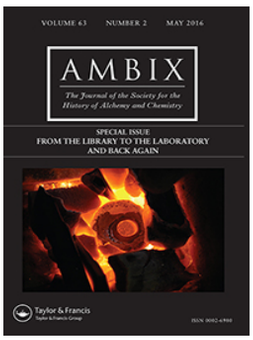

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ISSN: 0002-6980 (Print) 1745-8234 (Online) Journal homepage: https://www.tandfonline.com/loi/yamb20

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To cite this article: Nils-Otto Ahnfelt & Hjalmar Fors (2016) Making Early Modern Medicine: Reproducing Swedish Bitters, Ambix, 63:2, 162-183, DOI: 10.1080/00026980.2016.1212886

To link to this article: https://doi.org/10.1080/00026980.2016.1212886

Published online: 07 Sep 2016.

AMBIX, Vol. 63 No. 2, May 2016, 162–183

Making Early Modern Medicine: Reproducing Swedish Bitters

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Historians of science and medicine have rarely applied themselves to reproducing the experiments and practices of medicine and pharmacy. This paper delineates our efforts to reproduce "Swedish Bitters," an early modern composite medicine in wide European use from the 1730s to the present. In its original formulation, it was made from seven medicinal simples: aloe, rhubarb, saffron, myrrh, gentian, zedoary and agarikon. These were mixed in alcohol together with some theriac, a composite medicine of classical origin. The paper delineates the compositional history of Swedish Bitters and the medical rationale underlying its composition. It also describes how we go about to reproduce the medicine in a laboratory using early modern pharmaceutical methods, and analyse it using contemporary methods of pharmaceutical chemistry. Our aim is twofold: first, to show how reproducing medicines may provide a path towards a deeper understanding of the role of sensual and practical knowledge in the wider context of early modern medical culture; and second, how it may yield interesting results from the point of view of contemporary pharmaceutical science.

Apothecaries were positioned at an intersection of many key areas of early modern natural philosophy, such as medicine, botany, zoology, and chymistry. In pharmacy, these areas also intersected with everyday life, as is visible in the consumption of medicine, spiced foodstuffs, and beverages, as well as imported luxuries such as tobacco, tea, and sugar.[1] Obviously, pharmacy's regular handling of substances

[1] Harold J. Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven: Yale University Press, 2007), esp. 29–31, 141–42; Hjalmar Fors, "Medicine and the Making of a City: Spaces of Pharmacy and Scholarly Medicine in Seventeenth-Century Stockholm," forthcoming in *Isis* (2016); Rudi Matthee, "Exotic Substances: The Introduction and Global Spread of Tobacco, Coffee, Cocoa, Tea, and Distilled Liquor,

DOI 10.1080/00026980.2016.1212886

and produce made it a highly sensual endeavour. Just like chymistry, pharmacy produced a wealth of data concerning colour, taste, texture, and fragrance that early moderns needed to—and tried to—make sense of. Through such data we can get a better sense of the context in which pharmaceutical knowledge was produced, and increase our understanding of the key product of the pharmacy: early modern medicine. By gaining access to the sensual world and gestural knowledge of apothecaries, we may also obtain important insights into many unknown aspects of early modern medicine and natural philosophy, and learn how these areas of knowledge interacted with consumption and trading patterns, and how they penetrated the everyday lives of early modern Europeans.[2]

Maybe because it is too obvious, the sensual aspect of pharmacy has not received much attention in the history of pharmacy, and is mostly absent even in recent overviews.[3] Reproduction as a methodology can be an important tool to correct this deficit, as it focuses our attention on the materials, rather than just on the texts of pharmacy.[4] Reproduction or reworking may also be part of the solution to a conundrum that faces historians of medicine generally, namely: how did early modern medicine work in practice? Making medicine is a good test case compared to practices that may be ethically problematic and/or dangerous, such as performing surgical procedures or ingesting massive doses of laxatives. In a more narrow sense, our aim is to investigate pharmaceutical recipes as textual records of practices, to reproduce these practices, and to reconstruct the contexts in which they took part. In pursuing these aims, we hope to gain a deeper understanding of the role of medicinal/pharmaceutical preparation in the wider context of early modern culture.

Early modern compound medicines usually consisted of dozens, sometimes hundreds, of herbs and exotic spices. Although often ascribed wonderful healing properties by early modern authors, few today believe that such compositions have any particular medical effects beyond that of serving as placebos. This discrepancy in interpretation is a highly interesting historical problem that may be due to the fact that the skills involved in producing the medicines are left out of the argument. A related problem is that we do not know whether recipes and manuals give reliable

[1] *Continued*
Sixteenth to Eighteenth Centuries," in *Drugs and Narcotics in History*, ed. Roy Porter and Mikuláš Teich (Cambridge: Cambridge University Press, 1996), 24–51, on 29; Patrick Wallis, "Consumption, Retailing, and Medicine in Early-Modern London," *The Economic History Review*, New Series, 61 (2008): 26–53, on 27–29.

[2] Smell, taste and texture are, just like visual properties and epistemological concerns, important determinants of which scientific and medical objects turn into consumer goods. C.f. Dániel Margócsy, "A Museum of Wonders or a Cemetery of Corpses? The Commercial Exchange of Anatomical Collections in Early Modern Netherlands," in *Silent Messengers. The Circulation of Material Objects of Knowledge in the Early Modern Low Countries*, ed. Sven Dupré and Christoph Lüthy (Berlin: LIT Verlag, 2011), 185–215, on 213.

[3] Stuart Anderson, ed., *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals* (London: Pharmaceutical Press, 2005); Rudolf Schmitz, Christoph Friedrich, and Wolf-Dieter Müller-Jahncke, *Geschichte der Pharmazie Band 2: Von der frühen Neuzeit bis zur Gegenwart* (Eschborn: Govi-Verlag, 2005).

[4] The approach is related, but cannot be reduced to recent interest in materiality and objects that is usually referred to as the "material turn." See, e.g. Tony Bennet and Patrick Joyce, eds., *Material Powers: Cultural Studies, History and the Material Turn* (London: Routledge, 2010); Ursula Klein and E. C. Spary, eds., *Materials and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago: Chicago University Press, 2010); Pamela H. Smith, Amy R. W. Meyers, and Harold J. Cook, eds., *Ways of Making and Knowing: The Material Culture of Empirical Knowledge* (Ann Arbor, MI: The University of Michigan Press, 2014).

information about how the medicines people *actually took* were compounded. Similarly, the skills and practical experience of physicians and other healers are also often ignored. The tradition has too frequently and easily been judged by its worst practices and practitioners. At the same time, we know too little about what highly experienced and intelligent early modern physicians and healers were capable of.[5] Recipes and the handbook-literature associated with the craft give some instruction on what measures were taken to assess the potency of component substances and composite drugs, and how medicines were produced, preserved, and stored. But this is not enough if one is interested in the product, just as cookbooks without actual cooking are of little help to people interested in eating. Raw foodstuffs, a kitchen, and a good—or maybe even just an aspiring—chef are also needed. Without access to the kitchen/laboratory, we know almost nothing about how the sum of all skills involved in procuring, handling, and preparing substances affected the final products.

