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Technology as Knowledge:
Cuneiform Technical Recipes and the Material World

by

Eduardo Andres Escobar

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor of Philosophy

in

Near Eastern Studies
and the Designated Emphasis

in

Science and Technology Studies

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Francesca Rochberg, Chair
Professor Niek Veldhuis
Associate Professor Massimo Mazzotti

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Abstract

Technology as Knowledge: Cuneiform Technical Recipes and the Material World

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Eduardo Andres Escobar

Doctor of Philosophy in Near Eastern Studies
and Designated Emphasis in Science and Technology Studies

University of California, Berkeley

Professor Francesca Rochberg, Chair

The human activity of making things has a long intellectual history, well predating the Industrial Revolution or even the term "technology" itself. This dissertation examines cuneiform sources written between the second and first millennium BCE in order to determine how technology interacted with and shaped scribal knowledge. With no clear boundary—between genuine and artificial, between the natural and human-made, between theory and practice, *episteme* and *techne*, knowing-that and knowing-how—with no term to distinguish between scribe and craftsman, cuneiform texts challenge how we think about both technology and knowledge. The case studies presented herein derive from cuneiform tablets written between the late second and mid first millennia BCE in what is today Iraq. These ancient clay tablets preserve technical recipes, explanatory lists of materials, and rituals bearing the hallmarks of scholarship. For the intellectual historian, they exemplify a discerning interest in the construction and proliferation of technical knowledge at an early stage of Middle Eastern textual history.

The work argues that notions of technology constitute an essential element of cuneiform scribal knowledge. Ignoring the technological component of cuneiform scholarship renders an incomplete portrait of *nēmequ*—the Akkadian term we translate as "knowledge," or "wisdom." Neo-Assyrian glassmaking recipes can function as literary or ritual texts focused on purity, Middle Assyrian perfume recipes can be read as cultural windows into the roles of female experts during the rise of the Assyrian territorial state, and even a solitary tablet containing wool dyeing recipes can expand our knowledge of the cultural role of garments in first millennium Babylonia. Technical recipes, in sum, constitute textual sources that inform and interact with the construction of knowledge at the local level. This work offers close, contextualized readings of Akkadian technical recipes, and utilizes frameworks derived from the history and philosophy of science and technology, in order to generate new methods for investigating the relationship between technology and cuneiform scribal knowledge.

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ABBREVIATIONS

Abbreviations used for text citations and in bibliographical references follow the conventions of *The Assyrian Dictionary*, vol. 20, *U* and *W* (Chicago Oriental Institute, 2010). *The Assyrian Dictionary of the Oriental Institute of Chicago* will regularly be referred to with the abbreviation CAD. Specific conventions for tablet citations and digital editions are outlined below.

Tablet Citation Conventions:

Cuneiform tablets are identified using a number of conventions, including museum catalog numbers and publication abbreviations. The Cuneiform Digital Library Initiative (CDLI; http://cdli.ucla.edu) collects and standardizes these conventions and assigns cuneiform tablets unique catalog ids that begin P######. It is useful to review the three conventions used throughout this work for referencing cuneiform sources, particularly for historians unfamiliar with Assyriological conventions; these are:

1. Museum numbers: **K.7942** ("K" is an abbreviation for Koyunjik, the mound in the north of Iraq that is the site of ancient Nineveh; "K" tablets are housed at the British Museum)
2. CDLI catalog numbers and digital edition: **P397390** (numbers can link to the CDLI catalog, such that K.7942+ = http://cdli.ucla.edu/P397390)

In the case of the Assyrian technical recipes discussed herein, editions and catalog data can be found on http://oracc.org/glass; using CDLI catalog numbers, these editions can be linked and cited directly. Thus, an edition of 7942+ is can be found and cited using the following link: http://oracc.org/glass/P397390. Print editions for these recipes are provided in the Appendix. Note that most cuneiform tablets are pieced together from several fragments. K.7942 is joined to K.8167. Glassmaking recipe K.203 is joined to ten additional fragments. Tablets with additional joins will be referred to simply by their main tablet, as in K.203+, where "+" includes the long list of smaller fragments that have been joined to the main text.

Finally, certain texts a better known by their publication numbers, as is the case with the perfume recipes discussed below, KAR 140. Thus, we can add a third convention for identifying cuneiform tablets,

3. Publication numbers: **KAR 140** ("KAR" is an abbreviation of E. Ebeling's *Keilschrifttexte aus Assur religiösen Inhalts* I/II = WVDOG 28, 1919; 34, 1923)

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I was guided to these faraway corners of ancient history by great mentors and by an unshakably supportive family, whose encouragement continues to energize my curiosity. Making things led to thinking about the intellectual history of making things. And this dissertation, major parts of it at least, have been on my mind for so long that I can't help but think of the result as in some way biographical. I humbled the generosity and support of my family, friends, colleagues, and mentors. Katherine Leu, my constant partner—my family, sister, parents, dear grandparents, and uncle in NYC have been by my side since the beginning. I also count among my family members Mary Stieber, a friend and professor who mentored me at The Cooper Union since day one. Thank you all.

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INTRODUCTION

> *Indeed, from the perspective of philosophy, what is needed is what may, for want of a better phrase, be referred to as a history of ideas about technology—that is, the study of how different periods and individuals have conceived of and evaluated the human making activity, and how ideas have interacted with technologies of various sorts.*
>
> Edward Mitchum, *Thinking Through Technology* (1994)

The present dissertation investigates how knowledge interacts with technology in cuneiform cultures. Cuneiform texts provide a unique opportunity for such an investigation. With no clear boundary between genuine and artificial, between the natural and human-made, between theory and practice, *episteme* and *techne*, knowing-that and knowing-how, with no term to distinguish between scribe and craftsman, cuneiform texts challenge how we think about both technology and knowledge. The case studies presented herein derive from cuneiform tablets written between the late second and mid first millennium BCE in what is today Iraq. These ancient clay tablets preserve technical recipes, explanatory lists of materials, and rituals bearing the hallmarks of scholarship; for the intellectual historian, they exemplify a discerning interest in the construction and proliferation of technical knowledge at an early stage of Middle Eastern textual history. The interaction of scribal knowledge with technology—including material transformation and classification—unifies the selection of original sources discussed. This work analyzes and interprets these sources within a history and philosophy of science framework, with the aim of demonstrating the epistemological value of cuneiform technical sources for the history of knowledge. I focused special attention on the ways in which cuneiform texts stress-test our inherited cultural and epistemic boundaries—my commitment is to the *history* of how ideas about technology change over time. In this work, the boundaries margins genuine-artificial and theoretical-practical knowledge are the first to undergo fundamental recalibrating via cuneiform recipes.

Notions of technology constitute an essential element of cuneiform scribal knowledge. Ignoring the technological component of cuneiform scholarship renders an incomplete portrait of *nēmequ*—the Akkadian term we translate as "knowledge," or "wisdom." This, in sum, is the thesis of this work. Accordingly, knowledge of "technology," broadly construed, is a primary ingredient of cuneiform intellectual history. In turn, an intellectual history of technology can affect significantly the ways in which we interpret cuneiform cultures. The cuneiform technical recipe texts provide some of the clearest evidence to support this claim. Since their discovery and decipherment in the early 20th century, Assyriologists have interpreted cuneiform recipes—for making perfume (13th and 9th centuries BCE), glass imitating gems (13th and 7th centuries BCE), and dyeing wool in exotic colors (6th century BCE)—as craft manuals, leaving unexamined the relationship between what we call "technology" and what the ancient scribes called "knowledge" (*nēmequ*).

This dissertation begins by reviewing a number of key textual sources that illustrate what constitutes "cuneiform recipe knowledge," a category of scholarship that has not previously been analyzed independently. Staking claim in this new territory of

"cuneiform recipe knowledge" requires interaction at the heart of philology (how do cuneiform scribes employ technical language?), epistemology (what is meant by knowledge?), and historiography (what does it mean to write an intellectual history of "technology"?)

Chapter 1 argues that history and philosophy of science and technology can significantly enrich our interpretation of cuneiform technical texts, and, equally, a conceptual understanding of "technology" is critical for generating new questions regarding ancient technical knowledge; Chapter 2 examines cuneiform recipe sources within their varied historical and epistemological contexts; Chapter 3 revisits the historiography of the Assyrian glassmaking recipes and asks whether the demarcation between chemistry and alchemy is as productive as previous scholars once argued; finally, Chapter 4, concludes with a reassessment of scribal knowledge (*nēmequ*) as it relates to what we call technology. The following synopses detail the project's organization and research goals:

> **Chapter 1** | *Technology as Knowledge*: This chapter employs critical frameworks from the history and philosophy of science to examine the relations between cuneiform scholarship and technology. Cuneiform procedural recipes—instructions for making glass that imitates precious stones, producing perfume, and dyeing wool, comprise the principal data set for this study. The chapter considers what it means to study technology as a form of knowledge, and why, as a result of our historiographical and philosophical leanings, this type of study has not previously been attempted. Rather than understand technology deterministically, as a history of "applied scientific" progress, from the cuneiform tablet to the digital tablet, it focuses on the intellectual history of recipes, the knowledge component of technical processes and the material world as it relates to the production of knowledge within cuneiform cultures.
>
> **Chapter 2** | *Localizing Recipe Knowledge in Cuneiform Cultures*: This chapter examines, historically, the nature of recipe knowledge, emphasizing the local dimension of cuneiform recipes. It situates my examination of wool-dyeing, perfume-making, and glassmaking recipes, within their historically (and epistemologically) variant geographies. Recipes from the Neo-Babylonian period (ca. 6th century BCE) are very different, linguistically and contextually, from those of the Middle Assyrian (13th century BCE), and glassmaking in the Neo-Assyrian empire (7th century BCE). Wool dyeing instructions veer closer to what we might expect to find in craft manuals. Others, such as the glassmaking procedures, are rife with metaphors and scribal hermeneutics, edging closer to literature and alchemy than simple craft instructions. What do these differences mean for historians interpreting cuneiform recipes? Can they be unified diachronically? In sum: what kind of (primary) sources are cuneiform technical recipes?
>
> **Chapter 3** | *Pure Knowledge from the Kiln*: Since at least 1925, cuneiform technical procedural recipes—clay tablets from between the second and first millennia BCE containing instructions for making kilns, glass that imitate precious stones and perfumes—have endured something of an identity crisis.

Assyriologists and historians of science have struggled to determine precisely how we ought to interpret and catalog these chronologically early and philologically challenging texts, which have been characterized as chemical, ritual, religious, alchemical, literary, and scientific. The goals of this chapter are two-fold. First, it synthesizes the modern history of these procedural recipes, from their decipherment to interpretation, in order to trace changes and developments in our attitudes towards Mesopotamian chemical knowledge; second, it provides a close reading of the principal Assyrian glassmaking procedures in order to determine whether characterizing these texts as "alchemical" is historically or analytically productive. It concludes that regardless of how we choose to categorize these "esoteric" texts, they were compelled by a scholarly interest in material and linguistic purity, a normative cuneiform scholarship.

Chapter 4 | *Concluding Remarks*: This brief chapter concludes the dissertation by providing a synthetic account of how technology and knowledge were, in cuneiform cultures, separated by no obvious epistemic margin. It revisits questions already addressed (Chapters 1–3) and requiring future research. The remarks in this section revisit what it means to propose a historical epistemology of cuneiform recipe and material knowledge, and reassesses the set of questions posed in Chapter 1 within the broader contexts of scribal knowledge, *nēmequ*.

Appendix | *Digital Text Editions and Semantic Ingredient Networks*: This Appendix provides links to text editions of cuneiform recipes on the digital corpus GLASS on ORACC (The Open Richly Annotated Cuneiform Corpus) at http://oracc.org/glass. Semantic networks are introduced in order to illustrate and explain the deep connections between undeciphered technical terms, and well-attested lexemes, and to lay the framework for future research on Akkadian technical vocabulary.

1

TECHNOLOGY AS KNOWLEDGE

ABSTRACT | Traditionally, the term "technology" refers to the manipulation of the material world aimed at the manufacture of physical objects that modify the ways in which humans interact with the world. Technology is usually rendered as a story of progress, from cuneiform tablet to the digital tablet. But the study of technology as solely the study of progress via objects fails to account for the subject's rich intellectual history, particularly as explored by cultures before and beyond the Western periphery. Anchored in the history and philosophy of science and technology, this chapter looks beyond past approaches to the history of technology as solely the study of material objects and, instead, analyzes technology as a form of scribal knowledge. This chapter focuses special attention on the ways in which cuneiform scholars interpreted and categorized the manipulation of materials without relying on binary models of knowledge, wherein *techne* (hands-on knowledge) is epistemically inferior to *episteme* (theoretical knowledge); or, wherein genuine materials are distinguished from artificial ones (as in precious stones and glass). What follows makes a case for why cuneiform procedural recipes, composed and copied between the second and first millennium BCE, provide exemplary case studies for the intellectual history of technology.

(keywords: #cuneiform #recipes #technology #historical epistemology #STS)

1.0 Introduction

The present chapter lays out a framework for the study of cuneiform technical recipes as intellectual history. It introduces how scribes interacted with glass, perfume making, and wool-dyeing technologies within scholarly cultures. When Assyrian scribes composed and copied instructions for "making lapis lazuli," were they attempting to reproduce nature in the laboratory as later alchemists did? Or was another operative framework involved, one altogether different from what we encounter in later historical periods? Can we identify a distinct thought component in technical craft experience (know-how) that is different from that of scribal epistemology (knowing-that)? In sum, this chapter explores the relationship between technology and scribal knowledge.

1.1 Technology and the Reproduction of Nature

> *… we sow cereals and plant trees; we irrigate our lands to fertilize them. We fortify riverbanks, and straighten or divert the courses of rivers. In short, by the work of our hands we strive to create a sort of second nature within the world of nature.*
>
> Cicero, *De Natura Deorum* (ca. 45 BCE)

> *Much technical sophistication and ingenuity was spent on the quest for these artificial stones in which man succeeded in imitating nature and of which the Mesopotamian chemist was rightly proud.*
>
> A. Leo Oppenheim, *Mesopotamia: Portrait of a Dead Civilization* (1964)

"You are not to be negligent; you are not to show these instructions to anyone."[1] This pithy secrecy clause is preserved on K.7942+, a cuneiform recipe from the 7th century BCE that contains instructions for making, literally, "cones of silver" (*ṣippat kaspi*[2]). As is common with such documents, the tablet is fragmentary, but enough of the recipe remains to establish that the *ṣippatu* of silver was not made fully, nor even mostly, of silver. This text provides instructions for alloying silver—for producing a copper-based "alloy of silver" that was meant only to *resemble* the unalloyed metal:

> **<u>K.7942+, obv. i 11'–16'</u>**[3]
> 2 shekels of alloyed bronze … are to be mixed into the silver… and cast. Once (this process) is complete, (the metal) is to be ignited, cast, and rubbed down with (a mixture) of oil and flour (until) it shines. This is "alloy of silver" (*ṣippat kaspi*); this silver is not…

"This silver is not" … not what? Not pure? Not distinguishable from the real thing? Tantalizing breaks at crucial points, as we will find, are common within Assyriology, the modern philological discipline responsible for the decipherment and interpretation of cuneiform tablets. In Assyriology, even the smallest of fragments can cause significant change to existing historical narratives. With recipes such as these, we also encounter

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[1] For full edition of text, see http://oracc.org/glass/P397390; translation reconstructed from K.7942+, obv. i 9', *x-at-ku la ta-mi-iš mam-ma la* ⌜*tu*⌝-[*ka-la-am*]; Interestingly, Oppenheim translated the verbal forms as imperatives, "Do not be negligent, do not show these instructions to anyone," which more closely resembles our modern cookbooks than an Akkadian second-person instructions, for which, see A. Leo Oppenheim, "Mesopotamia in the Early History of Alchemy," *Revue d'Assyriologie et d'Archéologie Orientale* 60.

[2] A. R. George, *Babylonian Literary Texts in the Schøyen Collection*, vol. 10, CUSAS (Bethesda, Maryland: CDL Press), 9–10; ibid.; ibid. Takes *ṣippatu* to mean "cone" based on the Von Soden, *AHW ṣippatu(m)* III, metal "Zapfen" or sapling ("Blatt-Trieb"). The more well-attested usages of the term *ṣippatu* refer to the cones of the pine tree (see *CAD* S s.v., *ṣippatu*). In a contemporaneous manuscript from the lexical list Murgud, however, *ṣippatu*, wr. ⌜*ṣip*⌝-*pa*-[*tu*] is equated to the Sumerian **ku₃-babbar-me-a** (literally, "silver that shines"). In this relevant section of Murgud, found on K.152+ rev ii, 1ff, the entry *ṣippatu* appears within the context metal alloys, including Sumerian terms like **ku₃-si₂₂ huš-a**, "rose gold" **urud sahar hu-luh-ha** "refined copper ore," and various types of "bronze" (**zabar**). Contextually, therefore, we can be sure that *ṣippatu* was a metallurgical term. For a digital edition of K.152, see: http://oracc.org/dcclt/nineveh/P393770).

[3] For Oppenheim's edition, see Oppenheim, 35ff.

technical terms like *ṣippatu*, a term associated with the cones of pine tree, but rarely associated with metalworking.[4]

K.7942+ is one of two such fragmentary tablets that, in 1966, compelled the Assyriologist A. Leo Oppenheim to publish an article entitled "Mesopotamia in the Early History of Alchemy."[5] According to Oppenheim, K.7942+ "obviously describes a method of producing a silver-like alloy from base metal ingredients—the '*leukosis* of copper' of alchemistic fame. The purpose of the operation is to deceive and the final formula is to allay any possible doubts of the 'chemist'."[6]

In the parlance of twentieth century historiography, Oppenheim *discovered* in Mesopotamian sources the historical *origins* of alchemy (*leukosis* of copper belongs to the vocabulary of pseudo-Democritus' *Peri asēmou poiēseōs, "On the Making of Silver"*).[7] Searching for the origins of knowledge in Mesopotamia—especially scientific knowledge—is a persistent feature of the historiography of the ancient world. Particularly in the mid-twentieth century, scholars like Oppenheim were prone to exercise what Francesca Rochberg has called "telling the history of science backward":

> Cuneiform astronomical texts, in their role as direct antecedents to Western astronomy, were readily incorporated into telling the story of science backward. The singling out of astronomy, particularly mathematical astronomy, as the Mesopotamian contribution to the history of science did its share in reinforcing the conception of the history of science backward from modernity to antiquity. *Because the ancients described or predicted phenomena such as the synodic appearances of planets or the first visibility of the moon, the question of what the ancients observed and predicted about natural phenomena was raised, but not why or how the ancient astronomers viewed the phenomena as objects of knowledge, or how the phenomena fit within a system of local epistemic values.*[8]

Alchemy, like astronomy, developed and worked within particular (usually Aristotelian) frameworks—the transmutation of metals, the mercury-sulphur theory, and the imitation of nature in the lab. Were these the concerns of cuneiform scribes? How might Oppenheim's analysis of technical recipes have looked had he focused on the ways in

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[4] The phenomenon of creating technical terms from well-attested words is found throughout the cuneiform procedural tradition. We will encounter, for example, terms like *kišru*, "knot" used to mean "sap" in the context of perfume making (Chapter 2; Appendix).

[5] Oppenheim.

[6] Ibid., 38.

[7] H.J. Sheppard discusses the metallurgical practice of whitening base metals, called leukosis, in the work of Pseudo-Democritus H.J. Sheppard, "Alchemy: Origin or Origins?," *Ambix* 17: 77. Amore recent edition of this alchemical treatises of pseudo-Democritus can be found in Matteo Martelli, *The Four Books of Pseudo-Democritus*, vol. AMBIX 60, Supplement 1, Sources of Alchemy and Chemistry (Wakefield, UK: Maney Publishing). On whitening of metals see especially ibid., 150–51.

[8] Francesca Rochberg, "Conceiving the History of Science Forward," in *The Frontiers of Ancient Science: Essays in Honor of Heinrich von Staden*, ed. Brooke Holmes and Klaus-Dietrich Fischer (Berlin: De Gruyter), 518. Italics my own.

which scribes viewed and interpreted the material world, or had he considered K.7942+ within a “system of local epistemic values”?

Perhaps Oppenheim would not have maintained that the “purpose of the operation" described in K.7942+ "was to deceive.”[9] Indeed, when we explore contemporaneous technical recipes, such as the corpus of Assyrian glassmaking texts, we find that the dichotomy between genuine and artificial was neither an obvious nor important distinction for cuneiform scholars at Nineveh. Indeed, in the 600+ lines preserved from the corpus of 14 Neo Assyrian glassmaking tablets and fragments, there remains not a single clear instance of language suggesting “deception”.[10] On the contrary, scribes made no orthographic distinction between a thing made of "artificial glass” and one made of “genuine precious stone.” The Akkadian noun *abnu* (wr. NA4), references both “genuine” and “artificial” stone; further, “glass” and “stone” were classified using NA4 as a determinative.[11]

Determinatives are unpronounced markers that, in the cuneiform writing system, precede Akkadian and Sumerian nouns and provide information regarding their semantic grouping.[12] In glass recipe K.203+ we find, for example, the following instructions:

---

[9] Earlier, in his *Ancient Mesopotamia: Portrait of a Dead Civilization*, Oppenheim had already framed the glassmaking recipes as reflecting the imitation of nature: “Much technical sophistication and ingenuity was spent on the quest for these artificial stones in which man succeeded in imitating nature and of which the Mesopotamian chemist was rightly proud.” A. Leo Oppenheim, *Ancient Mesopotamia: Portrait of a Dead Civilization* (Chicago: The University of Chicago Press), 323.

[10] K.4266+ (P395468) rev. i 22’–23’ preserves a line which has been taken to suggest otherwise. This rather difficult to interpret line reads: “To 1 mina and 3 shekels of *zukû* which [has] the appearance (lit: body) of gold…” (*a-na* 1 MA.NA 3 GÍN *zu-ku-*ˈ*ú*ˈ *ša* SU KÙ.SI22 *ša-ak-nu*. The important portion here is the qualifying phrase *ša zumur* (SU) *hurāṣi*, literally, “which has the body of gold.” What precisely is meant by “body” (*zumru*) in this context is explored further in 2.4 in the context of corporeal metaphors. It is worth noting that pyrite or calcite inclusions in lapis can create the appearance of containing particles of gold. In sum, Oppenheim’s translation “which has the look of gold” can be somewhat misleading. A. Leo Oppenheim et al., *Glass and Glassmaking in Ancient Mesopotamia: An Edition of the Cuneiform Texts which Contain Instructions for Glassmakers with a Catalogue of Surviving Objects* (London: The Corning Museum of Glass), 52.; see also Marco Beretta, who discusses this passage in the context of ancient imitations Marco Beretta, *The Alchemy of Glass: Counterfeit, Immitation, and Transmutation in Ancient Glass Making* (Segamore Beach, MA: Science History Publications/ USA), 3.

[11] Determinatives are indicated in transliteration by the use of superscripts, thus, in the writing NA4.ZA.GÌN.DUR5, the determinative NA4, indicating the class “stone” is transliterated ^{na4}ZA.GÌN.DUR5.

[12] This point is developed by Rochberg in *Before Nature*, for which see Francesca Rochberg, *Before Nature: Cuneiform Knowledge and the History of Science* (Chicago: University of Chicago Press), 85–102.

> If you want to make "lapis lazuli" (^{na4}*zagindurû*): you grind separately 10 minas of *immanakku*-stone, 15 mana of salicornia ashes, and 1 2/3 mana of "white plant." You mix (them) together. You set (the glass) into the cold kiln with four openings and arrange it between the openings.[13]

Read literally, Neo-Assyrian glassmaking recipes like K.203+ instruct one to "*make* lapis lazuli," to "*make* quartz", to "*make* turquoise." The verb *epēšu* "to make, do" has a broad semantic range, and could describe just about any action—when it takes a direct object, the verb could be used for any act of building or creation, from constructing a house, to creating mankind.[14] That is to say, in the Assyrian glassmaking texts precious stones are *made*, built, they are constructed, they are *not* replicated. Translating *abnu* (NA4) as "glass" in the context of Assyrian glassmaking recipes is a rationalist interpretation of what is otherwise, in Akkadian semantics, a much more nuanced relationship between making and imitation.

It is difficult to restrain the intuition to tell the history of science backwards. Classifying a precious material as either "real" or "artificial" material makes a great deal of sense to us. Historically, culturally, and economically, we care that our diamond rings are made of diamonds and not cubic zirconia, and we make these distinctions evident in our language. Today, in ordinary language we use the qualifier "artificial" to describe just about everything, from grass to intelligence. A recent book by Marco Beretta entitled *The Alchemy of Glass*, containing the subtitle *Counterfeit, Imitation, and Transmutation in Ancient Glassmaking*, is testament to this strategy.

Beretta, understandably, follows the authority of Oppenheim in dealing with cuneiform sources, and states that "Mesopotamian glassmakers linguistically distinguished the natural blue stone of lapis lazuli 'from the mountain' (*uqnû šadi*) and designated the artificially-produced version of 'lapis lazuli from the kiln' (*uqnû kūri*)."[15] However, the text to which Beretta (via Oppenheim) refers, which distinguishes between "lapis lazuli from the mountain" (i.e., the real thing) and "lapis lazuli from the kiln" (i.e., imitation glass) pre-dates the Assyrian glassmaking recipes by centuries. This document, an inventory list (VAT 16462) dates to the reign of the Middle Assyrian king Tukulti-Ninurta I (1243–1207 BCE). It catalogs precious materials owned by the palace

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[13] K.203+ obv. i 21'–24' (http://oracc.org/glass/P393786), *šum-ma* ^{na4}ZA.GÌN.DUR$_5$ *ana* DÙ-*ka* 10 MA.NA IM.MA.NA; 15 MA.NA NE ^{ú}NAGA 1 2/3 MA.NA ^{ú}BABBAR *a-he-e*; [*ta*]-⌜*mar*⌝-*raq* 1^{niš} ĦI.ĦI *ana ku-ú-ri šá* 4 IGI-MEŠ-*šá*; [*ka*]-⌜*ṣi-ti*⌝ *tu-še-rid*-[*ma*]

[14] The semantic range of *epēšu* is substantial, encompassing 44 pages of The Chicago Assyrian Dictionary, see *CAD* E s.v., *epēšu* (especially meaning 2b) for instances of *epēšu* in building and creation contexts. Akkadian preserves a number of verbs for making; *banû* "to build" is the most common in administrative contexts, but it does not appear in procedures.

[15] Beretta, 3.

at Kār Tukulti-Ninurta;[16] the cataloged materials included "kiln-made *pappardillu*-agate,"[17] "kiln-made *ṣurru*-obsidian,"[18] and "kiln-made *sāmtu*-carnelian."[19]

VAT 16462 is unique in classifying stones as "kiln-made," but in preceding the Neo-Assyrian glassmaking recipes by six centuries, it is difficult to draw a meaningful historical connection; furthermore, VAT 16462 is also an administrative list, not a scholarly text. Nevertheless, if we turn our attention to the local dimensions of VAT 16462 (and away from the burden of finding within it evidence for a "pan-Mesopotamian" mode of thought),[20] we find a fascinating list that catalogs a vast range of materials—including kiln-made gems—that were carefully designed and tallied for the production and restoration of cult objects. If these kiln-made gems were merely "artificial" imitations of their "genuine" (i.e., "natural") counterparts, then they were either of such fine quality that they could trick even the gods, or else, the cultural value of the genuine-artificial distinction was not as universal as Oppenheim believed.

[16] For a full edition consult Franz Köcher, AfO 18 Franz Köcher, "Ein Inventartext aus Kār-Tukulti-Ninurta," *Archiv für Orientforschung* 18.
[17] ^{na4}BABBAR.DILI *ku-ri* is mentioned in VAT 16462 obv. i 7, 8, 12, 29
[18] ^{na4}ZÚ *ku-ri* is mentioned in VAT 16462 obv. i 11, 25, ii 23, iii 7.
[19] ^{na4}GUG *ku-ri* is mentioned in VAT 16462 obv. i 23, ii 23, 36, iii 7'.
[20] What I criticize here is the idea that cuneiform scholarly sources can be divorced from their historical contexts. Knowledge is contingent, and responds to its cultural environment. This theme is covered fully in Chapter 2.

1.2 Cuneiform Technical Recipes: A Crash Course

The metalworking recipe K.7942+ is an exceedingly rare text, the only the metal working recipe of its kind. With its fragmentary state of preservation and its use of rare technical vocabulary, K.7942+ and recipes like it, have assumed a peripheral position in modern Assyriology. Critical editions of the technical recipes—and, equally importantly, their historical interpretations—date, still, to the middle of the twentieth century. But what are technical recipes? And are they sufficiently unified in their use of language, structure, and in their context to consider them a distinctive textual category?

This work uses two terms interchangeably. The term first is "recipes," and second is "procedure." This is due to the fact that all technical recipes are procedures; not all procedures, however, are recipes. Broadly speaking, I take "procedures" to be any instructional text that provides step-by-step directions using second person verbal forms. "Recipes," are a subset of procedural texts. They employ procedural language to provide instructions for the preparation and admixture of materials (often, by means of the manipulation of fire). From a cross-comparative historical perspective, we can add that cuneiform technical "recipes" share family resemblances with later scientific genres such as the chemical-alchemical recipes of the Hermetic traditions[21]. In ordinary language of course, the term "recipe" refers to the culinary arts.

As Jean Bottéro noted in his discussion of the Old Babylonian (ca. 1800 BCE) cooking recipes housed at Yale, the recipe texts have yet to be unified within a single study:

> We should note that although we are only discussing cooking recipes here, there were other recipes known in that land involving other products: the fabrication of perfumes and unguents; dyes; colored glass to replace colored semiprecious stones; beer; the raising and training of horses. Infrequently and sometimes inadequately studied, these documents constitute a true "literary genre."[22]

Well before Bottéro, the *Handbuch der Keilschriftliteratur* catalogued the various texts discussed in this work as "Chemie, Rezepte";[23] this category of texts has been known for some time. In that regard, the unification of these texts is not new. Yet their status as esoteric texts, as outliers within the discipline of Assyriology, has—for a range of motives, to be explored throughout this work—endured with little change.

