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2. Quicksilver and aesthesis

This shiny silvery preparation is literally an eye catcher in the Leiden University eighteenth-century anatomical collections [Ill. 6, Ag0020]. Housed in the anatomical museum of the Leiden University Medical Center, it is briefly described in the most recent catalogues as ‘an exceptionally fine specimen’, and attracts the visitors’ attention straight away with its silvery shimmer.¹ The curator of the collection in the 1950’s, Ms Elshout (the later professor Luyendijk-Elshout) attributed it to Eduard Sandifort (1742-1814), professor of anatomy at Leiden University from 1771 to 1814. There are other mercury-injected preparations of the lymphatic system in the collections too, some wet, some dry, some of separated lymphatic vessels, others of lymphatic vessels in situ, of the heart, the liver, the penis, and the intestines [Ills. 1-10]. Were these all made by Sandifort? And why these body parts and with mercury as an injection mass? How were they used? What did they mean to their contemporaries? In this chapter, I will explore the possible answers to these questions, and pay specific attention to the material aspects of aesthesis.

Moreover, I argue that the initial choice for mercury as injection mass for the lymphatic system was no coincidence, but the result of both the materiality and the meanings of mercury in the second half of the seventeenth century. Quicksilver to the late seventeenth-century anatomist was easy to discern, it was the penetrating, cool, wet opponent of dry, hot sulphur, it was cleansing, resurrecting, influenced the hands and was a source of eloquence. This chapter will explain those meanings and how they changed, as the subsequent reappearance of mercury as an injection mass for anatomical preparations in the second half of the eighteenth century was possible because of subtle changes in the meanings of mercury. The materiality of mercury in these preparations gives us access to, and is better understood through, a complex world of anatomical and medical knowledge and practices. These objects are, after all,

¹ Elshout 1952, LUMC 2011: “*Buitengewoon fraai praeparaat van de lympheklieren uit de regio inguinalis. De klieren zijn gepraepareerd op de fascia abdominus superficialis, die geplet en gehard is. De lymphevaten zijn met kwikzilver opgespoten, waardoor een zeer fraai effect verkregen is.*”

evidence of complex social relationships; they are simultaneously products and modellers of a distinct epistemic culture.² As Klein and Spary have recently pointed out, materials can be challenging things that ‘provoke their investigators to expand and refine their activities and understanding.’ Materials speak irresistibly, and not only through their interpretation and representation.³ In the case of mercury, we will see its agency and meaning are in its colour, its effect on the human body, and its volatile and intangible character. The mercury-injected preparations made by Sandifort were the products of typical eighteenth-century aesthetics.

The mysterious origins of the Leiden mercury preparations

So why and how were these preparations originally made and perceived? That question is in fact very hard to answer. A.M. Elshout attributed three preparations to Eduard Sandifort in the 1950’s stating that some of these preparations had originally been attributed to the seventeenth century Leiden professor of anatomy, Nuck (1650-1692), but that it was more likely they were Sandifort’s work as Nuck only left dry preparations, and because they were made exactly according to Sandifort’s technique.⁴ This statement is interesting enough, but unfortunately Elshout in her catalogue records did not refer to sources that attributed the preparations to Nuck, nor did she elaborate on what ‘Sandifort’s technique’ purports to be.⁵ Curiously, in her 1952 PhD thesis on the eighteenth-century Leiden anatomical collections, Elshout concludes that Nuck’s preparations were most likely all removed from the collections in 1721, and that Sandifort only described two dry preparations by Nuck in his 1793 listing of the Albinus collection.⁶ Moreover, she excluded the 38 preparations that she thought to be Sandifort’s work from further discussion in her thesis as these were, strictly speaking, not a part of the eighteenth-century Leiden University anatomical cabinet: they were not listed in the four volume *Museum Anatomicum* catalogue made of the Leiden anatomical collections by Eduard Sandifort and his son Gerard in the years between 1793 and 1835, nor are they described or attributed to Eduard

² Harvey 2009, p. 5, 12.

³ Klein & Spary 2011, p. 9.

⁴ These preparations now are LUMC catalogue numbers Ag0020, Ag0021 and Ag0022.

⁵ Catalogue records Elshout 1952, LUMC 2011, also see Appendix I.

⁶ Elshout 1952, p. 14, Sandifort 1793, vol. 1, p. 89, describes no. 407-408 as follows: “CCCCVII. *Portio intestine cum portione mesenterii, vasis nonnullis mercurio impletis. Nuckii ut videtur. CCCCVIII. Portio intestine, cujus vasa lactea impleta mercurio. A Nuckio, aut Swammerdamio, ut videtur.*” This suggests he was not entirely certain about the origins of these preparations either.

Sandifort in any other catalogue.⁷ After briefly describing the mercury-injected, and some other, preparations Elshout concluded that ‘the investigator gets the impression that these preparations have been made more to flatter the eye than for a scientific purpose, although the style of preparing is entirely different than that of Ruysch’ – a style she characterizes elsewhere as ‘excessive’.⁸

But would Sandifort really have gone to the trouble of making such refined preparations only to ‘flatter the eye’? Why would he have made preparations imitating a style and technique apparently last used by a predecessor almost a century earlier? And why would those preparations subsequently have been virtually ignored by his contemporaries and successors? In order to come closer to answering any of these questions, we have to delve into the history of making mercury-injected anatomical preparations, in particular the practice of so doing by Antony Nuck. Nuck is generally believed to have been the first anatomist who successfully used mercury to inject the lymphatic system, and to create lasting mercury-injected preparations.⁹ So why did Nuck create these preparations, and why was he so successful at it?

Injecting and preparing as experiment

Antony Nuck (*1650) graduated from Leiden University in 1677 with a dissertation on diabetes, and subsequently practiced medicine and anatomy for a decade in The Hague. In 1687 he was appointed professor of anatomy at Leiden University, a post he would hold until his early death in 1692. In his time, he was famous for his numerous dried preparations of lymph glands, arteries, veins, eye and saliva ducts, many of which were injected with a mixture of mercury, lead, and tin (the lymph glands), and coloured wax (arteries and veins). In his lectures, Boerhaave mentioned how impressed he was as a student by the sight of mercury-injected lymph vessels mounted on wooden boards at Nuck’s house.¹⁰ [Ill. 1, 2] Preparations of mercury-injected lymph glands were an admired novelty in the late seventeenth century for two reasons: the development of lasting anatomical preparations from injecting experiments was in full swing, and the lymph glands were a largely mysterious bodily structure.

⁷ Elshout 1952, p. 23-4, Sandifort 1793-1835, vol. 1-4.

⁸ Ibid., p. 24, 57.

⁹ On Malphigi: see Cole 1921, p. 293, quoting Malphigi 1661. The most convincing study to point out Nuck as the first who used solidifying mercury to make lasting preparations of the lymphatics is Helm & Stukenbrock 2003, p. 72.

¹⁰ Boerhaave 1747, p. 576.

Anatomy was primarily experimented in seventeenth and eighteenth-century Leiden. In the 1660s, anatomical structures and functions such as the lymphatic system were discovered through injections with air and coloured fluids. The instrument of choice for these injections was the syringe. Reinier de Graaf (1641-1673), a Delft physician who had studied medicine in Leiden, improved the syringe, and even wrote a short treatise on its use in anatomy: *Korte beschryving van 't gebruik der spuylt* (1668). In it, he presented his own version of the syringe: a copper tube with a piston, onto the front of which tubes of different shapes could be screwed [Ill. 31]. With this instrument, the anatomist could inject liquids of different colours into the veins and arteries of dead bodies to demonstrate to students which arteries supplied which intestines, and how blood flowed through the arterial system. It was also very useful in the vivisection of animals, which provided the anatomist with an opportunity to show the audience bodily functions *in vivo*. For example, De Graaf demonstrated the flows of the pancreatic juice in bound and gagged living dogs.¹¹ De Graaf also saw great opportunities for anatomists to discover thus far 'hidden things', which would be of benefit to everyone and would make the anatomist himself 'immortal'.¹²

It may seem a bit strange to us now that De Graaf apparently selflessly shared his discovery with his contemporaries, enabling them to make themselves immortal too. But to him it made perfect sense: patents and copyright did not exist, and the usual manner of purchasing instruments for anatomists was to take an illustrated description such as De Graaf's to a blacksmith and have the instrument made there. By publishing his new find, De Graaf knew that he would at least get the credit for this particular model of syringe, although he was unlikely to gain anything from it financially. More importantly, only having the description of such an instrument and its use did not in itself enable an anatomist to perform injection experiments successfully. Animal and human bodies and body parts are resistant materials to work with; it is hard to discern small veins to begin with, let alone injecting them successfully with coloured liquids. Too little pressure, and nothing happens, too much pressure, and the fluid destroys structures instead of highlighting them. Use the wrong colour and hardly anything will be seen of an otherwise successful injection.

¹¹ De Graaf 1676 (1671), p. 30-4.

¹² De Graaf 1989 (1668), p. 14.

Like any *artes* in the Aristotelian sense –anything that requires skilled handiwork- early modern anatomy required endless practice.¹³ De Graaf appears to have taken this for granted, but in other anatomical handbooks we do find warnings, such as in Blankaart's 1678 *Nieuw-hervormde Anatomie* (Newly Reformed Anatomy). He wrote that before anything could be accomplished in the art of healing, knowledge of human anatomy should be acquired, 'not from books... but from practice, to acquire a skilful hand'.¹⁴ Over a century later, in the introduction to the 1790 *Anatomical Instructor*, Pole still notes that to 'Those who wish to become complete Anatomists, I must urge to devote a sufficient time at the usual places of instruction; to them, I hope, this treatise will be found, what I mean it to be, an useful companion and assistant.'¹⁵ Later on, he states that 'imitating nature by colours' [in preparations] is an art in itself, distinct from, but very necessary for anatomy. Once again, this can only be learned through practice.¹⁶ This shows that descriptions of such practical finds as De Graaf's improved syringe could only partly spread new anatomical experimental knowledge. In order to truly learn the techniques, an anatomist needed to experiment with them himself, and only the most persistent and most skilled practitioners would eventually attain satisfying results. I will return to the importance of hands-on experience for making mercury-injected preparations shortly.

