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Gold and silver: perfection of metals in medieval and early modern alchemy

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Abstract. For a long time alchemy has been considered a sort of intellectual and historiographical enigma, a locus classicus of the debates and controversies on the origin of modern chemistry. The present historiography of science has produced new approaches to the history of alchemy, and the alchemists' roles have been clarified as regards the vicissitudes of Western and Eastern cultures. The paper aims at presenting a synthetic profile of the Western alchemy. The focus is on the question of the transmutation of metals, and the relationships among alchemists, chymists and artisans (goldsmiths, silversmiths) are stressed. One wants to emphasise the specificity of the history of alchemy, without any priority concern about the origins of chemistry.

Keywords. History of alchemy, precious metals, transmutation of metals.

INTRODUCTION

For a long time alchemy has represented a sort of intellectual enigma, a critical difficulty for the philosophical and scientific historiography because of the relationships between alchemy and modern chemistry, which have strongly influenced the reconstructions of the origin of chemistry as a specific and institutionalised discipline. The positivistic tradition constructed and conceptualized alchemy as a form of proto-chemistry, and emphasised the difference between the empirical contents of the alchemical writings which were to be preserved, and the mystic, Hermetic, metaphysical dimension which was to be dropped out owing to its unscientific features. This approach deserves to be praised because it called the attention to the historical relevance of the alchemical writings, to the necessity of their analysis, study and edition. In 1887-1888 Marcelin Berthelot and Charles-Émile Ruelle published the three volume *Collection des anciens alchimistes grecs*, that has been a crucial source for almost a century.[1]

Today Berthelot's approach appears to be unsound because it is obsolete: a suitable historical perspective is to be based on the study of alchemy as a specific, centuries-old form of knowledge, and one must forget or put aside the question of the presumed transmutation of alchemy into chemistry. Without denying the existence of some interactions among alchemy, chymis-

try and chemistry, one must emphasise that the adventurous events of alchemy, the historical facts concerning the various alchemical traditions are largely different from those of the history of early modern chemistry.

ANCIENT AND MEDIEVAL ALCHEMY

The entry on "Alchemy" of the *New Dictionary of the History of Ideas* (2005) is divided into two sections devoted respectively to *China* and to *Europe and the Middle East* in order to enlighten the historical and conceptual relevance of Chinese and Western alchemy. [2]

Thanks to Joseph Needham and his school the history of the Chinese science represents a substantial chapter of the present history of science, and the volume 5 (two parts, 1974-1976) of their multivolume *Science and Civilisation in China* contains a very detailed reconstruction of Chinese alchemy.[3] Alchemical conceptions and practices were truly present in the Chinese empire, and Chinese alchemy developed during twenty centuries of documented history, and can be divided into two branches: external alchemy, that is the preparation of elixir through the manipulation of substances, and internal alchemy (inner elixir) aimed at the spiritual perfection of the alchemist. In 2005 Fabrizio Pregadio has published a volume entitled *Great Clarity. Daoism and Alchemy in Early Medieval China* in which he states that the crucible was the main tool of the Chinese alchemist from a symbolic, ritual and technical point of view,[4] and such a statement confirms the multifarious dimensions of the alchemical quest for knowledge.

In the Western and Mediterranean contexts alchemy had practical origins in Hellenistic Egypt, during the ruling of the last Ptolemaic Pharaohs and the beginnings of the Roman domination, and was codified between the first and the fourth century A.D. in Alexandria of Egypt. The *chemeia* was originally constituted of practices of artisans and of recipes aimed at the preparation and imitation of natural substances. In Alexandria the first alchemists were devoted to the working of metals, with a particular attention to gold and silver, and to the preparation of artificial, precious stones (pearls and emeralds), and to the colouring cloth using cheaper imitations of the expensive, imperial natural purple. Their activities consisted in the imitation of natural, precious substances and of purple cloths, in colouring silver to look like gold, or copper to look like silver, therefore they were a kind of *bijoutiers*. In Alexandria a middle class probably existed which aspired to a way of life similar to that of the Greek and Roman nobility, and needed some imitations of gems, of precious stones, and of purple because this class could not afford the original and natural ones.

These activities of imitation explain why the first alchemical texts, written in Greek on papyrus, contain about 250 workshop recipes. The Leiden and Stockholm Papyri date from the third century A.D. and present recipes relating to gold, to silver, to precious stones and to textile dyes. In 1981 Robert Halleux edited a new version of the original texts of the Leiden and Stockholm Papyri in a new collection dedicated to *Les Alchimistes Grecs*.[5] Pseudo-Democritus's alchemical writings have been recently published by Matteo Martelli in two critical editions, both in Italian and in English, and these editions confirm the four main sections of the Greek-Egyptian *Chemeia*: production of gold, of silver, of artificial gems, which included making and working glass, and colouring wool with artificial purple.[6] To Martelli we owe some outstanding contributions to the knowledge of the ancient Greek alchemy.[7] In the context of the Greek-Byzantine alchemy the *chemeia* was specified as *chrysopoeia* (the art of making gold) and as *argyropoeia* (the art of making silver).