According to modern scholarship, cuneiform recipes were (and remain) arcane craft manuals. As a result, such texts have had little or no place in discussions of

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[21] Matteo Martelli has most recently written about cuneiform recipes in the context of alchemy, see Matteo Martelli and Maddalena Rumor, "Near Eastern Origins of Graeco-Egyptian Alchemy," in *Esoteric Knowledge in Antiquity*, ed. Klaus Geus and Markham J. Geller (Berlin: Max-Planck-Insititut für Wissenschaftsgeschichte).; but as we will find in Chapter 3, the connections between chemistry, alchemy, and Assyrian glassmaking were made as early as the mid 1920s.

[22] Jean Bottéro, *The Oldest Cuisine in the World: Cooking in Mesopotamia*, trans. Teresa Lavender Fagan (Chicago: The University of Chicago Press), 25.

[23] Rykle Borger, *Handbuch der Keilschriftliteratur*, vol. III (Berlin: Walter de Gruyter), 116–17.

cuneiform intellectual history, or in the study of what Akkadian scribes called *nēmequ,* "knowledge." In no previous work have technical recipes been deemed "scholarly." Partly, this is to do with the fact that modern scholars have intuited a categorical difference between craft practice (*techne*) and scholarly knowledge (*episteme*), a distinction, that, as we will find, is not reflected in cuneiform scholarly traditions. The fundamental questions that inform this work, therefore, involve both classification and epistemology: What are cuneiform technical recipes? How do these historical texts inform the relationship between technology and knowledge? Why, in other words, should we take these texts seriously as scholarship?

We can begin to answer these questions with KAR 140. KAR 140 is a perfume recipe from the Middle Assyrian period (13th century BCE); a well preserved section of the tablet (rev. i 7–25) reads:

> In pouring for the 13th time, you gather the oil. You wipe clean the *diqāru*-vessel. You heat up the liquid mixture. You then wash a *ḫarû*-vessel, and pour (the mixture) into the *ḫarû*-vessel. You pour 2 cupfuls of "knots of *perṣaduḫḫu*-aromatic" into the interior (of the *harû*-vessel). (The mixture) is to sit all day. During the evening, you pour it into into an *agannu*-vat. You place 3 seahs of *perṣaduḫḫu*-aromatics into the interior (of the *agannu*-vat). It is to macerate overnight. At sunrise, you wipe clean the *diqāru*-vessel. You pour into the *diqāru*-vessel the aromatics that have softened within the *agannu*-vessel and have macerated overnight. You ignite a fire beneath the *diqāru*-vessel, and the aromatics, which have become hot, you pour (their) oil into the *diqāru*-vessel. You stir it, and wipe it clean. You remove the *bulû*-wood, but do not remove the coal. You raise its flame high. The oil-mixture will expel froth. You wipe down the interior of the *diqāru*-vessel with a *šuḫattu*-cloth. You stir (the mixture) and cover it up. (After the mixture) sits in its *diqāru*-vessel for 4 days, you re-ignite its flame in the morning and you stir it. You should not make the fire strong.
> ————
> In pouring for the 14th and 15th time your procedure is the same as the 13th time. For these two (decanting)-processes of yours, (the mixture) is to remain (in a *diqāru*-vessel) 4 days at a time.[24]
> ————

In many ways, this Middle Assyrian perfume recipe for a royal scent identified as *perṣaduḫḫu*-oil resembles our modern cookbooks, with a few differences. Rather than use imperative verbs ("chop 2 onions and add a dash of salt"), Akkadian recipes employ the second person present (durative) forms of the verb, instructing an anonymous "you." In KAR 140 above, this unnamed agent is addressed directly: "You stir it, and you wipe it clean…you raise the flame high."

When we turn to examine the physical format of KAR 140 itself, we can distinguish sections separated by section rulings that run across the width of the tablet, these section rulings, which function as punctuations, are indicated by the dashed lines in the translation above.

[24] KAR 140, r i 7–25 (http://oracc.org/glass/P282611)

Perfume recipe KAR 140 describes filtering and maceration of herbs and aromatics. This multi-step filtering process (literally, "your pouring," or "you washing" in Akkadian *tabaki*) is necessary for producing *perṣaduhhu*, an "oil of sweet myrrh" characterized as "fit for a king."[25]

KAR 140 rev. ii 6–8

6. [...] 1 ITI U4-MEŠ*te* *tu-pa-ša-aḫ-šu i+na* 1 ITI U4-MEŠ ˹*te*˺
7. *ta-na-ši-a a-na* ÚTUL-*šu tu-tar-šu a-na* 40 *ma-ás*-[*sa-a*]-˹*te*˺
8. *pir-ṣa-du-ḫi tu-še-ṣa-šu e-li-a ša* UGU MAN *i-qab-bi-ú*

Translation

You allow it to rest (lit: cool down) for a full month. After a full month you lift it out (the processed oil) and return it to a *diqāru*-vessel. After 40 washings you will extract oil of sweet myrrh (*perṣaduḫḫu*), that is processed, (and) which they call "fit for a king" (*ša* UGU MAN).

Multiple extractions ("washings") are needed in order to extract the strongest possible oil. Only after forty "washings" is the scent considered sufficiently regal.[26]

The more closely we read cuneiform technical recipes the less familiar they become. In just 19 lines the modern translator of KAR 140 will encounter 5 technical terms that have yet to be translated with any certainty; these terms can be separated into two basic types: instrumentation (*diqāru*, *ḫarû, agannu*, *šuḫattu*) and ingredients (*perṣaduḫḫu*, *bulû*). This density of untranslated technical terms is common within the glass and perfume-making procedures. In most cases, a one-to-one translation cannot be achieved. Unresolved technical terms constitute a major component of Akkadian technical and scientific recipes. In contrast to previous studies, this work proposes that we should not aim to reach one-to-one correspondences of ancient terms to modern lexica. We should explore, rather, the semantic *context* of technical terms, maintaining a proximity to contemporaneous sources so as to assure that our translations are localized historically and semantically. In the Appendix (and text editions therein), I employ network visualization analysis tools to create semantic maps of difficult to translate ingredients.[27]

Thus far, our outline of cuneiform recipes can begin, first, with the observation that (**a**) *cuneiform recipes followed a structured linguistic and material format*; i.e., clay tablets on which recipes were written were physically structured using line rulings, and the linguistic formats of the texts employ a predictable syntax, using second person verbal forms. Secondly, we can add that the texts (**b**) *contain a dense distribution of*

[25] This phrase is quite complex in the original Akkadian; consult Chapter 2 and Appendix for a philological discussion of this line.
[26] The association of perfumed oil with Assyrian kingship is significant, as is the class of female experts called *murraqqītu*, "perfumer"; we will return these matters in Chapter 2.
[27] Reading and interacting with semantic ingredient networks requires some basic introduction to network analysis and its utility for Akkadian semantics. This discussion can be found in the Appendix.

rare technical vocabulary, so rare, in fact, that even our best research dictionaries, including *The Chicago Assyrian Dictionary*, have struggled to define the terms.

Another perfume recipe from the same Middle Assyrian corpus, KAR 220, ends with a unique colophon, which attributes its recipe knowledge to a female expert named *Tappūtī*, called the "companion of the goddess *Bēlet Ekallim*" (*Tappūtī-Bēlet-Ekallim* in full):[28]

> Perfume making recipe for 2 *seahs* of processed cane oil, fit for a king, according to the mouth of *Tappūtī-Bēlet-Ekallim*, the perfumer: month *Muhur-ilāni* on the 20th day; the eponymate of *Šunu-qardu rab šaqê*.[29]

Here, the recipe ends by providing historical information, including the year name of a high official (called an "eponymate"), which allows us to date the text to ca. 1239 BCE, the fifth regnal year of the Assyrian king Tukulti-Ninurta I. This date is compelling, as it places KAR 220 in the historical context of the late second millennium, a period during which the political and scholastic prominence of Assyria was still in its infancy compared to that of its southern neighbor, the territorial state of Babylonia.[30] Colophons such as these prompt us to consider recipes for their historical data. Even in cases where colophons are not preserved, recipes can be contextualized within complex socio-political environments;[31] thus, we can add that (**c**) *cuneiform recipes are historical texts*.

To examine the historical context of recipes further, we can look to the later Neo-Assyrian glassmaking recipes, which we can date securely to the late 7th century BCE, the period of the so-called Library of Ashurbanipal.[32] Neither the earlier perfume recipes nor the later glassmaking texts were found in craft workshops, both corpora belonged to royal or elite archives (further emphasizing the scholarly locus of the texts).[33] This point is reinforced as well, in the list of ingredients. For example, the

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[28] A dissertation by G. De Clercq discusses the history of the goddess Belet-ekallim G. De Clercq, "Die Göttin Binegal/Belet-ekallim nach den altorientalischen Quellen des 3. und 2. Jt. v. Chr.: mit einer Zusammenfassung der hethitischen Belegstellen sowie der des 1. Jt. v. Chr".

[29] KAR 220 rii 8'–10' (P282617); for information regarding this eponymate, see Helmut Freydank, "Zu den Eponymenfolgen des 13.Jahrhunderts v. Chr. in Dūr-Katlimmu," *Altorientalische Forschungen* 32.

[30] Nicholas Postgate provides a general overview of the rise and fall of Assyria in Nicholas Postgate, "The Land of Assur and the Yoke of Assur," *World Archaeology* 23.

[31] Chapter 2 focuses on this very task.

[32] K.203+ (P393786) rev. ii 23'–28' preserves the beginning of a palace colophon; fragment K11314 (P399221) 6' also preserves what appears to be a palace colophon: [E2.GAL ^{m}AN].ŠAR2-[DU3?-A? ...] "[Palace of] Ashurbanipal.." Eleanor Robson in has troubled the category of libraries, particularly as it relates to the "Library of Ashurbanipal," which encompasses a collection of archives at Nineveh, for which see Eleanor Robson, "Reading the Libraries of Assyria and Babylonia," in *Ancient Libaries*, ed. J. König, K. Oikonomopoulou, and G. Woolf (Cambridge: Cambridge University Press, 2013).

[33] See Chapter 2 for the archaeological and historical contexts of these corpora.

perfume recipe KAR 220 which instructs one to use "water from the palace well of Aššur" (*mû ša būrte ša ekallim ša Aššur*).[34] Here we arrive at a fourth important point: (d) *cuneiform technical recipes were recovered and belonged to elite scholarly contexts*.

Because previous interpretation of cuneiform recipes have assumed them to be practical handbooks, the connection between these texts and Assyrian political identity has yet to receive adequate attention. What does it mean, for example, when an Assyrian glassmaking recipe records instructions for making "Elamite carnelian", as in a fragmentary section of K.4266+, which states: "1 mina of *zukû*-glass, 15 shekels of… 10 shekels of lead: (these) are the ingredients for Elamite carnelian according to (the expert) *Wa*-(…)"[35] The state of Elam, located in what is now modern Iran, was a political and martial rival of the Assyrian state. This attribution of technological expertise to Elam, and the ownership of that knowledge by Assyrian scribes, is not trivial. Indeed, from the perspective of political history, the humble corpora of Assyrian technological recipes—13th century perfume making (including 6 tablets and fragments) and late 7th century BCE glassmaking procedures (14 tablets and fragments)—bracket both the rise and fall of the Assyrian imperial state.

In addition to a shared linguistic register (lists of ingredients followed by second person verbs) and historical data, procedural texts strategically utilize the polyvalence of the cuneiform script and homophony in the Akkadian language in order to create new technical terms. Scribal hermeneutics often underlie technical instructions, as in, for example, the introductory section for a glass making procedure, which details how one ought to set up a four-chambered kiln (literally, a "kiln with 4 eyes"). Here, the reader is provided with the following instruction:

> **K.203+ obv. i 18–20**
> … *qurū*-wood that have no knots on the surface, bound up with an *apu*-strap that you cut in the month of *Abu*, these logs should go into the bottom of the kiln.

Two Akkadian terms remain unidentified in the above passage: *qurū* and *apu*. *The Chicago Assyrian Dictionary* (henceforth, CAD) tentatively identifies *qurū* as 'a cutting of wood' and *apu* as a 'leather strap' based on a contextually literal reading, and the understanding that both *qurū* and *apu* refer to tools and objects necessary for the construction of a kiln. However, a closer look at the heuristic relations of terms demonstrates an underlying level of meaning, which can only be accessed by examining closely the multivalence of the cuneiform writing system; two scholarly mechanisms can be identified in this *qurū*/*apu* passage above, homophony, and graphemic polyvalence:

> **Homophony:** The term *qurū*, a near homophone of *kūru* "kiln," is contextually salient to the introductory section of the text, which details the construction of a kiln; similarly, the *apu* "leather strap" with which the logs are bound is related to the Akkadian writing of the month ^{iti}NE = ^{iti}Abu. In the second example, *apu*, the change occurs between the plosives (b and p), a common phonetic shift in

[34] KAR 220 obv. i 2.

[35] See K.4266+ (P395468), r i 15'–17': 1 MA.NA NA$_4$ *zu-ku-ú* 15 ⌜KISAL⌝ […]; 10 KISAL *a-ba-ru maš-ka-an-ti* ⌜^{na_4}⌝ [GUG]; *e-lam-me-ti ša* ŠU-MIN ^{m}*Wa-a*-[…]

Akkadian. Indeed, a revised reading *abu* for "leather strap," is entirely permissible given the polyvalence of the cuneiform script.

Graphemic polyvalence: In the ^{iti}NE example above, the relationship between the sumerogram IZI = *išātu*, "fire" and writing of the month Abu employ the same cuneiform sign: NE .

Taking these scholarly strategies into account, we may re-read the passage, as a scribe might have, incorporating the various levels of meaning into a single sense translation that captures the multivalence of cuneiform scholarship:

K.203+ (sense translation)
"kiln"-wood (*qurū*) logs with no knots on the surface, bound up with the "father"-strap (*apu*), the logs that you cut in the "month of fire"—also called the month of the father (Abu)—these are the logs that should go into the bottom of the kiln.

Regardless of whether *apu* or *qurū* signified objects extent in the natural world, they were undoubtedly purposeful within the context of cuneiform scholarship. These terms may, to modern interpreters appear to be mere, "imaginary" ingredients, but in fact, they serve an explanatory purpose within the passage above.[36] The signs foreshadow a thematic interest in kilns, fire, and as we will find in Chapter 3, are also directly related to scholarly concept of purity. This brings us to the fifth and final observation, that (e) *scribes employed the polyvalence of the cuneiform script to generate technical knowledge*. This tactic may generally be called "scribal hermeneutics."[37]

Thus, in answer to the initial question: *what are cuneiform recipes?* We can outline the following introductory points. Cuneiform technical recipes contain:

- **a.** Structured instructions that employ second person verbal forms
- **b.** Dense distributions of technical vocabulary
- **c.** Elements of socio-political history
- **d.** Archaeological and historical connections to elite scholarly contexts
- **e.** Evidence of scribal hermeneutics

As we will find in Chapter 2, not all recipes contain elements **a**–**e**. As with any set of ideal types, criteria **a**–**e** are best used as a roadmap for distinguishing local variations.

Having summarized these general criteria for what makes cuneiform recipes a unified textual category, we can now turn to the epistemological questions: Do cuneiform recipes reflect a distinctive form of knowledge? What can cuneiform recipes tell us about "technology" as it relates to scribal knowledge? To approach these broader concerns will require both close and distant analyses of cuneiform recipes as well as engagement with social scientific and philosophical literature regarding procedures and

[36] We will return to this passage and the construction of the kiln in Chapter 3.
[37] C. Jay Crisostomo, "Bilingual Education and Innovation in Scholarship: The Old Babylonian Word List Izi" (Dissertation, University of California, Berkeley).

knowledge of materials. Much of the work ahead is dedicated to dismantling dichotomies in an effort to more closely approximate frameworks of scribal knowledge.

1.3 Cuneiform Recipes as Knowledge

> *Humans are thinkers and humans are agents. There is a natural temptation to view these as distinct capacities, governed by distinct cognitive states. When we engage in reflection, we are guided by our knowledge of propositions. By contrast, when we engage in intelligent action, we are guided by our knowledge of how to perform various actions. If these are distinct cognitive capacities, then knowing how to perform an action is not a species of propositional knowledge.*
>
> Jason Stanley, *Know How* (2011)

> *The denial of a thought component to technology is thus the consequence of adopting a theory of the relationships of science and technology. This theory holds that scientists generate new knowledge which technologists then apply… It is hard to avoid the conclusion that the separation of knowledge and technology is both recent and artificial.*
>
> Edwin Layton, *Technology as Knowledge* (1974)

That cuneiform recipes exhibit a predictable structural and linguistic format would suggest that practical knowledge, at least according to cuneiform scribes, could be textualized in Akkadian and codified via explicit sets of instructions and propositions. To ask "what is recipe knowledge?" is to engage in a deeper concern regarding the type of knowledge that recipes transfer. Sociological accounts describe recipes as the "attempt to transfer practical abilities or 'know-how' from a skilled or knowledgeable performer to a novice by offering step-by-step directions in terms that are familiar to the novice and by utilizing behaviors already within the repertoire of the novice."[38] Historical recipes can benefit from a modern sociological analysis of recipes knowledge, but only partially. Cuneiform recipes are indeed instructional, and as we have seen, share a superficial resemblance to a recipe one might find in a cookbook. However, this similarity, is only skin-deep, as there is no evidence that Assyrian glassmaking texts, for example, were meant to instruct novices. Quite the opposite.

Employing rare technical vocabulary and orthographies, cuneiform recipes are a testament to language games that could only have been interpreted by expert scribes. In other words, rather than the sociological "cookbook" model of recipe knowledge wherein technical skills are transmitted from expert-to-novice, what we find in cuneiform procedures is an expert-to-expert model of transmission. Nevertheless, there is a great deal to learn from the work of sociologists Harry Collins, and more recently, Neil Gascoigne and Tim Thornton, particularly where it concerns what Collins has called

[38] Leigh S. Schaffer, "Beyond Berger and Luckmann's Concept of 'Recipe Knowledge:' Simple versus Standardized Recipes," *Sociological Viewpoints*, no. Spring 2010 Issue: 56.

"(somatic) tacit knowledge."[39] To understand the tacit knowledge debate, it is worth spending some time as well, with two of their predecessors, mid-twentieth century philosophers Michael Polanyi and Gilbert Ryle.

It was Polanyi, in his (1966) *The Tacit Dimension*, that coined the term "tacit knowledge." *The Tacit Dimension* begins with a seemingly simple statement: "*we can know more than we can tell.*"[40] For Polanyi, the archetypal example of tacit knowledge is the act of riding a bicycle, a task so simple and somatically dependent that it cramps the mind to imagine a corresponding recipe, i.e., a set of textual instructions for riding a bike. Painful trial and error and bodily experience appear to be the only remedy for the unenlightened bicyclist, as according to Polanyi:

> If I know how to ride a bicycle . . . this does not mean that I can tell how I manage to keep my balance on a bicycle . . . I may not have the slightest idea of how I do this, or even an entirely wrong or grossly imperfect idea of it, and yet go on cycling . . . merrily. Nor can it be said that I know how to bicycle . . . to coordinate the complex pattern of muscular acts by which I do my cycling . . . I both know how to carry out [this performance] as a whole and also know how to carry out the elementary acts which constitute [it], although I cannot tell what these acts are.[41]

Tacit knowledge is "personal," to use Polanyi's characterization; and it is decidedly not explicit. Only through the process of codification, in our case, the writing and dissemination of historical recipes, does tacit knowledge transform into explicit instructions. Polanyi's concept of tacit knowledge can directly intervene in our interpretation of cuneiform technical knowledge. Take for instance, the following excerpt from a Neo-Babylonian (ca. 6th century BCE) wool-dyeing recipe, newly edited here based on a recent tablet join:[42]

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[39] H. M. Collins, *Tacit and Explicit Knowledge* (London: The University of Chicago Press).

[40] Polanyi used the phrase "personal knowledge" to describe what later sociologists like Harry Collins would call "tacit knowledge," see Michael Polanyi, *The Tacit Dimension* (Gloucester, Mass.: Peter Smith), 4.

[41] "The Logic of Tacit Inference," in *Human and Artificial Intelligence*, ed. Frederick J. Crosson (New York: Appleton-Century-Crofts), 223.

[42] The original edition of this small, unprovenanced text was produced by Erle Leichty, but a recently discovered fragment, unknown to Leichty, significantly restores the excerpt quoted here: Erle Leichty, "A Collection of Recipes for Dyeing," in *Studies in Honor of Tom B. Jones*, ed. Marvin A. Powell and Ronald H. Sack, Alter Orient und Altes Testament (Neukirchener-Vlyun: Neukirchener Verlag). For a digital edition, see http://oracc.org/glass/X000001; this new fragment (BM 82978) belongs to top right obv. (lower right rev.) of BM 062788. The join, to my knowledge, was made by Irving Finkel, who is currently producing a full text edition of the recipe. A recent publication by M. Martelli and M. Rumor Martelli and Rumor, 50ff. discusses this text and Finkel's forthcoming publication.

BM 62788+, rev. 11'–13'

11'. ^{sig}BABBAR *tal-qu u* NA$_4$ *ga-bu-ú mál-ma-liš* LÁ *ina* A-MEŠ *ina* IZI ŠEG$_6^{šal}$
12'. EN A-MEŠ IDIM *ha-at-hu-ru-tú* SÚD u ^{sig}BABBAR *tal-qa šú-nu-tú*
13'. *mál-ma-liš* LÁ *ina* A-MEŠ *u* A *šá* ⌜IM⌝ *ina* IZI ⌜ŠEG$_6$⌝^{šal} E$_{11}$-*ma*
^{sig}*ar-ga-man-nu*

Translation

You take natural wool and alum and weigh them in equal parts, you heat it (the mixture) in water over a fire until the liquid mixture has been exhausted; the pulverized *ḫatḫuru*, and the natural wool, you weigh them in equal parts, you heat the mixture in water and "water of clay" you over a fire, pull it out: purple-*argamannu*

These pithy instructions for dyeing wool purple-*argamannu* pose more questions than provide explicit directions for the novice. How much wool is to be dyed? What temperature should the mordant mixture be? How do you know when to remove the wool from the dye mixture? Without instrumentation, temperature was gauged "by feel," experience and know-how—such questions were certainly answerable, not by scribes composing recipes, but by Babylonian weavers and launderers putting to use their somatic tacit knowledge.[43]

In glassmaking, today as in the ancient world, controlling the temperature and color of molten materials is essential, particularly in the application of copper oxides, which can quickly render blue glass green if temperatures and oxygen levels are not kept in check. Knowing which alkali plants to use in order to flux glass (i.e., to lower the melting temperature of silica) was also the domain of specialized craftsmen. As we have seen, controlling temperature is also central to wool dyeing processes; applying colorant and mordants goes hand-in-hand with precise temperature control. Perfume production, in turn, depends heavily on experienced olfactory senses. The ability to produce and certify that a scented oil is "fit for a king"[44] is not a job for the novice nose. Recent studies in neuroscience have argued that scent is among the most complex and least understood of our five senses.[45] It warrants repeating that in textual sources, essential instructions are missing, that somatic craft knowledge is *not* apparent in

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[43] The phenomenon of tacit knowledge is not unique to cuneiform recipes. A similar set of questions can be asked of later historical recipes for purple dyeing, as in the following recipe from the Syriac corpus of pseudo-Democritus:

> Again another [recipe for] cold purple [dyeing].
> It is the purple made by means of that water which, after boiling, makes its flowers [i.e. the flowers of the purple dye] soft. Wool is plunged in: it takes alum and it is left [to soak] for one day. Afterwards you wash it. You must throw it into flour… and wash it again. This is the purple [dyeing]

Translation Matteo Martelli, for which see Martelli, AMBIX 60, Supplement 1, 186–87; ibid.

[44] Translation my own; see Chapter 2 and Appendix for complete discussion of KAR 220's colophon, its philological challenges, and the historical data it provides.

[45] Ann-Sophie Barwich, "Up the nose of the beholder? Aesthetic perception in olfaction as a decision-making process," *New Ideas in Psychology*.

cuneiform recipes, (nor is it suitable for the procedural format of Akkadian recipes) which call for the employment of explicit propositions and protocols.

Underlying any given set of explicit instructions—as in, e.g., *išāta ṭābta lā qatirta tašarrap adi iharraṣu* "you burn a good and smokeless fire until your (glass) mixture glows yellow,"[46]—is a sense-dependent know-how, somatic knowledge. Assyrian glassmaking recipes do not instruct one *how* to recognize a proper smokeless fire, or *when* the requisite temperatures (of the kiln and glass mixture) have been achieved. Successfully producing "quartz-glass" (^{na4}*dušû*) in the kiln requires, moreover, a keen sense of color perception, being able to discern between a yellow, orange, or golden glow (these fine differences in hue are indistinguishable in the verbal root *ḫrṣ*, which refers commonly to the color/material "gold").

In addition to the negotiating between tacit and explicit elements in cuneiform recipes, we can also consider the language of recipes in sociological terms, specifically, the concept of "context independent" instructions. Neil Gascoigne and Tim Thornton remark that "all knowledge can be fully articulated, or codified, in context-independent terms."[47] The Akkadian *ana epēšika* (literally, "for your making") might be classified as one such "context-independent" phrase that is found only in procedural texts, as in, for example, the glassmaking recipes for making blue glass, which begin *šumma* ^{na4}*zagindurra ana epēšika* "if you want to make lapis lazuli." The phrase *ana epēšika* is attested as early as the Old Babylonian period (ca. 1800 BCE) in mathematical texts,[48] and persists into Late Babylonian astronomical procedures (2nd century BCE)"[49]

These general structures remained relatively unchanged—following Gascoigne and Thornton, one could argue, these elements became "codified" over centuries—providing the structural framework for a vast thematic range of procedural texts, including instructions for curing medical afflictions, training horses, dyeing wool, making mutton stew, solving a mathematical problem, calculating the position of a planetary body, and treating witchcraft. All such texts share in common not only a general structural and linguistic format, but, as well, a set of general properties, research goals (outlined in 1.1), that characterize cuneiform procedures of all periods.

Epistemologically, historical recipes are marked by a tension between textual codification and somatic tacit knowledge. Bringing to light the tacit knowledge necessary to make glass, perfume, or dye wool—the parts of those techniques that cannot have been codified in cuneiform procedures—is central to defining holistically what "technology" means in the context of knowledge. If nothing else, discussions of

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[46] K.203+ rev. i 50'–51.'

[47] Or codified in context-independent terms.

[48] In mathematical contexts, the preposition used is *ina* rather than *ana*, as Ritter translates "in your proceeding" rather than "for your making". Both variations attach the second person prefix *-ka* to the infinitive form of the verb *epēšu* "to make."

[49] The phrase *ana epēšika* is one of a number of similar instructional phrases that is nearly always preceded by the conditional particle *šumma* "if," the first element in propositional phrases throughout the cuneiform intellectual tradition. For propositional statements in omen literature, see Francesca Rochberg, ""If P, Then Q": Form and Reasoning in Babylonian Divination," in *Divination and Interpretation of Signs in the Ancient World*, ed. Amar Annus (Chicago: The Oriental Institute of the University of Chicago).

tacit knowledge throw a wrench into the traditional narrative that casts these texts as mere craft manuals. How can we define the difference between the knowledge of a scribe and the knowledge of a glassmaker? In the case of cuneiform procedures, we can say that the distinction is between knowing *about* glassmaking (scribal knowledge) and knowing *how* to make glass (technological-craft knowledge). But this insight will get us only so far in elucidating the difference between scribal knowledge. To more fully explore the epistemological dimension of craft know-how, we must turn to philosophy and consider how what we call "intelligence" manifests in non-literate domains.

For the historian of technology Edwin Layton, who wrote an article entitled "Technology as Knowledge" (this work's namesake), knowledge of technical skill constitutes "the 'ability to use one's knowledge effectively.' A common synonym for technology is 'know-how.'"[50] Layton, here, echoes Gilbert Ryle's examination of knowledge found in his *The Concept of Mind*. Already in 1949, Ryle proposed that "knowing *how*" (i.e., propositional knowledge of abstract truths) and "knowing *that*" (non-propositional enactment of skill) are cognitively co-dependent.[51] The details of his arguments, steeped in mid-twentieth century behaviorism, are not as salient, for the present purposes, as his examination of what he calls the "intellectualist legend."[52]

What Ryle called an "intellectualist legend" is the idea that "the intelligent operation must embody two processes, one of doing and another of theorizing," an iteration of Cartesian dualism wherein mental cognizance is incommensurate with the physical performance of an action.[53] According to the "intellectualist legend," proper practice depends on knowing the rational maxims that dictate those sets of action—the rules and procedures. The interpretation of ancient "intellectual" cultures grist for Ryle's mill, as cuneiform scribes were rarely explicit regarding their theorems and maxims, not just in technical recipes, but also in quantitative disciplines like astronomy and mathematics. Yet we should not, according to Ryle, use theoretical maxims or axioms as the measure for determining the theoretical rigor of a historical culture.

Jason Stanley has stated that "the person acting on theoretical knowledge has an instruction booklet, which she reflects upon before acting. In contrast, part of the skill that constitutes skill at tennis involves reacting to situations for which no instruction manual can prepare you."[54] The dichotomy between the practical and the theoretical is also found in cultural hierarchies of knowledge, as in, for example, the popular distinction between the knowledge of the professor and the knowledge of the plumber,

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[50] Edwin T. Layton, "Technology as Knowledge," *Technology and Culture* 15 (1974).
[51] He adds that "complex procedures can only come into being through knowledge…but how" he asks, "can there be "know-how" without knowledge?" Ibid., 33–34.
[52] Ryle's arguments are ultimately anti-Cartesian; The Concept of Mind proposes a logical fallacy in the Cartesian model of mind, wherein knowing-that and knowing-how are independent non-communicative processes.
[53] Seen in this light, it becomes clear why so much modern literature on tacit knowledge and recipes, reassessing Ryle's ghost in the machine, regards machine learning and AI. Gilbert Ryle, *The Concept of Mind* (Chicago: University of Chicago Press), 32. Indeed, much of the work that has gone into the study of tacit knowledge by Harry Collins has focused on how machines can replicate human bodily experience and craft, as in, for example, making bread Collins.
[54] Jason Stanley, "The Practical and the Theoretical," *The New York Times*

which is predicated on the separation between abstract knowledge of propositions (the professor's *episteme*) and somatic knowledge of craft (the plumber's *techne*). The divorce between the abstract and the practical is intuitive, but ultimately, artificial and philosophically as well as historically problematic. Nevertheless, it is a division that is constantly reified.