Although the experiments and discoveries of De Graaf and his contemporaries with injections of coloured liquids were very innovative in terms of making structures and functions visible, they did not provide lasting preparations, as the injected substances did not solidify and preserve the injected structures. Creating lasting injected preparations was something many anatomists wanted: that way, you could preserve the results of your experiments and show them to others at any time. This first became possible in Leiden in 1666 when Jan Swammerdam (1637-1680) developed solidifying fluid wax masses and thus successfully made injected preparations, which could be preserved either dried or in fluid.¹⁷ Others in Europe were also experimenting with mercury injections and more permanent preparations

¹³ Also see Smith 2004.

¹⁴ Blankaart 1688, p. 2 of the introduction: "...en dat niet uit boukken (...), maar uit eigen ouffeninge, om van tyd tot tyd een vaardige hand-greep the krygen."

¹⁵ Pole 1790, p. xiv.

¹⁶ *Ibid.*, p. 250.

¹⁷ Boerhaave mentioned 1667, but Swammerdam himself stated that he demonstrated his method of the solidifying injection mass to Van Horne, Slade, Thévenot and Steno in Leiden (Cole 1921, p. 301).

at the time: Malpighi mentions using mercury to study the finest branches of the vessels of the lungs in 1661. The first account we have of a mercury injection in an experiment in the Netherlands is from Amsterdam in 1672, and Swammerdam was involved in it; it is therefore likely that he first experimented with hardening mercury injections in the same period.¹⁸

Within decades, the practice of hardening injections with mercury and coloured wax in anatomical preparations would spread throughout Europe, with varying success. In 1695, Blankaart extended a section on ‘The new method of embalming’ to a new Latin edition of his *Reformed Anatomy*. In it, he briefly mentions the possibility of injecting vessels with a mercury amalgam, but he seems unimpressed with the use of the technique for clarifying anatomical structures, stating that this was mainly done ‘for financial gain’.¹⁹ This remark suggests that at least to some late seventeenth-century anatomists mercury-injected anatomical preparations were merely commercial commodities, not research objects or scientific commodities that could be used in acquiring and exchanging anatomical knowledge.

Yet in *The Anatomy of the Brain* of the same year, Humphrey Ridley (?-1708), an MD from Nottingham who studied in Oxford, Cambridge, and Leiden, notes that an injection with mercury “...by its permanent nature and colour, contributes mightily towards bringing to view the most minute ramifications of vessels, and secretest recesses of Nature.” Ridley preferred mercury to wax, the latter being too coarse for the finest vessels.²⁰ By the early eighteenth century, the Leiden professor and instrument designer Musschenbroek even offered a standardized instrument for mercury preparations: ‘An Iron one [pipe] for Injecting of Mercury’, that cost 1 Florin, which would be about 10 Euros now.²¹ But when young Nuck was coming of age and started to study medicine and anatomy in the 1670s, creating lasting anatomical preparations injected with waxes and mercury in order to discover and map bodily structures was still a new and exciting field.

Besides the fact that lasting preparations were difficult to make, their quality by the late seventeenth century was generally rather low. Dried preparations tended to shrink and discolour from their protecting layer of lacquer and were prone to damage by insects, larvae, and moulds, whereas wet preparations in alcohol suffered

¹⁸ Lindeboom (ed.) 1975, p. 23, *pars altera*, p. 15-16.

¹⁹ Blankaart 1695, p. 758, XXX.

²⁰ Ridley 1695, *preface*, p.4.

²¹ Erndl 1711, p. 62.

from discolouration, putrefaction and dissembling – the Ruysch and Albinus preparations are a notable exception to this. This also shows from the preparations kept in the Leiden anatomical theatre, established in 1594. According to Sandifort senior, in the first fifty years of its existence, the anatomical theatre was equipped with ‘the bones – either loose or kept together by their own connective tissue, or artificially reconnected and assembled – the skin and other parts, dried or put in alcohol without the right preparation’ of those punished by military or civil authorities and dissected in the theatre.²²

However, by the mid-seventeenth century, these preparations were ‘dilapidated by old age, or demolished by inconsiderate hands’.²³ They were replaced when Louis de Bills, a Flemish nobleman well-versed in anatomy, donated a number of preparations to the theatre in 1655 that were remarkably well-preserved for the time. The most outstanding piece was a dried male human body, a stuffed skin complete with beard, scalp and eyes.²⁴ By 1771, the De Bills preparations would be discarded too, as they had either gone bad or had been badly damaged.²⁵ Although the dried preparations made by De Bills lasted already twice as long as the earliest ones, their 115 years are child’s play compared to the dried and wet preparations made in the late seventeenth and eighteenth centuries, still with us over three hundred years later. For these long-lasting preparations, mercury has a particular appeal: unlike coloured wax, it can even penetrate the smallest of vessels, it has the looks of a precious metal, yet it is cheaper and easier to inject than precious metals, and unlike other non-precious metals, it is not susceptible to corrosion and hence suitable for wet preservation too.

Moreover, the mapping of the lymphatic system and its function was a topical affair in the second half of the seventeenth century, a quickly developing field. Alexandrian anatomists Erasistrates and Herophiles both observed lymph vessels in animals in the third century BC, but thought them to be either arteries or veins. In the sixteenth century, the first accurate descriptions of lymph vessels appeared, most

²² Sandifort 1793, *Introductio*, p. XIII “*Verum quod attinet ad praeparata Anatomica, solitum tantummodo fuit eorum, qui a politico vel militari Magistratu morte erant puniti, & in Theatro dissecti, ossa vel soluta, vel suis ligamentis adhuc cohaerenta, vel arte iterum nexa & composita, pelles, partesque alias, siccatas, aut sine praeparatione idonea liquori immisas...*”

²³ De Bills 1655, p. 7: “...door ouderdom vervallen, ofte door onachtzame handen gebrooken zijn”.

²⁴ *Ibid.*, Huisman 2009, p.85.

²⁵ Sandifort 1793, *Introductio*, p. XIV.

notably Eustachius' account of the thoracic duct (1564), the biggest lymphatic vessel in the body. It was only in the seventeenth century that it was established that the lymphatic vessels and glands are actually a separate and interconnected system, and even then its exact functioning and lay-out remained largely mysterious. Ruysch contributed considerably to the knowledge of the lymphatic system with his discovery of the valves in the lymphatic vessels, published in 1665, to which I will return later on.

It would be Paolo Mascagni (1755-1815), a contemporary of Sandifort, who discovered in the 1780's about fifty percent of all the lymphatic vessels known today. Mascagni can also be credited with the finding that every lymph vessel enters at least one lymph node, and the disproval of the existence of arterial and venous lymph vessels. The exact function of the lymphatic system would remain a controversial topic up to the early twentieth century, not least because it is extremely difficult to discern the lymph glands in a dead body.²⁶ Their obscurity made it very complicated to devise the lay out of the entire lymphatic system, let alone to visualize it in an anatomical preparation. Mercury, whether or not mixed with other substances, turned out to be the perfect injection material for the lymphs because of its penetrating qualities, as we will also see in the next section.

The possibility to create lasting preparations that showed the course of the lymph glands was therefore a welcome novelty in the late seventeenth century. However, if creating visually clear, lasting preparations was already problematic, making one which distinguishes the small and generally well-hidden lymph glands was even more difficult. Although many anatomists, including Nuck, were not very vocal about the problems and challenges they encountered when trying to make lasting preparations, there is a number of accounts from various periods that describe the difficulties of making mercury-injected preparations of lymph, and other, vessels. Some stress the importance of finding a suitable corpse to make a lymph gland preparation. Nuck's student Boerhaave's description of Nuck's techniques of preparing the lymphatic system mentions that a skinny corpse was preferred.²⁷ This preference had to do with the fact that the lymph glands tend to be covered with body fat in more corpulent bodies, something also mentioned by the Scottish anatomist Charles Bell over a century later, who wrote: 'when there is much fat the dissection of

²⁶ Ruysch 1665, Luyendijk-Elshout 1964, Mascagni 1784, 1787, Olry & Motomiya 1997, Eales 1974.

²⁷ Boerhaave 1747, p. 571.

them [the lymph glands] is difficult, and to preserve them it is absolutely necessary that the subject shall be thin, and anasaruous.²⁸

The above already indicates that the lymph glands are notoriously difficult to inject – according to Bell injecting the lymphatic glands was the most difficult part of practical anatomy.²⁹ Not only are the lymphatic vessels tiny and covered by other structures, the smaller ones cannot be filled through the larger ones (like blood vessels), because of the many valves in the vessels. Fredrik Ruysch first described these lymphatic valves in *Dilucidatio valvularum in vasis lymphaticis et lacteis*, which he published shortly after obtaining his medical degree in 1665. In order to make the lymph glands visible in much-wanted lasting preparations, a substance with special visual, penetrating, and lasting qualities was needed, and that was mercury. This section has shown that the importance of experiment and practice, of sensory and bodily involvement of the anatomist in making mercury-injected preparations, was even greater than with wax-injected preparations. Because of the difficulty of the procedure and the spectacular results of successfully injecting mercury, it remained the ultimate proof of anatomical skill for almost two centuries. In the next section, I will show that it was the combination of this somatic involvement with the aesthetic, symbolic, transmutational, and medical qualities of mercury that made it the perfect candidate for the exploration and mapping of the lymphatic system in the late seventeenth century, but also that it was exactly some of those selfsame qualities that made it a controversial material for part of the eighteenth century.

The Material Meanings of Mercury

The previous section suggests that the materiality of mercury in the Leiden preparations gives us access to, and is better understood through, a complex world of anatomical and medical knowledge and practices. These objects are, after all, evidence of complex social relationships; they are simultaneously products and modellers of a distinct epistemic culture.³⁰ Returning to the Klein and Spary statement that materials can be challenging things that speak irresistibly, not only through their interpretation and representation, we will see that mercury's agency and meaning are in its colour, its effect on the human body, and its volatile and

²⁸ Bell quoted in Tompsett 1970, p. 10-13. 'Anasaruous' means affected by dropsy (oedema), which causes the lymph glands to swell.

²⁹ Ibid.