Alchemy was born as a set of practices but became more and more sophisticated from a philosophical point of view. Alchemy acquired a complex whole of philosophical ideas and conceptions as regards matter and cosmos; Eastern and Greek philosophies became the theoretical base which guided the operations and the experiments, and shaped alchemical language that turned into a difficult and allegorical jargon. Thanks to various philosophical and religious concepts, alchemy was transformed into a true philosophy of nature which was destined to play an important role in western culture until the Eighteenth century. Some particular versions of Platonism, of Stoicism, of Hermetic Gnosticism and a few aspects of Aristotle's theory of the elements are traceable in the alchemical thought which presented itself as something new, specific, well defined in the various historical and cultural contexts.

The corpus of the Greek alchemical writings is composed by anonymous tracts or by pseudonymous tracts ascribed to mythical or famous authors. Zosimos of Panopolis in Egypt (about 300 A.D.) was the first alchemist to sign some systematic treatises of alchemy in which the platonic aspects are coloured by a strong Hermetic dimension. However, in Zosimos's writings an outstanding role is attributed to instruments, and his *Hypomnemata* open with some statements *perì organon kai kaminon*. In her new edition of Zosimos's *Mémoires Authentiques* (2002) Michèle Mertens considers the manuscripts, the preceding editions – Berthelot's and Ruelle's one is qualified as "très mediocre" – the studies on Zosimo. In her detailed introduction Mertens

presents a technical introduction devoted to the *appareillage de Zosimo*, to his alchemical instruments and apparatuses.[8] The Byzantine Manuscripts contain many drawings of apparatuses, and Berthelot had tried to reconstruct their structure and their presumed working. The progressive increase of the philosophical and mystical dimension in the alchemical literature did not involve an undervaluation of the experimental and practical aspects. In the Byzantine collections of Greek Alchemical Manuscripts, the book on the production of gold, ascribed to Democritus, has a short introduction devoted to the imitation of purple, and is entitled *Physikà kaì mystikà*, that is *Natural and Secret Things*, according to Lawrence Principe's suitable translation.[9]

In the Middle Age Greek alchemy was preserved by Byzantine culture and from the VII to the XI century the alchemical canon was constructed by Byzantine scholars through selections and collections of texts. Emperors, monks, theologians and scholars were interested in alchemy, and focused their attention on the making of gold and of precious metals, therefore the Byzantine intelligentsia selected a specific type of alchemical tracts which were included in Greek-Byzantine collections, and such collections were translated into Syriac and Arabic. Starting with the VIII century some Arabic alchemical texts were produced in the context of an extraordinary flourishing of the Arabic culture. From the Syriac *kīmīyā* Arabs coined the term *al-kīmyā* which was very successful and was steadfastly used during the whole Middle Age and the Modern Age. Owing to the expansion of the Arabic empire and the spreading of the Arabic as a new common language, in the Islamic world it took place an assimilation of knowledge from the Greek, Persian and Iranian sources. In Islam, alchemical writings show the influences from Egyptian, Syriac, Sabean cultures, too.

Alchemy strongly rooted in the context of the Arabic scientific research, and a Latin manuscript, called the *Morienus*, was translated from Arabic in 1182 as *De compositione alchemiae*, and can be considered as the starting moment of the penetration of the Arabic alchemy into the Latin world: writings ascribed to Jābir ibn Hayyān, alias Geber were the most famous texts of the medieval alchemy. The Islamic alchemy is characterized by various aspects, but the alchemical research was focused on the making of gold, using mercury and sulphur, and on the production of an elixir (*al-ʿiksīr*) which, when combined with some vile metals, could transform them into gold or silver, and even it could be used as a true elixir, able to guarantee a long life or immortality.[10]

During the XII century the translations from Arabic into Latin composed a very important corpus of alchemical writings, and alchemy attracted the attention of famous scholars and philosophers: Albertus Magnus and Roger Bacon contributed to the development of alchemy in Europe. The art of distillation became a central subject of research: the utilization of minerals, concentrated acids, alcohol, and some new techniques of distillation, which allowed to obtain many distillates and the celebrated quintessence, modified in a substantial and dramatic measure the practices of the alchemists. Thanks to the research of Chiara Crisciani and Michela Pereira, we can now consider the XIV century as the apogee of the Latin alchemy: Arnaldo of Villanova's, pseudo-Ramon Lull's, John of Rupescissa's alchemical works testify to the impressing philosophical level reached by alchemy. Alchemy was a true philosophy of nature, based on some outstanding experimental practices, which was focused on the production of the elixir, on the transmutation of metals into silver and gold[1], and on the use of mercury in various experiments and chymical processes.[11]

It is worth noting that during its long history alchemy evolved but maintained a strong core of knowledge: in medieval and modern texts it is possible find recipes and experimental practices which are identical to those contained in the Greek papyri of Egyptian origins.