We have decided to study just one out of several thousands of early modern medical compositions: *Swedish Bitters*, a composite elixir with a bitter taste, fragrant smell, and brownish-black colour. This was considered a universal medicine, to which were ascribed the properties of warming the body and aiding the constitution, strengthening and renewing the limbs and the mind, preserving good health into old age, and functioning as an antidote to several specific diseases. Although the recipe has changed over the centuries, it is simple enough to follow, and easily located in the relevant pharmaceutical literature. The ingredients of Swedish Bitters are mostly medicinal simples of plant origin, such as saffron and gentian root. These were ground together, alcohol was added, and the mixture was left for a few days before it was filtered and ready to use.[6]

We chose Swedish Bitters as the subject of our investigation for several reasons. First of all, it is quite well-suited for a historical object biography. Its origins can be traced to a comparably well-documented time and place, and it quickly gained a broad European market. Thus it can be described as an early modern "blockbuster" drug that, furthermore, has experienced continued use as a medicine up to the present day. This process of dissemination and continuous usage is historically interesting for its own sake. Second, Swedish Bitters is a suitable subject for laboratory reproduction. It is possible to identify and obtain most of its component substances, and the process of compounding it is not overly complex compared to that of many other early modern medicines. Importantly, it is not dangerous to handle the components, and it is safe to taste and drink, at least in small quantities. Our third reason is that Swedish Bitters might be of interest also from the point of view of contemporary medicine. Recent studies have shown that several of its component plant substances have beneficial physiological effects on the human body. However, no systematic studies have ever been made of the effects of these substances when

[5] The situation is similar to that current in the history of alchemy no more than twenty years ago, when historians routinely dismissed the high levels of skill involved in practical alchemy (see the Introduction to this special issue).

[6] John Lindgren and Lauritz Gentz, *Läkemedelsnamn: Ordförklaring och historik* 1–2 (Stockholm: Svensk Farmaceutisk Tidskrift, 1986), 114–15.

taken in combination.[7] This last point, however, is something that we have to deal with in a future study. In keeping with the theme of the present collection, this article has a methodological focus. It follows rather strictly our efforts at establishing the compositional history of the medicine and making laboratory reproductions.[8]

We have proceeded by making use of three complementary methodologies. First, we have tried to make a "paper reconstruction" of Swedish Bitters: investigating the contextual background of the medicine, determining which recipes to use, establishing the identity of each component substance and which parts of plants to use, and so on. Second, we have sought to reproduce it in the laboratory, by establishing the pharmaceutical procedures, finding the necessary equipment and substances, and making the drug. Third, we have acquired historical samples of Swedish Bitters from museums and contemporary commercial manufacturers, and compared them to our own products by means of modern methods of analysis. In this paper we will address each of these methodologies in turn.

The many lives of Swedish Bitters

Swedish Bitters was first created either in the final decades of the seventeenth century, or sometime between the 1720s and 1740s. It gained widespread popularity as a universal medicine in the eighteenth century and entered a number of pharmacopoeia and recipe collections in the nineteenth. In this section we give a short overview of the major contexts of Swedish Bitters during its three hundred years as a medicine, and how these changing contexts have affected the medicine's composition.

Early modern physicians—as well as many other groups—often compounded and made use of their own medicines. Buying and selling medicines of secret composition could be a profitable business. Many physicians altered inherited formulae or recipes found in pharmacopoeias, and conducted more or less systematic experimentation in the laboratory and on their patients. In 1692, two Swedish physicians, Urban Hiärne (1641–1724) and Gustaf Lohrman (1640–1694), petitioned Charles XI, the King of Sweden, for a privilege to sell arcane remedies. They wanted, as they put it, to make available to the public the many medicines that they had discovered during their long careers as physicians.[9]

Here we find the first important context of Swedish Bitters, in the experimental pursuits of physicians of high social status. Both Hiärne and Lohrman were royal physicians and enjoyed the patronage of the Court. Both would in turn hold the position of President of the Swedish Collegium Medicum. Although they received the privilege they sought, Hiärne and Lohrman never began to produce medicines

[7] For the inherent potential of this line of research, see Christina Lee and Freya Harrison, "AncientBiotics—A Medieval Remedy for Modern Day Superbugs?," https://www.nottingham.ac.uk/news/pressreleases/2015/march/ancientbiotics---a-medieval-remedy-for-modern-day-superbugs.aspx (accessed 27 May 2016).

[8] Medical usages and early modern social and commercial contexts, in particular the global circulation of components, will be discussed in future articles.

[9] Lindgren and Genz, *Läkemedelsnamn*, 114–15.

privately.[10] Lohrman died only two years later, and Hiärne remained busy with other projects.[11]

Urban Hiärne is usually acknowledged as the inventor of Swedish Bitters. The original Swedish name of the composition, *Hiärnes Testamente* ("Hiärne's Testament"), comes with the story that the medicine was Hiärne's gift to mankind or, alternatively, that the beneficiaries were his own children, whose income would be secured by the sale of this remarkable remedy.[12] But was Hiärne the real inventor? His and Lohrman's petition stated that they would manufacture several specific remedies, not one. Hiärne's papers contain a list of twenty-seven medicines which he claimed to have invented. The petition included no recipes, but its description of the effects of two of these medicines indicates that they may have been of a similar composition to that of Hiärne's Testament (Swedish Bitters), although the effects of neither correspond to it precisely. Other medicines included tinctures of specific colours, volatile elixirs, a volatile balsam, a syrup, an essence for toothache, and so on.[13] Hence, if Hiärne invented the medicine, he kept it secret even in his own description of his inventions. This seems unlikely and hence another interpretation is that he just lent his name to the product.

In addition to being a physician, Urban Hiärne had been a famous alchemist, or perhaps more accurately, a seventeenth-century chymist, Paracelsian iatrochemist, and gold-maker.[14] These interests made him a credible inventor of a famous universal medicine. Two of his sons, Christian Henrik Hiärne (1709–1794) and Ulric Leonhard Hiärne (1712–1758), would build on their father's reputation to the best effect they could. In a letter, Daniel Tilas, a prominent mining official, provided a vivid description of Christian Henrik Hiärne, who was his maternal uncle:

> [H]e travels to and fro around the entire southern coast of the Baltic, and makes great miracles and strange cures. When the mood falls on him to be imposing and magnificent, he has money as if it were grass, equips himself at times with great carriages as an extraordinary ambassador, but sometimes pleases himself with small coupés, that the smallest of Öland ponies would be too big for; but on the other hand, when he steps down from his heights to perceive the depths, then he is so destitute that he goes home to sell all his pretensions for a few farthings for his sustenance. He understands the correct power of imagination, and can, with a mere thought, so torture and quench his enemy, that he would think himself enduring a hellish torment, and he is so strong when it comes to thinking, that he can allow his absent friend to partake of his emotions … In addition,

[10] They knew each other well, and had, together with a small group of other Stockholm physicians, pursued laboratory work during the years 1680–1682. The work came to an end due to the death of a third partner, Dr Gregoire Francois Durietz, in 1682. According to Hiärne, it was he who had been the primary force behind the cooperation. Urban Hiärne, "Bilaga 2. Een kort Berättelse, Om det Konungl: a Laboratorij," in Axel Key Anteckningar rörande Urban Hjärne MS 812 Hagströmerbiblioteket.

[11] On Hiärne's projects and tasks, see Hjalmar Fors, *The Limits of Matter: Chemistry, Mining and Enlightenment* (Chicago: University of Chicago Press, 2015), 49–50; Sten Lindroth, "Urban Hiärne och Laboratorium Chymicum," *Lychnos* (1946–47): 51–116, on 57.

[12] J. V. Broberg, "Om 'Hjärnes testamente,'" *Hygiea* 42:5 (1880): 283–86, on 284.

[13] Axel Key Anteckningar rörande Urban Hjärne Ms. 812 Hagströmerbiblioteket. "Bihang till Urban Hiärnes Relation till Kongl. Majt. om Laboratorium Chemicum."

[14] For a discussion of terms and of Hiärne's chrysopoetic agenda, see Fors, *Limits of Matter*, 11–12, 60–64, 70–72.