What is unarguably our most advanced scientific instrument to date, the Large Hadron Collider, is home to an international community of scientists, many of them physicists who fall into one of two clans. On the one hand, there are the *theoretical* physicists and on the other hand, the experimentally-minded *applied* physicists. Cultural reifications of the practical and theoretical knowledge dichotomy are found all over our society, such that making the intuitive leap that they must have also existed in past knowledge cultures comes rather naturally. It also helps explain why, throughout the 20th century, historians were keen to call technology "applied science."[55] The myth of the professor and the plumber is a recurrent one in the history of Western knowledge. Our contemporary caste system of thinkers and doers becomes reified in ancient actors, and in our interpretations of ancient technical texts. Taken seriously, the intuitive separation between ancient craft recipes (*techne*) and proper scholarship (*episteme*) becomes an ontological boundary, such that technological knowledge is instinctively excluded from our current conceptions of scribal knowledge.

Yet one need not retreat to Mesopotamian antiquity to find the fib in this fable. Alisha Rankin, in her analysis of a 16th century letter written to Anna of Saxony, details the ways in which the use of the German term *Wissenschaft*, which we now translate as "science," "referred [then] to 'how-to' knowledge rather than abstract concepts."[56] As Rankin states, "Anna followed her statement to the empress with three pages of detailed and highly practical therapeutic advice, in which were embedded two medicinal recipes. Her *Wissenschaft* was not 'knowledge of,' but rather 'knowledge how to.'"[57] In this way, the "intellectualist legend" functions not just as a feature of Ryle's philosophy of mind, but also as a heuristic tool for identifying epistemological attitudes in historical texts. Already, there is good reason to pause on the notion that 16th century *Wissenschaft* more closely approximates the Akkadian term for knowledge, *nēmequ,* than modern terms like "science," or even ancient ones like "philosophy."[58]

The embeddedness of Akkadian terms for technical skill within a broader vocabulary of scholarship and "expertise," makes "technology" particularly difficult to extract from the broader, and more inclusive category of "knowledge" called *nēmequ*.

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[55] See discussion in 1.4 below.

[56] Harold J. Cook, Pamela H. Smith, and Amy R. W. Meyers, "Introduction: Making and Knowing," in *Ways of Making and Knowing*, ed. Pamela H. Smith, Amy R.W. Meyers, and Harold J. Cook (Ann Arbor: The University of Michigan Press), 9.

[57] Alisha Rankin, "How to Cure the Golden Vein: Medical Remedies as *Wissenschaft* in Early Modern Germany," ibid., 114.

[58] The final chapter of this work (Chapter 5) discusses and reassesses the methods and consequences of redefining *nēmequ* in these frameworks. Notably, Marc van de Mieroop has employed the term "philosophy" to describe cuneiform scribal knowledge in his latest monograph, *Philosophy Before the Greeks*. Marc Van de Mieroop, *Philosophy Before the Greeks: The Pursuit of Truth in Ancient Babylonia* (Princeton: Princeton University Press).

Take for example, the term *ummânu*; it is the Akkadian noun that means "expert," but can refer simultaneously to a skillful scribe or a knowledgeable glassmaker. An *ummânu* could, in modern terms, refer to either a plumber or a professor. A section of the Assyrian glassmaking recipes makes this double semantic sense quite vivid:

> **K.4266+ rev. i 34'–38'**
> i 34'. *i-na a-li-ku* 2 *be-er* ^{d}KU$_3$-be *tu-še-ši-ib*
> i 35'. ^{udu}SISKUR *ta-ṣa-bat a-na um-ma-ni*
> i 36'. *ki-is-pa ta-ka-si-ip*
> i 37'. ⌜*maš*⌝*-ši-it a-na tam-šil-te te-si-ip*
> i 38'. ⌜*a*⌝*-na* UDUN *tu-še-ri-*⌜*id*⌝
>
> **Translation**
> In the process, you set up *Kubu* divinities within two double hours. You sacrifice a sheep. You make a funerary offering to the experts (*ummânu* of yesteryear). You collect the ingredients in a (casting)-mould and set it down into an *utūnu*-kiln

Who were these *ummânu* experts for whom sacrifices were be made? Were they ancient glassmakers or ancient scribes? Technicians or literati? Interpreting the phrase *ana ummânī kispa takassip*, "you make a funerary offering to the experts," depends on how *we* interpret expertise. Here, the distinction between knowing-how and knowing-that is at odds with how knowledge was framed in terms of *nēmequ*. In Akkadian, someone who is "skilled" is *emqu*, a derivation of the verbal roots (*nmq*), *nēmequ*—simply, knowledge.

Akkadian technical scholarship offers no obvious distinction between *episteme* and *techne*. Rather, as argued in Chapter 3, it would appear that for cuneiform scribes, both *episteme* and *techne* appeared to have been on equal footing. Moreover, tacit knowledge, and the tension between knowing *how* and knowing *that*, between theory and practice, and between *episteme* and *techne*, is manifest in recipes from all periods. This epistemic tension is precisely what allow cuneiform recipes to enter larger discussions regarding technology and knowledge, or technology *as* knowledge.

From the perspective of textual history, sociology, and philosophy of science, we can outline three overlapping positions to the question: What makes recipe knowledge *knowledge*?

> **a.** A textual historian's position (espoused throughout this work) would state that recipe knowledge is inherently local, responding to the socio-intellectual contexts in which it is circulated;
> **b.** A philosopher considers the more universal relations between knowing-that, knowing-how, and knowing-when, which, are to varying degrees co-dependent features of human cognition (at least for the anti-Cartesians); Polanyi and Ryle are both concerned with the metaphysical dimension of *personal* or tacit knowledge and know-how;

> **c.** Finally, a sociologist, in contrast to the philosopher, is concerned with the *collective* aspects of tacit knowledge, the socialization of instructions, and (at least in the case of Collins) the potential to achieve tacit knowledge in machines.

At a minimalist level, these interrelated stances illustrate the complexity of recipe knowledge. Incorporating elements from points a, b, and c above enables cuneiform sources to enter into a broader comparative dialogue concerning the nature of scholarship in historical cultures. Manifest in cuneiform recipes is a hybrid[59] model of technological-scribal knowledge, which is unveiled only by re-coupling the persistent and intuitive binaries (theory v. practice, nature v. culture) that continue to infiltrate the modern interpretation of ancient knowledge cultures.

1.4 Modern Dichotomies, Ancient Hybridity

Structural anthropologists highlighted binary oppositions as a universal feature of human cognition and knowledge production. Levì-Strauss' raw and cooked dichotomy marks but a single entry in a long list of similar pairings, which include: rational and irrational; real and artificial (or natural and man-made); realism v. antirealism; and, as we have already seen, theory v. practice. To varying degrees, Assyriologists have—either tacitly or explicitly—imported all of these into their historical reconstructions of ancient Mesopotamia. We might take as an example a recent description of recipe knowledge (via cuneiform medical texts), proposed by Barbara Böck:

> Contrary to Greek or Latin medical tradition in classical antiquity ancient Mesopotamian scholarship did not produce any theoretical work or treatise. Babylonian and Assyrian practitioners did not summarize recipes according to preparation and application but rather stated how drugs were prepared and administered in each remedy in a somewhat casuistic manner.[60]

According to Böck, Greek and Latin medical scholars were theorists (making evident their interest in abstract deductive method), while Assyro-Babylonian scholars were practitioners that "prepared and administered each remedy in a somewhat casuistic [practical] manner." Any number of articles and edited volumes in the study of Mesopotamian medicine have taken the *episteme-techne* dichotomy to be both analytically, and ontologically productive. The theory-leadenness of practice—and as we have seen, the relation between knowing that, knowing how, and knowing when—has not been sufficiently implemented in the study of cuneiform technical and scientific texts. Particularly in the study of Mesopotamian medicine, comparative approaches tend

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[59] As I use "hybridity" below, I do not draw on the Homi Bhabha's notion of hybridity from post-colonial literature Homi K. Bhabha, *The Location of Culture* (New York: Routledge). Rather, I employ the term in a more basic sense to mean a theory-laden admixture of disciplines that comes to characterize scribal/technical knowledge.
[60] Barbara Böck, "On Medical Technology in Ancient Mesopotamia," in *Advances in Mesopotamian Medicine from Hammurabi to Hippocrates*, ed. Annie Attia and Gilles Buisson, Cuneiform Monographs (Leiden: Brill), 110.

to focus on the issue of ancient rationality, i.e., the prevalence of "Greek rationality"[61] and theory. In its current state, the narrative of ancient medicine—a historiographical and philological challenge too monumental to take on here—is a history of Classical thinkers and Mesopotamian doers.

The creation of dichotomies opposing (and co-dependent) pairs is, according to Bruno Latour, a feature of modern thinking, anchored in what he has called "a perverse taste for the margins,"

> Just as the adjectives and designate representations of collectives that are neither natural nor social in themselves, so the words 'local' and 'global' offer points of view on networks that are by nature neither local nor global, but are more or less long and more or less connected. What I have called modern exoticism consists in taking these two pairs of oppositions as what defines our world and what would set us apart from all others. So four different regions are thus created. The natural and the social are not composed of the same ingredients; the global and the local are intrinsically distinct. Yet we know nothing about the social that is not defined by what we think we know about the natural, and vice versa. Similarly, we define the local only by contrast with what we think we have to attribute to the global, and vice versa.[62]

But do these modern dichotomies, whether theory v. practice or nature v. culture, impair our ability to interpret cuneiform texts? If we follow Latour—yes. He adds, "the strength of the error that the modern world makes about itself is now understandable, when the two couples of opposition are paired: in the middle there is nothing thinkable — no collective, no network, no mediation; all conceptual resources are accumulated at the four extremes." If an interaction between technology and knowledge is to be found in cuneiform cultures it will require the re-coupling of modern dichotomies that have left "nothing thinkable" in the middle. In order to move towards a dialectic between theory and practice,[63] between the real and artificial observation and writing, such as we find in cuneiform scholarship, it is the middle that provided a space of epistemic interaction for cuneiform scribes and their worlds; it is precisely the middle that is of interest.

Recoupling certain dichotomies like *episteme-techne*, or genuine-artificial, is the beginning of a broader project that seeks to test the margins of other related pairings. Nature v. culture, and the intrinsic coupling of technology with progress, is bound up in an Enlightenment scheme that takes the Laws of Nature as its model,

> The Laws of Nature allowed the first Enlightenment thinkers to demolish the ill-founded pretensions of human prejudice…they no longer saw anything in the

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[61] Any number of edited volumes and articles have focused on comparing Greek Hippocratic corpora to Mesopotamian diagnostic procedures; see, for example, H.F.J Horstmanshoff and M. Stol, eds., *Magic and Rationality in Ancient Near Eastern and Graeco-Roman Medicine* (Leiden: Brill).

[62] Bruno Latour, *We Have Never Been Modern* (Cambridge, Mass.: Harvard University Press), 122.

[63] See Chapter 3.

> *hybrids of old* but illegitimate mixtures that they had to purify by separating natural mechanisms from human passions, interests or ignorance.[64]

This nomic model of explanation pits two opposing forces against one another; these binary oppositions, man v. nature, rational v. irrational, and as we have seen, *episteme* v. *techne*, are to be found only in the most developed historical cultures. For the modern, and previously, for the Enlightenment thinker, Latour explains, there was no room for "the hybrids of old." Here, he explicitly linked constructivist themes from Science and Technology Studies (STS) with themes of political philosophy, repeatedly asserting that the nature-culture divide is a creation of social (or, more specifically, Western) ingenuity. It is the mechanism by which Western societies sort the multitudes of hybrid networks that constitute their cognitive and material existence into seemingly autonomous worlds of nature and culture. So basic is the resulting duality in "modern" thought that, according to Latour, it underwrites all other ways of grasping the world.[65]

To recover the "hybrids of old" requires defamiliarization with one's own modernity (and by extension, the Enlightenment philosophical frameworks that gave rise to modernity). Cuneiform texts, what Benno Landsberger referred to as the remains of an "alien" civilization,[66] are up to this challenge. Indeed, cuneiform cultures are best understood when we re-couple binary oppositions and embrace frameworks of hybridity. After all, scribal knowledge, *nēmequ*, is, by modern standards, a semantic and cultural hybrid—a category that comes to include, by today's measure, an admixture of the sciences, humanities, and technical crafts.

1.5 Technology Before Progress

Juxtaposing the terms "ancient" and "technology" has a somewhat jarring effect. "Technology" sounds fundamentally modern. Mention "ancient" in a twenty-first century classroom and students are inclined to think about dusty ruins and dead civilizations; mention "technology" and those same students will point to their latest and shiniest gadget. There are historical reasons that explain this dissociation. Despite the term's ancient etymology in the Greek *techne*, "technology" gained its modern usage only after the Industrial Revolution, when there was an immediate need to think about technology in autonomous terms.[67] Thus, in our intuitive way of understanding

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[64] Latour, 35. Italics my own.

[65] Jasanoff has underscored the importance of Latour's model of hybridity to her own concept of co-production, adding, "[a]n appealing aspect of this view is that it genuinely is about *co*-production – that is, it does not presuppose any *a priori* demarcations of the world before that world is worked upon by human imagination and labor." See Sheila Jasanoff, *States of Knowledge: The Co-production of Science and Social Order* (New York: Routledge), 22.

[66] Benno Landsberger, *The Conceptual Autonomy of the Babylonian World*, trans. Thorkild Jacobsen, Benjamin Foster, and Heinrich von Siebenthal, vol. 1, Monographs on the Ancient Near East.

[67] David E. Nye, *Technology Matters : Questions to Live With* (Cambridge, Mass.: MIT Press), 10ff.

"technology," the term is synonymous with—or should at least reflect—*progress*. If technology is the so-called "handmaiden" of science, then it too, according to the modernists, must follow a rational progression.

Larry Laudan, in his (1977) *Progress and its Problems: Towards a Theory of Scientific Growth*, defined the problematic relation between rationality and progress as (yet another) distinction that required blurring. "Insofar as rationality and progressiveness have been linked at all," he stated, "the former has taken priority over the latter—to such a degree that most writers see progress as *nothing more than* the temporal projection of a series of individual rational choices. To be progressive, on the usual view, is to adhere to a series of increasingly rational beliefs."[68]

Technology and rational progression are related concepts, particularly in historiographical frameworks favoring "technological determinism," the "belief that changes in technology exert a greater influence on societies and their processes than any other factor."[69] In the literature of Science and Technology Studies (STS), this concept has yielded vibrant discussions concerning the ability of technology to catalyze or *determine* historical change.[70] Technological determinism is found more commonly in studies of modern (i.e., post 18th century) innovations. In the study of the ancient world, technological determinism is more nuanced—"softer" in STS terms—but still present. As in, for example, discussions of Late Bronze Age warfare and collapse in the Mediterranean, by Robert Drews and Mario Liverani, which have argued that chariot warfare was a central agent of change during this period.[71]

But the idea that technology is powerful enough as a force to *determine* historical change, that technical innovations progress rationally overtaking older systems of knowledge, is incompatible with the ways in which technology—the material world and its transformation, and the construction of knowledge itself—is represented in cuneiform scholarship. As Rochberg has observed, "progress" seems not to have been an epistemic value for cuneiform scholars,

> Despite development from older traditions, none of the new developments in intellectual interests entirely supplanted older tradition, suggesting that progress was not an epistemic value for the scribes. The positivistic story of scientific progress is not bolstered by the cuneiform evidence as each new development coexisted with older material. This is seen in the perpetuation of omens and in the kinds of schematic associations known from omen divination into birth astrology.[72]

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[68] Larry Laudan, *Progress and its Problems: Toward a Theory of Scientific Growth* (Berkeley: University of California Press), 5.
[69] Merritt Roe Smith, "Technological Determinism in American Culture," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge, MA: The MIT Press), 2.
[70] Leo Marx, "Technology: The Emergence of a Hazardous Concept," *Technology and Culture* 51.
[71] Discussed further in Chapter 2, within the context of MA perfume recipes (2.2).
[72] Rochberg, *Before Nature: Cuneiform Knowledge and the History of Science*, 280.

Indeed, cuneiform scribes are often unclear as to where and *when* knowledge comes from. Glassmaking recipes attributed their knowledge to dead experts and were found in a scholarly context wherein the king himself claimed to have retrieved "knowledge from before the flood,"[73]

> **K.2694+, i 16–17**
> 16. *áš-ta-si kam-mu nak-lu šá* EME.GI$_7$ *ṣu-ul-lu-lu ak-ka-du-u ana šu-te-šu-ri áš-ṭu*
> 17. *ḫi*!*-ṭa-ki* GÙ.SUM *ab-ni šá la-am a-bu-bi*
>
> **Translation**
> I have read artfully-written texts in which the Sumerian version was obscure and the Akkadian version for clarifying (too) difficult. I am enjoying the cuneiform wedges (sc. writing) on stones(s) from before the flood.

Even astronomers like Šamaš-eṭir, living in Hellenistic Uruk made sure to acknowledge that their profession was of ancient origins. TCL 6 38, a text containing ritual rites to be perfumed at the Rēš temple—one of the principal loci of celestial research during the Late Babylonian period—preserves a unique colophon that recounts a biography of the tablet and the knowledge therein:[74]

> 43. (Written by) the hand of Šamaš-ēṭir, son of Ina-qibīt-Anu, son of Šibqat-Anu.
> 44–46. Wax-table (containing) the rites for the Anu-worship, the pure *šuluḫḫu*-purification rites, the ritual regulations of kingship, including(?) the divine *šuluḫḫu*-purification rites of the Rēš-temple, the Ešgal-temple, the Eanna-temple and the (other) temples of Tiranna, the ritual activities of the exorcists, the lamentation priests, the singers and the craftsmen, all of them, who are subservient to the ..., not to mention all that concerns the apprentices, in accordance with the contents of the tablets, 47–50which Nabopolassar, king of the Sealand, carried off from Uruk. And at that time(?) Kidin-Anu from Uruk, the exorcist of Anu and Antu, descendant of Ekur-zākir, the high priest of the Rēš-

[73] The sources and translations for these two exemplars are discussed in AfO 50 Jeanette C. Fincke, "The Babylonian Texts of Nineveh: Report on the British Museum's Ashurbanipal Library Project," *Archiv für Orientforschung* 50 (2003–2004): 120ff.; ibid., 121, n.88–89. For an extended discussion of secrecy colophons, see Kathryn Stevens, "Secrets in the Library: Protected Knowledge and Professional Identity in Late Babylonian Uruk," *Iraq* 75.

[74] For a discussion of this colophon within its socio-intellectual context, see Eduardo A. Escobar and Laurie E. Pearce, "Bricoleurs in Babylonia: The Scribes of *Enūma Anu Enlil*," in *"The Scaffolding of Our Thoughts": Essays on Assyriology and the History of Science in Honor of Francesca Rochberg*, ed. C. Jay Crisosotomo, et al. (Leiden/Boston: Brill).

> temple, saw these tablets in the land of Elam and during the reign of Seleucus and Antiochus, the kings, he copied and brought (them) to Uruk.[75]

Scientific, including medical knowledge, could be attributed to ancient sages, as in BM 40152, which claims: "Tested recipes, which are available; a copy from a wooden tablet of Nūr-Marduk, the sage of Babylon."[76] The connection between knowledge production and traditional centers of knowledge, such as Babylon (as in the phrase *gabarē Bābili*, "copy from Babylon"), are exponentially more common than tablets claiming individual authorship. In this manner, cuneiform intellectual traditions—and indeed, we could say the origins of scientific knowledge as presented by scribes—more closely aligned with Early Modern concepts of *prisca sapientia* "ancient wisdom," as found, for example, throughout the alchemical writings of Isaac Newton:

> Newton attempted to make a synthesis of his occult-alchemical and exact-scientific research. For him a means of attaining this goal was the study of the so-called "prisca sapientia," a tradition of ancient wisdom. Newton considered that the original wisdom of the ancients, which had been gradually lost through the ages, was most fully retained in the Hermetic tradition. He saw himself as endeavoring to explain, by means of experimental science, this "sapientia," which had grown unintelligible.[77]

If progress, one of the defining characteristics of modern technological and scientific knowledge, was not an obvious value for the development of cuneiform technical knowledge, then what is needed is an epistemological framework that accounts for the knowledge content of technology without a dependency on progress—*technology before progress*.

For some time now, cultural historians and historians of technology have recognized the recent entry of "technology" into our lexicon. They remind us that the term "technology," despite its ancient Greek roots, is first attested in the seventeenth century, and only in the late 19th century does it begin to gain currency, referring then to what we might call the "mechanical arts."[78] It took until the 1930s for "technology" to become a popular term. As such, any history of technology, including an intellectual history, is left with two options: either confine the "history of technology" to the last century, or else, broaden the term substantially. This work undoubtedly leans towards the latter.

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[75] Translation Marc J.H. Linssen, *The Cults of Uruk and Babylon: The Temple Ritual Texts as Evidence for Hellenistic Cult Practises*, Cuneiform Monographs (Leiden: Brill-Styx), 172.

[76] Translation Irving Finkel, see BM 40152 rev. iii 29'–31': [*b*]*u-ul-ṭú lat-ku-tu*$_4$ *šá ana* ŠU^{II} *šu-ṣu-ú* [GAB]A.RI GIŠ *le-u*$_5$*-um šá* ^{m}*nu-úr-*^{d}AMAR.UTU UM.ME.A KÁ.DINGIR.RA.KI Irving Finkel, "On Late Babylonian Medical Training," in *Widsom, Gods and Literature: Studies in Honour of W.G. Lambert*, ed. A. R. George and Irving Finkel (Winona Lake: Eisenbrauns), 142, n. 12.

[77] Karin Figala, "Newton's Alchemy," in *The Cambridge Companion to Newton*, ed. I. Bernard Cohen and George E. Smith (Cambridge: Cambridge University Press), 370.

[78] Marx.

Tracing the genealogy of keywords like "technology" and "nature" is a necessary move if one is to calibrate and import those terms into analyses of the ancient world. Left untraced and under-analyzed, a keyword like "technology" becomes, as Leo Marx has characterized it, a "hazardous concept." Marx criticizes the extraction of the human element from histories of technology, stating that "by consigning technologies to the realm of things, this well-established iconography distracts attention from the human—socio-economic and political—relations which largely determine who uses them and for what purposes.[79]" We can add, further, that the intellectual component of technology, including the interaction and manipulation of materials, is a deeply human activity with strong ties to the textual cultures of the ancient world. The present work moves from one keyword to another, from "technology" to "recipe, to "knowledge," and back again, dismantling and introducing new components to the mechanisms that weight these terms. Yet the aim will remain constant: to more fully explain and understand the relationship between technology and *nēmequ*, knowledge. The first step in this process requires historical contextualization—putting technological knowledge *back in its place*, the subject of Chapter 2.

[79] Ibid., 576.

2
LOCALIZING RECIPE KNOWLEDGE IN CUNEIFORM CULTURES

ABSTRACT | Chapter Two examines technical recipes from four distinct periods of cuneiform intellectual history, beginning from the most ancient, these include: Middle Assyrian perfume-making recipes from Aššur, a Neo-Assyrian perfume recipe from Nimrud, the Neo-Assyrian glassmaking recipes from Nineveh, and an unprovenanced Neo-Babylonian wool dye recipe. The aim is two-fold. First, to describe and analyze the social and cultural locus of recipes, what they meant within cuneiform cultures of specific times and places in order to discern what such texts can tell us about scribal interpretations of technical knowledge. Second, and most importantly, this chapter examines the historiography of recipe texts across time, in order to focus attention on a question critical to this work: what kind of (primary) sources are cuneiform technical recipes?

(keywords: #local knowledge, #technology, #language, #recipes)

2.0 Introduction to Local Knowledge

> There is a line among the fragments of the Greek poet Archilochus which says: "a fox knows many things, but a hedgehog one important thing"
>
> Isaiah Berlin, *The Hedgehog and the Fox* (1953)

What kinds of sources are cuneiform technical recipes and can they be relied upon as primary sources for writing a history of ancient technology? P.R.S Moorey, in his (1994) *Ancient Mesopotamian Materials and Industries: The Archaeological Evidence*, drew a sharp distinction between practical craft, and the scribal knowledge of technology contained in the glassmaking recipes, which he considered "an inadequate source for the history of technology":

> These [recipe] texts are part of a traditional Mesopotamian literary enterprise: the compilation of lexical lists. These had always included terms for natural stones, so the artificial manufacture of such stones (once it became a regular industrial activity) was of interest. Thus the glass texts, in accord with this long-standing purpose, concern themselves with little more than the appropriate technical vocabulary. As the technical procedures themselves were of little interest, and probably unknown, to the scribes, their descriptions are rudimentary: sufficient for the purposes of lexicography, but inadequate as descriptions of an actual technology. Literary tradition is a notoriously inadequate source for the history of technology.[80]

Moorey's statement countered A. Leo Oppenheim's assertion (posthumously published in his "Man and Nature in Mesopotamian Civilization") that: "the best source of

[80] P.R.S. Moorey, *Ancient Mesopotamian Materials and Industries: The Archeological Evidence* (Oxford: The Clarendon Press), 211.

meaningful information bearing on Mesopotamian man's technical know-how is contained in a special text category I call the 'procedural instruction.'"[81] It is difficult to imagine two more contradictory positions. Nevertheless, these two stances partake in the same ambition to compose a *history of Mesopotamian technological practices*. In this sense alone, this chapter deviates from—and looks to challenge—the methodological goals of both Moorey and Oppenheim.

Because both Moorey and Oppenheim were focused on the reconstruction of *technological practice* neither scholar took seriously how recipes could function as evidence of *scholarly* knowledge. If the procedures could not, in some way, reflect on Mesopotamian technological practices, then they were (merely) literary texts, and could reflect nothing but "Mesopotamian scribal tradition's obsession with lists of words"—serving no purpose at all for historians of technology. Take for example, the following claim by Moorey, from the same volume on Mesopotamian industries:

> Scribes were not interested in the practical processes of manufacture, as craftsmen would have been, but simply in systematically cataloguing the technical vocabulary for the equipment, the materials, and the procedures used in any specific craft. These texts are an integral part of the Mesopotamian scribal tradition's obsession with lists of words, with lexical texts and lexicography.[82]

Thus, technical procedures, according to Moorey "should not be taken as primary sources for the study of ancient technology, only as significant secondary ones." Oppenheim, in contrast defended those same set of texts as exemplary primary sources, "the best source of meaningful [technological] information." Rather than ask whom we should believe, this chapter challenges the very question at the core of the Moorey-Oppenheim debate. Instead of asking whether recipes constitute an appropriate source of evidence for reconstructing the history of technological practices, this chapter analyzes how and why such texts could function within the local contexts of cuneiform *scholarship*.

If technical procedures were indeed a species of lexical lists, as Moorey opined, how did this interest in lexicography manifest in the recipes? If local variation is a

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[81] A. Leo Oppenheim, "Man and Nature in Mesopotamian Civilization," in *Dictionary of Scientific Biography XV*, ed. Charles Coulston Gillispie (New York: Charles Scribner's Sons), 649. Moorey responds to this very statement in his introduction to *Ancient Mesopotamian Materials and Industries: The Archaeological Evidence*, stating that "[i]t is not just pedantry to emphasize that it was, of course, scribes not illiterate craftsmen who composed and wrote these texts. If there was a value judgement implied, and this is by no means self-evident, then it was one made by scholars not by artisans. This distinction is of the greatest importance in assessing the value of such texts for any reconstruction of the history of ancient technology. Scribes were not interested in the practical processes of manufacture, as craftsmen would have been, but simply in systematically cataloguing the technical vocabulary for the equipment, the materials, and the procedures used in any specific craft. These texts are an integral part of the Mesopotamian scribal tradition's obsession with lists of words, with lexical texts and lexicography." Moorey, 16.

[82] Moorey, 16.

central feature of the lexical tradition and its historical development, should we not expect the same from the recipes?[83] If, following Oppenheim, cuneiform procedures are to be read as primary sources, how do those sources reflect their historical contexts? How did scribes respond to and codify the chemical concoctions of their respective eras? How, in sum, can we employ such texts to trace change, scholarly innovation, or creativity? These questions are fundamentally incompatible with the framework shared by Moorey and Oppenheim, because they are not rooted in an attempt to reconstruct "Mesopotamian technology practices"; here, the focus is *local*. It is Babylonian, Assyrian, 7th and 9th century BCE, belonging to particular palaces within particular cities, and situated in cuneiform scholarly rather than "industrial" craft cultures. These particular differences are not necessarily incompatible, synthetic accounts of Mesopotamian civilization—particularly when informed by rigorous anthropological frameworks—benefit directly from localized analyses of data and vice-versa. The difference lies simply in how scholars choose to deal with incomplete sources and historical discontinuity.

Indeed, while Oppenheim and his contemporaries were certainly aware of the chronologically scattered and physically incomplete nature of cuneiform tablets, they remained motivated by the idea that such documents—even when separated by centuries or millennia—reflected a unified culture, a "Mesopotamian civilization." In an essay titled "The Measure of Mesopotamia," Oppenheim opened by clarifying his use of the term "Mesopotamian civilization":

> I use this term ["Mesopotamian civilization"] just as we may use the term "European civilization" when striving to express the unity represented by the aggregate of Europe's individual civilizations that confronts us as we view them in their totality against the backdrop of the non-European world. Thus, the designation "Mesopotamian civilization" emphasizes its inherent unity without minimizing the diversity that the several distinct regional formulations and the multiphasic development of that civilization produced within the geographical and temporal limitations mentioned.[84]

Oppenheim's passage reflects a determined search for historical unity, a claim which he repeats throughout this long introductory essay. In some ways, his (1967) definition of "Mesopotamia" is nuanced and inclusive of local variation, as stated in the excerpt above: "'Mesopotamian civilization' *emphasizes its inherent unity without minimizing the diversity that the several distinct regional formulations and the multiphasic development of that civilization produced within [their] geographical and temporal limitations*." But the sources available to Oppenheim, and the drive to unify cuneiform cultures under a single "Mesopotamia" ultimately inundated the call for local variation.

Nowhere is this synthetic goal more evident than in Oppenheim's famous "stream of tradition"—a metaphor and (quasi-metaphysical) historiographical device meant to describe the intellectual unity of cuneiform cultures over three millennia, the "cultural

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[83] As discussed in chapter 3.