RENAISSANCE AND EARLY MODERN ALCHEMY

During the Renaissance and the early modern Era alchemy had a strong influence on various fields, from cosmology to natural philosophy, from religion to the vision of human history, from pharmacy to mineralogy, from metallurgy to medicine. Alchemical texts started being printed with some series of imagines that are still today a resource in order to understand the universe of symbols which nourishes the human psyche. The Sun and the Moon represented Gold and Silver, and these noble metals were also portrayed as the King and the Queen in order to emphasise their primary role in the processes of transformation. The alchemical and astrological symbols of the sun and of the moon were also used during the XVIII century in the Tables of Affinities to paint gold and silver. Metals were considered mixed substances, and like living creatures they were born and grew in the subterranean world: nature had a specific operating time for the maturation of metals in her wombs, and metals composed a sort of ascending ladder to the top of which there were silver and gold. Late medieval alchemist aimed at modifying the times of nature, cooperating with nature, but also surpassing her

[1] This transmutation was also a process of spiritual progress of the alchemist.

in the production of the noble metals. Transmutations were not dreams or fantastic enterprises but were a true project of acceleration of the natural times, based on man's ability to perform, because in its origins alchemy was also the art of making. In Johannes de Monte-Snyder's *Metamorphosis Planetarum*, published in German in 1663, it is possible to read about the metamorphosis of plants and of bodies which are guided by the Sun and the Moon. This text also considers the transformations of metals because mercury and sulphur bind man to the philosophical gold, that is, to the highest principle.

During the Renaissance many collections of alchemical books were published: in 1572 the printer Petrus Perna published in Basle a collection focused on the *Turba Philosophorum* entitled *Auriferae Artis, quam Chemiam vocant* which was reprinted in 1593 in an enlarged edition of two volumes.[12] The *Turba philosophorum* is a Islamic treatise in which the alchemical doctrines are exposed in a sort of congress of the pre-Socratic philosophers that is presided by Pythagoras. In 1546 Janus Lacinius Therapus had published in Venice a collection of theoretical, alchemical works, the first part of which contains the *Pretiosa Margarita Novella* of Petrus Bonus of Ferrara, one of the most important alchemical treatise of the XIV century. [13]

In her important book on *Alchimia. I testi della tradizionale occidentale* Michela Pereira reconstructs the histories of alchemy from the Greek world to the Modern age, and the chapters of this huge book devoted to early modern philosophical and religious contexts clarify the substantial impact of alchemy, in its various forms and declinations, on modern culture.[14] In the age of the Scientific Revolution alchemical texts were firmly rooted in the European cultural landscape. This presence has caused many historiographical controversies concerning alchemy, the Paracelsian tradition, chymistry and chemistry, and so on. Here, I cannot resume these debates but I only want to emphasise that a description of the genesis of modern science cannot ignore the question of alchemy. Andreas Libavius defended alchemy as an art against the Paracelsians,[15] and in 1602 Gaston Duclo published his *Apologia Chrysopoeiae et Argyropoeiae adversus Thomam Erastum*, that contains a defence of the arts of making gold and silver against Thomas Erastus, a professor of medicine in Heidelberg.[16] The controversies about alchemy remained alive and vivid from the Renaissance to the Age of Enlightenment.

The exhibitions devoted to alchemy in its relationships with the figurative arts are frequent in the institutional contexts of Europe and North America. For example, the exhibition of 2004 on *Kunst und Alchemy* at Düsseldorf, was focused on the mystery of the *Verwandlung*, namely transformation.[17] The catalogue of this exhibition contains chapters on the history of alchemy and thematic chapters aimed at illustrating the ties between alchemy and arts. In many seventeenth century pictures it is usual to find representation of alchemical laboratories and some very diversified images of the alchemist. In his mammoth history of the macrocosm and of the microcosm (1617-1624),[18] which is rich of amazing plates, the English physician and philosopher Robert Fludd (1574-1637) presented a mirror of the whole nature and the image of art together with a description of the human arts. These arts were alchemy as regards the mineral world, agriculture as regards the vegetable one, and medicine as to the animal one. Every part of the cosmos is tied to the other parts and these connections produce a complex and linked cosmological whole. Among the various connections one can isolate those between Saturn and lead, Sun and Man, Moon and Woman, but in the underworld Sun and Moon are connected with gold and silver.