> he knows how to speak deeply using the most dark words about the secrets of nature, hence I know no other conclusion from all this, except that he is an adept.[15]

Tilas's description of Christian Henrik as "making strange cures" fits the bill for the inventor of a universal medicine. However, Christian Henrik published a description of his compositions in 1739 in his *Huus- och Rese- Apotheque* (*Home and Travel Pharmacy*). In the preface, Christian Henrik made a point of stating that he was privy to the laboratory work of his famous father. Again, Hiärne's Testament (Swedish Bitters) is not mentioned among the sixteen remedies presented and, again, two of the listed medicines cover the alleged effects of the "testament" rather well.[16]

This brings us to the third possible inventor, Ulric Leonhard Hiärne. In a 1772 letter to the President of the Swedish Collegium Medicum, he was described as "travelling around the country with his bottles." These were, we may presume, filled with Swedish Bitters, each containing one *uns* (= 30 grams) of liquid at a cost of six copperthalers each. Ulric Leonhard was also warned by the Collegium Medicum against proclaiming his own medicines as more effective than those sold by apothecaries.[17]

We cannot at this point ascertain which one of the three men invented the composition: Urban, Ulric Leonhard, or Christian Henrik Hiärne. Nevertheless, it was the latter two, or perhaps just Ulric Leonhard, who made the Bitters famous through travelling salesmanship in Sweden and Germany. Here, therefore, we find the second important context of Swedish Bitters, namely that of itinerant sellers of medicine, mountebanks, and vendors of miracle cures.[18]

Let us now turn to the content and composition. The recipe that may be the oldest copy is contained in a manuscript entitled "Count Bonde's own trials in medicine," a collection of recipes that can be securely dated to the period 1751–1764.[19] A second and possibly older manuscript is known, which was published by J. V. Broberg in *Hygiea* in 1880.[20] Judging from the handwriting and spelling, Broberg dated it to the 1730–1750s. It lists the same ingredients as Bonde's but with a difference in the quantity of agarikon. Both compositions are listed in Table 1.

As is evident from Table 1, the medicine consisted mostly of simple components derived from the plant kingdom. The plant substances were to be ground together in a mortar and mixed into good quality alcohol (*bränvin*) together with one part of theriac, a famous and highly complex antidote and universal medicine

[15] Daniel Tilas, *Till Herr Axel Fredrich Cronstedt tilläggning til des historie om mystiska naturkunnigheten. Stockholm den Junij 1758*, Bergskollegiums arkiv, huvudarkivet D 6:3, Riksarkivet.

[16] [Christian Henrik Hjärne], *Huus- och Rese- Apotheque: Anno 1739* (Stockholm: Peter Hesselberg, 1764), [12–13]. Broberg observes that his contemporaries did not credit C. H. Hiärne with the invention of Swedish Bitters: Broberg, "Om 'Hjärnes testamente,'" 283.

[17] J. O Hagström to Abraham Bäck, 3 August 1772, quoted in Lindgren and Genz, *Läkemedelsnamn*, 115.

[18] Roy Porter, *Quacks: Fakers and Charlatans in English Medicine* (Stroud: Tempus, 2000).

[19] "Gref Bondes egna försök i Medicinen," MS 324 Hagströmerbiblioteket. Gustaf Bonde (1682–1764) was a prominent politician, alchemist, and hermetic philosopher. Many of the other recipes are collected from and attributed to acquaintances of Count Bonde, including Magnus von Bromell, Hiärne's successor as director of the *Laboratorium Chymicum* at the Bureau of Mines. Hiärne's Testament is discussed on 106–7.

[20] Broberg, "Om 'Hjärnes testamente.'"

TABLE 1

INGREDIENTS IN HJÄRNES TESTAMENT ACCORDING TO BONDE AND BROBERG

Aloë	2 lod (26.4 g)	2 lod (26.4 g)
Crocus (saffron)	1 quintin (3.32 g)	1/4 lod (3.32 g)
Rhabarber (rhubarb)	1/2 lod (6.65 g)	1/2 lod (6.65 g)
Agarikon	1/4 lod (3.32 g)	1/2 lod (6.65 g)
Ceduar	1/2 quintin (1.66 g)	1/8 lod (1.66 g)
Theriac Andromachal.	1/2 lod (6.65 g)	1/2 lod (6.65 g)
Gentiana	1/2 quintin (1.66 g)	1/8 lod (1.66 g)
Myrrha (myrrh)	2 lod (26.4 g)	2 lod (26.4 g)
Brännvin (vodka)	1 stop (1.3 l)	
Sokker (sugar)	8 lod (106 g)	1/4 skålpund (106 g)

Source: "Gref Bondes egna försök i Medicinen," MS 324, Hagströmerbiblioteket, and Broberg, "Om 'Hjärnes testamente.'"

attributed to important classical authorities. As no recipe was given for the theriac, we may safely assume that it was to be bought ready made from a pharmacy.

Invented during antiquity and continuously used throughout the middle ages, theriac became subject to revision and reformulation by apothecaries and humanists working on classical botany in the mid-sixteenth century. By 1568, the new product was "hailed as equal to that made by Galen for the emperors."[21] In all likelihood, the theriac used in Swedish Bitters derived its composition from the *Pharmacopoeia Augustana* (1st ed. 1564). The *Augustana* was widely used in Sweden, and its recipe for theriac was copied into the first Swedish Pharmacopoea from 1686, *Pharmacopoeia Holmiensis*.[22] This theriac contained sixty-four ingredients as listed in Table 2.

From the late seventeenth- and early eighteenth-century point of view, there is nothing outlandish about the ingredients of Swedish Bitters. There are no advanced pharmaceutical operations involved in the composition, and no chymical operations such as distillation, or methods considered typical of Paracelsian or chymical medicine. It had the hallmarks of a traditional Galenic medicine, relying as it did on a wide selection of botanicals from the Mediterranean, as well as from tropical parts of the world.[23] Essentially this was a rather conservative product, little more than an alteration of the proportions of theriac, the most famous of universal medicines.[24] A comparison of Swedish Bitters (Table 1) with the "Theriac

[21] Richard Palmer, "Medical Botany in Northern Italy in the Renaissance," *Journal of the Royal Society of Medicine* 78 (1985): 149–57, quotation on 152; Christiane Nockels Fabbri, "Treating Medieval Plague: The Wonderful Virtues of Theriac," *Early Science and Medicine* 12:3 (2007): 247–83, on 252–58; Robert Leigh, *On Theriac to Piso, Attributed to Galen* (Leiden: Brill, 2016), 125–31; Schmitz, Friedrich, and Müller-Jahncke, *Geschichte der Pharmazie, Vol. 2*, 203–6.

[22] *Pharmacopoeia Augustana* (Rotterdam, 1653), 400–2; *Pharmacopoeia Holmiensis: Galeno-Chymica* (Stockholm, 1686), 48–49.

[23] Patrick Wallis, "Exotic Drugs and English Medicine: England's Drug Trade, c. 1550–c. 1800," *Social History of Medicine* 25 (2012): 20–46, on 21.

[24] Theriac's reputation even reached China: Carla Nappi, "Bolatu's Pharmacy: Theriac in Early Modern China," *Early Science and Medicine* 14 (2009): 737–64.

TABLE 2

THE SIXTY-FOUR INGREDIENTS OF THERIAC

Animal origin: powder of viper, castoreum [dried preputial follicles of the beaver], honey.

Herbal origin: Sea squill, Long pepper, opium, trochists (medical cakes made of sugar and melted cocoa), dried red roses, iris, licorice, caraway seed, two types of water germander, Peruvian balsam, two types of cinnamon, agaric, myrrh, zedoary, saffron, spikenard, camel grass, frankincense, black pepper, white pepper, dittany, white (common) horehound, rhubarb root, lavender, parsley seeds, catmint, pink peppercorn, ginger, indigo plant, wild ginger, liquid ambar orientalis, angelica root, amomum, turmeric, nard, valerian root, indian cassia, gentian root, anise, *cytinus hypocistis*, cubeb pepper, gum Arabic and acacia senegal, fennel, cardamom, brittle willow, alpine pennygrass, St John's wort, fruits of Bishops flower, Sagapenum, birthwort, wild carrot seeds, opoponax, centaury, galbanum.

