printed productions from the beginning of the 16th century. The older group contains images ranging from extremely simple, instructive line drawings of alchemical instruments with no artistic value, all the way to the most detailed illuminations in luxurious parchment codices surviving from the late medieval and early modern period. The latter group comprises depictions that accompanied printed alchemical writings. These also range from simple woodcuts of minimal aesthetic value, to artistically and symbolically elaborate copperplates and etchings, some of which were the work of important artists. The invention of book printing radically expanded access to education but also offered new technical possibilities for alchemical iconography. While woodcuts had basically the same expressive powers as drawings, especially when it came to depicting alchemical instruments and equipment, artistically more advanced copperplates and etchings were media that encouraged a new flowering of symbolically conceived alchemical iconography. It was not yet possible to print them together with the text (i.e. to insert the engraved plates into the press page with the letters), but with the arrival of a new type of literature and prints, such as books of emblems, alchemical iconography became an extraordinarily impressive example of graphic art in books. This was enhanced by the fact that the illustrations in printed books, especially the most luxurious editions, were sometimes coloured.⁷²⁴

⁷²⁴ Eisenstein (1980); Moran (2022a), p. 4; Schneider (2000), pp. 620–622.

The very first drawings of alchemical apparatus appear in Greek alchemical texts from the 5th century,⁷²⁵ but we can get a better idea of them only from later surviving Arabic and Greek manuscripts.⁷²⁶ This group includes drawings that accompany the Greek-language alchemical texts, which were created in Byzantium during the 10th–11th centuries and are now kept in the Biblioteca Marciana in Venice (cod. Marcianus graecus 299).⁷²⁷ This collection contains texts by the alchemists Zosimos of Panopolis, Olympiodorus, Stephanus of Alexandria, and Cleopatra.⁷²⁸ It includes drawings of seven different distillation apparatuses, two depictions of the apparatus known as *kerotakis*, several schemes, and one important symbol taken from the gnostic tradition, namely the snake biting its tail (*ouroboros*) accompanied by the words *en to pan*, which symbolised the unity and mutual interconnectedness of the universe (Fig. 238). All the drawings, with the exception of the *ouroboros*, are strikingly geometrically simplified. They are in effect just schematic drawings of the apparatuses rather than attempts to capture their real three-dimensional appearance. We do not know if these depictions were copies based on original models or whether they were created later. It is most likely, however, that these depictions came from rare surviving sources, because some of them appear in compilations and handwritten copies as late as the 18th century. One important centre where these manuscripts have survived is the Greek monastic complex at Meteora.⁷²⁹ Nevertheless, the

⁷²⁵ Limbeck (2014), p. 241.

⁷²⁶ Cf. for instance an anthology of Greek alchemical texts composed and copied in 1478 by Theodore Pelekanos. See BNP, Grec. 2327.

⁷²⁷ Letrouit (2002), pp. 85–112; Obrist (2003).

⁷²⁸ See Schütt (2000), pp. 126–131 and 135–140; Roberts (2019), pp. 69–102.

⁷²⁹ Koutalis, Martelli, and Merianos (2018), pp. 11–43.

European tradition of medieval alchemical iconography cannot have been influenced by this codex, because it was bequeathed to the Biblioteca Marciana only in 1472 by Cardinal Bessarion,⁷³⁰ but it would certainly have attracted the attention of humanist scholars.⁷³¹

As a result of the influence of Arabic sources dealing with alchemy and natural sciences, which were being systematically translated into Latin from the mid-12th century onwards,⁷³² this kind of schematic drawing began to appear in manuscripts of Western European provenance from the beginning of the 13th century. The same did not apply, however, to the symbolic and imaginative iconography, which was left out of the assimilation process. Yet the texts themselves, with their figurative language, served as a rich source of inspiration for the development of a specifically Latin alchemical symbolic iconography.⁷³³ This started from the translated texts, the imagery of which was articulated using the period repertoire of visual arts. It also used schemes and diagrams based on contemporary mnemotechnic approaches and concepts of the ‘art of memory’, which combined geometric depictions with verbal symbols,⁷³⁴ as well as schemes influenced by the Neoplatonic analogy between the microcosm and macrocosm (man and the world), and illustrations of mysti-

cal visions such as those, for instance, from the works of Hildegard of Bingen.