³⁰ Harvey 2009, p. 5, 12.

intangible character.³¹ This section will show that the changing uses and meanings of mercury in chemistry, medicine and specifically as injection mass from the seventeenth century onwards, are all closely connected and rooted in mercury's distinct materiality, and thus indispensable for understanding the Sandifort preparations.

Mercury was the most likely candidate for injecting the lymphatic vessels to seventeenth- and eighteenth-century anatomists for a number of reasons. There are practical material qualities that make it very suitable as injection mass, but as we will see it also had less obvious, symbolical properties in favour of it. Of course mercury's common name, *quicksilver*, immediately gives away the first material quality: its extreme mobility. Then there is the fact that even a very insignificant thread of it can be fairly easily discerned by the human eye, and that its silvery shimmer warrants a refined and pretty finish.³² This quality ensures the use of mercury in preparations is compatible with aesthesis: it brings out a certain beauty in them. But what makes the materiality of mercury particularly significant in the case of the Leiden preparations is the changing meaning mercury had in medicine and chemistry in the long eighteenth century. Although often interrelated, for the sake of clarity I will subsequently discuss the chemical, and subsequently the medicinal, meanings and uses of mercury in this period, and show finally how they influenced the use of mercury as an injection mass in anatomical preparations.

Chemical mercury

To understand the changes in the materiality of mercury, we have to explore what mercury represented before 1700 and afterwards. As Pamela H. Smith has shown in her 2010 chapter on vermilion, mercury, blood, and lizards, early modern artisans understood the flow of blood and the flow of metal in similar ways, and sixteenth-century metalworking was part of a web in which vermilion, red, blood, mercury, gold, and lizards gave access to powers of nature, transformation, and generation. Mercury was traditionally associated with resurrection and transmutation.³³ In early modern alchemy, of which metallurgy was an important part, mercury played an essential role, together with sulphur. The idea that sulphur and mercury were the

³¹ Klein & Spary 2011, p. 9.

³² Also see Tompsett 1970, p. 10.

³³ Smith 2010, p.44-5, 47-8.

basic elements of all metals came from the works of Jabir Ibn Hayyan, which were translated from Arabic to Latin in the twelfth century.³⁴ Mercury was one half of the metaphorical chemical marriage between the royal couple of the red king (sulphur) and the white queen (mercury). These were principally philosophical concepts of sulphur and mercury, not identical to the material form of the two elements, but they drew on their physical characteristics.³⁵ Some alchemists even believed the copulation between philosophical sulphur and mercury produced the Philosopher's Stone, although how exactly that conjunction took place was far from straightforward.³⁶ The two elements of this metaphorical chemical marriage were opposites: sulphur was associated with dryness, fire and heat, whereas mercury was thought to be cool and wet, even to the extent that it was said to be found mostly in green, wet areas.³⁷

But how were these traditional chemical meanings of mercury significant for the late seventeenth- and early eighteenth-century Leiden anatomists, and for Anthony Nuck, the first known Leiden creator of mercury-injected preparations, in particular? That can only be understood through the epistemological transformations in the field that Newman has termed chymistry – the totality of chemical and alchemical technology and theory in Early Modern Europe.³⁸ Within this totality, alchemy denotes the chemistry of metals, and transmutational alchemy, or chrysopoeia, the transmutation of metals. These transformations, in full swing exactly when Nuck made his preparations, have been greatly clarified in recent historiographical work by Newman and Principe. Chemistry was, after all, not a discipline within the early modern university, although it was certainly also practiced by university-educated men. Concerned not only with the quest for the Philosopher's Stone, chrysopoeia (metallic transmutation; particularly making gold), but also with artisanal practices such as making pigments and medications, chemical practice was long situated mainly in monasteries, courtly, and medical circles.³⁹

Alchemists were alternately viewed as either wise men or quacks and frauds, as is illustrated by these two seventeenth-century paintings. [Ill. 34, 35] Whereas Van Ostade's alchemist is a laughable figure, burning away his last possessions in a messy

³⁴ Smith 2010, p. 39.

³⁵ *Ibid.*, p.40.

³⁶ Kavey 2007, p. 127.

³⁷ Smith 2010, p.47.

³⁸ *Ibid.*, p. 499.

³⁹ Newman 2006b, p. 498.

workshop, Teniers' alchemist is a respectable intellectual, a man of the world, (symbolized by the globe), consulting a book in a fairly organized studio workshop.⁴⁰ However, these contrasting and sometimes outright negative portrayals started to change in the course of the seventeenth century, when the alchemical emphasis on experimental analysis became increasingly important in natural philosophy and medicine. Methods for, and knowledge about, the purification of metals turned out to be indispensable for seventeenth- and eighteenth-century medicine and chemistry.⁴¹

For example, in the 1623 catalogue of the Leiden anatomical theatre, a coloured print of Breughel the Elder's *Alchemist* is listed, an image in which the alchemist is depicted as a money-wasting quack, destined for the poorhouse [Ill. 32].⁴² However, in 1669, the first chemical laboratory at Leiden University was established, 'to complement the medical faculty' and where the students could be trained in the 'operations and experiences of Chemistry'.⁴³ By the late seventeenth century, most natural philosophers used theories and experiments that originated in alchemy, but they wanted to distance themselves from certain associations alchemy also had with deceptive and secretive arts like magic and witchcraft.⁴⁴ Transmutational alchemy, the branch of alchemy concerned with chrysopoeia, was increasingly vilified by natural philosophers worried about their social status and reputation.⁴⁵ By narrowing their definition of alchemy to metallic transmutation, and defining chemistry as a new and respectable discipline, they aimed to incorporate it into academia, and indeed did so with eventual success. Newman has situated the real divorce between 'alchemy' and 'chemistry' in Lemery's conscious excision of 'alchimie' (metallic transmutation) from the 1679 third edition of his popular *Cours*

⁴⁰ Early modern humanists such as Erasmus and Petrarch even displayed a general disdain for alchemy, but others, like Agricola, recognized its potential in natural philosophy. The latter tried to 'purify' the term alchemy to its Greek root *chymeia* (probably derived from the word for smelting metals, *cheein*) by discarding the Arabic definite article *al*. This resulted in the sixteenth and seventeenth century in the alternate use of forms of both words, *alchemia* and *chemia*, sometimes even in the same text, without significant distinction in their meaning. (Newman & Principe 1998, p. 38).

⁴¹ Roberts 2005, Powers 2012, p. 141-169.

⁴² Barge 1934, p. 43.

⁴³ "Naedemale tot perfectie der medische faculteijt in deze Universiteijt noch ontbreeckt een laboratorium Chijmicum, waerdoor de studenten in operationibus et experiential Chijmica kunnen geoeffent werden; soo is bij den Heeren dese vegaderinge aangenomen, iemant te dispicieren, dewelcke een soodanigen laboratorium Chijmicum sal connen oprechten, ende also de ervarentheijt der natuerlicke operatien door het middel der Chijmie te demonstreren." Resolutions of the Curators, 8 August 1668, quoted in Jorissen 1909, p. 14.

⁴⁴ Moran 2011, p. 302.

⁴⁵ Principe 2011, p. 312.

de Chimie, and, by the first decades of the eighteenth century, natural philosophers were widely ridiculing ‘gold-making’ and portraying alchemists as frauds.⁴⁶ Yet chemistry was not incorporated into academic discourse without a struggle, and some of the chemists who publicly rejected chrysopoeia continued to pursue it privately, while others maintained that metallic transmutation was just a subset of chemistry, and as late as 1783 a claim that gold could be made through metallic transmutation was seriously investigated by the Royal Society.⁴⁷

These tendencies were noticeable within the Leiden academy as well. In his inaugural lecture of 1731, Gaub pleads for the incorporation of *Chemia* in the academic arts. In his address, he stressed that although chemistry, with its dirty hands-on experimental practice, seems far removed from the elegance of rhetoric, a visit to a chemical workshop (‘officinam Chemicam’) would make clear that chemistry does not delight the ears but the eyes, that here it is not words but demonstration that delivers facts. Gaub argued that philosophy and medicine are rightfully academic disciplines because they know and cure the body; chemistry can contribute to this by providing knowledge about the constitution of the material of bodies.⁴⁸ Seven years later, Abraham Kaau gave a declamation in Leiden satirizing alchemy, portraying the alchemist as greedy, secretive, stubbornly foolish, and diametrically opposed to the systematically working chymist, who aimed to acquire knowledge about the material world and did so openly.⁴⁹

In Leiden, the public defence of chemistry and ridicule of alchemy were the accumulation of a process that had started well over twenty years earlier, when Kaau’s uncle, the Leiden professor Herman Boerhaave (1668-1738), did not mock chemistry’s history, but apologized for it, as he was embarrassed by what he thought to be its excrescences (greed, silliness), but who also was excited about what it could mean for medicine and natural philosophy.⁵⁰ Therefore he was also propagating the new chemistry, in which mercury was still an important element. Boerhaave initially believed quicksilver to be a fixing principle of metallic bodies, without which all

⁴⁶ Knoeff 2002, p. 14-16, Newman 2006b, p. 511, Newman & Principe 1998, p. 39 Interestingly, art historian De Clippel also identifies the increasing incorporation of alchemy in natural philosophy in iconography in the Low Countries: around 1670, depictions of ‘alchemist’s workshops’ increasingly show studies filled with books and less laboratory-like settings with instruments than before. (De Clippel 2007, p. 35-7)

⁴⁷ Principe 2011, p. 306, Neumann 1766, p. 8, Fara 2003, p. 485.

⁴⁸ Gaubius 1907 (1731), p. 177-199.

⁴⁹ Kaau 1738, p. 6.

⁵⁰ Principe 2011, p. 305-306, Boerhaave 1718.

metals would be loosely floating particles. It was through studying elements like mercury that he could glimpse the perfection of the Creator. After all, the symbols for mercury and gold suggested that gold was a purified form of mercury – the purest metal actually possible.⁵¹

Boerhaave performed many experiments attempting to purify mercury, and through this chemical experimentation came to the conclusion that no mercury was 'fixed' into gold or silver, regardless of how long it stayed in the fire, how strong the fire was, or how many times it was distilled. It was through these experiments that he eventually changed his mind about the possibility of metallic transmutation.⁵² Boerhaave stated that 'it does not appear through these experiments that mercury and fire may form metals. Therefore fire... is not demonstrated to be the Sulphur of the Philosophers, fixing mercury into metal.'⁵³ This experiment and conclusion show that, although Boerhaave and his contemporaries distanced themselves from transmutational alchemy, they were still familiar with the traditional alchemical knowledge of metals and materials. They took from it the emphasis on analysis and the quest for the reduction of materials to their pristine state, and used these approaches to investigate traditional claims about the properties of materials such as mercury.