Mineral origin: Lemnian earth, [Silicates of aluminium, magnesium, and iron], chalcitis ("burnt copper"), Dead Sea bitumen (asphalt).

Source: "Theriac Andromachi Senioris ex Galeno," *Pharmacopoeia Augustana*, 400–402; "Theriaca," *Pharmacopoeia Holmiensis: Galeno-Chymica*, 48–49. Underlined substances also appear as simple plant substances in the formula for Swedish Bitters (see Table 1).

Andromachi Senioris ex Galeno" of the *Pharmacopoeia Augustana* and the theriac of the *Pharmacopoeia Holmiensis* (Table 2) shows this clearly. Agaric, myrrh, zedoary, saffron, rhubarb root, and gentian root (underlined in Table 2) appear in both recipes. Aloë alone was not part of theriac. This too was a rather cautious addition. Aloë was a popular and widely used drug in the seventeenth century. It is, for example, present in 18.4 per cent of the recipes in the 1686 *Pharmacopoeia Holmiensis*.[25]

Although we cannot know for certain that this was the composition sold by Christian Henrik and/or Ulric Leonard Hiärne, it would have functioned very well as the type of universal medicine hawked at markets. Swedish Bitters relied on components that were available in any well-stocked European pharmacy, and was easy to make; both good properties in a medicine hawked by an itinerant seller.[26] In addition, the presence of the sixty-four components of theriac along with the seven main plant components would have made it more difficult for a trained apothecary to sniff out individual substances, making it virtually impossible to produce a perfect copy without access to the recipe.

Nevertheless, by 1777 the recipe seems to have been sufficiently well known among Swedish physicians and apothecaries that it was included under the name of *Elixir Amar[um] Hiern[ei]/Hierners Elixir* in the official Swedish pricing list of medical treatments and pharmaceuticals. Later it was included in several German pharmacopoeas, such as *Ph. Borussica in* 1829, where it appeared under the name *Elixir ad longam vitam*. It was also included in *Ph. Helvetica* and *Ph. Russica*.[27]

The recipe for Swedish Bitters would undergo a major change as it moved from the context of itinerant selling of a universal medicine to that of a standard pharmaceutical product. The 1775 *Pharmacopoea Svecica* contained a major alteration of

[25] *Pharmacopoeia Holmiensis.*

[26] William H. Helfand, *Quack, Quack, Quack: The Sellers of Nostrums in Prints, Posters, Ephemera and Books* (New York: The Grolier Club, 2002), 15.

[27] *Kongl. Maj:ts nådiga medicinal-taxa; Gifven Drottningholms Slott then 6 Augusti 1777* (Stockholm: Kongl. Tryckeriet, 1777) [23]. Other names were *Tinctura Aloës composita med syn.*, *Elixir ad longam vitam*, *Elixir amarum Hjaerneri*, *Elixir suecicúm*, and *Tinctura sacra*, as well as the popular names *Werners Lebenselixir*, *Jernitz' Schwedisches*, *Schwedentrank*, *Alter Schwede*, and *Balsam švedský*. Lindgren and Genz, *Läkemedelsnamn*, 115.

TABLE 3

COMPARISON BETWEEN THERIAC IN PHARMACOPOEA SVECICA 1775 AND HJÄRNE'S TESTAMENT (SWEDISH BITTERS) IN G. BONDE'S RECIPE BOOK

Theriaca	Hjärne's Testament/Swedish Bitters
Angelica root 29.7 g	
Gentian root 209.3 g	Gentian root 1.66 g
Valerian root 89.1 g	
Zedoary root 29.7 g	Zedoary 1.66 g
Cardamom 29.7 g	
Myrrh 29.7 g	Myrrh 26.6 g
Saffron 29.7 g	Saffron 3.32 g
Opium 29.7 g	Agarikon 3.32 g
	Rhubarb 6.65 g
	Aloë 26.6 g
	Theriac Androm. 6.65 g Sugar 106 g
Elderberry syrup 2241 g	Alcohol (Brännvin) 1.3 l.

Source: *Pharmacopoea Svecica* (Stockholm: Henr. Fougt, 1775), 193–94; "Gref Bondes egna försök i Medicinen," Hagströmerbiblioteket MS 324.

the recipe for theriac, reducing the number of ingredients from sixty-four to nine.[28] Consequently, the recipe for Swedish Bitters changed too, as it continued to be made with one part of pharmacy-made theriac. The similarities between the 1775 Pharmacopoea Svecica recipe for theriac and that for Swedish Bitters are also significant, as illustrated in Table 3.

As seen in Table 3, four of the ingredients in Hjärne's Testament (Swedish Bitters) are similar to those of the 1775 theriac. The latter is strongly dominated by angelica root, gentian root, and valerian root, which constitute eighty per cent of the solid herbal ingredients. In Hiärne's Testament, on the other hand, the dominating ingredients aloë and myrrh constitute more than sixty-nine per cent of the herbal content. The significant reduction of the number of components in theriac meant that Swedish Bitters now was more similar to the original sixty-four-component theriac than the medicine then being sold at pharmacies under the name of theriac. This may to some extent explain the popularity and reputation of Swedish Bitters. Its status as a variety of theriac and universal remedy in its own right would become even more pronounced as many subsequent renderings of the recipe would simply omit the mention of theriac, and mixed the angelica, gentian, and other ingredients straight into the compound according to the proper proportions.

The new version of Swedish Bitters was stocked in pharmacies well into the second half of the twentieth century. By then, apothecaries were becoming increasingly uneasy with the product, which was considered old-fashioned and probably

[28] *Pharmacopoea Svecica* (Stockholm: Henr. Fougt, 1775), 193–94.

useless. In 1965 the *Socialstyrelsen*, the Swedish National Board of Health and Welfare, decided that it should no longer be sold in a standardised packaging, although it was still permissible for apothecaries to sell it by weight. In an 1964 article in *Svensk Farmaceutisk Tidskrift*, the editor of the journal explained that although it would be difficult to come to grips with the fundamental trust that the public held in medicines such as Swedish Bitters, it was clear that they had no place in rational medical therapy.[29] Swedish Bitters was subsequently phased out, although it continued to be sold in Swedish pharmacies as late as 1986. Hence, modernist sentiments and ideology (rather than clinical trials) put an end to its career as a standardised product, and would eventually curtail its popularity. Nevertheless, few seventeenth-century medical compositions have been as successful in the long-term as Swedish Bitters, at least in terms of popularity and sales. It may be the only early modern composite medicine of European origin still widely consumed as a medicine today. As sales were curtailed in pharmacies, the composition migrated to health stores, where it can be found today in such diverse places as Continental Europe, Australia, and Barbados. Numerous versions are, of course, available for sale over the Internet.[30]

As we have seen, Swedish Bitters may or may not have had its beginnings in pharmaceutical experiments among late seventeenth-century court physicians. It was established as a cure-all in the eighteenth-century medical market and subsequently adopted into numerous official pharmacopoeas during the late eighteenth and early nineteenth century. In this way it became a standardised product sold in pharmacies well into the second half of the twentieth century. Finally, in becoming a health supplement, it returned to the more unregulated medical market that had made its reputation. During each phase the recipe—but also the meaning, interpretation, and context of the medicine—shifted. What then, is it that we are supposed to reproduce?