In Malachias Geiger's *Microcosmus* (1651) the symbol of the potable gold "chimice praeparati" presents a true image of the macrocosm and of the microcosm in which the human figures of the sun and of the moon are entering in the alchemist's laboratory, and this image confirms that alchemy was both a philosophical cosmology and a series of laboratory practices.

The search for the philosophical stone to be used in the transmutation of metals in gold was still a topical argument in late Seventeenth century because Robert Boyle (1627-1691), the supposed father of modern chemistry, was highly interested in the research of this stone and of the secret of the alchemical transmutations.[19] During his life Isaac Newton (1642-1727) devoted much more time to alchemy, theology and sacred history than to mathematics and physics.[20]

I do not want to emphasise too much the symbolic features of the metallurgical alchemy in the early modern age, and in the final part of my presentation I want to call the attention to the ties between artisans and alchemists, to the relationships among some able goldsmiths, silversmiths, alchemists and chymists in XVII century Europe. In 2007 Vladimír Karpenko published a paper on alchemical coins and medals,[21] but we owe to Lawrence M. Principe's research some outstanding clarifications about the different social contexts of interest in precious metals. Principe has cast light upon the relationships between artisans and natural philosophers, between jewellers and scholars, and has defined the various places and contexts in which the alchemical practices were present in modern age.[22] The types of chymical discourses were numberless, but one needs to emphasise

the ties between high culture and the craftsmanship of the artisans.

Johann Rudolph Glauber (1604-1670) was a German chymist, alchemist and pharmacist who was active in Amsterdam. He was very attentive to the practical matter, technological and analytical dimensions of the chymical research which he combined with the interest in alchemy. In 1646-47 he published a two-volumes treatise in German, on the art of distillation, and in 1656-1661 a textbook on the prosperity of Germany. In the latter book, he argued that a systematic application of chymical knowledge to manufacturing of goods would lead to higher prosperity in his native country. In 1658-1659 Glauber published a treatise on the salts, but he had already published (1646) a treatise on the true potable gold, and between 1663 and 1664 he published two treatises on the Hermetic medicine and on the explanation of the true alchemical secrets.[23]

In Amsterdam Glauber became acquainted with the three Grill brothers, German jewellers and silversmiths, who were active in the Low Countries. Anthoni Grill, an aurifaber, criticized some chymical processes used by Glauber and affirmed that the famous chymist did not use a correct process to separate gold from silver. As a jeweller, Grill dedicated his attention to the essaying of the precious metals, and had invented a less expensive technique than those used by chymists and alchemists. Principe has discovered some sources which point that Grill had created a method of producing gold and silver in laboratory, and was able to exhibit some samples of artificially produced gold and silver.[24]

During his long tour across Europe the Danish physician and naturalist Ole Borch (Olaus Borrichius, 1626-1690) met Grill at Amsterdam in 1662. There Grill showed him that the combination for some months of lead with a particular spirit of salt had produced a fine piece of good silver.[25] In The Hague Andries Grill, Anthoni's brother, had a laboratory and a jeweller shop which were visited by European travellers wishing to observe his practices of obtaining gold and silver. In 1659, knowing to his financial debts, Anthoni Grill was obliged to leave Amsterdam, and fled to Sweden where he became a successful public officer in the field of metallurgy, a crucial activity of the Scandinavian country.

In Amsterdam Anthoni Grill had acquired a big house and there he built some large chymical laboratories that after his departure were used by Glauber for a short time. Grill was at the centre of cultural exchanges with travellers, German university professors, visitors of his laboratories and of his shop. They spread all over Europe Grill's practical research.

The case of the German jewellers of the Low Countries, reconstructed by Principe, demonstrates that the traditional dark, witchlike image of the alchemical and of the chymical laboratories does not fit the historical facts. In the Dutch context of the *Gouden eeuw* some fruitful exchanges between artisans and naturalists took place, and were historically significant.

A SHORT CONCLUSION

In Modern age alchemical texts and practices were very popular and alchemists played a crucial role in the history of science because, quoting Tara Nummedal, "in joining the hands on manipulation of matter with more theoretical speculations about its composition and transformation, alchemists (like physicians) modelled the extraordinary potential of the union of head and hand long before it became a hallmark of modern science".[26]

However, alchemy was not able to become a branch of that institutionalised research which produced modern science. In the map of the new knowledge created by the Scientific Revolution that established the academic topics to be investigated one cannot find alchemy. The modern scientific discourse was often engaged to denounce the "dreams" of alchemy.

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