[84] A. Leo Oppenheim, *Letters from Mesopotamia* (Chicago: University of Chicago Press), 1–2. Italics my own.

continuum maintained so effectively by the scribal tradition" in his words.[85] Oppenheim explained that the stream of tradition was "what can loosely be termed the corpus of literary texts maintained, controlled, and carefully kept alive by a tradition served by successive generations of learned and well-trained scribes."[86] According to this model, Mesopotamian culture, (if it has not already been implied,) is wholly represented by the textual culture of scribes, the elite few.[87] Oppenheim's "stream of tradition"—first published over a half century ago—has been contagious in the discipline of Assyriology, despite convincing opposition; to quote Robson:

> The word 'tradition' encapsulates the mid-century Assyriological consensus about the conservative nature of cuneiform culture, while 'stream' invokes a natural, self-perpetuating process that does not depend on individual creativity or local singularity. The worry is that the unreflecting repetition of Oppenheim's famous words sometimes does more harm than good, as it inhibits discussion of innovation, creativity, individualism, and localism in cuneiform culture.[88]

What Robson has identified as the unreflecting repetition" of Oppenheim's "stream of tradition" can be found in the most recent publications mentioning the glassmaking recipes from 7th century Nineveh (2.4), recipes which are said to be distant copies of second millennium originals. Even in 2017, studies of ancient technology continue employ these procedures as evidence for Late Bronze Age glassmaking, despite the fact that they derive from the 7th century BCE Palace of Ashurbanipal, nearly a thousand years later.[89]

As a heuristic tool Oppenheim's "stream of tradition" is especially unsuited for the analysis of procedural recipes because technical recipes are, by their very nature, episodic (as textual sources) and contingent (insofar as the knowledge they record). The

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[85] *Ancient Mesopotamia: Portrait of a Dead Civilization*, 13.

[86] Ibid.

[87] For Oppenheim, the scribe exemplified "Mesopotamian civilization," in his (1967) "Measure of Mesopotamia," he states: "What, then, one is led to inquire at this point, was the driving force that brought into existence and preserved the artistic and intellectual coherence that held Mesopotamia together, gave it its existential individuality, maintained and revitalized again and again the vast body of traditions and attitudes that constituted the backbone of this civilization? My answer is: the scribe—the scribe who wrote and copied cuneiform signs on soft clay, the scribe who has left us all those records through which we are able to follow, however inadequately, this millennial development." *Letters from Mesopotamia*, 8.

[88] Eleanor Robson, "The Production and Dissemination of Scholarly Knowledge," in *Oxford Handbook of Cuneiform Culture*, ed. Karen Radner and Eleanor Robson (Oxford: Oxford University Press), 557.

[89] As recently as 2017, we find, e.g., "[t]hese 7th century BCE manuscripts probably go back to the mid-second millennium, when glass-making and glazing first began on a large-scale. Shiyanthi Thavapalan, Jens Stenger, and Carol Snow, "Color and Meaning in Ancient Mesopotamia: The Case of Egyptian Blue," *Zeitschrift für Archäologie* 106: 202, n.33. The statement derives from Oppenheim's original assertions published in his introduction to the glassmaking recipes Oppenheim et al.

cultural significance of terms, phrases, and processes occurring in recipes are understood most productively by way of comparison with contemporaneous sources, which document the trade of raw materials and the rituals appropriate to particular periods of particular cities. There is an important difference between characterizing a recipe as a product of "Mesopotamian civilization," and analyzing that same text as the work of a 9th century scribe from Nimrud. The former, if left unchecked can lead to ahistorical assertions concerning "Mesopotamian" achievements, including technological ones. This would suggest that the region saw little to no cultural change over time since preserving the even flow of the "stream," is predicated, as Robson remarked, on conservatism, after all. The latter approach—the framework used here—localizes recipe knowledge, does not assume conservatism as an epistemic goal of cuneiform scholarship, and emphasizes linguistic and cultural difference. Enough evidence exists now that we can identify the fine granularity of local variation to the extent that we can identify significant differences between a 9th century BCE perfume recipe from Nimrud (2.3) and a 7th century BCE recipe from Nineveh (2.4), even as both are "Neo-Assyrian" according to modern Assyriological convention. In this way, cuneiform recipes are not only suited for, but also motivate, local analysis.

Thus in contrast to Moorey and Oppenheim, this approach calls for abandoning the intuition to write from these scattered textual procedures a synthetic history of "Mesopotamian" technology. What remains, once this move is made, are four discreet sets of cuneiform sources separated by chronologically and even culturally. What remains, in other words, is not a corpus of materials for writing a history of Mesopotamian technology, but rather a series of episodes concerning the role of technical knowledge in scribal cultures at four culturally and intellectually distinct moments of ancient Middle Eastern history. These four episodes—case studies in technology as knowledge—are presented in the following order:

2.1 A Neo-Babylonian Wool Dyeing Recipe (ca. 6th century BCE)
2.2 Middle Assyrian Perfume Recipes from Aššur (13th century BCE)
2.3 A Neo-Assyrian Perfume Recipe from Nimrud (ca. 9th century BCE)
2.4 Neo-Assyrian Glassmaking Recipes from Nineveh (7th century BCE)

Note that the order of presentation is episodic and local instead of diachronic. It is designed to disrupt the tendency of modern historians to think of technology in terms of rational diachronic progression, addressing further the issues introduced at the end of the previous chapter (1.5). The aim here, whether it concerns the study of wool dyeing, perfumery, or glassmaking, is to put technological knowledge *back in its place*. The goal is to understand how technology was reflected in scribal cultures in the form of procedural recipes, in an effort to shift away from a history of objects, towards an intellectual history of material knowledge. Finally, in concluding, this chapter will revisit the historiographical potential of these textual sources, as well as offer a rebuttal to the question initiated by the Moorey-Oppenheim debate: what kinds of (historical) sources are cuneiform recipes?

2.1 A Babylonian Recipe for Dyeing Wool (ca. 6th century BCE)

BM 62788+ is a text dating to the Neo-Babylonian period (ca. 6th century BCE, henceforth NB) that preserves recipes for dyeing (and/or re-dyeing) wools by means of plant and mineral extracts; the instructions yield exotic blues, and rich purples—colors known to have been associated with elite trade and contemporaneous cult festivities. BM 62788+ is unprovenanced—it is the only text analyzed in this chapter that lacks an archaeological record of its find spot. A seemingly odd place to begin "localizing recipes" to be sure, but an excellent test subject for demonstrating what can be done with even esoteric, unattributed texts.

This single column tablet measures 7 cm (longest length) by 6.6 cm wide, with a thickness of 1.8 cm. The obverse preserves four distinct sections separated by four single rulings, and is in a poor state of preservation; the reverse is well preserved by comparison and contains nine discreet sections separated by rulings. Erle Leichty published a partial edition of the tablet in 1979, and it remains, still, the only edition.[90] The recent discovery of a new fragment, BM 82978, however, has facilitated the production of a new translation, edition, and copy of the reverse (below).

Although the obverse of the tablet is highly damaged, what remains of it points to the use and reuse of dye baths, in an effort, it would seem, to enrich the color of woolen garments that had lost their vibrancy; in obv. 13'–14', we read for example:

BM 62788+ obv.
12'. [ŠUB *ana* ŠÀ] *áš-šu* ⌜x⌝ E11-*ma* sígZA.[GÌN].NA
————
13'. [A-MEŠ] ⌜*ṣi*⌝-*pi šu-nu*-⌜*tú*⌝ *ri-e-ḫi* SÍG-ḪI.A *ana* ⌜ŠÀ⌝ ŠUB
14'. [*a-na maḫ*]-⌜*ri*⌝-*im-ma* 1-[*šú*] 2-*šú* 3-*šú* DÙuš ⌜EN⌝[91] *ṣi-pi* ŠUB *a-na lìb-bi*

Translation
[you dip it] so that … you pull it out: "lapis-lazuli" *takiltu*-wool (wr. sígZA.[GIN3].NA)
————
You dip the various wools into those liquids which were left over from the (previous) dye-mixture (*mû ṣīpi šunūtu rēhi*); you will do this once, twice, thrice—until you dye it (the wool completely) …

Lines obv. 13'–14' provide instructions for reusing the same dye bath that produces the "lapis lazuli" (*takiltu*) wool of line obv. 12'. If this interpretation is correct, it finds support in contemporaneous administrative evidence. Purple, or "lapis-lazuli" *takiltu*-colored wool was closely monitored by NB temple economies, as attested by YOS 19, 74, a contract which preserves the disbursal of 6 minas of *takiltu*-colored wool given to a weaver:

[90] Leichty.
[91] EN is to be read *adi* here.

Translation YOS 19, 74[92]

*Innin-šumu-uṣur
*Tāb-Uruk received 6 minas of "fresh" purple wool from Nūrēa
Gimillu
Ipšaru.
He (*Innin-šumu-uṣur) bears the responsibility for entering this purple wool (*takiltu*), the 5 (sic?) minas, in the writing board of the Lady-of- Uruk.
(witness list follows)

The phrase *ša pî ruqqi,* "fresh from the cauldron" (translated simply as "fresh" above) is especially suggestive.[93] It provides contemporaneous evidence for an aspect of technology rarely acknowledged: preservation. Mudbrick architecture weathered, perfumes dissipated, metals oxidized, and colored wools discolored. To avert discoloration, Babylonians used *gabû*, "alum" as their principal mordant. (A mordant is a fixative, and, as the Latin root *mordere* "to bite" suggests, mordants like alum allow for organic dyes to attach to—"bite"—the un-dyed fabric.)[94]

We find alum used throughout the start of each recipe on the more well-preserved reverse, which provides instructions for creating various shades of blues, some, exceedingly rare and costly, but nevertheless attested in temple administrative documents from the period. The translation below includes the new fragment BM 82978; note the regular occurrence of "alum" (*gabû*) at the start of each section:

BM 62788+BM 82978 Rev. Translation

rev. 1'
(broken)
————
rev 2'–5'
[you take natural wool and alum], you weigh in equal parts, you heat it in water over a fire, you crush the (...) and (along with) lapis-*takiltu* wool, you heat it over a fire in (...) water (or) *ḫarru*-water (i.e., city canal water)
————
[you pull it out]: *ḫašmanu*-colored wool
————
rev. 6'–8'
[you take natural wool] and alum, you weigh in equal parts (and) you heat it in water over a fire until the liquid mixture has been exhausted (TIL), you weigh pulverized *ḫathuru*[95] (and) "lapis lazuli" in equal parts, you heat it in water over a fire, pull it out: "lapis from the mountains"-*takiltu* wool (^{síg}ZA.GÌN.KUR.RA)

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[92] Translated by Elizabeth E. Payne, "The Craftsmen of the Neo-Babylonian Period: A Study of the Textile and Metal Workers of the Eanna Temple" (Yale), 132.
[93] Ibid., 137, see n.245.
[94] Zvi C. Koren, "Modern Chemistry of the Ancient Chemical Processing of Organic Dyes and Pigments," in *Chemical Technology in Antiquity*, ed. Seth C. Rasmussen (Washington, D.C.: American Chemical Society [Oxford University Press]), 200.
[95] Little is known about the plant other than its foreign origin, and, in this instance, the fact that it was pulverized.

————
rev. 9'–10'
you place “beets” (GAZI^{sar}) into the water and you boil them with fire, you sift (the dye mixture), you take natural (un-dyed) wool and you place it into the mixture, you heat it over fire, you pull it out: purple-*argamannu*
————
rev. 11' —13'
you take natural wool and alum and weigh them in equal parts, you heat it (the mixture) in water over a fire until the liquid mixture has been exhausted; the pulverized *ḫathuru*, and the natural wool, you weigh them in equal parts, you heat the mixture in water and “water of clay” you over a fire, pull it out: purple-*argamannu*
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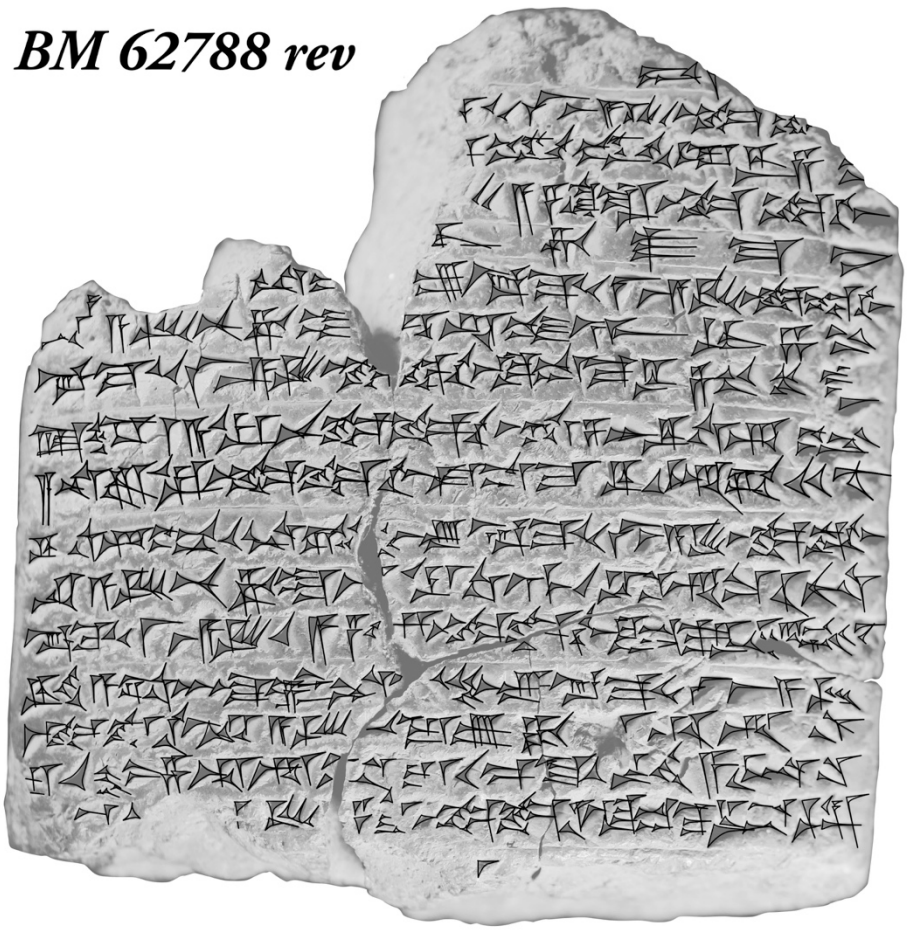
rev. 14' —17'
you comb out the various wools and you weigh them in equal parts with alum; you heat it over a fire in water with either *ḫathuru*, or *inzaḫurētu*, or *ḫūratu*(!);[96] these various wool(-dyeing ingredients) you weight them together in equal parts, you heat (the mixture) over a fire with water (or) water "from an irrigation ditch," you pull it out: red-*tabarru* colored wool
————
rev. 18'
(broken)

[96] For *ḫūratu* in rev. 16’, the signs read GIŠ-TÚG-U, or ^{giš}TÚG^{u}, *taskarinnu*, for “boxwood”; I have read instead *hūratu* (^{giš}HAB^{u}), based on the regular co-occurrence of *ḫathuritu, inzaḫurētu,* and *ḫūratu* in administrative documents. It appears the scribe of BM 62788+ employed the sign TÚG “garment” rather than HAB; a fortuitous error, considering the subject of the recipe. There is little justification for reading ^{giš}TÚG^{u} “boxwood” in this context.

Figure 1: Copy of BM 62788+ rev.:[97]



Instructions in BM 62788+ are pithy, providing only basic metrological information particularly in contrast to glass and perfume recipes discussed in 2.2–4, which provide detailed measurements of volume and weight. Alum—the principle mordant used in these texts (Akk. ^{na4}*gabû* "alum")—is simply "weighed in equal parts" (lit: “you weigh together” Akk. *malmališ tašaqqal*) with the un-dyed wools, as in rev. 14'–16. Although we are not told from the source of the dyes (mineral, plant, geographical origin), we can deduce that the dye mixtures were made of crushed plants, minerals, or a combination thereof[98]. BM 62788+ provides a number of Akkadian terms that for dyes that include: *ḫathuru, inzaḫurētu,* and *ḫūratu* (likely, "madder").[99] These three ingredients are interchangeable, and yield a red wool called *tabarru*.

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[97] Copy made by author from photograph and collations, reproduced with thanks to the Trustees of the British Museum.

[98] The verb *hašālu*, (GAZ.GAZ for *tahaššal*) as in rev. 3’, indicates that these ingredients were all crushed, likely into a powder form dissolvable in water.

[99] The identification of *hūratu* as “madder” can be found in M. Stol, "Leder(Industrie)," in *Reallexikon der Assyriologie und Vorderasiatischen Archäologie*, ed. Dietz Otto Edzard (Berlin: Walter de Gruyter), 534–35.

rev. 14' —17'

you comb out the various wools and you weigh them in equal parts with alum; you heat it over a fire in water with either *ḫathuru*, or *inzaḫurētu*, or *ḫūratu*(!); these various wool (dyeing ingredients) you weight them together in equal parts, you heat (the mixture) over a fire with water (or) water "from an irrigation ditch," you pull it out: red-*tabarru* colored wool

As with previous technical terms, *ḫathuritu, inzaḫurētu, ḫūratu* are left untranslated. Unlike earlier recipes what makes these technical terms compelling is that they not at all rare. Indeed, despite the tablet's lack of archaeological context, the ingredients mentioned in BM 62788+ are well represented in contemporaneous administrative texts. Tracing the occurrence from our wool dye recipe in administrative documents provides a productive avenue for contextualization of a recipe that remains, at present, isolated from its local context.

Administrative texts such as YOS VI 168, for example, provide reference to the trade of *takiltu* wool, dates the text to the 7th day and 6th year of king Nabonidus, and includes a specific reference to the *takiltu* colored wool:

> Date: tašritu, 7th day, year 6 of Nabonidus, king of Babylon. 3 minas 10 shekels of the *takiltu*-dyed wool are the tithe of Nādin-aḫi, 5 minas of the *takiltu*-dyed wool and 40 minas of iron are the tithe of Šamaš-zēr-ibni.[100]

Recall that in rev. 6'–8' of BM 62788+, *takiltu* is produced by heating water with alum and *ḫathuru*. And indeed YOS VI 168 accounts, as well, for the large scale import of *inzaḫurētu* and *ḫūratu* dye, in quantities as large 233 minas 20 shekels and 120 minas respectively. Organic dyes and/or colored wool garments regularly appear on the same administrative tablets. Moreover, it is not unusual to find dyes like *ḫathuru, inzaḫurētu,* and *ḫūratu*, shipped together with alum (*gabû*).

In one instance, Nbn 794, *inzaḫurētu* is imported into Sippar in equal quantities to alum.[101] However, in most cases, the proportion of *inzaḫurētu* to alum is 2:1.[102] Nbn 794 is particularly compatible with our wool-dye recipe because it explicitly groups *inzaḫurētu,* alum (*gabû*), and *takiltu*-colored wool, as in our recipe tablet (BM 62788+ rev. 14'–17' above), providing evidence for the thesis, proposed by Stefan Zawadski, that wool garments were re-dyed.[103] Indeed, as intimated by the broken obverse sections BM 62788+, the text should be viewed as belonging to the family of administrative documents that recorded both production and the maintenance (i.e., re-dyeing) of

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[100] Laetitia Graslin-Thomé, "Long-distance trade in Neo-Babylonian Mesopotamia: the effects of institutional changes," in *Dynamics of Production in the Ancient Near East 1300–500 BC*, ed. Juan Carlos Moreno García (Oxford: Oxbrow Books), 168.
[101] Stefan Zawadski, *Garments of the Gods: Studies on the Textile Industry and the Pantheon of Neo-Babylonian Sippar*, vol. 218, Orbis Biblicus et Orientalis (Göttingen: Academic Press Fribourg), 45.
[102] See especially Zawadski's Table 2 in ibid.
[103] Ibid.

garments. Still, the question remains as to why committing such a recipe to writing was of importance to a cuneiform scribe.

An answer may lie in a Babylonian ritual known as the Babylonian *lubuštu* ceremony. Zawadski's two-volume *Garments of the Gods* collected texts related to the textile industry at Sippar from the Ebabbar archive.[104] These documents testify to a rich industry of garment preparation for a clothing ceremony called *lubuštu*, during which the cult statues of the gods were freshly clothed with garments of the richest colors available. The procession and clothing rituals could take place on a monthly or yearly basis, and was, without doubt, a regular part of scribal administration and urban culture. The ceremony was no small event. By Zawadski's estimate, 1100 sheep required sheering in order for the weavers to craft divine garments.[105]

Wool dyeing during the Neo-Babylonian period was a specialized trade sustained by complex local temple economies and long-distance trade. Dyed wool garments were important economically and could be used as a form of payment,[106] but dyed wool was also a product of high cultural value. Rich blue and purple garments were gifted to the gods themselves, and became an element of divine and elite identity. But the translation of color terms, the subjectivity of perception, and the epistemological gap between the pithy instructions provided on BM 62788+ and the knowledge of the expert dyers and launders, exemplifies the translation difficulties discussed at length in the previous chapter.[107]

Moreover, while Babylonian weavers, dyers, and launderers were indeed knowledgeable experts, we should resist the intuition to imagine them as full-time guilds in the service of the temple. When clothing ceremonies like *lubuštu* were not in season, weavers would take on other craft or construction related trades; TCL 12, 94, for example, lists rations for work on the Takkīru canal, includes a weaver named Innin-zēru-uṣabši.[108] This example is rare, not because weavers rarely worked in other trades, but because scribal administrators were, by nature, pragmatic—rarely did they record a person's professional title unless it served some purpose for the task at hand. In most cases, ration lists and other administrative texts simply documented the person's family name (including the patronymic), and little else. We should expect, in other words, a society filled with jack-of-all trade figures like Innin-zēru-uṣabši.

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[104] Ibid.

[105] "“If you have sheep, you have all you need”. Sheep Husbandry and Wool in the Economy of the Neo-Babylonian Ebabbar Temple at Sippar," in *Wool Economy in the Ancient Near East and Aegean: From the Beginnings of Sheep Husbandry to Intitutional Textile Industry*, ed. Catherine Breniquet and Cécile Michel (Oxford: Oxbrow Books), 443. Note that this number accounts for the production of new garments of sheep. Obviously, re-dyeing older garments would not have required fresh wool.

[106] Zawadski collected a number of Neo-Babylonian texts describing the bartering and payment of services using wool "Payment in Wool in the Economy of the Ebabbar Temple at Sippar," *Revue d'Assyriologie et d'Archéologie Orientale* 96.

[107] Recent studies on color have attempted to reconstruct the semantic scope of such terms and will provide valuable data for reassessing texts like BM 62788+; for which see Thavapalan, Stenger, and Snow.

[108] Payne, 140.

In sum, BM 62788+ provides demonstrable correspondence between administrative realities and procedural knowledge. Technical terms are employed, but these terms are neither rare nor exclusive to the procedures. But well beyond the scope administration, knowledge of dyes and colored wools was of cultural importance for Babylonian scribes. Colored wools remained a powerful component of ritual and even healing in Babylonia, long after the decline of the Neo-Babylonian empire. A Late Babylonian medical text lists rare stones (a topic we will revisit in Chapters 3 and 4), threaded together on a string of red wool and bound further in "lapis lazuli," *takiltu*-colored wool:

> Jasper, *saḫḫû*-stone, carnelian, lapis lazuli, *ḫulāl-īnī*-stone, *muššar-īnī*-stone, blood stone, *agate*, *pendû*-stone, *kurgarrânu*-stone that contains *silver* and gold, *kapāṣu*-stone that contains gold: 11 stones for *birratu*-disease of the eyes of the left hand. You thread (the stones) with red wool. You wrap (them) in lapis lazuli-(*takiltu*) wool. You bind (them) on his left hand.[109]

Colors like *argamannu*, a rich purple, and among the most expensive dyes, traveled as far north as Harran, the site of the temple of Sin, the moon god's temple. During the reign of Nabonidus, the site attracted the attention of the king, who took it upon himself to restore the temple to its former glory. One of Sin's great devotees, Adda-guppi, the mother of Nabonidus, was central to that restoration, and her literary autobiography (dated 574 BCE) preserves a fascinating section wherein Adda-guppi forgoes elite dress—for a period of 95 years no less—as a sign of pious affection for the god Sin; here *argamannu* is a symbol of elite status:

> **Ex I col. i, 21–28**[110]
> To calm my god and my goddess, I did not wear purple (*argamannu*) garments, a silver and gold ornament, a new garment, perfumes or good oil on my body. I was dressed jewelry of gold or silver, new garments, perfumes or good oil on my body. I was dressed in a torn garment and my outer garments were sackcloth. I praised them. The praise of my city god and goddess was established in my heart and I

[109] SpTU 2, 022 + (P348627) obv. i 8–11, translation Philippe Clancier, for which see http://oracc.org/cams/gkab/P348627, note that I have modified Clancier's translation of ^{síg}ZA.GÌN.NA from "blue-green wool" to the more literal "lapis lazuli wool," in order to reflect the orthographic connection between the precious stone and the term for color. For this same passage, see Anais Schuster-Brandis, *Steine als Schutz- und Heilmittel: Untersuchung zu ihrer Verwendung in der Beschwörungskunst Mesopotamiens im 1. Jt. v. Chr.*, vol. 46, Alter Orient und Altes Testament (Münster: Ugarit-Verlag), 247-64.

[110] A newly edited anthology by Charles Halton and Saana Svärd (section 7.1.5) provides a useful summary and updated introduction to the Adda-guppi inscription. That translation is used here with permission from the editors, with the minor modification of the term "purple (*argamannu*)," which I have inserted to draw attention to that particular color Charles Halton and Saana Svärd, eds., *Women's Writing of Ancient Mesopotamia: An Anthology of the Earliest Female Authors* (Cambridge: Cambridge University Press), 170.

> guarded their watch. I did not leave out any of good things, but carried them before them.

Adda-guppi's literary inscription provides a brief inventory of elite goods, status symbols, that included—in addition to purple (argamannu) wool—perfumed oils, the subject of the recipes that follow.

Thus, enriching colored wool, renovating old garments, and clothing the cult statues, was of concern not only to scribes, but to rulers themselves. And even if BM 62788+ does not explicitly concern ritual, it lies within a network of administrative documents that aid in contextualizing the recipe's purpose: not merely to preserve the tricks of the garment industry, but to keep bright the garments of rulers and gods.

2.2 How to Smell Like a King in the 13th Century BCE

In their classic study on the history of scent, *Aroma: A Cultural History of Smell*, Classen et. al. note that ancient scents were often closer to balsams, or thick ointments, rather than the modern alcohol-based fragrances with which we are familiar,

> Whereas when we think of perfumes today, we inevitably imagine them as liquids, an inhabitant of the ancient world would be just as likely to enjoy perfume in the form of a thick ointment, to be smeared liberally on the body, or a fragrant smoke, infusing the air with its odour. Our own English word 'perfume', in fact, literally means 'to smoke through', indicating the importance this method of imparting fragrance had for our ancestors.[111]

Fragrance, whether in the form of perfumed oils or incense, was a crucial element of Assyrian ritual and elite identity. Just as the cult statues of the gods were clothed (as we saw in Neo-Babylonian sources), so too were they anointed with complex fragrances infused with rare ingredients. Aromatic oils were produced by expert perfumers, a trade well-attested in Middle Assyrian sources. But the MA perfume recipes, just as the wool-dyeing and glassmaking instructions, do not disclose the intended purpose of the product. Were these perfumes meant to anoint divine statues? Were they worn by elites at Aššur? How far were they exported? Answers to these questions can only suggested with the aid of contemporaneous source materials.

MA perfume recipes provide instructions for macerating and filtering aromatic plants. Rare Akkadian terms describing the various ingredients, tools, and botanical byproducts, represent the principle challenge in the interpretation of these recipes. Technologically, the recipes are straightforward, even rudimentary:

1. heat extraction: collect and cook the aromatics in large basins.
2. maceration: allow the aromatics to rest in water.
3. filtering: remove unwanted particles by sifting and filtering.

[111] Constance Classen, David Howes, and Anthony Synnott, *Aroma: The cultural history of smell* (New York: Routledge), 16.

4. refining: repeat previous processes (2–3) until desired concentration is achieved.

KAR 220 exemplifies the type of instructions the corpus of perfume recipes provides:

KAR 220 Obverse Translation:[112]
Obverse col. i

If you want to process aromatic cane oil: (take) 2 seahs worth of cane, along with their *tubāqu*-roots (i.e. the whole cane). Once you have washed them, you set down a *šaḫtiṣu*-sized *diqāru*-vessel and heat *tābilu*-aromatics with fresh, high-quality water from a palace well of Aššur. You transfer (the mixture) into a *ḫarû*-vessel.

You (then) pour on top of this liquid mixture, within the *ḫarû*-vessel: 1 liter of *ḫāmimu*-aromatic, 1 liter of *jaruttu*-aromatic, (and) 1 liter of myrtle, good-quality (and) filtered. These are your measurements, to be apportioned according to the amount of water taken. You perform (the steps prescribed) at sunset and nightfall! (The mixture) is to steep overnight.

At dawn, when the sun rises, you filter the liquid and these aromatics through a *sūnu*-cloth into a *ḫirsu*-vat. You clarify the mixture (by filtering it) from this *ḫirsu*-vat to another *ḫirsu*-vat. You remove the *minduḫru*-particulates. You wash 3 liters of crushed nut- sedge with the liquid mixture of these aromatics. You remove the *paḫutu*-particulates.

You put on top of this (filtered) liquid mixture of aromatics, within a *hirsu*-bowl: 3 liters of myrtle, 3 liters of cane, crushed and filtered. You measure out 4 seahs of this liquid mixture that has (steeped) overnight with aromatics. You filter through a sieve: 1 ½ liters of unfiltered mash made from almonds (together with) 2 cupsful—(using) small cups–of wood shavings from the *kanaktu*-tree. You gather up the oil (produced) in a *harû*-vessel. In the liquid mixture . . .

Obverse col. ii

You remove it from the interior of the *diqāru*-vessel . . . line 2 the ingredients . . . line 3 In your fourth pouring . . . You heat up . . . *tābīlu*-aromatics.. [You pour] ... ½ liter of cane, ½ liter of myrtle ... on top of the heated liquid mixture. (The mixture) is to steep overnight . . . and these aromatics . . . from this *hirsu*-bowl [to another *hirsu*-bowl] . . .

You remove the unwanted particulates. You measure out ... which are sifted, 4 seahs of liquid, which from . . . You ignite . . . (with) this reed and myrtle. You pour into the mixture: water that is like . . . (and the various) oils. [You stir it]

[112] I provided this translation and a brief summary of perfume-making technology, in section 9.2.2 of Halton and Svärd.; For a full text edition, visit http://oracc.org/glass/P282617

with a stirrer. Once the fat oils, the water, and aromatics have penetrated each other (and) have intermingled . . . you gather the (fire?) beneath the *diqāru*-vessel . . . (rest of column broken)

Reverse col. i

[You measure out ... amount] of this liquid mixture that has (steeped) overnight with [aromatics.]