Getting our stuff together

Our project is a collaboration between a historian of science (Fors) and a research pharmacist (Ahnfelt). This dual competence has been significant for the planning and execution of our reproduction work. Some craft skills have not changed over the centuries, and as Ahnfelt already had experience of compounding pharmaceutical preparations, we did not need to worry about inept weighing and handling of substances. Another problem was that the eighteenth-century recipes for Swedish Bitters contain a small quantity of opium as well as several other active medical substances, in particular powerful laxatives. Therefore it was necessary for us to conduct at least part of our work in a secure laboratory environment which held the necessary permits. Here Ahnfelt's position as a trusted actor in the Swedish community of research pharmacists became a key

[29] Rune Westerling, "Hjärnes testamentes droppar," *Svensk farmaceutisk tidskrift* häfte 36 årg. 68 (1964): 1009–10.
[30] See, e.g. http://www.herbalsupplies.com.au, https://www.swedishbitters.com, http://www.schwedenbitter.de (accessed 1 May 2016).

project asset. Although our project is formally connected to the Department for History of Science and Ideas at the Faculty of Arts, Ahnfelt was graciously offered work-space and access to equipment at the Division for Pharmacognosy at Uppsala University's Faculty of Pharmacy, as well as regular coaching by the head of the division, Ulf Göransson. This connection in turn opened up supply chains, making it possible for us to order many of our substances from the university's regular suppliers of pharmaceutical herbal products.

With much of the infrastructure and necessary skills in place, it remained for us to research the recipe history of Swedish Bitters (as outlined in the previous section), and to decide which version of the medicine we would compound. To avoid an impasse, we decided to begin by making a very simple version of Hiärne's Testament by modern methods, and then produce several more versions, increasing the level of complexity and incorporating historically accurate working methods as we went along. This strategy would lead to several versions of our medicine, each of which could be compared with the others by means of smell, taste, and touch, as well as through modern analytical methods.

Our first version of Hiärne's Testament was produced using a standard modern procedure, and could be compounded quickly. We used the recipe as given in Broberg (see Table 1), which was the oldest recipe known to us at the time. Plant components were purchased from a pharmaceutical supplier along with a modern composition of theriac, supplied by the same company. Components were ground up individually in a large porcelain mortar supplied by the Division of Pharmacognosy. Each component was mixed with laboratory grade ethanol diluted to forty per cent (by vol.), left to rest for six days, and filtered. Plant extracts were then mixed together in the correct proportions to make our first batch of finished elixir.

Upon evaluating our procedure, we realised that several modifications were needed with respect to substances, equipment, and procedures.

Substances

A major skill of the early modern apothecary was knowing how to evaluate substances by means of smell, sight, taste, and touch. These evaluations served to indicate the quality of an ingredient, including the conditions in which it was grown, harvested, and transported; its age and reasonable shelf-life; whether it had been adulterated; and (perhaps most importantly) whether it should be used or destroyed. Quality expressed both monetary value and healing virtue, and was reflected in the visual appearance, taste, and smell of the composite medicines that were created from simples.[31] In a more precise medical sense, smells were understood to carry

[31] India Mandelkern, "Taste-Based Medicine," *Gastronomica: The Journal of Critical Food Studies* 15:1 (2015): 8–21, on 10–13; J. P. Griffin, "Venetian Treacle and the Foundation of Medicines Regulation," *British Journal of Clinical Pharmacology* 58:3 (2004): 317–25, on 318–23; Fors, "Medicine and the Making of a City."

the qualities (hot, cold, wet, dry) of substances from which they emanated. Hence smells could cause disease, but also act as healing agents.[32]

After handling dried plant material of different types it became immediately obvious to us that the sense of smell must have been the most important tool of the early modern apothecary, both to ascertain and to advertise the quality of ingredients. The small room in which we unpacked purchases from our pharmaceutical supplier quickly began to smell significantly different from all other rooms at the division.

While the smell of pharmaceutical museums differs little from that of any other building, someone entering an early modern pharmacy would have been transferred into another world by the odours present there. Furthermore, attentive visitors would probably have been immediately able to ascertain whether the inventory was fresh and in regular circulation, or had been sitting on the shelves for a very long time. Similarly, an experienced early modern apothecary must have been able to immediately ascertain whether a product was sufficiently fresh by means of the sense of smell. For instance, certain substances, such as high-grade medicinal rhubarb, have a strong, almost overpowering smell, while others are more subtle. Myrrh, on the other hand, does not smell much until its aroma is released by being rubbed between the fingers.

Pharmacopoeias and other sources often provide exhaustive lists of ingredients that can be identified with comparable ease by cross-checking names with those found in pharmaceutical works of the post-Linnean era. However, single modern chemical and botanical terms rarely suffice to explain the complexity of the early modern ingredient. Growing conditions, collection, preservation, and transport practices have changed dramatically.[33] Some of these changes may have yielded improvements in quality, while others seem to have decreased quality and potency. Modern medicine does not assign value to the smell and taste of medicine in the same way that early medicine did and many non-European medical traditions still do.

We realised this most fully when we gained access to a sample of first-grade Chinese medical rhubarb from a contact in Hong Kong. While the rhubarb from our ordinary pharmaceutical supplier looked like wood chips and had a vague smell, the new sample had a powerful, almost overbearingly pungent smell which was nevertheless still strangely attractive. We both agreed that our senses informed us that this was something that was neither food nor poison, but a medicine of some sort. The experience clearly demonstrated to us the importance of the sense of smell in quality assessment. It also explained why some early (pre- and early sixteenth-century) European accounts of rhubarb stated that it was odourless, while later

[32] Richard Palmer, "In Bad Odour: Smell and Its Significance in Medicine from Antiquity to the Seventeenth Century," in *Medicine and the Five Senses*, ed. W. F. Bynum and R. Porter (Cambridge: Cambridge University Press, 1993), 61–68, on 63. On eighteenth-century medical theories of smell, see Alain Corbin, *The Foul and the Fragrant: Odour and the Social Imagination* (London: Picador, 1994), esp. chaps. 1 and 2.

[33] B. K. Holland, "Prospecting for Drugs in Ancient Texts," *Nature* 369 (30 June 1994): 702; T. J. Motley, "Techniques: Bioprospecting Historical Herbal Texts by Hunting for New Leads in Old Tomes," *Trends in Pharmacological Sciences* 25 (2004): 494–98; Sarah E. Nelson, "Persephone's Seeds: Abortifacients and Contraceptives in Ancient Greek Medicine and Their Recent Scientific Appraisal," *Pharmacy in History* 51 (2009): 57–69.

FIGURE 1 Rhubarb root AA grade (left) and rhubarb root (*rhabarberwurzel geschnitten*) from Galke GmbH, Bad Grund, Germany (right).

accounts described its smell as highly distinctive. Early observers seem to have had access to old and dried out samples, adulterated goods, or different plant species (Figure 1).[34] As the example of rhubarb shows, attempts at replication must take into account that early modern medicinals were products of artisanal manufacture. They were not just parts of plants, but also the outcome of elaborate processes of growing or gathering, drying, storage, and various other refinements.

This is also demonstrated by the case of alcohol, which in terms of quantity is the largest ingredient in Hiärne's Testament. We may not simply assume that early modern alcohol was identical to the brands sold today. Lindeke *et al.* have studied the chemical composition of seventeenth-century alcohol in a study of the spirit and wine found on the warship *Kronan*, which sank off the coast of Sweden in 1676. Among many other items recovered was a wooden chest containing twelve pewter bottles with liquid contents. Analysis suggested that these contained spirits in various mixtures with seawater and other impurities, but that they had contained the same liquid at the beginning. The liquid in three of the bottles was found to have "a fragrant, floral but somewhat peaty nose" and these flasks were subjected to further analysis. This showed that they originated from the fermentation of grain, which could have been domestically produced. Taking advice from Lindeke, we decided to use a similar alcohol for our medicine, and found it in a raw grain alcohol intended for artisanal whisky manufacture, but as yet unaged in casks.[35]

A further problem is that other parts of the plant might have been used during the early modern period, as compared to what is used today. The quantity used and the season in which plants were gathered may also have changed. Apothecaries, just like

[34] We wish to thank Eric Brand for kindly supplying us with the mentioned sample. Medicinal rhubarb (Chin: *Da Huang*) is derived from the root of a different species of rhubarb to our common food rhubarb and is still used in Traditional Chinese Medicine: Clifford M. Foust, *Rhubarb: The Wondrous Drug* (Princeton: Princeton University Press, 1992). On learned early modern discourses on the smell of rhubarb, see Stefan Hessbrüggen-Walter, "Problems with Rhubarb: Accommodating Experience in Aristotelian Theories of Science," *Early Science and Medicine* 19 (2014): 317–40, on 326–30.