Hence the supposed complicity of vermilion red and white, sulphur and mercury, fire and water, in addition to the centuries-old association of blood and mercury, was still widely known by the late seventeenth and early eighteenth century. Although nowhere mentioned explicitly, these associations may well have been a reason for anatomists to choose vermilion red wax and silvery-white mercury to inject, respectively, the veins and lymph glands in anatomical preparations. It gave those preparations an additional elegance: not only do they look elegant, but their materiality may well have referred to old chymical and medical knowledge too. After all, according to the predominant Hippocratic humoral theory, the red blood was concocted (literally 'cooked') in the liver, it nourished the organs and was associated with hotness and dryness, whereas the function of the lymphatic system was largely a mystery, but with its mostly invisible contents and the milky fluid found in the chyle

⁵¹ Knoeff 2002, p. 144-6, 211.

⁵² *Ibid.*, p. 151.

⁵³ Powers 2007, p. 235, Boerhaave 1734, p. 162.

it might well have been the wet, cold, balancing opponent of the blood. What better way to show this than with red wax for blood and silvery mercury for the lymph?⁵⁴

For the medical men and anatomists occupied with exploring the lymphatic system and circulation of the blood, and the making of lasting anatomical preparations in the second half of the seventeenth century, an anatomical preparation injected with red wax and solidified mercury would therefore have been quite easy to read and use: red wax for the hot, red blood, mercury to visualize the otherwise almost invisible cold, wet, whitish lymph vessels. In the early eighteenth century transmutational alchemy was increasingly condemned in favour of the supposedly more academic, but actually hard to distinguish, chemistry. It is therefore not unimaginable that, at least for some anatomists, mercury, with all its transmutational connotations, at certain moments appeared to be less desirable as an injection mass. But at least before 1700, in addition to the suitable symbolism mercury provided to the anatomist, it had another material quality that made it a very appropriate injection mass – a quality that also made it popular in medicinal use.

Medicinal mercury

Apart from symbolical and philosophical meanings and metallurgic uses, mercury also had a long history as a remedy. Traditionally, mercury was used to cure skin eruptions and venereal diseases. Although its usefulness as a cure for syphilis was debated from the early eighteenth century onwards, for want of a more effective cure mercury continued to be prescribed for venereal diseases well into the nineteenth century. This ongoing use was rooted in the idea that the all-penetrating qualities of mercury would expel poisons and disease from the body.⁵⁵ Hence early eighteenth-century mechanistic professors of medicine and chemistry in Leiden also praised mercury for its purifying qualities: its particles were thought to cleanse even the tiniest canals of the body from misbalancing impurities.⁵⁶

⁵⁴ The chyle duct and its function were topics of heated debate in 1650s Leiden. See Luyendijk-Elshout 1974, p. 17-29. As appears from a description of the English 1712 catalogue of the Leiden anatomical theatre, mercury was incidentally also tried on preparations of other structures. On page 22 “*The Matrix, and a stone of a Man spowtid with quikzilber.*” is listed, but this seems to be an exception.

⁵⁵ Swiderski 2008, p. 7, 97.

⁵⁶ i.e. Nuck 1685, p. 37: “*Mercurius namque vel maxime exiguos glandularum canaliculos in tantum aperit, ut excretio fiat satis copiosa..*”.

However, by the mid-eighteenth century, it was already widely known that mercury could be dangerous too when used imprudently. For example, in the 1740 *Medicina Pharmaceutica*, published by the Leiden apothecary Johannes Schröder with a foreword by professor Gaub, mercury is said to induce drooling and is listed in different concoctions as a cure for ‘many vicious diseases’, but the author also warns that it can be extremely dangerous when used in the wrong way.⁵⁷ And in Houttuyn’s 1761 book on natural history it is noted that a dog that licks the saliva of someone who started drooling from a mercurial cure may die.⁵⁸ Yet mercury, either pure or combined with other substances, remained a standard ingredient in medication for decades to come. Gerard van Swieten (1770-1772) had studied with Albinus in Leiden in the 1720s and later became the personal physician of Maria Theresia of Austria; he is known to have experimented with making sublimated or purified quicksilver, and to have avidly prescribed it to syphilis sufferers during his years in Vienna. He also praised the accuracy of mercury-filled thermoscopes (thermometers), first made in 1724 by D.G. Fahrenheit.⁵⁹ In the 1805 *Pharmacopea Batava*, commissioned by the government and compiled by a committee led by the Leiden professor of anatomy Sebald Justinus Brugmans, a full six pages are still devoted to this substance which consists of ‘shiny, exactly spherical balls running everywhere’, and that ‘in the fire calmly and completely evaporates’.⁶⁰

So although mercury continued to be used as a drug well into the nineteenth century, it was clear from the middle of the eighteenth century onwards that using mercury was not without its side effects.⁶¹

Mercury as injection mass

As we have now seen, the materiality of mercury as an (al)chemical element and a drug with particular material, symbolical, and visual qualities, cannot be considered separately from its use as an injection mass in anatomical preparations by the late seventeenth century. Previously, historians have suggested that mercury ended up in the hands of anatomists after having first been used by their suppliers, instrument makers, and in experimental baro- and thermometers, but in the past decades it has

⁵⁷ Schroder 1985 (1741), vol. 1 p. 222, vol. 3 p. 153-4 .

⁵⁸ Houttuyn 1761, p. 67.

⁵⁹ Van der Korst 2003, p. 40, 173.

⁶⁰ Brugmans et al 1805, p. 22, 179-185.

⁶¹ Also see Dewhurst 1957.

become clear that modern professional categories fail to describe and understand early modern ways of knowing.⁶² Men like Ruysch, De Graaf, Swammerdam, Nuck and even Boerhaave were polymaths; all were (al)chemist, instrument maker, anatomist, physiologist, apothecary and medical doctor at the same time. Nuck himself praised mercury for its penetrating qualities in a 1685 work on the tear and salivary ducts:

*“Mercury opens the small canals of the glands so widely that secretion can occur abundantly. Once mercury has made itself part of the blood, divided into an innumerable quantity of small round particles, it easily adapts itself to every shape of the pores and shatters the sharp deposits of salts where they have settled. When they have been brought into motion, most of the obstructions are abolished, and when these are removed all the disease-generating substances are washed away through the salivary ducts...”*⁶³

Because of this penetrating and cleansing quality, mercury was thus both very suitable as the main ingredient of an injection mass, and as a medicine in clearing out all kinds of obstructions. On top of these curing qualities there were other, more allegorical, meanings inextricably attached to mercury: it was traditionally associated with resurrection, as quicksilver separates into numerous tiny, perfectly round balls but merges back into a perfectly smooth mass when these balls are captured together in a vessel or container.⁶⁴ And then there is of course the *god* Mercury, protector of merchants and thieves. Nuck referred to mercury on various occasions as ‘Noster Mercurius’, which Luyendijk-Elshout translated as ‘friend mercury’, but written with capitals, this term does not refer to common mercury (Hg), but to philosophical Mercury, the union between sulphur and argent vive or first mercury.⁶⁵ Moreover, Nuck used a rather elaborate analogy in his 1691 *Adenographia* to explain his work on the lymphatic system. He compared himself to a *Mercator* or seafaring merchant, sailing unexplored rivers of bodily fluids in order to discover unknown lands and

⁶² Luyendijk-Elshout 1974 p.156 suggests late 17th C. ‘research physiologists’ were introduced to mercury through the first baro- and thermometers, an idea refuted by the more recent works of i.e. Newman, Principe, Gallison and Daston.

⁶³ Nuck, 1685, p. 37, translation from Luyendijk-Elshout 1974, p. 159-160.

⁶⁴ Abraham 1998, p.125, Dobbs 1900, p. 21-22.

⁶⁵ Abraham 1998, p. 124.

treasures.⁶⁶ In addition, the planet Mercury was traditionally thought to influence the hands, the anatomists' most important instruments together with the eyes, and to be 'a bright star, a great source of eloquence, of subtle ingeniousness and of the fine arts, and the enemy of vanity'.⁶⁷ From this it appears that Nuck's reasons to try and use mercury as an injection mass were multiple and not all purely practical.

This becomes even clearer when the downsides to the uses of mercury as an injection mass are taken into consideration, some of which must have been immediately clear to Nuck and his contemporaries. Mercury's weight means that if a column of it builds up inside a vessel, it could easily rupture it if only even slightly too much of the mass was injected. Even if an injection was initially successful, it would remain very delicate, especially as long as the mercury mass had not dried, and handling it could cause the preparation to fall apart anyway. As noted before, injecting lymph glands with mercury was therefore something that not only required the right equipment, a sharp eye, and a lot of patience, but also hard won tacit bodily knowledge, a practical skill that is hard to describe in text. Just as he had taught Boerhaave, Nuck knew that early decay or artificial oedema helped in making the lymph glands easier to find. In order to fill the capillary lymph vessels ('saugadern'), he would look for a very small vessel and insert a tiny iron tube through which he inserted the mercury, mixed with tin or lead to ensure it would harden.⁶⁸ However, these kinds of descriptions would be of little help for someone wanting to make their own mercury-injected preparations. This returns us once more to an important aspect of aesthesis: tacitly. Creating a mercury-injected preparation is largely tacit bodily knowledge, something that can only be learned through endless practice and experience.

In general, seventeenth- and eighteenth-century how-to descriptions of injecting preparations, with mercury or otherwise, are few and far between. The descriptions that can be found tell us nothing about how much mercury should first be used, in which proportions to mix the mercury with other metals, and at which temperature to keep it in order for it to remain fluid during the process of injecting without scorching the preparation and allowing it to harden once inside the vessels.

⁶⁶ Nuck, 1691, p. 4.