When considering sources of inspiration, we should also mention the medieval tradition of fantasy-driven décor, which developed in the form of visual decoration of both secular and religious buildings and in manuscript drolleries.⁷³⁵ Another source of fantasy décor was to be found in bestiaries⁷³⁶ and various fantasy travelogues, such as the highly popular Mandeville manuscript.⁷³⁷ Inspiration was also taken from astrology, which included not only personifications and allegories of planets and constellations, but also more complex compositions of the so-called decans⁷³⁸ or the ‘children of the planets’.⁷³⁹

To some extent distinct, although in all cases intermingled with other sources of this pictorial language, was the group of themes adopted from Christian iconography and subsequently modified. The emergence of this tradition was connected with the fact that from the 13th century alchemical theory in the West was influenced by religious and even directly theological concepts. Let us add that even the works of the Greek alchemists Zosimos of Panopolis⁷⁴⁰ from the 3rd century, or Stephanus

730 Roberts (2019), p. 75.

731 Pictorial documentation of technical drawing in the traditions of antiquity, via older Byzantine sources or otherwise related to antiquity, had always attracted the attention of Renaissance scholars; cf. Galluzzi (2003), p. 47.

732 Ploss, Roosen-Runge, Schipperges, and Buntz (1970), pp. 123–124; Pereira (2008), pp. 363–375; Schütt (2000), pp. 262–268.

733 See Rampling (2022), pp. 162–163.

734 Sven Limbeck defines them as ‘visualisations of abstract contents, such as numbers, proportions, developments, principles, or theories. Using graphic means, they acquire purely conceptual content of spatially opposite dimension, that is, the invisible becomes visible through the means of geometric shapes, colours, but also symbols and text.’ Limbeck (2014), p. 241.

735 Baltrusaitis (1960).

736 Pastoureau (2011).

737 Krása (1990), pp. 268–297.

738 See Gundel (1936); Warburg (1982), pp. 39–51; Morel (2008), pp. 120–148.

739 See Hauber (1916); Blume (2000), pp. 158–194.

740 In the writings of Zosimos, as in the works of later medieval alchemists, these ideas were related not only to the general philosophical framework of alchemical theory but also to its technological approach: ‘Indeed, the work of Zosimos gives the first description of a fully workable device for distillation in antiquity... He views evaporative processes as the conversion of a body into semi-material spirit (pneuma) or as the release of such spirit from a body in which it had been trapped. In accordance with Stoic theories of matter, this pneuma is the principle of brilliance, activity, and colour, indeed, of life itself. Hence a still or sublimatory acquires a profound soteriological importance for the alchemist, since

of Alexandria from the 7th century,⁷⁴¹ were already imbued with mystical ideas. Arabic alchemy was likewise influenced by religious concepts from Islam.⁷⁴²

One of the earliest Western manuscripts containing original alchemical iconography is the *Liber secretorum alchimie* (The Book of the Secrets of Alchemy), which was compiled or written around 1257 in Italy.⁷⁴³ The oldest illustrated version has survived in a Flemish translation from the second half of the 14th century in the National Library of Austria in Vienna (cod. 2372).⁷⁴⁴ Its illustrations draw chiefly on geometric cosmological schemes and some symbolic elements from the Book of Genesis. This type of scheme was not alchemical *sensu stricto*: it was adopted from contemporary educational literature and writings on natural sciences. In a similar way, the schemes of the *Ars magna* by Raimondus Lullus were transposed into alchemical iconography and symbolism in a way that made them part of slightly differently organised compositions.⁷⁴⁵

it is the instrument that allows him to liberate the pneuma from its material prison.’ Newman (2004), pp. 29–30.