You scrape it off; you remove the *ṭinṭinu*-particulates ... this liquid mixture ... you filter it and you clarify it . . . your liquid mixtures, those which you have [clarified] . . . you pour it out ... [you add] 3 seahs of "sweet myrrh" (*persạduḫḫu*) onto the top of this liquid mixture . . . The liquid that is mixed and has been heated . . . you stir with a stirrer . . . (once the oil and aromatics) have interpenetrated . . . fire . . . you cover up the top of the *diqāru*-vessel. From daybreak to . . . you gather the fire beneath the *diqāru*-vessel . . . the oils, waters, and aromatics . . . the liquid mixtures and *šēlûtu* which . . . (rest of column broken)

Reverse col. ii

... At daybreak . . . (the aromatics) which have interpenetrated each other . . . fire . . . you cover the top of the *diqāru*-vessel, you cool it off. You make prepare a *šappatu*-jar reed oils. You lay a *sūnu*-cloth with a *bittu*-implement across the *šappatu*-jar. Then, taking a little oil at a time, you strain it through the *sūnu*-cloth into the *šappatu* jar. You go about removing the *ṭišṭišu* and *midduḫru* particulates that have been left over in the bottom of the *diqāru*-vessel.

Colophon: Perfume-making recipe for 2 seahs of processed cane oil, fit for a king, according to the mouth of Tapputi-belet-ekallim, the perfume-maker: month Muḫur-ilāni on the 20th day; the eponymate of Šunu-qardu, the chief cupbearer.

Despite the scope of the corpus, of which KAR 220 represents only a fraction, not a single line of the MA perfume recipes describes the aesthetic quality of the scents produced. Echoing the literary style of the NB wool dye recipe (2.1), finished perfumes are characterized with all the poetic flair one might expect from an accountant. In one instance, we are told that the perfume is "ready for export" (lit. "for the road"), in another, the fragrance is "fit for a king." A number of essential details concerning perfume making remain tacit. As usual we are not told for how long the raw materials should be cooked, whether the cooking vat (Akk. *diqāru*) should be covered or even which "oil" (Akk. *šamnu*) should be used. Postgate has stated that "[s]esame oil was the normal oil in Assyria,"[113] and based on administrative documents, there is good reason to believe this was the case. However, the term *šamnu* can refer in Akkadian to either oil or fat, and an argument could be made that the MA recipes provide instructions for producing a fat balsam infused with perfumes—what we now call *enfleurage*. A view

[113] J.N. Postgate, *Bronze Age Bureaucracy: Writing and the Practice of Government in Assyria* (Cambridge: Cambridge University Press), 115.

from the present brings these ambiguities to light, but there is little doubt that scribes knew exactly what was meant by *šamnu*.

Quantities are significant, and in one instance we are told that large volume of myrtle oil "ready for export" is 3 seahs (or about 30 liters). The various units of measurements mentioned in the perfume recipes were well known to MA administrators. Following Postgate, these units can be assigned modern equivalencies:[114]

Weight/ Volume	Akkadian Term	Metric Value (approximate)
1 talent	*biltu* (wr. GÚN)	±30kg
1 mina	*manû* (wr. MA.NA)	±500g
1 seah	*sūtu* (wr. BÁN)	±10 liters
1 liter	*qû* (wr. SÌLA)	±1 liter
1 cup	*kāsu* (pl. *kāsāte*, wr. *ka-sa-a-te*)	±1/5 liter

In MA perfume recipes such as KAR 220, ingredients terms themselves already point to a local component, as in, e.g., the "water from the palace well of Aššur" (*mû ša būrte ša ekallim ša Aššur*).[115] Contemporaneous texts testify to the cultural function of certain scents, for example, the use of "myrtle" (Akk. *asu*) in the following text describing the anointment of an Assyrian divine statue after a victorious battle: "3 seahs [±30 liters] of myrtle oil, poured (*tabbuk*) in the House of Aššur on the feet of the gods, on the day the king defeated the Muskaean troops at the town of Quba-of-the-Forts of the land of Ḫanigalbat".[116]

Foreign ingredients were accompanied by foreign terms, which were key components in these aromatic admixtures. Among the most valuable of these is a resin called *perṣaduḫḫu* (or *pirṣaduḫḫu*), likely the "sap (lit. 'knots') of sweet myrrh."[117] As argued in the Appendix, the translation of "sweet myrrh" (or opopanax) while tentative, is based on a computational analysis of *perṣaduḫḫu*'s sematic context. Although the term *perṣaduḫḫu*—likely a Hurrian loanword—is exceedingly rare, an unpublished contemporary letter, dated 1200 BCE and from Tell Sabi-Abyad (northern Syria), informs us of the ingredient's incredible expense:

[114] Ibid., 53ff.

[115] The writing URU.ŠÀ.URU for the city of Aššur is found elsewhere in Neo-Assyrian documents dealing with land grants made by the king to private individuals, see VAT 9658 and VAT 9626, text no. 27 in *Neo-Assyrian Royal Grants and Decrees* (Rome: Pontifical Biblical Institute).

[116] *Bronze Age Bureaucracy: Writing and the Practice of Government in Assyria*, 158.

[117] *CAD* Ṭ s.v., *ṭūru* suggests opopanax as a translation, but it is not clear why this identification was made.

T93-20 (K09-70-163)[118]

Speak to Tammitte, thus says Uṣur-Nabû: (React) as soon as you have read my letter.

Earlier I have given you the following instructions: "caravans which set out to me from the land Carchemish should not pass without you(r consent)," and (I added): "seal all wares." Now I have heard that caravans (in fact) have set out to me, (and I repeat) "any caravan that sets out to me, be it of Ilī-padâ, of the princess, or of the magnates—seal everything". I have heard (that) they carry balsam (*perṣaduḫḫu*); if any balsam (*perṣaduḫḫu*) is missing, the death penalty [awaits y]ou.

(date on edge) Day 4 (, 5 or 6)

While administering the trade of rare ingredients appears to have been the domain of male accountants, the expert production of perfumes was decidedly different. Based on all known sources, perfume-making in second millennium Aššur was a principally female profession, indicated by the Akkadian term *muraqqītu*, as well as the female determinative preceding the names of perfumers. Contemporaneous administrative texts, collected by Stefan Jakob, demonstrate the extent of the profession at Aššur.[119] KAR 220, for example, ends with a unique colophon (discussed in 1.2 and translated in full above), which attributes its recipe knowledge to a female expert named *Tappūtī*, called the "companion of the goddess *Bēlet Ekallim*" (*Tappūtī-Bēlet-Ekallim* in full):[120]

> Perfume making recipe for 2 seahs of processed cane oil, fit for a king, according to the mouth of *Tappūtī-Bēlet-Ekallim*, the perfumer: month *Muḫur-ilāni* on the 20th day; the eponymate of *Šunu-qardu* the chief cupbearer.[121]

Similarly, the colophon of VAT 09659 (PKT pl. 6–8, rev. 31) preserves the partial name of yet another female perfumer: "excerpted (from) [...]-*ninu*, female perfume maker."

Late Bronze Age perfume industries were widespread throughout the Mediterranean world, well beyond the territorial state of Assyria. As far west as Pylos, in the western Peloponnese, Linear B tablets attest to a class of professionals called *a-re-pa-zo-o* "perfume boiler"; the title is descriptive of the process of heat extraction in

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[118] I thank Prof. Frans Wiggermann (personal correspondence 27-8-2016) for his translation of this unpublished letter, which expands upon the pithy CAD *pirṣaduḫḫu* entry.

[119] Jakob lists the known texts perfumers (*muraqqi'u*/*muraqqītu*) at Aššur, wherein the only explicit instances of a male perfume-maker come from two texts, one of which is broken see Stefan Jakob, *Mittelassyrische Verwaltung und Sozialstruktur*, Cuneiform Monographs (Leiden: Brill-Styx), 476. 7.1.a. Mentions of perfume-makers in Middle Assyrian sources are typically preceded by the female determinative MUNUS or else written using the feminine form of the Akkadian noun, *muraqqītu*.

[120] De Clercq.

[121] KAR 220 rii 8'–10' (P282617); for information regarding this eponymate, see Freydank.

perfume making.[122] That the rather limited administrative records of Mycenaean Greece account for a specific class of perfumers associated with the palace, demonstrates the importance of perfumed oil for Mycenaean elites. Just as in contemporaneous Aššur, rulers at Pylos kept close inventory of perfume production, accounting for the import and export of vessels and ingredients, and the professionals to whom those raw ingredients were assigned. There is no doubt that the profession of the perfumer during the LBA remained closely tied to palatial activity, a point which comes as little surprise considering the value of the ingredients necessary to produce an elite scent.

Historically, within the geography of the Middle East, perfumes remained an important aspect of elite identity. The courts of Darius III (380–330 BCE) was staffed with over a dozen royal perfumers, responsible for adorning the palace with fragrant flowers for feasts. In ancient Iraq the trade and production of perfumes can be traced to cuneiform documents as early as the third millennium BCE. Discussions of aromatics and perfume industries include Walther Sallaberger's (2010) discussion of the Ur III aromatics industry at Umma as well as Robert Middeke-Conlin (2014) article, which rightly points out that although the trade of aromatics was a well-documented industry, there is no evidence for the production of essential oils in third millennium sources:

> Limet (1978: 154), against Levey (1959: 38), explains there is no evidence in the Ur III period for the production of essential oils. It is followed by Joannès (1993: 253), who also cites a lack of evidence for essential oils at Mari. The same is understood here. Fixed oils, which are described by (Charles 1985: 50) as greasy, non-distillable, non volatile oils which are obtained from oil rich seeds of certain crops, are used as the vehicle for most perfumes in this period.[123]

Indeed, even the MA perfume recipes, written a millennium after the Ur III sources discussed by Sallaberger and Middeke-Colin, demonstrate no evidence of steam distillation—the technological process that allowed for the production of essential oils in antiquity, nor do we find such evidence in the later (ca. 9th century) cuneiform perfume recipe from Nimrud (2.3). Current archaeological evidence for the most advanced perfume industry comes not from the scholarly cultures of Mesopotamia, but from the workshops of early second millennium Cyprus. There, at a site called Pyrgos/Mavroraki, a team of Italian archaeologists led by Maria Rosaria Belgiorno discovered an industrial complex dating to 1850 BCE. This Middle Bronze Age site preserved funnels, basins, and perfume bottles preserving the archaeobotanical traces of a wide range of aromatics. But most importantly, Pyrgos/Mavroraki preserves clear evidence of distillation, a technology at the core of modern chemistry, entirely unattested in the Assyrian perfume recipes:

> Distillation is an advanced system of boiling, during which steam laden with small particles of essential oils is channeled into a cold container where it condenses in a pure liquid scent without any waste. Of course, the scent produced

[122] Maria Rosaria Belgiorno, *I profumi di Afrodite e il segreto dell'olio: Scoperte archeologiche a Cipro* (Roma: Gangemi Editore), 79.
[123] Robert Middeke-Conlin, "The Scents of Larsa: A Study of the Aromatics Industry in an Old Babylonian Kingdom," *Cuneiform Digital Library Journal*, no. 1.

> in this manner is of better quality. In antiquity maceration in oil and water was the most common method, described in detail by Theophrastus, Pliny the Elder and Dioscorides.[124]

An important lesson is to be learned from this find. Namely, we should not assume a causal relation between advanced literate cultures and advanced technological cultures. If we take the MA perfume recipes as a measure of contemporary perfume technology in Assyria, then we must conclude that the Assyrian technologies were at best rudimentary compared to those of the Cypriots centuries earlier. Unlike the perfume industries of 19th century BCE Cyprus, and against the arguments made by Martin Levey in the 1950s, the Assyrian perfume recipes demonstrate no evidence of essential oil distillation.[125] These observations on the nature of Bronze Age recipes and technology, far from being tangential, form part of a larger historiographical discussion of which the MA perfume recipes are a part. Because more than any other period of Near Eastern antiquity, historians have highlighted the Bronze Age, and the Late Bronze Age in particular, as a period of technological revolutions. Where the perfume recipes fit into the political and technical innovations of that period is the subject of the section that follows.

2.2.1 Late Bronze Age Technological Revolutions

The abundance of studies focusing on the Mediterranean during the LBA, especially in the last two decades, have dubbed the era an “international” period, characterized by "a paradigm shift in territorial governance." The city states of the Old Babylonian period were supplanted by larger territorial states, "Great Powers," that included Egypt, Babylon, Hatti, Mittani, and by the 14th century, Assyria, each with their respective capitals and great kings, who regarded themselves "brothers" in the correspondences of the era. These centuries that bracket the second half of the second millennium BCE saw the rise of Akkadian as the *lingua franca* of communication among kings, scribes and craftsmen travelled between royal courts, art styles—particularly in the Levant—became hybridized. But the system eventually became unsustainable, the LBA witnessed a chain reaction of collapse during the 12th and 11th centuries; palatial powers as far west as Pylos, on the western coast of the Peloponnese, and even Babylon itself, faced invasion and destruction. Both the rise and fall of the great powers of the period were systemic in nature, and covered the expanse of the Mediterranean world. Thus—channeling Braudel's *The Mediterranean and the Mediterranean World in the Age of Philip II*—Marc Van de Mieroop characterized the LBA as "The Age of Rameses II."[126]

Because LBA studies must account for an area as far east as Elam (modern SW Iran), and as far west as Pylos (modern SW Greece), it is expected that we should find a

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[124] Belgiorno, 63.
[125] Martin Levey, "Evidences of Ancient Distillation, Sublimation and Extration in Mesopotamia," *Centaurus* 4, no. 1.
[126] Stefan Jakob provides an up to date summary of the Middle Assyrian period in Stefan Jakob, "The Middle Assyrian Period (14th to 11th Century BCE)," in *A Companion to Assyria*, ed. Eckart Frahm (Hoboken, N.J.: John Wiley & Sons Ltd).

number of specialized studies. Seen from the vantage point of art historians like Marian Feldman, this period saw the development of an "International Style" in art (particularly evident in the Levant).[127] Philologists have focused on the development and spread of literate cultures, writing systems like Linear B and Ugaritic (an alphabetic cuneiform script), first appeared in the Mediterranean during the LBA. For archaeologists, the LBA has provided monumental evidence of palatial architecture, and a ship wreck preserving evidence of luxury goods from across the Mediterranean.[128] Meanwhile, archaeologists, like Harvy Weiss, have focused on the question of LBA decline, particularly as related to climate change.[129] Of interest here is the issue of how, collectively, these sweeping changes in the political climate of the Middle East were echoed in the technology of the period.

Studies of LBA technology have generally mirrored the broad, systemic explanations that have come to characterize the study of LBA political history. In both cases the LBA has been viewed as a period of "revolution." As Eleanor Robson related, the "paradigm shift in territorial governance was fed by and fed into the technological revolution of the Late Bronze Age (LBA): improvements in transport, communications, and militaria, as well as in the availability of huge variety of manufactured articles."[130] Do the technical recipes reflect the interdependent nature of LBA technology and society? What constitutes, for modern scholars, a technological revolution?

When LBA studies have highlighted the central role technology played in shaping the ideologies of that period, they have almost inevitably taken adapted a framework of technological determinism, "this belief affirms that changes in technology exert a greater influence on societies and their processes than any other factor."[131] Robert Drew's (1993) *The End of the Bronze Age*, for example, argued that the collapse of the Great Powers (what Drews refers to as the "Great Kingdoms") during the LBA was due to overpowering of one technology—the javelin and long sword—over another, the horse-driven chariot:

> The thesis of the present study is that the Catastrophe came about when men in "barbarian" lands awoke to the truth that had been with them for some time: the chariot-based forces on which the Great Kingdoms relied could be overwhelmed by swarming infantries, the infantrymen being equipped with javelins, long swords, and a few essential pieces of defensive armor.[132]

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[127] Marian H. Feldman, *Diplomacy by Design: Luxury Arts and an "International Style" in Ancient Near East, 1400–1200 BCE* (Chicago: University of Chicago Press).
[128] Joan Aruz, Kim Benzel, and Jean M. Evans, eds., *Beyond Babylon: Art, Trade, and Diplomacy in the Second Millennium B.C.* (New Haven: Yale University Press).
[129] Ibid.
[130] Eleanor Robson, "Technology in Society: Three Textual Case Studies from Late Bronze Age Mesopotamia," in *The Social Context of Technological Change: Egypt and the Near East, 1650–1550 BC*, ed. A.J. Shortland (Oxford: Oxbow Books), 39.
[131] Smith, 2.
[132] Robert Drews, *The End of the Bronze Age: Changes in Warfare and the Catastrophe ca. 1200 B.C.* (Princeton: Princeton University Press), 104.

Drew's thesis emulates a classic STS study by Lynn White, which has become a typological example of technological determinism.[133] White argued that "[t]he use of stirrups radically reduced the likelihood that armoured knights would fall off their horses during combat; it increased their efficiency in battle, and thus, the theory ran, fostered the rise of feudal society based on landownership and the use of force."[134] The connection between new technologies and changing ideologies is reflected in Near Eastern Studies within the work of Mario Liverani. Liverani's (2014) *The Ancient Near East* (revised from his 1988 *Antico Oriente: storia società economia*), provides a synthetic account of the LBA that begins with a section titled "The Late Bronze Age: technologies and ideologies." In that section Liverani focuses, like Drews, on the introduction of the horse, instructions for training horses; his discussion of LBA technology highlights, as well, our Middle Assyrian perfume recipes:[135]

> Finally, the Middle Assyrian archives yielded texts on the production of perfumes and spices. This development was a response to the new needs of the royal courts (or new solutions to old problems), located in the new epicentres of technical advances and commercial interactions, such as Syria, Anatolia and the Jezira. As such, these new types of texts constitute a clear expression of a cultural environment that was increasingly technical and practical, rather than scientific and scholarly.[136]

Liverani's interpretation of the technical recipes (as primary sources) is instructive. Although he defends—counter to the thesis of this work—the modernist separation between technical/practical and scientific/scholarly, he emphasizes the relation between territorial expansion and the interaction with new centers of commerce and culture. This second point, the connection between territorial expansion and technical knowledge, is indeed reflected in the LBA technical procedures. Briefly recounting the biography of a Babylonian scholar named Marduk-nādin-aḫḫe allows us to trace the consequences of Assyrian expansion and cosmopolitanism.

Territorial expansion was accompanied by changes to the cultural landscape of Assyria. By the middle of the 14th century BCE, during the rule of Aššur-uballiṭ (1353–1318), Aššur was divided into a number of neighborhoods, including a Babylonian quarter that featured a temple for the god Marduk.[137] Overseeing that temple was a

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[133] Lynn White, *Medieval Technology and Social Change* (Oxford: Oxford University Press).

[134] Massimiano Bucchi, *Science in Society: An Introduction to Social Studies of Science* (New York: Routledge), 77.

[135] Unfortunately, Liverani also includes as one of his primary sources a translation of a glassmaking recipe (his text 16.2), mistakenly dating it to 1600, when the text was excavated from 7th century Nineveh; that glass recipe is Oppenheim's Text A. Oppenheim et al., 36–39. and can be read at http://oracc.org/glass/P394484 Mario Liverani, *The Ancient Near East: History, society and economy*, trans. Soraia Tabatabai (New York: Routledge), 276–78.

[136] Ibid., 278.

[137] F.A.M. Wiggermann, "A Babylonian Scholar in Assur," in *Studies in Ancient Near Eastern World View and Society: Presented to Marten Stol on the Occasion of his 65th*

Babylonian scholar, a scribe named Marduk-nādin-aḫḫe/Marduk-uballiṭ/Uššur-ana-Marduk.[138] This historical detail is consequential to the history of technical recipes. As Frans Wiggermann discovered, Marduk-nādin-aḫḫe was the grandson of a Babylonian scribe named Uššur-ana-Marduk, "'governor of E[kur]' and a son of the Kassite regent in Dilmu."[139] Uššur-ana-Marduk had two sons, Marduk-uballiṭ, the father of our Babylonian scholar at Aššur, and Ile"e-bulṭa-Marduk of Babylon, the author a perfectly preserved glassmaking recipe that lacks a secure archaeological provenance.[140] That recipe, BM 120960, has been the subject of a great deal of speculation since Gadd and Thompson first published the text 1936 by; this is owed to its curious colophon, which cites a mythical Sealand king named Gulkišar, elsewhere unattested:[141]

BM 120960 Colophon:
šá ŠU ^{m}Á.GÁL-DIN-^{d}ŠÀ.ZU
DUMU *muš-šu-úr-an*-^{d}AMAR.UTU
É.MAŠ ^{d}MARDUK LÚ.NUN.KI
ITI.AB.È UD 24.KAM
MU ÚŠ.SA *Gul-ki-sár* LUGAL.E

Translation
According to Ile"e-bulṭa-Marduk,
son of Uššur-ana-Marduk,
temple administrator of Marduk, a native of Babylon.
Month Ṭebētu, 24th day,
Year after that in which Gulkišar became king.

Birthday, 10 November 2005, and his Retirement from The Vrije Universiteit Amsterdam, ed. R.J. van der Spek (Bethesda, Maryland: CDL Press), 201.

[138] Distinguishing a text or scholar as "Assyrian" or "Babylonian" is a nuanced task, requiring the synthesis of several types of historical data. Archaeological context and personal names, such as Marduk-nādin-aḫḫe, can serve as evidence for identifying the presence of Babylonian scholars in Aššur. In a number of cases, as we have already seen, cuneiform scholars left behind colophons; when these are preserved they provide prosopographical and historical information. Very often, some or even all of this data is unavailable, and we are left only with fragments of the texts themselves. In such instances, it is language—specifically, Akkadian dialects and orthographic variations—that allow us to localize the cultural identity of texts and scholars. This will become clearer in the section that follows, which looks more closely at the language of Neo-Assyrian perfumes.

[139] Wiggermann, 205.

[140] The text is attributed to Tall'Umar (Seleucia) on the Tigris, but, as it was acquired through the antiquities market, nothing is known of its actual find spot.

[141] Wiggerman discusses in some detail the orthographic complexity of the name Ile"e-bulṭa-Marduk (wr. ^{m}Á.GÁL-DIN-^{d}ŠÀ.ZU), for which see Wiggermann, 225–27.; for the first published edition of the text see C.J. Gadd and R. Campbell Thompson, "A Middle-Babylonian Chemical Text," *Iraq* 3, no. 1.

BM 120960 appealed to scholars like Thompson, Gadd, and Oppenheim for its "cryptographic" orthography, which suggested to early interpreters a connection between cuneiform glassmaking recipes and the history of alchemy (a connection discussed further in chapter 3). The connection between Marduk-nādin-aḫḫe and the development of historical recipes at Aššur is too tenuous to be causal, but is nevertheless suggestive of the idea that technical procedures, as a scholarly genre, were synchronic with the cultural expansion of Assyria.

To conclude, the corpus of Middle Assyrian perfume recipes, when they are localized in their historical context, enrich our understanding of Assyria's political and cultural history (and vice versa). Between the 14th and 13th centuries, Aššur underwent rapid territorial expansion, which, in turn, affected the economy, language, and culture of what was once a humble city in the northern Tigris. For the first time in its history, Aššur became a cultural force. In their effort to secure and expand this power, Assyrian kings endeavored to interact "brother to brother" with the great kings of the region, they imported and exported raw materials from distant lands, and in order to manufacture those materials into luxury goods, they also imported, and developed locally, expert technical knowledge. The perfume recipes provide a glimpse into that world, a world in which female experts oversaw the production and quality control of a regal scent—an "eau de Tukulti-Ninurta"—the recipes themselves characterize as "suitable for export" (literally: "scented oil of the road," *riqītu ša ḫarrāni*). We are not certain where such scents may have traveled, although it is tempting to draw a correspondence between the scents mentioned in the recipes and the inauguration of the king's new capital at Kar-Tukulti-Ninurta.

Thus, from what may seem a modest and esoteric corpus of recipes, we can extract a great deal of information. We know that myrrh and myrtle were among the principal notes mentioned in the perfume, indeed, even today these are recognized in the perfume industry as "oriental" notes. We also know, moreover, from administrative records that the ingredients employed in perfume making were highly regulated by the elites of Aššur—indeed even the well water (mentioned throughout the perfume recipes) was regulated by elites.[142] Although their scholarly output was historically new as compared to their southern neighbors, Assyrians of the 13th century BCE were on the rise, and by the 9th century BCE, had conquered the better part of the known world. That period of political dominance frames the next recipe, a fragmentary text from the Governor's Palace at Nimrud, the last known Assyrian perfume recipe.

2.3 A Ninth Century BCE Perfume Recipe from the Governor's Palace

Centuries after the MA perfume recipes, within a 9th century BCE structure known as the Governor's Palace, located in the city of Nimrud (ancient Kalhu), a team of archaeologists led by Max Mallowan discovered a trove of over 200 cuneiform tablets. Among these, was a little known fragment of a perfume recipe. The text, IM 56867 (ND

[142] Postgate notes a Middle Assyrian law (section 17) that mentions the regulation of well water in Postgate, *Bronze Age Bureaucracy: Writing and the Practice of Government in Assyria*, 31.

460)[143] has not been subject to philological (nor historical) analysis. Indeed, when Wiseman and Kinnier Wilson, epigraphers at Nimrud, listed the tablet in their excavation report, they called it a "[m]edical text, or part of a detailed recipe since no specific part of the body is mentioned."[144] Two decades later, Nicholas Postgate, in (1973) *The Governor's Palace Archive*, was able to connect the text (No. 215 in his catalog) to the corpus of earlier Middle Assyrian perfume recipes. Although Postgate provided a more reliable transliteration of the fragment than Wiseman and Wilson, he did not translate nor comment on the text's philological details—thus an updated edition of the text is offered for the first time below:[145]

IM 56857 (ND 460)
Obverse
1'. [...^{dug}*a*]-˹*ga*˺-*ni*
2'. [...]-*šú*
3'. [...^{dug}*a*]-˹*ga*˺-ni
4'. [... ^{šim}]EN.DI[146]
5'. [... *iṣ-ṣa*]-˹*ru*˺-*ḫu*[147]
6'. [...] ˹ŠÉŠ˺?[148]
(broken)

Reverse
1'. [...] x [...]
2'. [...] *a-na* ˹*ba*˺-[*ma-te*]
3'. [...] DUB^{aq}[149] [...]
4'. [...] *a-na ba*-˹*ma*˺-[*te*]
5'. [...] *sa* ʾ*a* ˹*ti*?˺ [...]

[143] P224557
[144] D.J. Wiseman and J.V. Kinnier Wilson, "The Nimrud Tablets, 1950," *Iraq* 13: 112.
[145] A significant portion of Postgate's transliteration has been employed here, however, many modifications have been made—these are indicated in the footnotes to the transliteration and in the analysis that follows the edition. A digital edition of the text can be found at http://oracc.org/glass/P224557
[146] EN.DI for *suādu* is a type of sedge, also attested in the MA perfume recipes. For this particular orthography see Borger, MZL n.164 Rykle Borger, *Mesopotamisches Zeichenlexicon*, second ed. (Münster: Ugarit-Verlag), 286.. In the Middle Assyrian perfume recipes, such as KAR 220 (obv. i 11) and KAR 222 (obv. i 12'), the same ingredient is written IM.DI.
[147] The verbal form *iṣṣarruḫu* (N-stem of *ṣarāḫu*, "to heat up") is reconstructed from similar lines in the MA recipes, including
[148] The reading is certainly tempting given the context, but not enough of the sign is preserved for securely reconstructing ŠEŠ.
[149] Postgate reads DUB-ak; this reading is improved by reading DUB^{aq} for *tamarraq* (*marāqu*), "to grind," a verb attested elsewhere in the same text (written syllabically *ta-ma-raq*.

6'. [... *pir*]-*ṣa*-˹*du*˺-[*ḫu*][150]
————
7'. [...] KI.LÁ *ša* ^{šim}ŠEŠ
8'. [...] x *ú*-˹*zak*˺?-[*ku*? ...] ˹MAN˺?
————
9'. [...] x x *ina* ˹*pa*˺-[*an*?] LUGAL
10'. [... *ta-ha*]-˹*ra*˺-*aṣ* 2 *qa* IÀ-[MEŠ] ^{šim}GÍR
11'. [...] ˹U$_4$˺-MEŠ [*te?*][151] ˹*ina*˺ ˹ÚTUL˺ ^{giš}*tal-tal-li-šu šá-*˹*kín*˺
12'. [...] x *nu*![152]*-bat-te-šu ta-ḫar-ra-aṣ* ˹*ina*˺? A-MEŠ
13'. [...] *a-na* 10 *u$_4$-me-šu* A-MEŠ *ša* ^{giš}*tal-*˹*tal*˺*-li*
14'. [...] x-*e* DUB^{aq} 2 *qa* IÁ-MEŠ ^{šim}GÍR TA* ^{giš}*tal-tal-li-šú*
15'. [...] x IZI *tu-um-mad a-di* É[153] *i-ba-šal-ú-ni*
16'. [... *ina muḫ*]-˹*ḫi*˺? NÍG.NA ^{šim}*qu-nu-bu tu-lab-bak ina muḫ-ḫi ta-za-*˹*riq*˺
17'. [... *ina mu*]-˹*ka*˺?-*ri-si* 5/6? MA.NA ^{šim}ŠEŠ *ta-ma-raq*
18'. [...] x *ta-ga-mar a-na* 2-*šú ta-bat-taq*
19'. [...] ˹*ta*˺-*kar-ra-ár-šú* 10 GÍN-MEŠ *ina ša* KUR.*gar-ga-miš*[154]
20'. [...]-x-*qu ta-ma-raq a-na* 2-*šú-ma ta-bat-taq*
21'. [...] ˹^{dug}˺[*a-ga-ni*][155] *ta-kar-ra-ár i-bi-ia-da*
22'. [*a*]-˹*na*˺ 2^{e} [... IÁ]-ME-*šu ta-ṣa-ḫa-at tu-ul-*˹*la*˺-<<al>>

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[150] Previously undeciphered; this reconstruction suggests reading the ingredient *perṣaduḫḫu* based on the combination of legible signs: ZA-DU. These two signs are preceded only by the sign *pir* in the MA perfume recipes (across 25 instances), thus the ingredient *perṣaduḫḫu* "sweet myrrh" is a probable.