⁶⁷ Bussagli 2007, p. 216, quotes from a fifteenth century Italian print of the spheres of Mercury: "*Mercurius di ragion lucida stella/produce d'eloquenza gran Fontana/subtili ingegni et chiaschun arte bella/ et è nimico d'ogni casa vana.*"

⁶⁸ Schultka & Göbbel 2003, p. 72-3.

Nor do they say anything about exactly what instruments to use, how much pressure should be applied, or how the finished preparations should be best handled. Many of these details may not have been consciously known by anatomists such as Nuck themselves, as they developed the technique by actually *doing* it. Even if the technical details about tools, mixtures, and temperatures would have been written down, simply just following these descriptions would not have guaranteed a successful mercury-injected preparation. Even Thomas Pole, writer of an exceptionally detailed 1790 handbook on dissecting and making anatomical preparations, warned the aspiring anatomist that

*“In making quicksilver Injections, the principal ingredients, and the first to be obtained, are time and patience, and not less so, an uniform fortitude against disappointments; for it will not unfrequently happen, that with the greatest care, a most promising preparation will be instantaneously destroyed by some trivial accident, when it has been almost completed.”*⁶⁹

As Pole also pointed out, a handbook of anatomical techniques could never be more than a guide; the only way to learn anatomy was through doing it.⁷⁰ The experimental character, the lack of description, and the difficulty of sufficiently describing such a procedure, combined with the notorious difficulty of injecting the lymph glands and the delicacy of the desired result, all stress the somatic tacit knowledge of injection practices. By somatic tacit knowledge, a term borrowed once again from Polanski and Collins, I mean that injecting anatomical preparations is the kind of knowledge comparable to riding a bicycle: it is something which can be explained in theory, but the only way to learn it yourself is to bodily involve yourself in it.

The combination of symbolical, chymical, and medical meanings and uses of mercury, and the bodily involvement required to learn how to inject mercury mixtures and create lasting preparations, fits very well with the combination of seeking beauty and the importance of sensory perception and materiality in aesthesis. Mercury as a material both ensured that anatomical preparations were elegant, refined artefacts. Especially for the initial makers of such preparations, such as Nuck, mercury-made preparations refer to a centuries-old body of the mystical and practical meanings of

⁶⁹ Pole 1790, p. 60.

⁷⁰ Pole 1790.

the substance, such as resurrection and purification, exploration and refined ingeniousness, as well as the possible structure and function of the lymphatic system that they demonstrated. The well-known impalpable character of mercury meant that the acquiring of the kind of somatic tacit knowledge needed to make a mercury-injected preparation became a way for an anatomist to prove his worth. In developing these skills, he showed he was well-versed in natural philosophy and chemistry, that he was able to use his sensory perceptions to gain knowledge of the body, to spread that knowledge in a beautiful, refined and perfect manner, and, last but not least, that he himself had also reached a level of perfection. Although the more symbolical and transmutational meanings of mercury became outmoded in the course of the eighteenth century, the material qualities of quicksilver meant it was never abandoned altogether as an injection mass for anatomical preparations. An anatomist who knew his injections techniques, especially those involving a material as hard to handle as mercury, was an elegant anatomist. This would prove to remain an objective for many years to come, although the means to reaching that goal were subject to change, as I will show in the following section.

Mercury and aethesis in Leiden anatomy between 1700 and 1771

What role, then, did mercury play in aethesis, and the anatomical practices and artefacts that were a part of it, in eighteenth-century Leiden? As mentioned before, Boerhaave in his lectures spoke admiringly of Nuck's mercury-injected, dried preparations of the lymph glands, and performed chemical experiments to establish the properties of mercury. As we have seen in the previous section, Nuck was familiar with mercury and its uses – not altogether surprising considering he started his career as an apothecary; his successors did not shy from using it as a drug either. In a 1740 reprint of his 1692 manual of surgery, cures, and healing for example, mercury is still listed as an ingredient of a concoction to remove sputums in the nose.⁷¹ It has even been suggested that Nuck's rather excessive use of his 'friend mercury' might have been the cause of his death after a short but severe illness.⁷² However, another, more contemporary, source states that while dissecting a dead body, Nuck cut open a lesion that was filled with a 'foul and malicious' matter, which attacked his heart and

⁷¹ Nuck 1740, p. 56.

⁷² Luyendijk-Elshout 1974, p. 158.

swiftly ‘cut his life cord’.⁷³ Hence after his death in 1692, Nuck’s colleagues and successors in Leiden and abroad initially continued to use mercury in preparations in their quest for knowledge, beauty, perfection, and elegance.

Few mercury-injected preparations from around the turn of the century survive however. This may have several reasons, such as the fact that even a finished mercury preparation is very fragile and thus easily damaged, but also could be due to the fact that the preparations are so difficult to make; the high price of mercury may have also contributed to this scarceness.⁷⁴ Nuck’s contemporary Ruysch, for example, used mercury injections rather sparingly in his many preparations, but he certainly appreciated its material and philosophical qualities. He wrote a treatise on the valves in the lymph glands when he was still a student (he graduated in 1664). Ruysch prepared his book by doing experiments in the years before 1665 to settle a long-running dispute among Leiden faculty and students.⁷⁵ He suspected there were valves in the lymph glands because he felt resistance when he was probing them with a small copper tube. In order to make them visible, he blew air into what he called the ‘water vessels’, and then dried his preparation in the sun and the wind. He then ‘saw the little valves, appearing like half-moons.’⁷⁶ Later in his career, Ruysch would use mercury to inject the smallest vessels, and there were allegorical references to mercury in his cabinets, like children’s skeletons holding serpents that bit their own tail.⁷⁷

Unfortunately, only one mercury-injected preparation made by Ruysch is known today. This preparation is now housed in the *Kunstkamera*, and Ruysch describes it as “Some membrane of which the arteries are filled with living mercury”, suggesting that in this case he had tried mercury as an enlivening injection mass.⁷⁸ There is a fairly straightforward explanation for Ruysch’s sporadic use of mercury as an injection mass. He probably found the silvery shimmer simply unsuitable for

⁷³ Overschuur in Nuck 1740, preface: “... door het Ontledigen eenes Doode-Lichaemes, waer in hy [ô droevig ongeluk!] een zekere blaesie kwam te openen, vervuld met een zeer kwaedaerdige en fenynige stoffe, die hem vervolgens nae het herte sloeg, den draedt zyns levens schielyk is afgesneden geworden....”.

⁷⁴ Chaplin 2005 p. 115, 143.

⁷⁵ Luyendijk-Elshout 1974, p. 34-9.

⁷⁶ Ruysch 1665, p.3-4.

⁷⁷ Abraham 1998, p. 181 mentions that “*The uroboros or paradoxical serpent, which devours its own tail and begets itself, is a symbol of the circular process of the opus alchymicum.*” Edward Kelly wrote of Mercurius: “*It is the wanton serpent that conceives of its own seed, and brings forth on the same day.*”

⁷⁸ Ruysch *Thesauri*, vol. 9, 1726, p. 39, no.94: “*Membrana Quaedam, cujus arteriae mercurio vivo sunt oppletae.*”

many of his preparations, as his objective was often to make them look as life-like as possible – something that could not be attained by using mercury. In Leiden too, the habit of making and collecting mercury-injected preparations established by Nuck continued for some time – although it did not seem to last.

Sometime between 1701 and 1707 the collections of Govert Bidloo (1649-1713), professor of anatomy at Leiden University from 1694 to 1713, were added to those of the Leiden anatomical theatre, and the 1707 visitor's catalogue is the first to mention a number of preparations kept in liquor, as well as preparations injected with mercury and coloured wax.⁷⁹ No makers are listed, but the mercury-and-coloured-wax preparations could also be part of Nuck's legacy. In the decade that followed, few preparations were added to the collection in the anatomical theatre, most of them curiosities such as shoes made of a man's skin and acquired by the keeper of the theatre, Gerard Blancken.⁸⁰ Only with the death of professor Johannes Jacobus Rau in 1719 was a substantive addition made again. Rau stressed the importance of gaining knowledge about the body through dissection, and making injected preparations, throughout his appointment, starting with his oration in 1713.⁸¹ However, he was weary of the kind of preparations his colleague and life-long competitor Ruysch made. In his oration he warned his students of a lack of naturalism in preparations in which artefacts were used, and Erndl, a Saxon physician who travelled through the Netherlands in 1707 and took classes with Rau, noted that when the students asked Rau his opinion of the preparation of the entire body of a boy of about eight years old kept by Ruysch:

"Mr. Raw [Rau] has said often, when we expected his Opinion concerning this Prodigy; that there was some wicked Arts us'd with the Boy, otherwise the Skin with the Muscles cou'd never have been so full of Blood, and kept their natural Colour".⁸²

In addition, when Uffenbach visited Rau's collection in his Amsterdam home in 1709, he remarked that many phials of the preparations were only half-filled with liquor – Uffenbach suspected Rau was too stingy to spend money on replenishing

⁷⁹ *Catalogues (1669-1753)*, 1707.

⁸⁰ *Catalogues (1669-1753)*, 1707, 1709, 1712, 1719.

⁸¹ Rau 1713.

⁸² Erndl 1711, p. 65-6.

them.⁸³ It is therefore not surprising that Rau's inheritance seems to have consisted mainly of instruments for cutting stones and bone preparations - Rau's specialities - and some preparations of the sensory and reproductive organs.⁸⁴ No mercury preparations were found in Rau's collection. In the 1720s, Bernard Siegfried Albinus, the young new professor of anatomy, a former student of Ruysch and Rau, catalogued and organized the newly-acquired collections. Meanwhile, he started working on his own preparations, which would later become the showpiece of the Leiden anatomical collections. In Albinus' work, the influence of his teachers was clearly visible. As we will see, his preparations in which lace sleeves and pieces of plants were used were clearly inspired by Ruysch, whereas his more austere osteogenetic preparations fit better within the tradition of Nuck and Rau.⁸⁵

Mercury injections did not seem to play a part at all in Albinus' preparations: none of his preparations mentioned in Sandifort's *Museum Anatomicum* have been injected with mercury. The only two mercury-injected preparations listed under his collections are, as we have seen, ascribed to Nuck, albeit doubtfully.⁸⁶ One of his students mentioned the use of a preparation of a mercury-injected testis during his lectures, but this seems to be an exception and might well be a legacy from either Nuck or Ruysch.⁸⁷ The almost complete absence of mercury preparations can be explained by the fact that Albinus' greatest research interests, such as osteogenesis, sensory perception, and the functioning and colour of the skin, required preparations in which mercury was of little use as an injection mass. As will be discussed in more detail in the next chapter, Albinus too strove to be an elegant anatomist, to reach perfection in all his work, but as his research interests were not the lymph glands, he chose to express his elegance, his skill, and quest for beauty, in coloured wax preparations and allegorical suspensions instead of mercury preparations. In Leiden, the first mercury-injected preparations to become part of the university collections after those made by Nuck were therefore those that first appeared in catalogues of the

⁸³ Von Uffenbach, 1753-4, vol. 3, p.621.