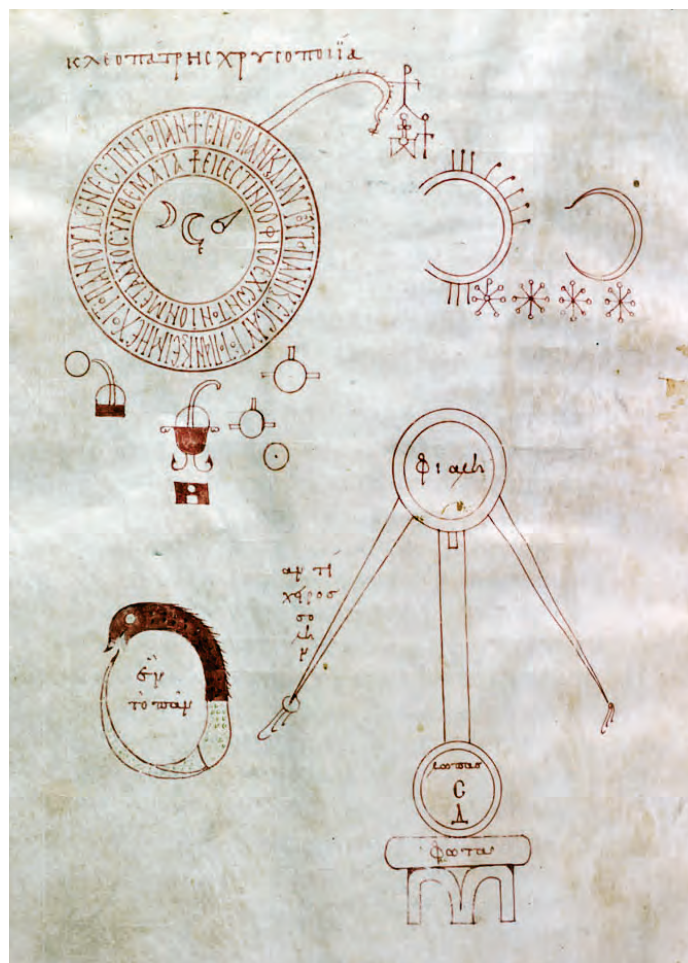
741 Haage (2001), pp. 83–108.

742 Von Lippmann (1919), pp. 355–382; Schütt (2000), pp. 157–253; Alleau (1968), pp. 588–598.

743 According to Obrist, its author is Constantinus of Pisa; see See Obrist (1991), p. 3.

744 Obrist (1982), pp. 67–116; Obrist (1991); van Lennep (1985), pp. 46–51.

745 In the work of Lullus, combinations of individual concepts in his schemata were created by a rotation of concentric volvelles, which fundamentally increased the number of potential semantic connections. In the work of the author of alchemical texts written under Lullus’s name, the original deductive and all-encompassing combinatoric is applied to the theoretical and practical principles of alchemy and developed into a sophisticated system of schemata, which did not rotate, but excelled in the geometrical richness of their shapes. See Pereira (1989); Kahn (2006); Limbeck (2014), pp. 266–269; Rampling (2020), pp. 46–56.



238. Ouroboros and distillation apparatuses. Collection of Greek Alchemical Texts, Biblioteca Nazionale Marciana, Gr. Z. 299, fol. 188v.

The illustrations in the *Liber secretorum alchimie* are formally and in terms of artistic rendition very simple, like those found in two other alchemical tracts contained in the same convolute (cod. 2372). Gratheus is named as the author of the first tract, while the second is called *Sapientia Salomonis* (The Wisdom of Solomon).⁷⁴⁶ In the nine illustrations of the first, we encounter for the first time a subject that would come to play an important role in alchemical iconography. It is the ‘revived vessel,’ a schematic phial or flask, inside of which

746 Van Lennep (1985), pp. 51–54; Birkhan (1992).