[151] U$_4$-MEŠ rather than BABBAR-MEŠ, as no white or shiny ingredient would make sense here; this line likely reflects a variation on the phrase found in KAR 140+ rev. ii 28: 4 U$_4$-MEŠ *i+na* ÚTUL-*šu šá-kín* "(After the mixture) has sat (*šakin*) in its *diqāru*-vessel for 4 days..."

[152] According to the copy, the sign is AŠ, but a NU is needed here, and is likely. This should not be read as a correction for a scribal error, but rather, a note for future collation; the term *nubattu* "evening" with the suffix *-šu* marks the beginning of a temporal phrase and is regularly attested in the MA perfume corpus, as in KAR 140 rev. i 30: *u$_4$-mi-šú ša-kín nu-bat-tu-šu* ^{dug}*a-ga-na ta-ma-si* "(The mixture) is to sit all day. During the evening (*nubattušu*), you wash the *agannu*-vat."

[153] The phrase *adi bēt*, wr. *a-di* É here, is a local clause construction particular to the Assyrian dialect, for which see Hämeen-Anttila 4.5.9 in Jaakko Hämeen-Anttila, *A Sketch of Neo-Assyrian Grammar*, vol. 13, State Archives of Assyria Studies (Helsinki: Neo-Assyrian Text Corpus Project), 132–33. Hämeen-Anttila takes such clauses to reflect location, such that, e.g., such that *bēt* (wr. É) + preposition comes to mean "where, wherever." In the present context, however, *adi bēt* has the same meaning as simply *adi* "until; as soon as." See also *CAD* A I s.v., *adi* a 7'.

[154] "...you set it down; 10 shekels as according to the (shekel) of Carchemish" this translation is supported by contemporaneous sources that cite a standard of weight called the "mina of Carchemish," for which, see SAA 06 235 (P334993).

[155] ^{dug}*agannu* can be reconstructed based on two points. First, it is very often the object of *karāru*, and second, it is the vessel within which aromatics macerate in MA recipes. This vessel is also attested on the obverse of the tablet (see above).

————
(blank)

Translation
Obverse
1'. ... *agannu*-vessel
2'. ... its...
3'. ... *agannu*-vessel
4'. ... nutsedge ...
5'. ... that has been heated
6'. ... you anoint?
(broken)

Reverse
1'. ...
2'. ...on (its) side...
3'. ... you grind it ...
4'. ...on (its) side...
5'. [...] *sa ʾa* ˹*ti*?˺ [...]
6'. ..."sweet myrrh"
————
7'. ... the weight of the myrrh
8'. ... which has been clarified? ...
————
9'. ... (which) in the presence of the king...[156]
10'. ... you break it off and 2 *qû* (±2 liters) of myrtle ... you ...
11'. ... after its *taltallu*-extraction has rested (in the vessel) for [x] days...
12'. ... you will break off on its side, (and) in the liquid mixture...
13'. ... for 10 days the (perfume) mixture of *taltallu*-extraction ...
14'. ... you grind down ... 2 *qû* (±2 liters) of myrtle oil; from its *taltallu*-extraction
15'. ...you light a fire; as soon as it (i.e. the mixture) cooks ...
16'. ...you soak a censer of cannabis and sprinkling it on top (of the mixture)
17'... using a *mukarṣītu*-instrument you grind 5/6? minas of myrrh
18'. ... you complete (the process)... and you divide (the mixture) into two halves
19'. ... you set it down; 10 shekels (as according) to (the standard) of Carchemish
20'. ... you grind down the ... (and) you divide it into two halves
21'. ... you set the oil into an *agannu*-vessel, (allowing it to) macerate overnight

[156] This translation remains tentative.

22'. for a second time .... you siphon out[157] the oil (lit: "its oil)[158] and you purify it
————
(remainder of tablet blank)

From a technological perspective, the NA perfume recipe IM 56867 is closely related to the MA corpus of perfume recipes, it describes heating aromatics in oil, and maceration (*labāku*, "to soften; soak," *biātu*, "to set overnight"). Just as the MA recipes, IM 56857 *does not* demonstrate evidence of steam distillation for the extraction of essential oils. A survey of the ingredients attested in both MA and NA perfume recipes, and those unique to this text fragment, will aid in clarifying the processes described in IM 56867. We can begin with a few notes regarding the highly damaged obverse.

For the present purposes, it is worth noting, from the highly damaged obverse—not transliterated previously—the reconstruction of two technical terms well-attested in the MA perfume recipes: the first a vessel called *agannu*, used for macerating aromatics, *agannu* appears 15 times in the MA recipe corpus; the second term is *suādu*, a type of sedge, translated "nutsedge" here. The ingredient *suādu* preserves the rare orthography EN.DI, likely preceded by the determinative GIŠ (which must be fully reconstructed).

The tablet's reverse preserves technical language specific to perfume-making, including new ingredients not found in the MA corpus. The principal aromatics from the MA recipes are repeated here, including *murru* "myrrh," and *asu* "myrtle." Here, however, they are written logographically rather than syllabically, thus *murru* is written ^{šim}ŠEŠ (rather than *mur-ru*) and *asu* is written ^{šim}GÍR (rather than *a-su*); this is to be expected in first millennium Akkadian scholarship, which regularly used logographic rather than syllabic orthographies. New ingredients and instruments unattested in the MA recipes include: *taltallu* (wr. ^{giš}*tal-tal-li*), an extraction of the date palm,[159] and a

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[157] According to the CAD, *ṣaḫātu* (translated "to siphon" here), should not be translated "to press," their reasoning is quoted here, as it is of immediate relevance to process described in IM 56857: "[t]he specific translation "to press" is to be abandoned, since sesame oil is obtained by boiling the seeds and skimming off the oil and not by pressing the seeds. The meaning "to press" moreover, excluded by the occurrences in the medical texts sub mng. 1c, where the object of the process *ṣaḫātu* is not the herb but the already-obtained juice (*mû*, lit. water). This suggests the more restricted meaning of drawing this liquid into vessels, which also fits the operations performed on wine and sesame oil. As to the processing of sesame, the verb *ḫalāṣu* used in this connection could describe the roasting and grinding of the sesame seeds (see *ṣāḫitu*), as well as the straining of the liquid through a cloth, while *ṣahātu* could refer to the final stage of skimming, and filling the jars, and be used by extension for the entire process."

[158] CAD Ṣ, s.v. *ṣāḫitu* "preparer of sesame oil" is a profession that derives from the same verb, *ṣaḫātu*, used here. That entry points out that "[t]he characteristic equipment of the *ṣāḫitu* were the oven in which he roasted the sesame seeds and the millstone (see *erû* B usage c-3') on which he ground them into a pulp which was mixed with water and boiled in order to extract the oil."

[159] According to *CAD* T s.v., *taltillu* means "(male) inflorescence of the date palm"; this definition comes from Landsberger's (1967) *The Date Palm and its By-Products according to the Cuneiform Sources*, who stated that the "the meaning <<Pollen, Staubgefäs>> is recommended." Benno Landsberger, *The Date Palm and its By-*

censer (*nignakku*, wr. NÍG.NA) of "cannabis" (*qunnabu,* wr. *qu-nu-bu*), which Erica Reiner believed to be an aphrodisiac.[160] Finally, the recipe mentions a tool called *mukarṣītu*, possibly a grinding implement. Rev. 6' preserves the signs ZA and a partial DU, if the reconstruction *pir-ṣa-du-ḫu* is correct here, then we can add *perṣaduḫḫu*, "sweet myrrh," and a well attested ingredient from the MA corpus, to the reconstruction of this NA fragment.

How do these various ingredients all come together? And for what purpose? One clue may come from a Neo-Assyrian letter dating to the later reign of Esarhaddon, SAA 13 76, which states:

> **SAA 13 76 (obv. 10–rev. 2)[161]**
> As for what the queen mother, my 'lord,' wrote to me, saying: "What is going into the ritual?" —These are its constituents: sweet-scented oil, wax, sweet-scented fragrance, myrrh, cannabis (*qunnabu*), and *ṣadīdu*-aromatic. [I will] perform it [for a]ll [the ... th]at the queen mother com[manded].
> [On the xth] day, they will perform the whole-offerings: one ox, two white sheep, and a duck.

"Assyrianisms"—phrases and orthographies particular to the northern dialect of Akkadian—are found throughout IM 56857. Phrases such as *adi bēt* (wr. *a-di* É; see rev. 15') for "until; as soon as" are attested only in Assyrian contexts. Metrological information, such as "10 shekels (as according) to (the standard) of Carchemish" (rev. 19') reflects contemporaneous trade relations with the ancient Syrian city to the West—

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products according to the Cuneiform Sources, Archiv für Orientforschung (Graz: Weidner), 19.. Here, however, the translation "extraction" is more precise given our current state of evidence. One of the difficulties of translating "date pollen" is that the term *taltallu* precedes other trees, as in the medical incantation which mentions the taltallu of (*tal-tal-lu-ú šá* ^{giš}GIŠIMMAR), for which see 9.47 in JoAnn Scurlock and Burton R. Andersen, *Diagnoses in Assyrian and Babylonian Medicine: Ancient Sources, Translations, and Modern Medical Analyses* (Chicago: University of Illinois Press), 193.

[160] The use of "cannabis" or *qunnabu* in Neo-Assyrian epistolary and medical sources was of interest to Erica Reiner, who, in her (1995) Astral Magic in Babylonia, remarked: "[T]he name of the herb called *sim.^{d}Išḫara*, 'aromatic of the goddess Išḫara,' which is equated with Akkadian *qunnabu*,'cannabis' may indeed conjure up an aphrodisiac through the association with Išḫara, goddess of love, and also calls to mind the plant named *ki.ná Ištar*, in Akkadian *suḫsi Ištar* or *majāl* Ištar, both meaning 'bed of Ištar.'" Erica Reiner, *Astral Magic in Babylonia*, vol. 85, Transactions of the American Philosophical Society (Philadelphia: American Philosophical Society), Text and images, 35. Reiner references a curious Assyrian text edited by M. Fales, BM 103205, which translates: "The salve of Išḫara is cannabis; the salve of Išhara is cannabis: from the mouth of Qiṣirayyu I heard (so)." Frederick Mario Fales, "Studies on Neo-Assyrian Texts II: "Deeds and documents" from the British Museum," *Zeitschrift für Archäologie und Vorderasiatische Archäologie* 73: 245, no. 12.

[161] An edition of the text may be found at: http://oracc.org/saao/P334244

such as we find in state correspondences of the same period.[162] As with the MA recipes, the Assyrian verb *karāru*, "to put down," is preferred over the traditional *šakānu* of the Babylonian dialect. Orthographic details include the writing ^{šim}GÍR for *asu*, and, moreover, the use of the subordinating suffix *-uni*, as in the verb *ibšalūni* (wr. *i-ba-šal-ú-ni*; fr. *bašālu* "to cook", see rev. 15'). Collectively, this evidence lends further support for the hypothesis that recipes preserve the linguistic imprints of local Akkadian dialects. Philological data provides substantial evidence for localizing recipe knowledge, and in cases such as the Neo-Babylonian wool dye recipe discussed at the start of this chapter, it is the only type of evidence available. So contingent is the language of this fragmentary tablet, that, had excavators found it in the basement of one of Chanel's perfume laboratories in Paris rather than the sands of Nimrud, the Assyrianisms alone would give away its source of origin. Luckily, this was not the case with IM 56867.

Archaeologists excavated IM 56867 in Room S of the so-called Governor's Palace. Operations at the Governor's Palace spanned more than a century (between roughly the mid 9th century and the early 8th century), during which five "governors" (*šaknu* or *bēl pāḫiti*) performed their various duties, all of which can be fairly represented by the archive uncovered in Room S.[163] According to Postgate, Room S, the find spot of our recipe, is reliable, despite the "incompleteness of the archive,"

> [w]e must stress the incompleteness of the archive. Although the texts from Room S were mostly found together, in a relatively undisturbed context … those from Room K (and M) were found in very disturbed circumstances and even if Room K was intended as their resting-place, it is obvious that many tablets were lost by dispersion or destruction in the course of time.[164]

It should be noted that IM 56867 was one of the only scholarly texts found at the Governor's Palace, an archive which (thus far) has uncovered principally legal and administrative texts,[165] including receipts for the payment of debts and texts mentioning the sale of slaves, other texts list non-Assyrian names—families and children of unsettled deportees, and prisoners of war from conquered lands.[166] IM 56867 remains an outlier in this sense, a text with a sound archaeological context and a list of potential questions regarding function. Were the ingredients closely monitored by governors for their use in trade? Was there a ritual purpose to the text? Or was the text simply moved from its original location? After all, the Governor's Palace was just across the street from the temple of Nabu, the patron god of scribal knowledge, a suggestive location given the thesis of the present work. The proximity between recipe knowledge, royal patronage,

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[162] See SAA 1 176, obv. 6–7, which preserves the following line, "two talents and 18 minas of silver according to the standard of Carchemish," which utilizes utilizing the same orthography for Carchemish (KUR.*gar-ga-miš*) as the NA perfume recipe. For a full edition, visit: http://oracc.org/saao/saa01/X900007

[163] J.N. Postgate, *The Governor's Palace Archive* (London: British School of Archaeology in Iraq), 8–9.

[164] Ibid., 24.

[165] Ibid., 1–4.

[166] Postgate cites texts nos. 113, 119, and 120 as specific examples of texts accounting for deportees. Ibid., 25.

and the god Nabu, is made explicit in the next set of NA recipes. With that, being fully immersed in first millennium scholarship, it is time to fast forward two centuries to examine the most complex of the technological recipes, the Neo-Assyrian glassmaking texts from 7th century Nineveh.

2.4 Neo-Assyrian Glassmaking Recipes as Literature

Thus far, the present chapter has contextualized technical recipes archaeologically and historically, with the aim of putting those texts *back in their place* within cuneiform cultures. Situating the recipes—whether Middle Assyrian perfumes, or Babylonian dyeing instructions—within their cultural context has, until now, relied upon demonstrating the relationship between raw materials and local administration. Acquiring colorants, minerals, and dyes used to craft "lapis" (*takiltu*) garments required complex long distance trade relations, well-documented in Neo-Babylonian administrative documents; NB texts show that those same colors were used to dress the cult statues of Babylonian gods (2.1). Perfumes, in turn, were used to anoint gods and kings, and there as well administrative documents point direct management of ingredients like "sweet myrrh" (*perṣaduḫḫu*), and the predominance of female perfumers called *muraqittu* (2.2). Both cuneiform recipes and administrative documents were committed to writing ingredients that signified local rites, and royal identity itself.

Contextualizing recipes in this way allows us to envisage why scribes would be compelled to write such texts without reducing it all to a scribal "obsession with lists of words," as Moorey put it. Proper rites and rituals required proper ingredients, proper combinations of raw materials, proper amounts of fire, of maceration, and filtration. But constructing technical knowledge also required proper words—and as we will find in Chapter 3—proper sign usage.

No set of procedures is more appropriate for analyzing philologically the inner workings of technical language than the Neo-Assyrian glassmaking recipes. The analysis that follows will consist of two parts: first, a brief introduction to the literary aspects of the NA glassmaking recipes (below); and second, a close reading (historiographical and philological) of the introductory section of the glassmaking recipes—the instructions for making and purifying a "four-eyed" kiln (Chapter 3).

From the perspective of the history of chemistry, the glassmaking recipes are the most sophisticated of the cuneiform procedures. Ingredients in the NA glassmaking recipes are carefully measured, crushed and mixed (fritted). In order to make glass, one must lower the melting temperature of silica (i.e., sand) by using a flux—in the case of the Neo-Assyrian recipes, this flux are the plant ashes of halophytic plants called *uḫūlu*, likely a species of salicornia. Note that the recipes do not inform us why these plant ashes are used, one must simply know when and how to employ them. Only after the sand has been cleared of contaminants, these plant ashes are added to the mixture and, finally, copper oxides (*erû nīhu* "slow copper" or *erû arḫu* "fast copper") are added in order to produce blues—to create "lapis lazuli," *zagindurû* glass (1.1). Julian Henderson lists five essential steps in ancient glassmaking:

(1) the selection and preparation of raw materials; (2) *making* the glass involving fritting the raw materials; (3) mixing the 'batch' and *melting* the glass; (4) *working* the glass to form the glass objects; and (5) annealing the objects.[167]

Of these, only steps (1)– (3) are to be found in the glassmaking texts. A typical instruction for making *zagindurû*, for example, reads:

> **K.203+ obv. ii 7–12**
> If you want to make "lapis lazuli" (*zagindurû*-glass): you grind separately 10 minas of *immanakku*-stone (and) 12 minas of salicornia (*aḫussu*).[168] You mix (these ingredients) together, and set down (the mixture) into a cold kiln with four chambers, arranging it between the openings. You burn a good smokeless fire until your mixture [glows red]. You take it out into the open air and you cool it off.

The final line "You take it out into the open air and you cool it off" (*ūmī tušellâmma tukaṣṣi*) is unusual and telling; it suggests knowledge of what we would now recognize as the chemical process of "devitrification," whereby glass is rapidly cooled in order to interrupt the slow annealing process (which could take several days depending on the thickness of glass) in order to create surface imperfections.[169] Here, the visual result would have been a semi-translucent blue glass with white surface dots, which resembled known varieties of speckled lapis.

Glassmaking and earlier perfume recipes share a number of similarities in terms of their historical context. Both sets of texts were found in or near the vicinity of institutional archives and both reference directly the involvement of the king in either the aspect of quality control (perfume "fit for a king") or, as we will find below, the king's divinely bestowed knowledge. Furthermore, both corpora are Assyrian—albeit from different cities and periods—and both preserve historical colophons that allow us to situate the texts within their scholarly contexts. The unusually long colophon of glassmaking fragment K.4073 provides an apt starting point for situating these recipes historically, it reads:

> **K.4073 Colophon:**
> Written [and checked] according to its original. I am Aššurbanipal, [king of the land of Aššur], on whom the god Nabu and the goddess Tašmetu bestowed [broad] wisdom; the one who has sharp eyes. I have written, checked, and collated on tablets the highest level of the scribal arts, such a skill as none

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[167] Julian Henderson, *The Science and Archaeology of Materials* (London: Routledge), 38.

[168] An Assyrian byform of *uḫūltu*, *aḫussu* is rarely attested and is one of the unusual cases of an Assyrianism in the NA glassmaking corpus. For the most part, the recipes are written in the literary dialect known as Standard Babylonian.

[169] As Henderson states, "if glass melt was allowed to cool too fast past the transition temperature (Tg), it would have produced what might be regarded as a colored stone," for which see Julian Henderson, *Ancient Glass: An Interdisciplinary Exploration* (Cambridge: Cambridge University Press), 17.

amongst the kings my predecessors had learned, everything pertaining to cuneiform signs, the wisdom of Nabu. And deposited (them) for the sake of my life, the preservation of my living, for the displacement of my illness. (For) the foundation of my royal throne, on that day I deposited them in the library of the temple of Nabu, the great lord, my lord, which is in Nineveh. In future days, Oh Nabu, look favorably upon this work and bless my kingship, whenever I call on you, take my hand! Whenever I go to your temple, constantly protect my way. Once this work is placed in your temple and established before you, look favorably (upon me) and remember my good fortune. Tašmetu, great lady, your beloved first-rank wife, who intercedes for me before you—may she sleep well in bed and [daily] ask you for my life without stopping. [Whoever trusts in you], Nabu, should never be ashamed.

Previous interpretations of the glassmaking recipes have focused solely on the chemical instructions, and have set aside this long colophon as simply metadata with no obvious relation to the content of the texts.[170] Yet this colophon, found on a fragment that includes instructions for producing glass using an ingredient called *mekku*,[171] makes explicit what the earlier perfume recipes and the later wool-dyeing recipe left implicit; namely, the kinship between scribal knowledge, kingship, and divine wisdom. For the present analysis, two aspects of the colophon are especially noteworthy: first, the connection between knowledge and vision (divine and regal) expressed in the phrase "the one who has sharp eyes"; second, the idea that knowledge—including technological—is recovered from the distant past, from a tradition of "original wisdom."[172]

Jean Bottéro's claim that "these documents constitute a true 'literary genre'"[173] is nowhere clearer than in the use of somatic metaphors that are used to describe the process of making glass in a kiln, beginning with the kiln itself, an instrument said to have, quite literally, "four eyes" (4 *īnū*).

<u>K.203+ obv. ii 7–10</u>
If you want to make "lapis lazuli" (*zagindurû*-glass): you grind separately 10 minas of *immanakku*-stone (and) 12 minas of salicornia. You mix (these ingredients) together, and set down (the mixture) into a cold kiln with its four chambers (lit. "its four eyes," 4 *īnīšá*), arranging it between the openings ("between the eyes" *ina birīt* IGI-MEŠ)

[170] In his edition of the glassmaking recipes, for example, Oppenheim did not bother to provide a translation of the colophon, nor did he take seriously the ritual language found in the introduction (discussed fully in chapter 3).
[171] Oppenheim suggested that *mekku* could be a West Semitic term for "glass," but this is not clear from the NA recipes. As Moorey has stated "*mekku* does not have to be glass; it might be a natural mineral ingredient used in the manufacture of frit or glass." Moorey, 195.
[172] This idea was already introduced in the first chapter, see 1.5.
[173] Bottéro, 25. See 1.2.

We translate—or understand scribes to have meant that—the kiln had “four openings” or “chambers” (as Oppenheim), rather than “eyes.” But this translation is overly rational and ultimately flattens the semantic scope of *īnu*, here, both technical and literary. Few things in Akkadian scholarship have four eyes—this detail has poetic parallels. It shares a relation to a well-studied section of the creation epic *Enuma Elish* (“When on high”) that describes the “making” of the god Marduk. In the first tablet of the creation account, Marduk’s limbs and wisdom are described synchronically as being four in number,

> ***Enuma Elish* I, 91–98**
> Anu rendered him [Marduk] perfect: his divinity was remarkable,
> And he became very lofty, excelling them in his attributes
> His members were incomprehensibly wonderful
> Incapable of being grasped with the mind, hard even to look on
> *Four were his eyes*, four were his ears
> Flame shot forth as he moved his lips
> His four ears grew large
> And *his eyes likewise took in everything*[174]

That the glassmaking kiln shares a physical attribute with the god Marduk suggests an intertextual relation between the kiln and divine wisdom, both the *kūru*-kiln of the glassmaking recipes and the god Marduk are instruments of creation, both are also sources of fire. Although the kiln itself is not deified, the *Kūbu*-deities—agents of purification discussed at length in the next chapter—are indeed preceded by the divine determinative.

The semantic range of "eyes" and "vision" is expansive within cuneiform scholarship. The association of eyes with wisdom, or understanding, is also captured in the Sumerian loanword *igigallu* "wise" (fr. IGI.GAL, lit. "great eyes"), and noun *igigallūtu* "wisdom " in the Assyrian royal inscription that states "with the wisdom (*igigallūtu*) which (I, Esarhaddon, obtained when) Aššur and Marduk opened my understanding in respect to the great gods.” Based on the available evidence it appears that *igigallūtu*-wisdom is associated principally with gods and kings. In the lexical list An = *šamu*, *igigallu* is listed among five other synonyms of *mudû* "wise," including *ḫassu* and *angallu*.[175]

The “four eyes” oversee the successful production of glass, and assure that the recipes are followed and the impurities of glass production are kept at bay (discussed further in the next chapter). It is inside the kiln that ingredients like quartz, copper oxides (“slow” and “fast” copper), and the ashes of halophytic plants, are reconstituted into transparent or opaque colored glasses. In two instances, this new form is called a “body” (Akk. *zumru*):

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[174] W.G. Lambert, *Babylonian Creation Myths*, Mesopotamian Civilizations (Winona Lake, Indiana: Eisenbrauns), 54–57. Italics my own.
[175] http://oracc.org/dcclt/nineveh/ P346038

K.4266+, rev. i 22'–23'

"to 1 mina and 3 shekels of blue (*zukû*) glass which has the look (lit: body) of gold…"[176]

K.4266+ rev. 22'–33'

"To 1 mina and 3 shekels of *zukû* which has the look (lit: "body") of gold, you grind into (the mixture?) 3 shekels of *anzaḫḫu* (…), and 3 shekels of red (*kalgguga*)-paste (…); you raise it out after the third processing. Once you have raised it out, you mix it and stir it. You place (the mixture) into a (…) *kallu*-bowl during daylight (so that) you may dry it. You place therein 2 *amratu*-measures of *teššu*-quality *amnakku*-sand which you have exposed to daylight. (You do this) on the day that you are advised."

The "body," or appearance of glass, given the content of the instructions, should mean not just the external look of the material, but also, the internal constitution the vitreous product. The distinction between external and internal qualities is not made explicit since no term for "substance," in the Aristotelian sense, exists in Akkadian. In K.203+ rev. i 53', for example, we are told "Once the glass is solid and takes on the appearance (lit: face) of quartz …" Here, scribes used the term *zīmu*, lit. "face" rather than to *zumru* "body" to mean "appearance." And here again, the intrinsic and extrinsic dichotomy remains ambiguous. If glass "takes the face of quartz" does that mean that it also adopts the qualities of that stone? If glass takes on "the body of gold," does it mean simply that the surface of the material is metallic, or does it also intimate a deeper transmutation?

Still another corporeal metaphor is employed in the phrase: *šumma sūma imtaḫḫarka*, which we may translate "when the mixture appears red." However, a more literal translation yields "if red has faced you," from the verb *maḫāru* "to face, confront." Within this the NA glassmaking corpus, even mundane subjects like metrological precision motivated scribes to employ metaphorical language—as found in the expression *maššītu ša lā šarat še'e* "(These are) the ingredients, not (missing even a single) hair of barley" appears twice in the glassmaking recipes;[177] the phrase comes after a section on making "turquoise" (*ašgigû*-glass).[178]

Corpuscular metaphors in NA glassmaking recipes—the "body" (*zumru*) of glass, and the "face" (*zimu*, *pānu*) of the kiln, measurements not missing a single "hair" (*šārtu*)—point towards an innovative, literary aspect of the texts not seen before (or after) in cuneiform historical recipes. That kilns and the vitreous products produced within them can be said to exhibit physical (anthropomorphic) features suggests a closer kinship to the language of later chemical and alchemical literature which was accustomed to elaborating on the transformation of material "bodies." Whereas this chapter has characterized the wool and perfume recipes as sharing a proximity to scribal administrative cultures, the glassmaking recipes from Nineveh tell a different story.

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[176] *a-na* 1 MA.NA 3 GÍN *zu-ku-*⌜*ú*⌝, *ša* SU KÙ.SI22 *ša-ak-nu*

[177] *maš-ši-tu ša la-a ša-rat še-e*, K.203+, r ii 17'; *maš-ši-tu* [*ša la*-a] *ša-*⌜*rat*⌝ [*še-e*], K.4266+, r i 7'

[178] In K.203+

A sustained reference to the "body" of both glass and the instrumentation used to produce glass adds a layer of interpretation to the Neo-Assyrian glassmaking procedures not found in other technical recipes. Read for their metaphorical content, Assyrian glassmaking recipes enter into a space of mixed categories, veering towards a type of technical *literature* that, as Aude Doody has stated, defies modern demarcations of genre:

> Modern scholarship often subsumes works of different form and function, such as the didactic poem, dialogue, treatise, manual, *eisagogē*, aphorism and commentary, under the term 'specialist/ technical literature', however 'specialist/technical literature' was not, as such, the subject matter of ancient genre theory. For this reason, the designation 'genre' when applied to specialist/technical literature can present difficulties.[179]

By focusing on the non-chemical aspects of the NA glassmaking, we bring to light the corpus' literary features and, equally, demonstrate the importance of including metadata such as colophons and interlinear data into our reading of historical recipes moving forward.

For example, a new fragment of the glassmaking texts, K.18490 (belonging to second column obverse of K.203+) allows us to identify the signs GABA.RI (*gabarî*); this identification alone has aided in reconstructing K.2520+, obv. 43, which can now be read: ⌜GABA.RI⌝ (blank) [DUB] LIBIR.⌜RA⌝ "copy of an ancient [tablet]." This reconstruction lends support to the point raised in 1.5, namely, the idea that technical knowledge was not gained by means of rational "progress," but by constant rediscovery of lost knowledge from the distant past (what I previously referred to as *prisca sapientia*). The intertextual dimension of the NA glassmaking recipes, the corpus' embeddedness in the scholarly cultures of Nineveh, is too large a topic for a single section to unpack. Therefore, we will revisit this corpus more substantially in Chapter that follows.

2.5 What Kinds of Sources Are Technical Recipes?

Why were technical recipes important for cuneiform scribes? Why do they belong to the intellectual history of cuneiform? And what kinds of sources are they? Moorey's assertion that the technical procedures "should not be taken as primary sources for the study of ancient technology, only as significant secondary ones," was followed by the recognition that even "[a]s secondary sources they are useful only so long as they are understood in their own terms."[180] Yet neither he nor Oppenheim, who made a similar claim about the glassmaking recipes being "literary," offered a clear method with which to study the procedures "in their own terms." Indeed, in every interpretation of the recipes we will encounter—and there have been numerous over the past half century, as

[179] Aude Doody, Sabine Föllinger, and Liba Taub, "Structures and Strategies in Ancient Greek and Roman Technical Writing," *Studies in History and Philosophy of Science* 43: 234.
[180] Moorey, 16.

we will find in the chapter that follows—the intuition has been that the knowledge contained within the recipes is, essentially, poorly transcribed craft knowledge of the sort that only a cunning chemist (rather than an Assyriologist) could decipher. In no previous study has the focus turned to why the procedures were of importance to scribes.

Once this interpretive shift has been made, once we pivot our frame of focus onto *scribal* interests, cuneiform recipes begin to expose a new set of concerns regarding the local nature of scribal knowledge and the role technologies played in the socio-intellectual cultures of the ancient Near East. The MA perfume texts exemplify what happens when we take so-called esoteric craft manuals and analyze them in terms of their local intellectual history. Even in instances when we cannot translate aromatic ingredients or instrumentation with certainty, we can contextualize their semantic context. Like the later wool dyeing and glassmaking recipes, Middle Assyrian perfume recipes describe the use of rare ingredients, imported across vast distances in the ancient Middle Eastern world, but they go one step further—they also import terms faraway (Hurrian) terms, like *perṣaduḫḫu*, "sweet myrrh," with the eagerness we would expect from an ambitious and newly expanding territorial state. As is well known, however, the cosmopolitanism we find in Middle Assyrian scholarly production was not gained through pacifism.