[35] B. Lindeke, C. Larsson, L. Einarsson, and M. Jahrehorn, "Spirits and Wine on Board the Warship Kronan," manuscript. We want to thank Björn Lindeke for his help and for making his research available to us in manuscript.

chefs, created balanced products by varying proportions in accordance with the quality and quantity of the ingredients at hand. Recipes give little guidance in these matters. How much to use of a substance, and the quality needed, were matters of experience among apothecaries. Saffron is a good example. As saffron is often called for in large quantities in early modern recipes, we may reasonably assume that it was of a lower quality (i.e. that a larger part of the plant was used) than is common today.[36] But this does not tell us much. Old herbs and spices quickly lose their fragrance and potency, and this is especially true of herbs and flowers. Locally procured herbs were replaced every year and were known to have greater potency just after harvest.[37] Among medical doctors conducting inspections of pharmacies it was a common complaint that apothecaries let their inventories of dried herbs grow old.[38] However, due to its high value no one would have thrown away a store of saffron, as both customers and apothecaries of course knew. They also knew that the saffron that had been lying in a jar for a long time needed to be used in greater quantity than a recently imported batch. Although the problem of learning how much saffron Swedish Bitters should contain, and what quality should be used, can be approached, it can never be fully solved. The situation is similar with many of our component substances.

For our second batch of Swedish Bitters, we used first-grade rhubarb and a modern alcohol assumed to be similar to that found in the Kronan shipwreck. We also compounded a theriac following the recipe in the 1775 *Pharmacopoea Svecica*. Ingredients were ground together (rather than individually) and in a different mortar (see below). Our noses and palates were rewarded, as well as our intellectual curiosity. This was a much more fragrant and tasty medicine than that obtained in our first effort. Furthermore, it tasted even better after a few weeks. It seemed to us that the alcohol added tones of complexity and depth to the elixir. Hence, our choice to use a more complex-tasting spirit than laboratory alcohol gave a partial answer to the pharmaceutical rule that elixirs should age for at least a year before being used.

Equipment and procedures

Even such an apparently simple skill such as grinding substances must be learnt (Ahnfelt was taught this in the early 1970s) and comes with its own tricks of the trade. The pestle needs to be handled correctly, and the mortar should be set up on a stable surface in a room separate from the pharmaceutical laboratory, as the dust from the pounding otherwise will contaminate the substances handled there. Our first porcelain mortar of a diameter of approximately 20 cm proved inadequate to our purposes. Only parts of the materials were pulverised, and due to the

[36] C. E. Lennmalm, *Handbok i handelsvarukännedom: Eller i kunskapen om de förnämsta handelsvarors ursprung, egenskaper, förfalskningar m. m.* … (Stockholm: Zacharias Haegström, 1808), 104–7.
[37] P. O. Almström, *Apotekarekonstens elementer: Lärobok för Apotheks-Elever* (Stockholm: W. Isberg, 1841).
[38] Fors, "Medicine and the Making of a City"; Wallis, "Consumption, Retailing, and Medicine."

FIGURE 2 Stone mortar from the Swedish Pharmaceutical Society (Inventory no. 27008). Photo by Hjalmar Fors, courtesy of Swedish Pharmaceutical Society.

shallowness of the mortar much of the material fell onto the floor. We decided that we would have to procure an old-fashioned pharmaceutical mortar. But which material was preferable? Eighteenth-century pharmacies used both iron and stone mortars, and many also had access to brass mortars. As is evident from Principe's essay in this issue, the choice of mortar may have important consequences for the result.

For our second batch of Swedish Bitters we approached the Swedish Pharmaceutical Society and asked to borrow a pharmaceutical mortar of sufficient size and depth from their museum. Available iron mortars were quite rusty, and we were uneasy about cleaning out and polishing museum objects. As we assumed that the rust would effectively become an additional ingredient in our elixir, we decided to borrow a large stone mortar. Interestingly, the recipe for theriac (*Electuarium Theriaca*) in *Pharmacopoea Borussica* (1834) included iron powder among ingredients, indicating perhaps that theriac was traditionally compounded in iron mortars, and that Prussian customers, at least, expected their theriac to have an iron tang (Figure 2).[39]

The mortar from the Pharmaceutical Society is of a hard greenish stone; is 19 cm high and 28 cm wide; weighs 19 kg including the pestle; and was probably made in the twentieth century. Unlike many early modern pharmaceutical mortars, this one is small enough to handle, and can be tilted by means of the two "ears" that protrude from its sides. The mortar had a vague smell of plant substances and contained about ten greyish seeds, probably mustard.

This stone mortar was much easier to use in comparison to the porcelain one, permitting a fast and easy pulverisation of materials. Several of these spread a fine and

[39] *Pharmacopoea Borussica: Die Preussische Pharmakopoe, übersetzt und erläutert von Friedr. Phil Dulf. Dritte vermehrte und verbesserte Auflage Zweiter Theil. Zusammengesetzte Mittel* … (Leipzig: Leopold Boss, 1834), 368.

irritating dust around the room. On one occasion we added a small amount of water to the dry substance in an attempt to reduce the dust, but this of course turned the substance into a paste that was much more difficult to handle, and the sample had to be discarded. Later we found an indirect pointer to these problems in a 1910 instruction for inspection of pharmacies. It stated that the grinding should be conducted in a separate room that must not be damp in any way, and that its walls should be easy to keep clean from dust.[40]

The problem of how to handle liquid or resinous substances also affects the recipes and order of composition. When we first attempted to compose a version of the sixty-four-ingredient theriac (although as yet with no powder of viper, opium, or castoreum), we had already excerpted lists of substances from the original texts as part of our work to identify ingredients. But we had not excerpted the accompanying instructions. When we began compounding the theriac a year later, we proceeded from our excerpts and not originals. Looking at these we made the (to us) reasonable assumption that the recipe's division of ingredient substances into several parts (to be ground separately) was due to the difficulty of handling the large number of components in a single batch.[41] As our batch of medicine was much smaller than that dictated by the original recipes, this step was omitted.

However, we should have returned to the sources and read the original recipes more carefully. Peru balsam is a liquid, and galbanum and opoponax have the consistency of resin. The resins proved to be more difficult to handle in the mortar than the dry substances. Opoponax was particularly difficult to work as the material is not homogenous. It is a resin with pieces of plant material interspersed, i.e. the various parts of the material are different from each other. In order to compensate for the loss of substances in the mortar we had to use ten per cent more of the substances than stated in the recipe.

The wine was also omitted, as it was deemed that its primary purpose was to dissolve the opium. However, both the *Ph. Augustana* and *Ph. Holmiensis* state that several ingredients, including all the resinous ones, should be dissolved before mixed with the solid components.[42] We will return to this question, and resolve these issues when we compose a third theriac. We will also have to take into account further issues of storage and fermentation. According to the literature, theriac should be stored for at least two months or even years before it reached its preferred strength and optimum potency.[43] Such processes of maturing and aging, and the complex chemical interactions of the ingredients of composite medicines, are among the reasons for turning also to modern chemical and pharmaceutical analysis.

[40] Algot Key-Åberg and Karl Ahlberg, *Apoteksvisitationer och med dem jämförliga apoteksförrättningar ur författningsssynpunkt* (Stockholm: C. E. Fritzes, 1910), 58–59.

[41] In the original composition all solid ingredients had a total weight of 1700 g., excluding honey and wine.

[42] *Pharm. Augustana*, 405; *Pharm. Holmiensis*, 48–49.

[43] Leigh, *On Theriac to Piso*, 51, 137.