⁸⁴ Albinus 1725, 1943.

⁸⁵ See chapters 3 and 6.

⁸⁶ Sandifort 1793, vol. 1, p. 89, describes no. 407-408 (Albiniana) as follows: "CCCCVII. *Portio intestine cum portione mesenterii, vasis nonnullis mercurio impletis. Nuckii ut videtur. CCCCVIII. Portio intestine, cujus vasa lacteal impleta mercurio. A Nuckio, aut Swammerdamio, ut videtur.*" This suggests he was not entirely certain about the origins of these preparations either.

⁸⁷ Box MS UvA, f596, hs II G24-27.

collections in the second half of the nineteenth century, and appear to have been made by Eduard Sandifort.

Ruysch and Albinus showed little interest in using mercury as an injection mass, and between 1710 and 1760, we find no mentions of mercury-injected preparations in catalogues or elsewhere in the Leiden archives. Neither did anything new seem to happen in the field of lymphatic research. It appears the focus of anatomists had shifted to other topics, most notably the spirit of life or *vis vitalis*, and the sensibility and irritability of body tissue.⁸⁸ Was this the only reason no more mercury preparations seem to have been made for a while? Or was it also because making mercury-injected preparations was so hard, so time-consuming and expensive? Or were those five decades of relative quiet caused by the dubious transmutational and medical properties ascribed to mercury? It is hard to tell, as none of the Leiden anatomists, or their students and visitors from the period, appears to have explicitly denounced the making of mercury-injected preparations for researching the lymphatic system, but the temporary halt in the creation of mercury-injected preparations was probably due to a combination of all of these factors.

However, from the 1760s onwards, lymphatic research once more became a major topic. From the 1750s, Alexander Monro II (1733-1817) and William Hunter (1718-1783) had been in a public dispute about who first discovered the lymphatic vessels to be absorbent.⁸⁹ In 1760, treatises by Alexander Monro II and J.F. Meckel appeared, challenging Nuck's views on the lymphatic system, and marked the start of renewed, international attention upon the lymphatic system. Nuck and his direct successors had held the view that the lymphatic system was interconnected with the arterial system. Yet Monro II had noticed that in cases of inflammation, blood tended to bypass the lymph glands and flow directly into the smallest vessels. Meckel, who had specialized himself in the nerve system, set out to repeat Nuck's *Adenographia*. He once again used mercury to trace the lymph vessels, studied the nodes closely, and came to the conclusion that the lymphatic system was in fact an entirely independent entity, with a flow of its own.⁹⁰

⁸⁸ See i.e. Steinke 2005.

⁸⁹ Ambrose 2007. It was actually Francois Glisson who discovered this first, but his mid-seventeenth century publication on the lymphatic system did not resurface until Monro II and William Hunter had independently reached the same conclusion. Hunter stopped battling with Monro II the moment he realized that Glisson was actually the first to describe the absorbent properties of the lymphatic vessels.

⁹⁰ Monro & Meckel 1760, Luyendijk-Elshout 1974 p. 163.

The lymphatic system was back on the anatomical research agenda once again. The Italian Paolo Mascagni (1752-1815) also returned to the injecting techniques originally developed in the second half of the seventeenth century to study the lymphatic system. The result was an initial exploratory account published in 1784, followed by a magnificent atlas of the lymphatic system that appeared in 1787, and that would remain the authoritative guide on the subject for over a century.⁹¹ In the preface, Mascagni notes that he was inspired by Nuck's mercury injections to trace the lymph vessels.⁹² That mercury must also have been the material of choice once again was because its cleansing qualities fitted well with the newly discovered absorbent properties of the lymphatic system. This is precisely the period in which Eduard Sandifort also came of age, graduated, and was appointed professor at Leiden University.

Hence it is no surprise that there are so many anatomical collections from the second half of the eighteenth century that contain at least a few mercury-injected preparations, not only in the Leiden collections, but elsewhere in Europe. For example, in the 1778 catalogue of the sale of the private collection of the London surgeon and professor of anatomy Magnus Falconar, a fair number of the wet and dried preparations listed had been injected. Most of them apparently only with red and yellow wax, but of the preparations of the lymph glands, 13 out of the 16 preparation mentioned are explicitly described as having the lymphatic vessels injected with mercury. Mostly in these examples the arteries are injected with 'red' and the veins with 'yellow'. This also goes for the *Preparations of Glands*: all four preparations are said to be injected with mercury. Another section on lymph glands lists 14 mercury-injected preparations.⁹³ John Hunter was apparently so proud of the mercury-injected epididymes (the coiled tube on the back of the testicle) of a boar in his collection that he had it mounted in a gilded, glass-covered frame [Ill. 33].

The recurrent but incidental appearance of mercury-injected preparations, mainly of the lymph glands, in late eighteenth-century anatomical collections reconfirms a number of points. First, that this period saw a renewed interest in research on the structure and function of the lymphatic system. Second, that it was still very hard to create a proper mercury preparation: it required a lot of skill and

⁹¹ Mascagni 1784, 1787.

⁹² Mascagni 1787, p. 36.

⁹³ Paterson 1778, p. 13, 27.

practice to create one in which the lymph glands were made visible without making them burst. But if it worked however, the result was stunningly beautiful. Put one mercury-injected preparation on a shelf amongst a host of other preparations, and your eyes are drawn to its shimmer even from a distance. Third, that mercury was seen as an appropriate injection mass for lymph glands only: veins and arteries could better be injected with coloured wax-based mixtures, but the almost invisible lymphatic glands with their mysterious contents and function were best marked by an equally intangible, still slightly mystical substance like mercury. These qualities explain why mercury and its properties suited the first Leiden investigator of the lymphatic system, Nuck, so well. Albinus, although an elegant anatomist in all respects, chose not to use mercury because of his interest in entirely different research topics. And, as we will see, the material meaning of mercury was also the reason Eduard Sandifort returned to this injection mass by the late eighteenth century.

The meaning of mercury to Eduard Sandifort

The short historiography of researching the lymphatic system, and the mercury-injected preparations resulting from it, suggest it is very possible that the old mercury preparations in the Leiden anatomical collection are indeed Eduard Sandifort's work: it was a hot topic in his time and field, he had the means and skills to make them, and based on catalogue records, the preparations must have entered the Leiden collection somewhere between 1770 and 1860. What remains curious though is that there is no mention of them during Sandifort's lifetime, or of any attribution of these preparations to his own handiwork by any of his close successors, including his own son. Sandifort may have used the mercury preparations in his lectures on anatomy and physiology, but unfortunately no lecture-notes remain.⁹⁴ This section of my book explores the possible motives Sandifort had for making these preparations, as well as the reasons why he and his successors may have felt it was unnecessary to explicitly mention and attribute them to his person. In order to do so, it is first necessary to look at the circumstances under which he arrived in Leiden in 1771.

⁹⁴ Molhuysen 1924, VII, Bijlage p. 84: 13 Maart 1807 "*Prof. Ed. Sandifort heeft sedert den jare 1770 standvastig lessen gegeven: over alle deelen der Anatomie (zoo publiek als privaat), over de Chirurgie, over de Morbi ossium, over de Fundamenta Artis Obstetriciae, over de Physiologie.*" (Also notes that his son Gerard has taken over the private anatomy lessons and the demonstrations now.)

In 1769, Eduard Sandifort was a Leiden University graduate and practising city physician in The Hague. When he was appointed as lector of anatomy at Leiden University in 1771, he faced a number of challenges. B.S. Albinus died in 1771, and he and his aesthesis had dominated Leiden anatomy teaching for years. Although Albinus' anatomical cabinet had long been housed on university premises he did not bequeath it to the university and it thus became the property of his wife upon his death. Undoubtedly aware of the fame and value of the collection, she decided to turn it into cash and auctioned it off as a whole, together with her late husband's personal library, which was sold in parts. This caused a great stir among anatomists and gentlemen natural philosophers both in the Low Countries and abroad. Leiden University managed to acquire the cabinet for 6,300 guilders, a sum that today would equal about € 55,500.⁹⁵

In short, the Albinus cabinet, although skilfully crafted, was relatively old-fashioned with its lace-wrapped, perfect, non-pathologic specimens of hands and heads – not exactly what was needed for teaching in the ailing Leiden medical faculty. When Albinus had been appointed in the early 1720's, Leiden had been one of the outstanding centres in Europe for the study of medicine. However, fifty years later, with Boerhaave long dead, Albinus an almost blind old man, and Holland's glory as a seafaring nation in decline, student numbers faltered and the medical faculty was in dire need of modernisation. This also shows from several travel accounts. Poole, already in 1742, describes a visit to the university and laments Boerhaave's death, but does not even mention the anatomical theatre or collections, and also seems to be little impressed with the botanical garden.⁹⁶ An English traveller who visited the university in 1775 states that "...you must not fail to see the Anatomy-chamber", but adds this is mainly because that is where "they preserve the money of *Egypt*; *Pagan* idols, --foreign dresses, birds from *China*, &c, &c." Again, not a word about anatomical preparations.⁹⁷

So when Sandifort was appointed in 1771 as the successor of Albinus, he was facing a daunting task. Although hardly mentioned in histories of Leiden anatomy, Sandifort probably tried to lift both teaching and the collection up to modern standards while simultaneously attempting to do justice to the tradition of elegance.