That the MA perfume recipes can be securely dated to the fifth regnal year of Tukulti-Ninurta I (ca. 1239 BCE), situates the texts squarely within the period during which the king founded his new capital at Kār Tukulti-Ninurta. But the king's ambition was not limited to the northern Mesopotamia; his expansion took him reign the looked south, to the city of Babylon; as Frahm writes,

> Claiming that his Babylonian opponent Kaštiliaš had violated an earlier Assyro-Babylonian treaty, Tukulti-Ninurta sent his armies against Babylonia, conquered the city of Babylon, and assumed the Babylonian title "King of Sumer and Akkad," a move that indicates the special status accorded to Babylonia by Assyria's political elite.[181]

When Tukulti-Ninurta I sacked Babylon, he returned to his northern capital with luxury good, but he also traveled back with Babylonian scholars, cuneiform scholarly tablets, and, in an unprecedented display of dominance, Marduk himself. So traumatizing was the kidnapping of Marduk's cult statue that it echoed in the Akkadian literary tradition well into the first millennium (the so-called Epic of Tukulti-Ninurta).

So long as cuneiform technical recipes remain separated by centuries, their status as historical documents will remain episodic. This condition will undoubtedly produce discomfort in scholars attempting to compose, from these diachronically scattered sources, a universal and/or evolutionary history of "Mesopotamian technology." The contingency of cuneiform scholarship, however, should not lead necessarily to a condition of utter disunity. What this chapter has attempted to demonstrate is that there are methods for producing historical analyses of technical procedures that are more precise, more local, less "Mesopotamian" in the essentializing sense, and more Assyrian

[181] Eckart Frahm, "Assyria and the South: Babylonia," in *A Companion to Assyria*, ed. Eckart Frahm (Hoboken, NJ: Wiley Blackwell), 290.

or Babylonian, more Nimrudian or Sipparian, more 9th century than 7th. Philologically, no one could deny that the sources presented here are unified—by the cuneiform script, by a linguistic register more prominent than this chapter has had occasion to present. If we ask: what unifies technical recipes across two-millennia? Two responses may be offered, the first philological and second, thematic.

Procedural language employs second person verbal forms, temporal phrases, local dialects (e.g. Assyrian orthography), foreign words, and decision-making possibilities (i.e. the ability to produce a result in more than one way). Certain stock phrases particular to the procedural "genre" syntactic similarity between an Assyrian procedure for producing lapis lazuli-colored glass and an enigmatic instruction for building a gnomon-like astronomical instrument called a "crescent" (Akkadian *uskara*), or calculating the last visibility of the moon:

> **K.203+**
> ***šumma*** *zagindurra* ***ana epēšika***
> "If you want to make lapis lazuli"
>
> **LBAT 1494, 1495**
> ***šumma*** *uskara* ***ana epēšika***
> "If you want to make a crescent"
>
> **TCL 6, 11 obv. 36[182]–37**
> GABA.RI 36!(34) ***ana*** **DU$_3$-*ka*** TA BAR *ša$_2$* 36 6 ITI BAR GUR-*ma* 40 *ša$_2$* ŠU$_2$ *u* NA *ša$_2$* DU$_6$ GIŠ-*ma* TA NA *ša$_2$* U$_4$ 1 *ša$_2$* BAR *ša$_2$* 36 ZI-*ma šum$_4$-ma al-la* 10 UŠ LA$_2$ ŠU$_2$ u NA *bal-ṭu-ut ana* UGU DAḪ
>
> ***For you to compute*** *the equivalent of 36 (years). From Nisannu (Month I) of the 36(th year) you go back 6 months, Nisannu, and you write 0;40 of the moonset-to-sunrise and sunrise-to-moonset of Tašritu, and you subtract (it) from the sunrise-to-moonset of day 1 of Nisannu of the 36(th year); and if it extends beyond 10°, you add the entire moonset-to-sunrise and sunrise-to-moonset on top.*
>
> **ACT 1 208 No. 200 r. ii 15[183]**
> [U$_4$.N]Á.ÀM ***ana epešika***
>
> ***For you to compute*** *the day of the last visibility of the moon*

Had the goal of this chapter been to explore diachronically, procedural language rather than local knowledge, it would have begun with a discussion of phrases such as *ana epēšika*, collecting all instances of such phrases across time and procedural genres. Such an effort, certainly worthwhile, would be rewarded with a catalog of procedural language

[182] P363684; translation follows edition at http://oracc.org/cams/P363684
[183] The phrase also appears in ACT 207a: 1 in a procedure for calculating a *simanu*-value, see CAD S s.v., *simanu* f.

and technical terms, but it would not disclose how and why such forms of knowledge interacted with their local knowledge cultures.

Unifying recipes thematically generates yet a different set of questions. In answer to: "why did cuneiform scribes compose and copy these recipes?" wool dyeing, perfumes, and glass recipes provides us with a number of compelling insights. The first of these is that the materials being produced in recipes—colored wools, perfumed oils, and glass—were all utilized in the making of cult statues. That, however, is only the beginning of a long-standing scribal interest in processing of raw materials (quite possibly, for the making of cult statues), the manipulation and control of fire, proper rites and craft purity (chapter 3), a medical and classificatory interest in botanical and mineral properties, the importation of foreign goods and vocabulary (chapter 2), and a socio-intellectual proximity to kingship and/or royal patronage. This thematic approach to procedures would also productive, but would also not necessarily localize where and why those themata mattered to scribes.

The approach taken in this chapter has focused on situating the recipes within their local historical environments with the aim of showing how and why such texts were produced during particular periods of cuneiform intellectual history. But the opposition between local and universal analysis need not be an opposition at all. Analyzing cuneiform recipes philologically or thematically across the *longue dureé* can productively enrich the discourse on technical literature, particularly as it concerns comparisons with later historical recipes. Both local and universal analyses can aid in *explaining* the value of the genre, whether we categorize that genre as "literary" (à la Bottéro), lexical (à la Moorey), technical, administrative, or a combination thereof. The way forward is collaborative and multi-disciplinary; the task of translating—particularly as it regards the decipherment of ingredients—is ongoing.

Since Oppenheim's publication of the glassmaking recipes in 1970, much progress has been made in sorting out probable ingredients based on Akkadian terms:

> One of the raw materials mentioned in the production of this glass is four shekels of 'red alum' (*ga-bi-e samu*). When Oppenheim was translating this passage in the late 1960s, this may well have appeared to be an odd material to be putting into the glass, and it is interesting to note that he does not make any mention of its place in his commentary on the text. However, the work of Alex Kaczmarczyk in the mid 1980s (Kaczmarczyk 1986) has shown that pink alums from the Western Oases of Egypt were the source of cobalt colourant for much if not most of the cobalt-coloured, lapis lazuli-imitating glass of the mid-2nd millennium B.C.E., certainly in Egypt and perhaps further afield as well. The texts were therefore hinting at the presence of alum in the production of some lapis lazuli-coloured glasses long before analysis showed that this was the probable source.[184]

Although attempts to combine textual, archaeological, and archaeometric data have been few, the situation today is better—particularly in terms of methodology—than

[184] A.J. Shortland, "Cuneiform Glass Texts: A Question of Meaning," in *Archaeology, History, and Science: Integrating Approaches to Ancient Materials*, ed. Marcos Martinón-Torres and Thilo Rehren (Walnut Creek, CA: Left Coast Press), 68.

Moorey had predicted in 1994. An edited volume titled *Archaeology, History, and Science: Integrating Approaches to Ancient Materials* (2008), has taken on this task.

Andrew Shortland, one of the contributors to that volume, and a specialist in second millennium glass technology in the Mediterranean world, published in that volume an essay entitled "Cuneiform Glass Texts: A Question of Meaning." Shortland's tone is very different from that of Moorey, as one of the editors notes:

> According to Shortland, we must consider the life-history of the text [i.e. Neo-Assyrian glass recipes] to understand its changing functions throughout the period. In this sense, just as these tablets may be illustrative of 2nd-millennium B.C.E. glass-making practice, they may also inform about much later—1st millennium B.C.E.—lexicographic and literary enterprises.[185]

The "lexicographic and literary enterprises" of Neo-Assyrian glassmaking recipes will constitute the core of the analysis that follows. More specifically, we will explore the texts' alchemical themes, and the most neglected scholarly element of the texts—the so-called "*Kūbu*-images" as Oppenheim translated them—presumably, apotropaic demons set up in the presence of the glassmaking kiln. As we will find, however, their presence is far more integral to the interpretation of the glassmaking recipes than past scholarship has acknowledged.

[185] Marcos Martinón-Torres, "Why Should Archaeologists Take History and Science Seriously?," ibid., 21.

3
PURE KNOWLEDGE FROM THE KILN

ABSTRACT | Since at least 1925, cuneiform technical procedural recipes—clay tablets from between the second and first millennia BCE containing instructions for making kilns, glass that imitate precious stones and perfumes—have endured something of an identity crisis. Assyriologists and historians of science have struggled to determine precisely how we ought to interpret and catalog these chronologically early and philologically challenging texts, which have been characterized as chemical, ritual, religious, alchemical, literary, and scientific. The goals of chapter three are two-fold: First, it synthesizes the modern history of these procedural recipes, from their decipherment to interpretation, in order to trace changes and developments in scholars' attitudes towards Mesopotamian chemical knowledge; second, it provides a close reading of the Assyrian glassmaking procedures in order to test whether a "thematic analysis" of technical language—focused on concepts of "purity"—can more sharply explain what motivated the production of technical knowledge at Nineveh in the seventh century BCE. This chapter argues that regardless of how we choose to categorize these texts, glassmaking procedures were marked by a scholarly interest in physical, metaphysical, and linguistic interests in "purity."

(keywords: #historiography of science, #alchemy, #chemistry, #*episteme* v. #*techne*, #glassmaking, #purity, #epistemology)

3.0 Introduction

The present chapter concerns concepts of "purity"—their effect on modern interpretation of ancient technical procedures (3.1), how they manifest in cuneiform scholarly cultures (3.2–3.3.2), and how such concepts can reshape our understanding of technology as it relates to textual knowledge in antiquity (3.4). Focusing on "purity" as a *thema* within cuneiform texts allows the present investigation to assess how Gerald Holton's "thematic analysis" of scientific knowledge might be applied towards an intertextual reading of the Neo-Assyrian glassmaking recipes. Holton's thematic analysis argued that underlying major scientific endeavor were what he called themata, recurrent themes in the scientific imagination that included commitments to constancy, evolution, homogeneity, voids and plenums, and symmetry.[186] Crucial to the analysis below is his claim that "themata can lay bare basic commonalities between scientific and human endeavors."[187]

Although cuneiform scribal knowledge has been the subject of a number of recent monographs, Holton's thematic analysis has yet to be employed in the study of ancient

[186] Gerald Holton, *The Scientific Imagination: Case Studies* (Cambridge: Cambridge University Press), 10.
[187] Ibid., x.

technical sciences.[188] However, the potential for applying this method has already been suggested; in the conclusion to *Before Nature*, Rochberg singled out Holton's thematic approach as a "fruitful area for future research," stating:

> Among the many tools of the scientific imagination, he [Holton] singled out three: the visual, the thematic, and the analogical. With respect to the cuneiform world I have focused on the analogical in previous chapters, but themata in cuneiform scribal scholarship would also be a fruitful area for further research.[189]

In the ancient Near East, "purity" was a broad, multivalent concept, representing a subject more suitable for a full dissertation than a single chapter. Past scholarship on "purity" in the ancient Near Eastern, has focused on how the it manifests in religious, ethical, and art historical contexts.[190] Although ritual aspects of purity and impurity will enter into the discussions below, the goal of this chapter is far more constrained. The aim here is to localize concepts of "purity" within Assyrian technical knowledge production and scribal concepts of the material world, to trace—via glassmaking recipes and related texts—"preferences or commitments to certain kinds of concepts, certain kinds of methods, certain kinds of evidence, and certain forms of solutions to deep questions and engaging questions."[191] What we find, is that what counted as evidence and explanation "in the laboratory" of cuneiform scribes investigating the material world was highly dependent drawing associative connections between material properties, the polyvalence of the cuneiform script, and cultural concepts of purity. What we call the "natural world" constituted, for scribes, a far more nuanced set of relations between language, properties, reality, and expertise.

At Nineveh, knowledge of glassmaking was situated within an intertextual framework wherein "pure" materials—qualified as *ellu* or *ebbu* (wr. KÙ 𒀭 and UD 𒌓)—included precious stones, "noble" metals, and knowledge (*nēmequ*) itself. Instructions for constructing a glassmaking kiln, included the invocation of purifying divinities (*Kubu*/*Kusu*), also written with the sign KÙ 𒀭 (see 3.1). Examining the language of

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[188] Recent scholarship on cuneiform's intellectual history includes: Eleanor Robson, *Mathematics in Ancient Iraq : A Social History* (Princeton, N.J.: Princeton University Press)., Niek Veldhuis, *History of the Cuneiform Lexical Tradition*, Guides to the Mesopotamian Textual Record (Münster: Ugarit-Verlag)., Rochberg, *Before Nature: Cuneiform Knowledge and the History of Science*., and Van de Mieroop.

[189] Rochberg, *Before Nature: Cuneiform Knowledge and the History of Science*, 277.

[190] For an art historical discussion concerning the materiality of "pure" or "noble" metals, for example, see Kim Benzel, ""What Goes in is What Comes out" - But What Was Already There? Divine Materials and Materiality in Ancient Mesopotamia," in *The Materiality of Divine Agency*, ed. Beate Pongratz-Leisten and Karen Sonik (Boston: De Gruyter). There are numerous discussions of purity in religious contexts, particularly as they relate conceptions of sin and transgression (discussed in 3.3). E. Jan Wilson has discussed concepts of holiness and purity in Mesopotamia. E. Jan Wilson, *"Holiness" and "Purity" in Mesopotamia*, Alter Orient und Altes Testament (AOAT) 237 (Kevelaer: Neukirchener Verlag).

[191] Robert King Merton, "Thematic Analysis in Science: Notes on Holton's Concept," *Science* 188: 335.

glassmaking and related texts, therefore, provides an entry point for unraveling further the conceptual relations between technology and knowledge in scribal cultures. A thematic analysis allows us to engage incisively with the *language of purity* in Assyrian technical scholarship.

Close-reading is central to interpreting the glassmaking texts, but so too is the historiographical consideration regarding where the texts fit into with respect to later chemical and magical knowledge. Since their discovery, these philologically challenging texts have been characterized as chemical, ritual, religious, alchemical, literary, and scientific (3.1). And there remains, still, the lingering question as to whether the interface of magic, chemistry, and linguistic multivalence at the center of the glassmaking recipes shares more than just a family resemblance to the later tradition of alchemy. Only after recounting the modern history of how scholars interpreted the glassmaking recipes can we move towards a more holistic reading of the texts within their local scholarly contexts. What we gain, finally, from a thematic of analysis of purity in Assyrian scholarship, is contingent corpus of evidence for revisiting a key question presented in Chapter 1, namely: Did cuneiform scholars distinguish between *knowing how-to* (*techne*) and *knowing that* (*episteme*) in their model of knowledge? Two and a half millennia ago, scribes at Nineveh provided an answer.

3.1 Assyrian Glassmaking: Chemistry or Alchemy?

In 1938, the Assyriologist Reginald Campbell Thompson read before the *Society for the Study of Alchemy and Early Chemistry* in London a paper descriptively entitled "A Survey of the Chemistry of Assyria in the Seventh Century BC."[192] Thompson's paper marked the first and last time an Assyriologist would contribute to the society's journal, called *Ambix*. His contribution to that journal was a survey, based on his editions of cuneiform technical procedures dating from between the 13th and 7th centuries BCE, as well as a career-long endeavor to produce dictionaries deciphering Akkadian terms for plants and minerals.[193] Although Thompson was drawn to all aspects of Mesopotamian culture (as both an archaeologist at Nineveh and curator at The British Museum, where he had access to his pick of source materials), he maintained as special interest in texts generally considered esoteric, including Assyrian magical texts.[194] It was a corpus of

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[192] R. Campbell Thompson, "A Survey of the Chemistry of Assyria in the Seventh Century BC," *Ambix*.

[193] Indeed, Thompson's contribution to *Ambix* can, by his own admission, be read as an abridged edition of his *Dictionary of Assyrian Chemistry and Geology* published two years earlier, *A Dictionary of Assyrian Chemisty and Geology* (Oxford: Clarendon Press, 1936), 3, note 2.; in 1949, he would compile yet another reference volumes on Akkadian botanical terminology, *A Dictionary of Assyrian Botany* (London: The British Academy, 1949). Thompson, with his longtime friend and fellow British Museum curator Cyril John Gadd, also translated a Middle Babylonian (13th century BCE) glassmaking procedure, see Gadd and Thompson. This text comes with its own set of philological and historiographical challenges that must be considered separately from the Neo-Assyrian procedures of the 7th century BCE.

[194] See, for example, R. Campbell Thompson, *The devils and evil spirits of Babylonia: Being Babylonian and Assyrian incantations against the demons, ghouls, vampires,*

about a dozen of the clay tablets and fragments containing instructions for making kilns, and glass that imitated precious stones, which provided Thompson with his main source for the survey of Assyrian chemical knowledge for AMBIX. The tablets enumerated lists of carefully measured minerals with instructions for transforming those materials into precious stones.[195]

For Thompson, there was no doubt that these fragmentary texts from the 7th century BCE preserved a compelling, albeit imperfect, snapshot of Mesopotamia's chemical knowledge. Before him lay undeciphered the earliest written traces of chemistry's history, the fragments of an oral tradition dating back to fourth millennium BCE:

> [T]he ancient Sumerians had a very practical knowledge of chemical methods even before the invention of writing, let us say, very early in the Fourth Millennium B.C. ... [t]he written word, however, of their methods has survived only sparsely by comparison, this being due to three causes: first, the illiteracy of the craftsmen; secondly, the habit of all Guilds to conceal their methods by the use of cryptic expressions; and thirdly, the close guarding of secrets, which were frequently handed down from father to son by word of mouth.[196]

The process of deciphering these fragments was, for Thompson, straightforward. "[I]t is obvious" he remarked, "that many chemicals can be identified from these recipes, since the formulae must be much the same as those used to-day."[197] On the basis of etymology, Thompson argued that Akkadian terms for plants and minerals within the glassmaking procedures could be identified with their modern counterparts:

> For instance, there is the word ^{abnu}*amna*(*k*)*ku*, and the two words *tuskû* and *lulû*, which can be shown respectively to be the glass-maker's sand and the two kinds of oxide of zinc known to the ancients. These occur in the recipe for *dušû*, which means properly 'crystal':
>
> 20 mana of ^{abnu}*amnaku*
> 60 mana of salicornia-alkali
> 2 mana of *mil'u* (saltpetre)
> 1/6 mana of *namrutu* (lime)
> 1 mana of *tuskû*
> 1/10 mana of *lulû*
> ^{abnu}*amna*(*k*)*ku* is obviously the chief component here, as in the other glass formulae, and will be the glass-maker's sand, not without a curious similarity in sound to the Greek ἀμμοκόνια [*ammokonia*], a calcareous sand.[198]

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hobgoblins, ghosts, and kindred evil spirits, which attack mankind. (London: Luzac and Co.).

[195] As discussed in Chapter 1.1, translated literally, the glassmaking procedures begin: "If you want to make lapis lazuli," offering no linguistic distinction between real and artificial precious stones.

[196] Thompson, "A Survey of the Chemistry of Assyria in the Seventh Century BC," 3.

[197] Ibid., 7.

[198] Ibid.

In order for Thompson to maintain his assertion that the glassmaking procedures were chemical texts, he simply omitted those sections of the texts that could not be deciphered etymologically or that could not be structured to resemble the interests and methods of early twentieth century chemists. The consequences of this curatorial act become apparent when one reads the texts quoted above from the very beginning. Known still by its accession number K.2520, the procedure reads quite differently from the "chemical" sections of the texts quoted by Thompson. K.2520 and its duplicates begin:

> **K.2520+, obv. 1–12**[199]
> When you lay the foundations of a glassmaking kiln, you search repeatedly for a suitable day during a favorable month, so that you may lay the foundations of the kiln. As soon as you complete (the construction of) the kiln, you set down *Kubu/Kusu* divinities[200] in order that an outsider or stranger cannot enter; one who is impure cannot cross their (divinities') presence. You will constantly scatter aromatic offerings in their presence. On the day that you [set down] "glass" (lit: "stone") within the kiln, you make [a sheep sacrifice] in the presence of the *Kubu/Kusu*, (and) you set down a censer (with) juniper (you ...) honey. You (then) ignite a fire at the base of the kiln. You (may now) set down the "glass" within the kiln. The persons that you bring close to the kiln must be purified, (only then) can you allow them to sit near (and overlook) the kiln. You burn various wooden logs at the base of the kiln (including): thick logs of poplar that are stripped, and *quru*-wood containing no knots, bound up with *apu*-straps; (these logs are to be) cut during the month of Abu; these are the various logs that should go beneath your kiln.

In his contribution to AMBIX, Thompson incisively omitted this key introductory passage from his synthesis of the glassmaking procedures: the construction and ritual preparation of the glassmaking kiln and the installation of enigmatic "*Kubu*-demons."[201] By omitting this passage, Thompson was also able to circumvent the use of the term "alchemy" to characterize the type of knowledge contained within these texts, despite the fact that Eisler (discussed below) characterized the texts as "alchemical" in 1925, the same year Thompson, and his contemporary Heinrich Zimmern first published the glassmaking procedures independently. By omitting the magical—and by association, irrational—elements of the glassmaking procedures from his survey, Thompson's synthesis of Assyrian chemistry concealed a series of lively debates on the nature of Assyrian (al)chemical knowledge dating back to the year the texts were first made public.

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[199] See http://oracc.org/glass/P394484 for a full edition K.2520+.
[200] Section 3.2.2 discusses the interpretation of reading ^{d}KÙ.BU as *Kusu* (wr. ^{d}KÙ.SU$_{13}$). For now, both translations are kept, as the standard reading for these divinities in the secondary literature is *Kubu*.
[201] This passage is to be examined in historiographical and philological detail below.

The glassmaking texts were in fact known as early as the late nineteenth century, but few dared reconstruct them from the piecemeal fragments,[202] which waited in Assyriological limbo until, in 1911, Benno Landsberger—considered one of the eminent patriarchs of the field—was able to identify new tablet joins, which he passed on to his colleague Heinrich Zimmern at Leipzig. In 1925, Zimmern and Thompson produced, simultaneously, the first print editions of the glassmaking procedures. They did not share their findings, in an effort (so Zimmern would claim) to identify areas of philological difficulty.[203] Zimmern's approach was different from Thompson's, as his aim was to produce a reliable translation of the text that would interest historians of alchemy, chemistry, and magic.[204] Thompson, in contrast, was and remained focused on the identification of plants and minerals with their modern counterparts.

As a result of Zimmern's translations, interest in Assyrian chemistry surged suddenly in 1925. Among those compelled by the content of Assyrian glassmaking texts was the cultural historian Robert Eisler, a follower of Carl Jung and an expert on werewolves. Eisler was among the earliest to advance the thesis that the glassmaking procedures were alchemical texts.[205] Unlike Thompson, Eisler focused exclusively on the introduction of the glassmaking texts, emphasizing its thematic elements, including the text's hemerology (choosing a specific day for the construction of the kiln) and magical elements. For Eisler, these themata represented common features of "magical practice," such that the Assyrian glassmaking recipes were in fact literary recipes relating the metaphorical birth of glass in a kiln. For Eisler, the text's "Embryonen," (the *Kubu* that are set down within the kiln, translated literally as "foetuses"), were to be understood as both a metaphorical representation of unfinished glass, and as quite possibly the earliest written record of homunculi. Moreover, Eisler drew correspondences between these texts and other known scholarly compendia from Mesopotamia, including medical texts listing plants, stones, and the correspondence between celestial and terrestrial phenomena, all of which, collectively, resembled notions of *sympatheia* in alchemy. Eisler concluded from these observations that the Mesopotamian glassmaking recipes were the forerunners of Egyptian and Western alchemy, drawing a comparison between the recipes and the historical transmission of Babylonian astronomical knowledge to the Mediterranean world. But the argument was met with immediate resistance.

In that same year, the historian Julius Ruska published a direct rebuttal, claiming that Eisler's characterization of alchemy, which Ruska associated solely with the transmutation of metals, was methodologically flawed. Ruska argued that the goal of deciphering these early procedures was not to draw a comparison with later historical periods, but rather to explain the nature of the technical instructions as clearly as possible, so that the chemists in his era could verify the validity of the information

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[202] Zimmern mentions that his first copy of one of the glassmaking tablets was in 1897 H. Zimmern, "Assyrische chemisch-technische Rezepte, insbesondere für Herstellung farbiger glasierter Ziegel, in Umschrift und Übersetzung," *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 36: 13–14.. Virolleaud in 1910 was, however, the first to publish, independently, a fragment of these chemical recipes Charles Virolleaud, "Une formule chimique: K 203," *Babyloniaca*.

[203] Zimmern, 177.

[204] Ibid.

[205] Robert Eisler, "Der babylonische Ursprung der Alchemie," *Chemiker Zeitung*.

through experiments; this, to his mind, was the primary duty of the historian of science.[206]

Eisler and Ruska disagreed on which aspect of glassmaking procedures was truly worth analyzing. For Ruska, like Thompson, no chemical knowledge was to be found in the strange ritual introduction texts; indeed, the content of the introduction was not even to be taken seriously as scholarship. It was, and has remained until today, an esoteric ritual, thematically divorced from the measurements of minerals found throughout the major part of the procedures. Ruska's stance was influential, and in 1970, when the Assyriologist A. Leo Oppenheim published a new edition of the glassmaking procedures, accounting for new fragments; he did so in collaboration with Robert Brill, a chemist at the Corning Museum of Glass in New York.[207] Using Oppenheim's translations, Brill attempted to reproduce the instructions preserved on the cuneiform tablets with limited success.[208] Thus Oppenheim, disappointingly it seems, was forced to declare that the texts were not chemical in the way that we understand chemistry today but rather literary. However, Oppenheim's characterizations of the texts was continually in flux; between 1966 and 1970 he was prone to vacillate between characterizing the technical procedures as literary, chemical, and alchemical.[209] His uncertainty was manifest in his translations of the technical vocabulary found in the glassmaking texts, which continue to cause difficulties for the modern translator (see Appendix).[210]

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[206] Julius Ruska, "Kritisches zu R. Eislers chemiegeschichtlicher Methode," *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 37: 280.

[207] Oppenheim et al.

[208] The Mesopotamian archaeologist P.R.S. Moorey commented on this fact, and on the discrepancy between the glass texts and the archaeological materials in 1994; see Moorey, 210.

[209] Oppenheim, "Mesopotamia in the Early History of Alchemy."

[210] In my Appendix, I argue that difficult technical terms can best be understood within semantic networks, for more on the development of this project, see: http://research-it.berkeley.edu/blog/16/04/22/semantic-network-analysis-and-cuneiform-intellectual-history.

3.2 Cuneiform Knowledge of "Pure" Technologies

> Creu Gwir fel Grydr o Ffwrnais Awen
> "Creating truth like glass from inspiration's furnace"
> Gwyneth Lewis, *Inscription over the Wales Millennium Center*

Earlier interpretations of the Assyrian glassmaking procedures, which characterized the corpus as either "chemical" or "alchemical," relied on partial readings of the texts, emphasizing one section of the recipes over another. On the one hand, if one were, like Eisler, looking to identify history's earliest alchemists, one need only focus on the strange divinities called *Kubu* (or *Kusu*) found within the introductory section of the glassmaking procedures. If, on the other hand, one were, like Thompson, searching for history's earliest chemists, that same ritual introductory section was best left ignored. As early as 1925, a wall was put up between these two camps, neither wishing to engage with the other. The texts were either chemical or alchemical—and by extension, rational or irrational, scientific or magical—there was no middle ground. How could there be? After all, by early and mid-twentieth century standards, technical specializations like alchemy or chemistry were thought to have their own specialized histories, which entailed their own values, their demarcated boundaries, which are, as we will continue to find, are so often incompatible with the admixture of disciplines that characterized cuneiform scholarship at Nineveh. What occurs when these approaches are combined, when the boundaries between "chemistry," "alchemy," and "magic" are set aside, when we analyze the texts fully and examine these procedures more holistically?

Unifying the scholarly texts and glassmaking recipes at Nineveh is a discerning scribal interest in language, including semantic, metaphorical, and graphemic associations—what we have called scribal hermeneutics (1.2). These texts can further unified, following Holton's approach, by means of their shared thema, their "commitments to certain kinds of concepts, certain kinds of methods, certain kinds of evidence, and certain forms of solutions." One of the, if not the most recurrent thema of technical scholarship is the concept of "purity," a concept which was as multivalent then as it is today.

To explore how Assyrian glassmaking recipes functioned within the frameworks of scribal knowledge production at Nineveh entails, first, an examination of how the cuneiform script allowed scribes to generate and associate technical terminology in glassmaking and related texts (3.2.1), and second, a philological analysis of the most enigmatic portions of the recipes, the purifying birth divinities called *Kusu*/*Kubu* (wr. ^{d}KÙ.SU$_{13}$(BU)-MEŠ or ^{d}KÙ.BI) mentioned in the construction of the glassmaking kiln (3.2.2). Collectively, these analyses will aid in both *localizing* the glassmaking recipes within the scholarly milieu of 7th century Nineveh and demonstrating the value of a thematic analysis for the study of early technical knowledge.

3.2.1 "Purity" in Scribal Hermeneutics

The Neo-Assyrian glassmaking procedures include 14 texts and fragments, preserving over 600 lines of text, a dataset that may seem limited to historians of later

periods.[211] Within those ~600 lines however, we find thousands of potential sign combinations, and within the sign combinations, layer upon layer of possible meaning. Just as Lawrence Principe has identified "secrecy and the binding of names" as an "almost ubiquitous feature of alchemy,"[212] we may likewise characterize cuneiform scholarly knowledge as inherently polyvalent. Thus, cuneiform scholarship was an open system of knowledge, wherein a single sign could mean many things.[213]

The mechanical differences between cuneiform and alphabetic scripts are to be found in the former's relation to polyvalence (semantic, phonemic, and graphemic), i.e. in cuneiform's ability to disguise meaning. Whereas in later alchemical treatises that employed alphabet scripts, secrecy relied on metaphor and use of *Decknamen*, the cuneiform script was capable of hiding meaning and producing metaphors by the use and arrangement of particular signs. Take for example the sign KÙ(). It is the logogram that represents the Sumerian noun **ku3**[214] and Akkadian noun *ellu*,[215] both of which mean "pure," but it also indexes the phoneme /ku/. The sign KÙ( ) is a homonym of KU4(), meaning "to enter," and KU (), a sign used in phonetic writing of the Akkadian noun *kūru* meaning, "kiln." As we'll find, scribes employed all of these signs in combination to great effect within the instructions for constructing a glassmaking kiln. Sign choices such these preserve not merely puns or scribal games, but rather reflections of scribal epistemology and one of the richest—and still untapped—resources for understanding how cuneiform scribes produced knowledge, including technological and chemical knowledge.