Assessing and analysing the products

Old bottles of dried-up medicines can be found in many museums and archives. In setting up our project we surmised that it might be possible to locate old samples of Swedish Bitters, which could be analysed for content and composition. We also bought several commercially available brands for the same purpose. During one of our visits to the museum of the Swedish Pharmaceutical Society, it turned out that our assumption had been correct. The society owned not one, but two bottles of Swedish Bitters, one from the 1940s and another from the 1960s. The museum's helpful custodians later unearthed what amounted to a gold mine: they presented us with a box of ten unopened bottles wrapped in plastic, produced in 1986. One of these bottles was immediately given to us. This meant that we, already at an early stage, had access to sample of old pharmacy-made Swedish Bitters, as well as several contemporary commercial products.[44] After tasting a few drops, we noted that our first laboratory product was both tastier and more aromatic, but that the 1986 sample had clear similarities with respect to taste and smell to some of the Swedish Bitters now commercially available (Figure 3).

The main method of analysis that we used was liquid chromatography, which establishes a kind of chemical fingerprint of a sample of liquid. This makes it possible to compare a number of samples with one other, and to establish chemical differences between them. Liquid chromatography is a technique designed to separate a number of compounds from samples of organic matter such as plants. In investigating a sample, one can find out its composition on a molecular level. For example, in the case of saffron, characteristic compounds would be crocin, crocetin, picrocrocin, and safranal, each of which gives the saffron its different properties, such as smell, taste, and colour.

Liquid chromatographic separation of the test samples was performed on both ethanol extracts of individual herbs and of various Swedish Bitter ingredients.[45] An example is included below (Figure 4), showing two chromatograms of saffron. The change of detection wavelength from 254 nm to 440 nm makes it possible to enhance signals coming from compounds with strong absorption in the visual range.

As should be clear to the reader by now, the chemical fingerprint of Swedish Bitters is exceedingly complex, and made even more so by decay or aging, and by the constant chemical interactions between its component substances. For example, many alcohol extracts of plant substances are light sensitive, which is why they are usually kept and sold in dark glass bottles. We have not yet studied the effects of long-term storage, but it appears that light affects some of the component substances of

[44] As the reopening of the old bottles of Swedish Bitters could potentially alter the content by introducing oxygen, we decided not to take samples from the older bottles until we had established our methodologies and had a better knowledge of how to use our equipment.

[45] The LC equipment (all Shimadzu) was a LC-20AD pump equipped with an SIL-20A HT auto sampler, a CTO-20AC column oven kept at 27.5°C, and a SPD-20A UV/VIS detector at 254 or 440 nm, respectively. The separation column was a Jupiter 5 micron 300 A 250 mm × 4.6 mm (i.d.) intended for semi pure samples. Flow rate was 1 ml/min and gradient elution was accomplished either by an increase of acetonitrile content from 5 to 55 % to the aqueous solution containing 1 % formic acid at a rate of 2 %/min.

FIGURE 3 Ten 100 ml bottles of Swedish Bitters on a tray wrapped in plastic. According to the label they were manufactured in November 1986. Photo by Hjalmar Fors, courtesy of the Swedish Pharmaceutical Society.

Swedish Bitters. Although stored in a dark place, the saffron that was extracted into ethanol on 23 March 2015 had already undergone a colour change by 18 August, changing from deep red to a colour similar to that of orange juice.

Early on we also started to discuss a complementary method, headspace gas chromatography analysis in combination with mass spectrometry (headspace GC-MS). This method examines the molecules that emanate from a substance into the surrounding air; or, to put it in a simpler way, it functions as an electronic nose that produces a graph of the chemical components of what we smell. The idea of using a complementary method is to get an additional "window" into the composition, gaining access to properties, and differences, that may not be visible through the primary method.

The presence of three bottles of old Swedish Bitters presented us with an interesting choice. Should we shift our focus from making the medicine according to its original early composition, with the sixty-four-component theriac? The alternative was to focus instead on reproducing Swedish Bitters using the simplified theriac of 1775 and later. The latter choice would make sense from the point of view of chemical comparison since we did not have, and could not expect to obtain, any samples of pre-1775 Swedish Bitters. In the end we decided to do both, but to start by attempting to reproduce the modern recipe, then working backwards towards the original composition. Comparing our freshly made reproduction with earlier as well as commercial versions would allow us to investigate the effects of aging and possible interactions between the ingredients.

Although so far we consider the results of our chemical analyses to be inconclusive, from the point of view of present day pharmaceutical science, this eighteenth-century medicine may not be so bad after all. The seven simple plant components of Hiärne's Testament (Swedish Bitters) still are considered to have interesting pharmacological

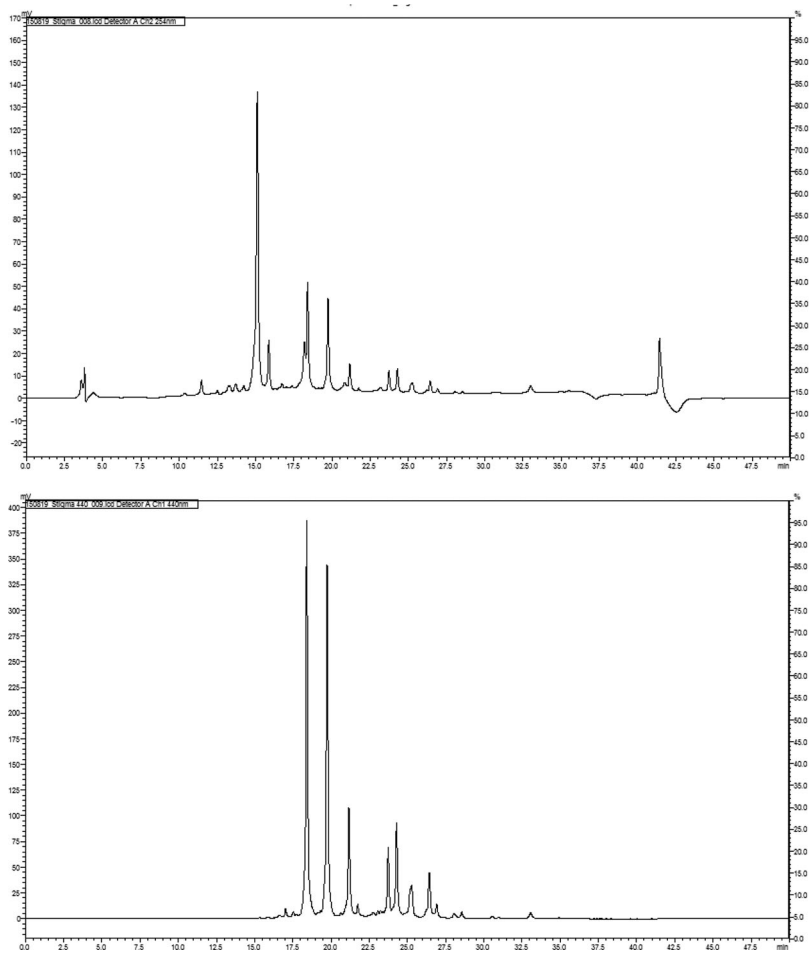

FIGURE 4 Chromatogram of saffron after separation on a Jupiter 5 micron 300 A 250 mm × 4.6 mm (i.d.) with detection at 254 nm (top) and 440 nm (bottom). Liquid chromatographic separation parameters were the same in both cases. We acknowledge the kind support of Camilla Eriksson, Division of Pharmacognosy, Uppsala University.

properties. Pharmacological studies have shown the presence of opiate like compounds in myrrh,[46] while saffron has attracted interest due to its potential as an anti-carcinogenic.[47] Agaric has also been studied for its potential value in treating cancer.[48] It is possible that these substances interact in an interesting way in the mixture, and through the process of aging. This is important, as pre- and early

[46] Lumr O. Hanuš, Tomš Řezanka, Valery M. Dembitsky, and Arieh Moussaieff, "Myrrh Commiphora Chemistry," *Biomedical Papers* 149:1 (2005): 3–28.