⁹⁵ All calculations to current prices have been done using a historic calculator: <http://www.iisg.nl/hpw/calculate.php>, 22 July 2010.

⁹⁶ Poole, 1742, vol. 2 p. 72-75.

⁹⁷ Anonymous: *Holland*. 1775, p. 25.

This shows in his preparations, as well as in his management of the collections and his ideas on teaching. In terms of teaching, Sandifort was eager to adopt the latest insights in teaching and to include pathology. Well into the eighteenth century, disease had been considered a misbalance of the Hippocratic humours, and the prescription of drugs was aimed primarily at rebalancing these humours so health would be restored. From the middle of the eighteenth century, the idea that disease might be located in a certain body- part steadily gained ground, meaning that it became increasingly important for anatomists and medical practitioners to study diseased body parts. This shift obviously provided a great impetus for bedside teaching, post mortem research, and the creation of collections containing pathological anatomy.⁹⁸

In 1761, at the age of eighty, the Italian anatomist Morgagni published his *De Sedibus, et Causis Morborum per Anatomen Indagatis*, a plea for the critical, experimental investigation of the root causes of deformations and pathologies, which would be reprinted well into the nineteenth century. The book soon spread across Europe and led Sandifort to declare a new programme for medical teaching. Hardly a decade after Morgagni's book was published, he held his inaugural address in Leiden. In *De Circumspecto Cadaverum Examine Optimo Practic Medicin Adminiculo*, Sandifort stated it is impossible to learn practical medicine without the cardinal knowledge of pathology, to be obtained by the study of the body through dissection.⁹⁹ And not only was dissection necessary for learning anatomy, both normal and pathological, it should also always be paired with the seeking of the laws of nature through the use of the senses and of reason:

“They, the physician, servant and interpreter of nature, cannot reign nature if he does not know it, if he does not obey nature, even though they possess most knowledge. Observing, describing and obeying the laws of that same nature is what they exert themselves on, they spend their lives amidst experiments, and they strive with all their power to come to the utmost knowledge about diseased nature.”¹⁰⁰

⁹⁸ Konert & Dietrich 2003.

⁹⁹ Sandifort 1772, p. 6: *“Haec practicae medicinae Gubernatrix. Hac ad intimosabditosque organorum recessus paratur via, funestae morborum exponuntur clades, tutior patet curandi methodus, & accuratior instituitur prognosis, ubi fatorum mandata rescindere non licet.”*

¹⁰⁰ Sandifort 1772, p. 10: *“Hi, medicum, naturae ministrum & interpretem, naturae non imperare posse, nisi hanc cognoscat, nisi naturae obtemperet, optime gnari. ipsius leges observare, notare,*

From this statement it becomes clear that the use of sensory perceptions and reason were also required to gain knowledge about pathology; further, there had to be more observations than that of a single case, and they had to be compared both to similar occurrences and to healthy anatomy. This was a shift away from the humoral understanding of disease and deformation towards a more localized one. Nonetheless, logic and aesthesis were still combined by Sandifort to gain anatomical knowledge, whether it was normal or pathological, ugly, wonderful, or beautiful. He was the first to give detailed descriptions of a congenital heart malformation that would later become known as the teratology of Fallot, and his Leiden successor Teunis Zaaijer (1837-1902) listed him as one of the great anatomists of the eighteenth century, among Cassebohm, Meckel and Sömmering.¹⁰¹ But Sandifort also had his findings concerning pathologies not only registered in minute descriptions but also in drawings and engravings [Ill. 46, 47], which led the French pathologist Jean Cruveilhier (1791-1874) to describe him as the 'father of pathological iconography'.¹⁰²

Irrespective of the focus on pathology in his own research and teaching, Sandifort was a profound admirer and careful guardian of the Albinus collection. According to his son Gerard, his admiration for the subtle anatomical Albinus preparations was so great that he barely dared to practice it himself.¹⁰³ James Edward Smith, the founder and first president of the London Linnean Society, visited Leiden and met Sandifort during his tour of the continent in 1786. On that meeting, Smith wrote that 'Professor Sandifort shewed me the Anatomical Theatre, and the preparations of Albinus; the latter can be seen in his presence only'; an indication of Sandifort's protectiveness of the Albinus collection.¹⁰⁴ That Sandifort also tried to work in the same tradition of elegant, subtle anatomy as Albinus, also appears from how one of his Italian connections, the previously-mentioned anatomist Paolo Mascagni, described him: as the successor of the immortal Albinus.¹⁰⁵ Mascagni did so in his 1784 work on the lymphatic system, which he tried to make visible through

illis obsequy student, aetatem inter experimenta consumunt, & ad intimam morbosae naturae cognitionem pervenire, omni nituntur ope."

¹⁰¹ Zaaijer 1866 p.21.

¹⁰² Luyendijk-Elshout 1989, p. 319.

¹⁰³ Ibid., p. 312.

¹⁰⁴ Smith 1793, p. 15.

¹⁰⁵ Mascagni 1784, p.132.

mercury injections, inspired amongst others, as we have seen, by Anthony Nuck.¹⁰⁶

Eduard Sandifort himself left no explicit clues as to his mercury preparations, but in the foreword to the first volume of the *Museum Anatomicum* catalogue that he made upon the request of the board of curators of Leiden University in 1793, he states that Nuck in his time was said to be the most skillful in injecting the lymph vessels, and that he had traced all lymph vessels in the body – a bit of an exaggeration, but it had indeed been Nuck’s aim to do so – with mercury mixed with lead or tin so it would harden. Sandifort concludes:

“Hence it is surprising that now that this part of Anatomy has finally reached a height in our time, after it had not been appropriately studied and even completely neglected for a while, our contemporaries refuse the honour of this [the discovery of hardening mercury injections, MH] to this man [Nuck], while he himself very rightfully believed he deserved it.”¹⁰⁷

The resentful tone is a bit strange. Which contemporaries is Sandifort talking about? It certainly cannot be Mascagni; as we just saw, he praised both Nuck and Sandifort himself extensively in his 1787 treatise on the lymphatic system. But this quote does show that Sandifort felt it unjust that the admired Nuck preparations had disappeared from the Leiden collections, and that might explain why he decided to create mercury-injected preparations of the lymph vessels himself.

The materiality of the preparations also suggests that if they were made by Sandifort, he made an effort to make them resemble Nuck’s work as closely as possible. The first indication for this is the make-up of two preparations of mercury-injected, dried lymph vessels [Ill. 1, 2].¹⁰⁸ They are mounted on glass plates; originally those plates lay sunken into black-lacquered wooden boards that had to be destroyed in the late twentieth century for health and safety reasons. Because mercury was, and is, leaking from the preparations, the glass plates have been put in vessels and sealed of. But the original presentation is similar to the way Boerhaave described the display of Nuck’s late seventeenth-century lymph preparations: injected with a mercury

¹⁰⁶ Mascagni 1784, Introduction.

¹⁰⁷ Sandifort 1793, *Introductio*, p. xi.

¹⁰⁸ Ak0005 and Ak0006.

mass, dried, and mounted on lacquered wooden boards.¹⁰⁹

Then there are the wet preparations, that can be divided into two groups: those of entire organs in which the lymphatics have been marked with mercury¹¹⁰, and three of lymphatic vessels either in part of an organ¹¹¹ or entirely separated.¹¹² The preparation of a part of the liver [Ill. 5] seems a bit of an oddity, because it is the only preparation of the lymphatic vessels in a part of an internal organ, and not in an entire organ or of separated lymph vessels like the others. Unfortunately, its original phial has also been lost, leaving us with very little clue as to why it may have been made. As Nuck first described in 1691, and as I experienced myself when trying to make a preparation (see Appendix), the liver is a particularly grateful organ for preparation, as its minute structure of vessels gives a spectacular visual effect when injected, so it is not unimaginable that this liver was one of Sandifort's first successful mercury-injecting projects.¹¹³

Then we have the two mercury-injected preparations of lymph vessels from the belly [Ill. 6 & 7].¹¹⁴ Unlike the previously discussed dried preparations of lymphatic vessels and the description of Nuck preparations, these preparations have not been dried, but preserved in oil of turpentine, which makes the tissue extra transparent, stressing the shimmer of the mercury injections even more. They are still in their original containers, enabling us to compare them to other preparations made by Sandifort. The finish of these two preparations resembles others from the Sandifort collection: the phials are the same size and shape, the lids and seals appear to be the same material as on others: turpentine as preservation fluid, cork stoppers sealed with a grayish wax. Sandifort therefore most likely made these preparations, still inspired by Nuck's idea of isolating and injecting the lymphatic system, but choosing a preservation method less fragile than drying and mounting them on wooden boards.

Then there are still two more wet preparations of mercury-injected lymph vessels, but this time not of separated lymph glands but of those in a child's heart and a penis [Ill. 3 & 4, colour plate 1].¹¹⁵ Both these structures were also described by

¹⁰⁹ Boerhaave 1747, p.576.

¹¹⁰ A0007 heart of a child, A0008 penis.

¹¹¹ A0022 part of a liver.

¹¹² A0020, A0021 lymphatic vessels from the belly.

¹¹³ Nuck 1691, p. 144-5.

¹¹⁴ A0020 and A0021.

¹¹⁵ A0007 and A0008.

Nuck in his 1691 *Adenographia*, but he mentions nothing about injecting them – yet according to Ruysch the penis was one of the hardest structures of the body to inject successfully.¹¹⁶ Aloo08 seems to underscore this notion: the preparer has used too much pressure while injecting the glands, giving the entire *glans penis* a silver-plated look instead of only highlighting the miniscule vessels. Although the preservation method of these two preparations resembles that of the three Ag preparations, in a glass container with oil of turpentine, the phials are remarkably different in size and shape than the other Sandifort preparations. Moreover, these two have been sealed with what is most likely a slate plate and also a grey waxy lacquer, but with a very different shade of grey than the Ag preparations. Obviously this can also simply mean that Sandifort made these preparations in a different period, but it is also possible that he felt the differently shaped phials and the slate lids fitted better with preparations inspired by the work of his illustrious predecessor.