[47] Saeed Samarghandian and Abasalt Borij, "Anticarcinogenic Effect of Saffron (Crocus sativus L.) and its Ingredients," *Pharmacognosy Research* 6 (2014): 99–107.

[48] Ksenija Durgo, Mladen Koncar, Drazenka Komes, Ana Belscak-Cvitanovic, Jasna Franekic, Ivan Jakopovich, Neven Jakopovich, and Boris Jakopovich, "Cytotoxicity of Blended Versus Single Medicinal Mushroom Extracts on Human Cancer Cell Lines: Contribution of Polyphenol and Polysaccharide Content," *International Journal of Medicinal Mushrooms* 15:5 (2013): 435–48.

modern medical texts often emphasise that compound drugs need to mature before reaching their full potency, while simple substances should be used while as fresh as possible.

Comparing the claimed effects of the original, eighteenth-century Swedish Bitters to the properties attributed to its individual ingredients in early modern pharmaceutical texts, we realise that the extravagant claims made for Swedish Bitters were not so extravagant after all, if understood in context. As it was a composite medicine, the effects of each substance were assumed to add up and provide strength, protection from external influences, good digestion, and so forth. Even the alcohol served a purpose, being regarded throughout the seventeenth and eighteenth centuries as a potent medicine that, among many other things, bolstered one's ability to withstand the plague. Aloë (*aloe ferox*) is a very potent purgative still in use, so the inclusion of a large proportion of aloë in a formulation said to provide good digestion makes sense.[49] The other major herbal ingredient is myrrh, while the remaining components make up thirty per cent of the herbal ingredients. Rhubarb root, present at a content level of 8.7 per cent, was known to be both an efficient purgative and an astringent once the purgative action vanished.[50] Saffron, present at 4.4 per cent, has been used since ancient times because of its flavour, colour, aroma, and taste, but also due to its reputation as a stimulant and aphrodisiac.[51] The low content of both gentian root and zedoary root at 2.2 per cent still provides bitterness to Swedish Bitters: gentian root has traditionally been used to stimulate appetite due to its extreme bitterness.[52]

The presence of theriac at 8.7 per cent of the composition is also interesting. Following the compositional theory that positive effects are cumulative, it too accounts for the alleged ability of Swedish Bitters to serve as a preservative against plague/pestilence. Furthermore, the medicine does not represent a departure from pharmacological theories in continuous use since the second century. It is also similar to many other preparations in the *Pharmacopoeia Holmiensis* where one can find six theriacs or "theriac look-alike" formulations. A couple of these attract our interest like, such as *Massa Polychresta* which contains zedoary, aloë, myrrh, saffron, and another thirteen ingredients, and *Pilulae de Agarico* which contains myrrh, agaric, saffron, and aloë.[53] Hence, the properties ascribed to Swedish Bitters by eighteenth-century actors and patients were well within the bounds of the expected. This was far from a quack medicine, but a real universal medicine, as defined by most medical actors of the time.

Concluding remarks

As appears from our narrative so far, Swedish Bitters is a highly complex product to reconstruct, and also a moving target. Not only does the recipe change, it is also

[49] William Charles Evans, *Trease and Evans Pharmacognosy* (Edinburgh: W. B. Saunders, 2002), 240–42.
[50] Foust, *Rhubarb the Wondrous Drug*, 136–57.
[51] M. Kafi, *Saffron (Crocus Sativus): Production and Processing* (Enfield, NH: Science Publishers, 2006), 2 and 170.
[52] Evans, *Pharmacognosy*, 315–16.
[53] *Pharmacopoeia Holmiensis*. It listed three theriacs, 48–53.

necessary to pin down each individual substance at specific historical moments. In the absence of substances surviving from the eighteenth-century, we also do not know what the final version of the Bitters or its ingredients were supposed to be like. Error may occur at each moment of our work. We may assume that we will never know if we will succeed in making a theriac that would have been recognised as such by early moderns. And, that said, we have not even discussed the most insidious challenge of them all: the gulf between ourselves and the historical actors with regards to (medical) world-view and everyday experiences of healing, and what this gulf entails in terms of differences in sensual and bodily experience. Even if we could accurately reconstruct the composition of an "early modern" medicine, we would never be able to reconstruct a truly early modern experience of making and using it.[54]

On the other hand, we have already learnt an immense amount from going beyond merely reading the recipe, and working actively with the materials of early modern pharmacy. By smelling, touching, rubbing between the hands, weighing, mixing, grinding, pouring, and eventually tasting, we can make immediate estimations of quality, not dissimilar to those that would have been made by early moderns. Yet even after just a few months of exposure to this knowledge tradition, its tools and materials have already engendered dozens of answers that were not apparent from just reading the literature. Early modern apothecaries would have needed much more. They studied for many years before taking on the responsibility of making medicines, in the process exposing themselves to many different batches of simple and compound medicinals of different qualities and age, and learning to make judgements about each medicine's proper strength, smell, and taste. This clearly illustrates the need of historians in this field to at least begin to access the gestural knowledge of pharmacy. Through the process of reproduction, it soon becomes obvious why apprentices travelled far and wide, why positions at large and centrally placed pharmacies were so eagerly sought out, and why some apothecaries were simply regarded as *better* than others.

Any number of interesting experiments can be conducted by means of early modern equipment and substances, but we are interested in a specific subset of practices only. Investigating our medicine, we want to ascertain to what extent advanced knowledge was required to make it. What can the medicine tell us about the practical and useful knowledge held by those who created and used it? Hence, to us it is in a sense sufficient to have shown, as we believe that we have done, that early modern pharmaceutical knowledge was much more advanced, interesting, and complex than previously thought. This is also a reason for investing so much effort in analysing our substances by means of modern laboratory techniques.

Furthermore, our work injects a note of caution into the study of historical medical recipes. Judging from lists of contents and proportions how recipes worked, or even assuming that they did not work at all, is precisely the kind of

[54] Michael Stolberg, *Experiencing Illness and the Sick Body in Early Modern Europe* (Basingstoke: Palgrave Macmillan, 2011).

armchair experimentation that has been thoroughly rejected in the last twenty years by historians of physics and alchemy.[55] In medicine, too, the wide diversity of qualities and ages of available substances makes written recipes that give exact proportions of various ingredients highly suspect as sources. What if one's rhubarb or saffron is of notably inferior or superior quality? In such cases an apothecary would probably have compounded the ingredients in other proportions, or even employed substitutes in order to create a reliable effect, and consistent taste and smell.

On a final note, this is engaging and highly rewarding work. One cannot learn through the historical literature on theriac that it actually tastes good, and has a striking and pleasant aroma. The sensual knowledge of the apothecary is a classic example of silent or gestural knowledge, and we must learn it in order to understand the practice of early modern pharmacy.[56]

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[55] See the Introduction and Principe's paper in this issue: Lawrence M. Principe, "Chymical Exotica in the Seventeenth Century, or, How to Make the Bologna Stone," *Ambix* 63 (2016): xxx–xxx; Principe, *The Secrets of Alchemy* (Chicago: University of Chicago Press, 2013), 102–6 and chap. 6; H. Otto Sibum, "Reworking the Mechanical Value of Heat: Instruments of Precision and Gestures of Accuracy in Early Victorian England," *Studies in History and Philosophy of Science* 26:1 (1995): 73–106.

[56] Textual descriptions of pharmacy, like botanical texts of the period, tend to focus on the visual properties of materials. See, e. g., Valent. Kräutermann, *Der Wohl unterwiesene Apothecker, Oder Gründliche Anleitung zur heutigen Apothecker-Kunst …* (Arnstadt and Leipzig: Ernst Ludwig Riedt, 1730), 8, 14. Similarly, early modern philosophers rarely emphasized the importance of smell, which was often associated with animal behaviour. Corbin, *The Foul and the Fragrant*, 6–7.