Finally there are two dry preparations, respectively of a piece of intestine and again a of child's heart, both injected with mercury and red wax.¹¹⁷ [Ill. 8 & 9] Given the pristine condition these two preparations are in, it is unlikely that they belong to Nuck. Sandifort listed a wax-injected, dried preparation of intestines ascribed to Swammerdam in the Albinus collection in Museum Anatomicum I, but there no mercury is mentioned, which makes it more likely that Sandifort made these two preparations as well.

Assuming that all nine mercury-injected preparations were made by Sandifort, why would he have done so and not have them subsequently listed as his work in the catalogues? As we have seen, it is very possible that this was somewhat of a private project for Sandifort, as it was not directly relevant for his main topics of research and teaching in Leiden – pathology and gross anatomy- but fitting for his admiration of the explorations and refined preparations of his illustrious predecessors, Nuck and Albinus. We have also seen that several aspects of aesthesis were important to Sandifort, such as gaining knowledge from sensory experience, materiality, hands-on practice, and reason, all directed towards working in a refined and elegant manner. It is in his mercury preparations that these factors come together most clearly, and it is not unlikely that he already started making them in the 1760s, when a renewed

¹¹⁶ Nuck 1691, p. 143, 147-8, Ruysch 1790.

¹¹⁷ Alo190 and a similar one without a catalogue number.

interest in lymphatic research arose; this may also have been why he kept them in his personal cabinet, showing them to interested colleagues and students every now and then.

The preparations clearly referred to his illustrious predecessors: he chose mercury injections in the style of Nuck, which by the 1770s seems to have had a dual function. On the one hand, research on the lymphatic system and its role in health and disease was far from completed, making mercury-injected preparations of the lymph glands of great interest once again. On the other, creating these preparations placed Sandifort firmly within the tradition that he called ‘elegant anatomy’.¹¹⁸ He went to quite some lengths to obtain his goals, even imitating the make-up of the lost Nuck preparations described by Boerhaave. Creating mercury-injected preparations Nuck-style must have been the ideal manner in which to continue the traditions of the Leiden anatomical collections for Sandifort. The use of a notoriously difficult preparation technique, and an injection material that was no longer immediately associated with obscure transmutational practices, guaranteed Sandifort was putting himself on a par with illustrious predecessors, while simultaneously working on a contemporary research topic. But by the late 1780s, when Sandifort was busy compiling the first volume of the *Museum Anatomicum*, research on the lymphatic system had peaked again.

Moreover, the University curators wanted catalogues listing the historical collections that were still deemed relevant for teaching, or due to their historical value, and new collections that showed how up-to-date Leiden University’s department of medicine was.¹¹⁹ No wonder that the small, eclectic, and slightly anachronistic collection of mercury-injected preparations of the lymphatic system, however pretty and refined, and made as a hobby by an anatomy professor famous for his work on pathology, was not mentioned in those catalogues - not even by his son and successor, Gerard Sandifort, over thirty years later in volumes 3 and 4 of the *Museum Anatomicum*. The 1827 third volume of the *Museum Anatomicum* primarily served to describe the newly-acquired collections of Bonn and Brugmans. Furthermore, in the preface to the fourth volume of the *Museum Anatomicum*, Gerard Sandifort states that in that work he has tried to list the most important specimens of pathological anatomy from the collection, with illustrations, claiming it

¹¹⁸ Elshout 1989.

¹¹⁹ A.C. 228, 26 April 1798. Transcription in Witkam 1968, appendix 38.

is pathology that is hardest to learn for the anatomist. After all, when dissecting, one can expect to encounter mostly normal anatomy, but with pathology, especially that of rare diseases, one cannot expect to learn through dissection only.¹²⁰ Although Gerard might have appreciated the few specimens of elegant anatomy his father made, and although they might have been housed in the anatomical theatre by that time, they were not part of the ‘core business’ of Leiden anatomy teaching around 1835.

Another reason no attention was paid to these preparations in the first decades of the nineteenth century may have been that by then mercury was becoming less popular with anatomists as an injection mass. Its penetrating qualities turned out to be a disadvantage in certain cases: mercury was found to break through the microscopic barriers between the lymph glands and the veins, leading to incorrect conclusions about their interconnections.¹²¹ Combined with the fact that mercury has to be mixed correctly with hardening agents in order to prevent damage to the finished preparation, due to temperature changes that cause the mercury to expand and retract, it would become increasingly unpopular as an injection mass in the course of the nineteenth century. These combined factors made the mercury-injected preparations created by Sandifort senior irrelevant for the listings in the last two volumes of the *Museum Anatomicum*. It is not likely that Sandifort junior omitted the preparations from the *MA* because he thought they referred to pre-eighteenth-century chymical symbolism. Mercury’s meaning changed in the course of the eighteenth century, losing, or at least loosening, its ties with many of its older, transmutational connotations. But mercury was still an accepted injection mass for anatomical preparations because of its material and visual qualities, as also shows from the previously mentioned ongoing listings of mercury preparations in eighteenth-century anatomical collections.

Besides, even though the downsides of mercury injections became more important in the nineteenth century, being able to inject lymphatic vessels with mercury remained a proof of skill. From the late eighteenth century onwards, the powerful group of practitioners who relied upon experimental skill and craftsmanship, like Eduard Sandifort, was steadily growing and stimulating the incorporation of hands-on experience in higher education, supported by

¹²⁰ G. Sandifort 1835, p. 1-2.

¹²¹ Knox 1836, p. 122, Cole 1921, p. 341-342.

administrators.¹²² But mercury injections were not for beginners: in his 1860 preparation handbook, Hyrtl remarks that it is ‘no job for students’, who ‘except in class have never seen lymph vessels, let alone that they wish profoundly to try and inject them’. According to Hyrtl, there are few anatomists who occupy themselves with this ‘specialism’.¹²³ Nonetheless, Dutch anatomists would continue to make elegant mercury-injected preparations well into the nineteenth century: Zaaijer described the mercury-injected preparations of his predecessor Halbertsma as ‘refined’ in his inaugural lecture of 1866, and former Leiden student Vrolik kept the tradition of injecting preparations with coloured wax and mercury alive until his death in 1880.¹²⁴ In this light, it is not surprising that, eventually, some of the elegant preparations made by Eduard Sandifort reappeared in a 1866 collection description by G.C.B. Suringar.¹²⁵

Conclusion

In this chapter I have shown the material aspects of the aesthesis complex of properties, experiences, and activities through an analysis of the use of mercury injections in anatomical preparations in the late seventeenth century and the second half of the eighteenth century. Eduard Sandifort’s reasons for creating mercury-injected preparations of the lymphatic system in the late eighteenth century stemmed from a deep admiration for the technical, practical injecting and preparation skills of his predecessors, and a wish to both be placed in the tradition of aesthesis in Leiden and to be a modern anatomist. The characteristics of aesthesis help us understand the eighteenth-century practice of injecting lymph glands with mercury. First, the silvery shimmer of mercury beautifies preparations of otherwise rather unsightly parts of body fabric. Following on from that, creating mercury-injected preparations was a hard-won skill, the kind of tacit bodily knowledge that can only be acquired through endless hands-on experience. That also suggests the last reason why the use of mercury fitted into the epistemic culture of aesthesis: these preparations are so refined and elegant, yet at the same time so undeniably a product of sensory experience and experiment combined with reason, that their beauty is not simply in

¹²² Klein & Spary 2010, p. 7.

¹²³ Hyrtl 1865, p. 655.

¹²⁴ dr. Laurens de Rooy, curator of the Amsterdam Museum Vrolik, pointed this out to me.

¹²⁵ Luyendijk-Elshout 1980, p. 318.

their shimmer, but in their unlikely material perfection, their deeper historical and symbolic meanings, and in the new knowledge they represent too.

Moreover, this chapter has made it clear that Eduard Sandifort's mercury preparations can only be understood through the history of the practice of using mercury as an injection mass for anatomical preparations; a history strongly intertwined with mercury's material meaning in transmutational alchemy, the latter's erratic removal from chemistry, and medicinal uses. Mercury was the injection mass of choice for the mysterious, difficult to locate, and supposedly cold lymphatic system. It was a fixing principle as well as a resistant, hard to handle material. Rooted in mid-seventeenth-century experiments and originally sought for its symbolic value, penetrating, resurrecting, and fixing qualities, as well as its attractive shimmer, mercury-injecting not only befitted aesthesis, but also referred to a host of historical and contemporary uses and meanings in medicine, mythology, and chemistry. Another reason for the popularity of mercury preparations, despite the difficulty of making them, was that they made it possible to permanently visualize a normally invisible and, until then, largely unknown bodily structure, the lymphatic system, which would have been difficult to make visible or accurately describe otherwise.

Injecting and discovering new structures could make the anatomist immortal, as Reinier de Graaf pointed out. Yet the immediate Leiden successors of Nuck, Ruysch and Albinus were occupied with other anatomical issues than that of the lymphatic system and thus created preparations with materials other than quicksilver. For their life-like preparations, coloured wax was a more appropriate injection mass, and they also needed other materials, like lace-rimmed sleeves, as we will see in the next chapter. Yet mercury-injected preparations of the lymphatic system were made, collected, and admired in many places throughout the eighteenth century. Thus it is no surprise that Eduard Sandifort picked up where his famous predecessor left off, and successfully tried to include himself in the tradition of elegant anatomy by creating and improving mercury-injected preparations of the, still largely mysterious, lymphatic system. After all, the miniscule lines of injected mercury in a preparation, now devoid of transmutational symbolism, remained a proof of the elegance of the anatomist who created it; of his refined taste, sense of beauty, and hard-to-match skill in making such a detailed and fragile object.

It turns out that the fact that Eduard Sandifort's mercury preparations were not listed in the *Museum Anatomicum* catalogues of the Leiden university anatomical

collection published by him and his son had practical reasons. When the first two volumes were published the preparations probably did not yet even exist, and the second two volumes, published after Sandifort senior died, simply had a different aim: they were meant to document the recently-acquired anatomical and pathological collections available for teaching at Leiden University, and not to give an overview of everything present in the Leiden anatomical collections. Because Sandifort's collections long remained largely undocumented private property, they were initially thought to be Nuck's. But they were in fact the latest products of aesthesis in early nineteenth-century Leiden, and creating mercury-injected preparations remained a proof of the skill and elegance of the anatomist well into the nineteenth century.