Thus, if we are to consider the glassmaking procedures as cuneiform scholars might have, we ought to begin with an exercise in scribal training and hermeneutics; we should attempt to think like scribes. To do so, let us attempt to answer, as a scribe might have, the following alchemically inspired question: *What is the relationship between knowledge and gold?* An answer may be found in the following lexical list found in the same scholarly context as the glassmaking procedures. This text, K.2054, explores—

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[211] The text ids for these manuscripts, following the conventions of the Cuneiform Digital Library Initiative (http://cdli.ucla.edu) are: P394484, P393786, P396928, P395468, P396900, P395469, P395291, P397046, P398181, P398442, P400231, P396602, P399221; to review conventions, see Abbreviations and Appendix I.

[212] Lawrence M Principe, *The Secrets of Alchemy* (Chicago: University of Chicago Press), 17.

[213] Cuneiform scribes were themselves fascinated by the possibilities of multiple meanings within scholarly texts. So deep was their interest in polyvalence that they developed a rich commentary tradition to explore hidden meanings in texts Eckart Frahm, *Babylonian and Assyrian Text Commentaries: Origins of Interpretation*, Guides to the Mesopotamian Textual Record (Münster: Ugarit-Verlag).. Digital editions of cuneiform commentaries can be found on the Cuneiform Commentaries Project (CCP), at: http://ccp.yale.edu

[214] I use **lowercase bold** to refer to Sumerian terms. UPPER CASE refers to sign values, and as usual, *italics* refer to Akkadian nouns and transliterations.

[215] *ebbu*, to be discussed below, is a synonym of *ellu*, but is more typically written using the sign UD (read ZALAG).

through various hermeneutic strategies—the Sumerian verb **zu** "to know."[216] On this Assyrian tablet from the 7th century BCE, we are provided with the following lexical equivalencies: to know = knowledge; to know = (the metal) silver; to know = (the metal) gold. How does the scribe arrive at these equations?

One of the terms for scribal knowledge in Akkadian (right column) is *nēmequ*. Scribes writing in Akkadian often utilized Sumerian logograms in order to render Akkadian nouns in shorthand. Thus, rather than write *nēmequ* syllabically (/*ne*/-/*me*/-/*qu*/), a scholarly text may simply impress on clay the sign ZU ().

K.2054, obv i 48–50 (CT 18, 29)		
Sumerian	Akkadian	translation
zu	*né-me-qu*	to know = knowledge
zu	KÙ.BABBAR	to know = silver
zu	KÙ.SI22	to know = gold

The orthography for the pairing is unusual, as the abstract noun *nēmequ* "knowledge" is more commonly written using the logogram: NAM.KÙ.ZU. Here, however, the final element of the compound sign has been isolated; thus the abstract Sumerian noun **nam.ku3.zu** "knowledge" can be interpreted as either the verb "to know" or, alternatively, an abbreviated rendering of the Sumerian abstract noun "knowledge" (**nam.ku3.**)**zu**, wherein the elements contained in parentheses are implied. In order to arrive at the equivalency "to know" = "gold," the second interpretation must be explored. According to the secondary reading, the penultimate sign in the compound logogram NAM.KÙ.ZU—the sign KÙ  for Akkadian *ellu,* "pure"—is implicitly rendered and introduced into the set of lexical relationships based on a scribal association with the normative orthography for *nēmequ* (NAM.KÙ.ZU). Thus, referenced in the logographic writing of *nēmequ* (NAM.KÙ.ZU) is a qualification "pure," which may be understood as a qualification for knowledge itself. Implicitly, then, the type of knowledge being explored in this small set of lexical entries is "pure" knowledge. As we'll see, this element of purity (KÙ) in *nēmequ* is essential to understanding the relationship between knowledge and metal.

To write "silver" (KÙ.BABBAR) or "gold" (KÙ.SI22) logographically, the scribe must begin with the sign KÙ . By way of non-explicit scribal associations (anchored in the scribe's deep cultural knowledge of the mechanics of the cuneiform script) the scribe is able to intimate, therefore, an underlying relationship between "pure"

[216] K.2054, obv i 48–50 (CT 18, 29; P346055) is part of the lexical series *Šarru*, an edition of the tablet can be found at http://oracc.org/dcclt/P346055. The colophon, rev ii, 31'–42', indicates that this is the third tablet of the series, and preserves an Ashurbanipal palatial colophon. By as early as the second millennium BC, the well-trained scribe was bi-lingual, and demonstrated scholarly competence in both Sumerian and Akkadian. Much of their scribal training and scholarly development took place within the framework of lexical lists. These lists take a variety of forms, from explorations of cuneiform signs, to lists of professions, to more abstract matters. The long and dynamic history of this development over millennia is presented in the work of Niek Veldhuis, especially his latest monograph; for which, see Veldhuis.

knowledge and “pure” silver and gold, both of which depend on the use of the sign KÙ 𒆠. Turning knowledge into gold is an exercise in *knowing* the mechanics and hermeneutical possibilities of the cuneiform script as well as developing an epistemic relationship between the abstract and the technological. The lexical equivalency that renders "pure knowledge as pure gold” is more than merely mechanical. In the above lexical excerpt, *episteme*, here, the Akkadian *nēmequ* “knowledge,” is in direct dialectic with craft knowledge, or *techne*. Inasmuch as the short lexical excerpt is an exploration of “knowledge,” it is also a theory-laden investigation of graphemic, linguistic, and material “purity.” These interdependent elements cannot be divorced.

The sign KÙ 𒆠 and the term *ellu* is one of several similar descriptors of purity in the Akkadian language, which include, notably, *ebbu* and *namru*, as we see in the Akkadian column of the lexical list below.[217] This lexical list, called Antagal, is discussed fully in 3.3.2. But one particular set of relations, in the second line (below), presents occasion for a brief interjection.

K.5, rev. ii’ 10’–12’ (CT 19, pl. 30–32)		
Sumerian	Akkadian	translation
$^{gu\text{-}ub}$**gub$_2$** **za-gin$_3$** **zabar** (UD.KA.BAR)	*el-lu* *eb-bu* *nam-ru*	to cleanse = pure lapis lazuli = pure bronze = shiny

That second line translates: “lapis lazuli = pure” (**za.gin$_3$** = *ebbu*). An *Antagal* scribe at Nineveh (most manuscripts of *Antagal* were excavated from Nineveh),[218] would readily have considered lapis lazuli as purity, part of the same family. Part of what makes this lexical equivalency compelling is that it would suggest an explanatory translation for the first set of glassmaking instructions on K.203+, *šumma zagindurra ana epēšika*, “if you want to make lapis lazuli.” An *Antagal* scribe could have understood the instruction *šumma zagindurra ana epēšika*, as, alternatively, **šumma ebba ana epēšika*, *“if you want to make a pure thing.” Therefore, inasmuch as the cuneiform writing system could *conceal* meaning, it could also anticipate connections, *foreshadow thema* that had not yet been made explicit. In the present case, as we will find below, the glassmaking recipes foreshadow and explicate the technology of glassmaking—which requires, still silica free of contaminants—by appealing to scribal concepts of purity, either by means of orthographic associations or by invocations to a mysterious set of divinities called *Kubu*.

[217] The Akkadian triplet: *ellu*, *ebbu*, *namru* “pure, pure, bright” is well-attested, as find below, in both lexical and ritual genres.
[218] Veldhuis, 308ff.

3.2.2 Malevolent Demons or Purifying Divinities? What is a *Kubu*?

Now that we are sufficiently trained in how cuneiform scribes could make things "pure" within their writing system, the time is right for kilns and demons. Let us return, then, to the introductory section of the glassmaking procedures translated earlier:

> **K.2520+, obv. 1–12**[219]
> When you lay the foundations of a glassmaking kiln, you search repeatedly for a suitable day during a favorable month, so that you may lay the foundations of the kiln. As soon as you complete (the construction of) the kiln, you set down *Kubu* divinities in order that an outsider or stranger cannot enter; one who is impure cannot cross their (divinities') presence. You will constantly scatter aromatic offerings in their presence. On the day that you [set down] "glass" (lit: "stone") within the kiln, you make [a sheep sacrifice] in the presence of the *Kubu*, (and) you set down a censer (with) juniper (you ...) honey.

For some time, the appearance of divinities called *Kubu* (wr. ^{d}KÙ.BU-MEŠ) in glassmaking has troubled philologists. That their appearance is infrequent and ambiguous prompted Oppenheim to declare that:

> The nature of these [*Kubu*] "gods" is, however, quite uncertain, and their function can only be described as vaguely apotropaic. They belong to the popular levels of Mesopotamian religiosity of which little is known. Suffice it to state here that the Kubu-deities are in no direct way related to the production of glass though they may in some way relate to the technological use of fire.[220]

Oppenheim translated ^{d}KÙ.BU-MEŠ as "Kubu-deities," and "Kubu images." But the more long-standing translation, based principally on the appearance of *Kubu* in medical texts, has understood these divinities to be a type of "demon" associated with infantile illnesses. What (or who) were these *Kubu* and where else did they appear?

F. Thureau-Dangin, in 1922, was the first to identify *Kubu* as demons, based on lexical, literary, and medical evidence, principally from the first millennium.[221] Zimmern, D.O. Edzard, Edith Porada, and every scholar since has followed Thureau-Dangin's interpretation. Therefore, if a revision is to be made, as it is here, it will have to return to the original (primary and secondary) sources. This revision argues that the beings formerly translated as *Kubu*, malevolent demons representing fetuses, should be expanded to include the more ancient divinity called *Kusu*. Collectively, *Kubu*, *Kusu*, and even a minor divinity called *Kusi-Banda*, are all unified orthographically in first millennium sources by the initial sign combination ^{d}KÙ, i.e., the divine determinative  followed by the sign  meaning "pure." The table below bring together the various first millennium (principally, Neo-Assyrian) attestations of such "pure divinities."

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[219] See http://oracc.org/glass/P394484 for a full edition K.2520+.
[220] Oppenheim et al., 33.
[221] F. Thureau-Dangin, "Notes Assyriologiques," *Revue d'Assyriologie et d'Archéologie Orientale* 19.

Text Category	Orthography	Comments on Function
"Washing/Opening of the Mouth" Ritual (*Mīs Pî*)	^{d}KÙ.SÙ; in earlier periods, this divinity was written ^{d}KÙ.SU$_{13}$(BU), thus historically, *Kusu* and *Kubu* are closely related orthographically.[222]	In K.4928+ and elsewhere in *Mīs Pî*, the divine being *Kusu* is referred to as the chief exorcist of Enlil,[223] a ritual companion to craftsmen and a being closely tied to purification by means of washing (See 3.3.2): "Kusu, the chief purification priest of Enlil, has purified it [the divine statue] with a holy-water-basin, censer, and torch, with his pure hands…May this god become pure like heaven, clean like the earth, bright like the center of heaven. May the evil tongue stand aside. Incantation: *šu-illa* prayer for opening the mouth of a god."[224]
	^{d}ku$_{3}$-si$_{22}$-ba[n$_{3}$-da] (*Mīs Pî* V 12a–13b)	The divinity *Kusi-banda*, appears in a Sumerian incantation on Tablet V of the ritual *Mīs Pî*, which translates: "Kusibanda, [the great goldsmith] of Anu, has prepared it in due form with red gold"; red gold is written **ku$_{3}$-si$_{22}$ huš-a**, mirroring the orthography of the god Kusi-banda.
Medical	^{d}KÙ.BI	JoAnn Scurlock and Burton Andersen (2005), just as Thureau-Dangin, understood *Kubu* as "the demonic personification of stillborn children."[225] They relate a number of medical sources wherein *Kubu* are

[222] In the third and second millennia *Kusu* was a divinity associated with birth and ovens, paired with the fire god Girra in an Old Babylonian incantation (written ^{d}KÙ.SU$_{13}$/SÙ). In the first millennium *Kusu* appeared in ritual procedures including the opening of the mouth ceremony, *mis pî*, and was directly associated with craftsmen and technical purity (there, written ^{d}KÙ.SÙ). For earlier attestations of Kusu, see Piotr Michalowski, "The Torch and the Censer," in *The Tablet and the Scroll: Near Eastern Studies in Honor of William W. Hallo*, ed. Mark E. Cohen, Daniel C. Snell, and David B. Weisberg (Bethesda: CDL Press).

[223] Christopher Walker and Michael Dick, *The Induction of the Cult Image in Ancient Mesopotamia*, State Archives of Assyria Literary Texts (Helsinki: Neo-Assyrian Text Corpus Project), 204.

[224] *Mīs Pî* Tablet III, 89–97, translation: ibid., 151.

[225] Scurlock and Andersen, 512–15.

		associated with childhood afflictions.[226]
Glassmaking	^{d}KÙ.BU-MEŠ, ^{d}KÙ.BI	What is unique about the glassmaking recipes is that *Kubu* divinities are clearly plural, written ^{d}KÙ.BU-MEŠ.
Lexical	*ku-u-bu*, *ku-bu*, ^{uzu}KU.BU	The term *Kubu* appears in the first millennium lexical commentaries of the sign list Aa and the series Murgud (a lexical commentary on the thematic series Ura).[227] In these lexical series, *Kubu* is written syllabically *ku-bu* (K.10072)[228] or logographically ^{uzu}KÙ.BU (K.4368[229]). In Murgud, *Kubu* occurs in the context of with the female reproductive organs, fetuses, and the amniotic fluids: ^{uzu}KÙ.BU = *nīd libbi* "laying of the womb" (K.4368, obv. i 3').
Literary	In *Enuma Elish Kubu* is written ^{uzu}KU.BU; this may also be read logo graphically UZU KU.SU$_{13}$ for *šīr Kusu*,	Note the sign KÙ for pure is not used here, as what is being described is not a divine entity, but the hide (*šīru*) of the (ultimate) birth, Tiamat.

[226] Attestations of *Kubu* within medical prognostication texts can be confirmed in both Assyrian and Babylonian (from Uruk) sources. For example, in the following, from ibid.:

> **DPS XL A 31–34 = *TDP* 220: 31–34**
> 31. If an infant is equally hot (all over) and his upper abdomen protrudes, "hand" of *Kubu* [wr. ^{d}KÙ.BI].
> 32. If the muscles of an infant's abdomen are unevenly colored with red and yellow, "hand of *Kubu*."
> 33. If an infant's insides are cramped and he is unevenly colored with yellow, "hand" of *Kubu*.
> 34. If an infant is continually cold and he gnashes his teeth, his illness will be prolonged: affliction by *Kubu*.

[227] See Veldhuis, 7.2.2.1.; For a thorough discussion of lexical commentaries see also Eckart Frahm, *Babylonian and Assyrian Text Commentaries: Origins of Interpretation*ibid., 242ff.
[228] Aa, see http://oracc.org/dcclt/nineveh/P382578
[229] Murgud, see http://oracc.org/dcclt/nineveh/P365317

	"skin of the divine creation being."	

On orthographic and intertextual grounds there appears a clear association between the *Kubu* of glassmaking recipes and concepts of pure birth and craft production in scholarly contexts. The sources collected above edify two related arguments relevant to the interpretation of the glassmaking recipes. Firstly, the appearance of *Kubu* in the glassmaking texts is metaphorically appropriate; *Kubu* function as a metaphor employed to connote the act of "birthing" glass in a kiln. And secondly, the proximity between technical knowledge and scribal hermeneutics.

Here, *Kubu* serve to purify what amounts to a ritual craft space. In the three known exemplars preserving the introduction of glassmaking recipes, *Kubu* feature prominently in the preparation of the kiln and precede the glassmaking instructions, which only appear after the kiln is prepared. The familiar metaphorical relationship of the kiln as a mother's womb (we still call the womb an "oven")—a metaphor that features this very set of glassmaking recipes in Mircea Eliade's (1971) *The Forge and the Crucible*—further exemplifies the salience of conjuring divine beings associated with fetuses.[230] A Late Babylonian birth incantation from several centuries later makes this metaphorical association explicit:

> **SpTU 5, 248 obv. 26–30[231]**
> She comes out from the watercourse and goes up to a potter's kiln and embraces the kiln and speaks as follows:
> "Pure kiln, great daughter of Anu, in whose middle a fire is burning. Abdomen, in whose middle warlike Giru has established his dwelling, you are sound and your equipment is sound. .... You fill and you empty, but I am pregnant and I cannot deliver soundly what is in my womb."

These literary and metaphorical readings cannot be ignored, and can be subsumed under within the broader cultural associations of birthing, ovens, creation, and infant afflictions with which *Kusu* of the glassmaking recipes were associated.

With the philological and literary context in place, we can now examine how the introductory section of the NA glassmaking makes use these purifying *Kubu* divinities.

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[230] Namely, Mircea Eliade's (1971) *The Forge and the Crucible* Mircea Eliade, *The Forge and the Crucible* (Chicago: The Univeristy of Chicago Press). *Kubu*, and Eliade's interpretation of *Kubu*, are also mentioned in Marten Stol and F.A.M. Wiggerman's *Birth in Babylonia and the Bible*, within their discussion of complications during pregnancy M. Stol and F.A.M. Wiggermann, *Birth in Babylonia and the Bible: Its Mediterranean Setting*, Cuneiform Monographs (Groningen: Styx Publications), 32.
[231] SpTU 5, 248 (P348835) obv. 26–30, translation Graham Cunningham, for which see: http://oracc.org/cams/gkab/P348835; for a recent discussion of this same incantation, see Érica Couto-Ferreira, "The River, the Oven, the Garden: the Female Body and Fertility in a Late Babylonian Ritual Text," in *Approaching Rituals in Ancient Cultures, Questioni di Rito: Rituali come Fonti di Conoscenza delle Religioni e delle Concezioni del Mondo nelle Culture Antiche*, ed. Claus Ambos and Lorenzo Verderame (Rome: Frabrizio Serra Editore).

As we are already aware, the KÙ sign (), is a logographic writing of the Akkadian noun *ellu*, or "pure." Scribes employed KÙ, and its phonemic homonym /ku/, strategically within the instructions for setting up a glass kiln:

> **(K 203+ o i, 5–7)**[232]
> In the house of the kiln (wr. *ku-ú-ri*) …you place (there) *Kubu* divinities (wr. KÙ.BU-MEŠ) in order that an outsider or stranger does not enter (wr. KU$_4$-*ub*) and one who is impure (wr. NU KÙ) does not obstruct them…

In the short passage above, the same phonemic value, /ku/, is indexed by the use of three different signs: KU (), KÙ (), and KU$_4$(). Thus, however skeptically one might approach Eliade's metaphorical reading, one could hardly deny the cuneiform specialist's rationale behind the employment of *Kubu* in the context of the glass texts. In order to assure a "pure" (or KÙ) process, a "pure" (^{d}KÙ.BU-MEŠ) divinities are conjured, so as to keep out the impure (NU KÙ) from entering (KU$_4$)[233] craft space of the glassmaking kiln (*ku-ú-ri*). An explanatory sense translation of the same passage would read as follows:

> **(K 203+ o i, 5–7)**[234]
> In the house of the kiln…you place there (*divinities of purification* called) *Kubu*, in order that an outsider or stranger does not enter (the pure craft space) and one who is impure (wr. NU KÙ) does not obstruct them (i.e., the craftsmen and the purity of the process itself)

Scribes utilize the phoneme /ku/ six times in the four lines that introduce the Neo-Assyrian glassmaking excerpted above. We can access this hermeneutic layer of the recipe by highlighting the phoneme /ku/ alongside the lexemes it represents:

Translation (K.2520+, 1–4)	Translation highlighting the phoneme **/ku/**
When you lay the foundations of a glass-making **kiln**, you search repeatedly for a suitable day during a favorable month, so that you may lay the foundations of the **kiln**. As soon as you complete (the construction of) the	When you lay the foundations of a glass-making **/ku/**-*ú-ri*, you search repeatedly for a suitable day during a favorable month, so that you may lay the foundations of the **/ku/**-*ú-ri*. As soon as you complete (the construction of) the

[232] http://oracc.org/glass/P393786
[233] The writing KU$_4$ is complemented by the phoneme /bu/ for Akk. *erēbu*, which could suggest, as well, an association between the *Kubu*-demons and the verb to enter, *erēbu*, both having /bu/ as their final element.
[234] http://oracc.org/glass/P393786

kiln, you set down *Kubu* in order that an outsider or stranger cannot **enter** one who is **impure** cannot cross their presence.	**/ku/**-*ú-ra*, you set down **/ku/**-BU-MEŠ in order that an outsider or stranger cannot **/ku/**-*ub* one who is *la* **/ku/** cannot cross their presence.

In Assyrian glassmaking texts purity interacts with the act of making, cuneiform polyvalence, and semantic pluralism achieved by means of orthographic associations. Collectively, these knowledge-making techniques generate multiple registers of associative meaning, such that the recipes function at both the practical level (know how) of *techne* and at the (knowing that) level of *episteme*, in exhibiting so-called magical reasoning. For scribes, knowing *how* and *that* was symmetrical and complementary in the process of constructing technological knowledge, and in the glassmaking texts, the kiln was the space wherein this epistemic symmetry was achieved.[235] *Kusu* divinites (^{d}KÙ.SU$_{13}$-MEŠ), lapis lazuli (ZA.GÌN with its lexical equivalence *ebbu*), and knowledge itself (NAM.KÙ.ZU) could all be made "pure" by means of impressing a reed stylus on clay.

As stated in the table above, what is unique about the Kubu divinities of the glassmaking recipes is that *Kubu* they are clearly written using the plural form ^{d}KÙ.BU-MEŠ. Thus, in both writing ^{d}KÙ.BU-MEŠ, and in the cultural context of Neo-Assyrian craft and ritual scholarship, a pluralistic reading is essential and necessary. *Kubu* divinities are purifying entities, they forewarn of the dangers of creation "birthing" glass in a kiln and stand witness to the technological conditions of purity required for producing uncontaminated glass from raw silica. Both physical *and* metaphysical, these so-called demons are not easily described in modern translation, but encompass, rather, the territory of scribal knowledge wherein *episteme* and *techne* could not be divorced.

3.3 Technologies of Purification in Assyrian Scholarship

Concepts of purity (and impurity or transgression) are typically analyzed within the context of religious studies. Yet the relationship between "pure" materials and knowledge encapsulates well the scholarly interest in technology that is the focus of this work. Thus far, I have focused—not unlike Eisler and Eliade—on the introductory section of the glassmaking. But how does the argument that *the glassmaking procedures were compelled by a technical and scholarly interest in purity*, correlate with the entire text corpus of Assyrian glassmaking? Moreover, how does this thema—i.e. a focus on technologies of purification—aid in contextualizing Assyrian glassmaking within the broader concerns of Assyrian scholarship?

[235] See 3.3.2 for a full discussion of how Assyrian technical scholarship, and glassmaking in particular, manages to recouple *techne* and *episteme*. These concepts are first introduced in 1.3.

3.3.1 Purification by Fire

We can begin by identifying processes of purification as they are represented in the most repeated phrases within the glassmaking instructions. Among the most commonly repeated phrases concerns the maintenance of a pure fire, unpolluted by smoke. In twenty-seven instances, the glassmaking texts preserve the phrase: "you burn a good smokeless fire" (*išāta ṭābta la qatirta tašarrap*).[236] The phrase reinforces what may appear an obvious claim, that fire is among the most important semantic actors in the network of glassmaking recipes. Fire is "extinguished" (*šadādu*), "burned" (*šarāpu*), "covered" (*katāmu*), it is used "to melt" (*ṣâdu*), and it is guarded over (*naṣāru*), you can "arrange" (*redû*) ingredients by the fire, and "pull (them) out" (*waṣû*) of the fire, and in the process of maintaining proper temperatures, you would also "strengthen" (*danānu*) that fire, in some cases, for seven days at a time during the process of annealing.

Fire, in addition to being a central actant in the glassmaking procedure, is vital to the contemporary ritual incantation series called *Šurpu*, literally, "burning."[237] *Šurpu* was one of a number of similar "burning" and ritual cleansing series, which were classed together by cuneiform scribes in the commentary traditions of the first millennium BCE. Ekhart Frahm has noted that "the Mesopotamian commentary tradition seems to have regarded them [*Šurpu*, *Maqlu*, and *Tummu bītu*] as closely related."[238] *Šurpu* provide ritual protocols for removing transgressions. And in tablets V–VI of the series, purity (i.e. freedom from various forms of punishment) is achieved by burning:

> ***Šurpu* V–VI, 68–72**
> the pain of my hardship, sin (*arnu*), transgression (*šērtu*),
> crime (*gillatu*), error (*ḫiṭītu)*,
> the sickness that is my body, my flesh, my veins,
> may be peeled off like this onion,
> may the fire consume it entirely today,
> may the oath (*māmītu*) leave so that I may see the light![239]

The italicized terms above have been the subject of philological debates.[240] There is a great deal of work to be done, still on concepts of Akkadian transgression. What is of interest here, however, is the technological component of *Šurpu* texts, specifically, the thematic and metaphorical relation between fire and purity. From a technological

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[236] The verb "to burn," *šarāpu*, occurs 37 times in the preserved texts.
[237] The series *Šurpu* consisted of eight tablets, first edited by Erica Reiner Erica Reiner, *Šurpu. A Collection of Sumerian and Akkadian Incantations* (Graz: Weidner)., which remains still the most complete edition of the texts.
[238] Frahm, *Babylonian and Assyrian Text Commentaries: Origins of Interpretation*, 121.
[239] *Šurpu* V–VI 68–72, see Reiner, *Šurpu. A Collection of Sumerian and Akkadian Incantations*, 31. Henceforth, references to Šurpu will be based on Reiner's edition.
[240] Terms for "transgressions" are difficult to define, and are the subject of entire volumes; in the series Šurpu "transgressions," usually of a personal nature, are, in Akkadian either *māmītu* or *arnu*, for which, see K. Van der Toorn, *Sin and Sanction in Israel and Mesopotamia: A Comparative Study* (Assen: Van Gorcum), 52ff.

perspective, each of the complex cultural terms for "transgression" above—*arnu*, *šērtu*, *gillatu*, *ḫiṭītu*, and *māmītu*—can simply be regarded as synonymous with impurity. In this framework, *Šurpu* texts are provide instructions for removing the "impure" (*lā ellu*, to use the vocabulary of the glassmaking recipes), by means of "pure" (*ellu* and *ebbu*) materials and processes.

To remove impurities, a range of ingredients could be employed. In addition to onions, this list includes wool,[241] reed matting,[242] goat hair,[243] and grains of flour. These materials are cast into the fire of a kiln, or brazier.[244] Although "burning" is in the title of the series, however, ritual cleansing can also occur by the use of water, or purified oil.

3.3.2 Purification by Washing

šamnu ellu šamnu ebbu šamnu namru
pure oil, pure oil, pure oil
Maqlu VII 31

Especially in *Šurpu* tablets VIII and IX, the success of the process depends on the purity of the materials themselves; the final section of *Šurpu* VIII speaks explicitly to the relationship between pure metals, pure stones, and the knowledge and expertise (*apkallu*)[245] of the god Marduk:

> ***Šurpu* VIII, 83–90**
> 83. He is purified, cleansed, bathed, washed, cleaned,
> 84. with the water of the pure Tigris and Euphrates, the water of the sea (and) [vast] ocean,
> 85. pure water, silver, gold, copper,[246] tin, lead, carnelian, lapis lazuli, chalcedony,[247] "pure"-stone,[248]
> *86. pappardilû*-stone, *papparminu*-stone,[249] *abašmu*-stone, *engiša*-stone, *lamassu*-stone, breccia,

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[241] *Šurpu* V–VI, 93–102.
[242] *Šurpu* V–VI, 83–92.
[243] *Šurpu* V–VI, 103–112.
[244] The term in Akkadian is *kinūnu*, written with the logogram KI.NE (literally, "fireplace" in Sumerian), *kīnunu*-braziers are used in a range of ritual contexts, for which see *CAD* K, s.v., *kīnunu* 2; there are many terms for kilns in Akkadian, including *kūru*, as in the glassmaking recipes, *utūnu* (wr. UDUN, with too appears in recipes for making *uqnû*-lapis, as in K.4266+ obv. iii 17'), and *tinūru* (wr. IM.ŠU.RI.NA).
[245] The term *apkallu*, written NUN.ME, the context of *Šurpu* VIII, 88, *apkal ilī* (NUN.ME DINGIR.MEŠ), "wise among the gods," is an epithet commonly assigned to the gods Ea and Marduk; the term can also refer to an expert class of priests called by the same name, as well as mythological sages and demons. See *CAD* A, s.v., *apkallu*.
[246] Reiner translates "bronze" for URUDU, but that is more commonly written ZABAR.
[247] Written ^{na_4}NÍR, note that Reiner reads "*ḫulālu* stone"
[248] I read NA$_4$ UD as *abnu ebbu*.
[249] For Reiner's UD.AŠ-stone and UD.AŠ.AŠ-stone, I read *pappardilû* (wr. ^{na_4}BABBAR.DILI) and *papparminu* (^{na_4}BABBAR.MIN$_5$)

87. *ajartu*-stone … tamarisk, *ēdu*-plant, *maštakal*, palm-shoot, *šalālu*-reed, pure plant …
88. upon the command of Marduk, exorcist among the gods, the wisest (apkal) among the gods, lord of life,
89. may (all this), with the waters from your body and the washwater from your hands,
90. be discarded so that the earth take it away; may the curved mace release your sin[250]

Purity, in this passage, is achieved by ritual cleansing, by invoking the god Marduk, and employing "pure" materials (qualified as either *ellu* or *ebbu*). In his *Mystical and Mythological Explanatory Works of Assyrian and Babylonian Scholars*, Alasdair Livingstone noted, in passing, a fascinating correspondence between the above passage and an explanatory list known as CBS 6060.[251] This list, from the southern city of Nippur—known for much of antiquity as a cult and religious center—has duplicates at Nineveh and fits into a unique category of explanatory scholarship deifies materials and associates those materials with divine beings and/or cult statues.

The almost exact level of symmetry between CBS 6060 (dup. K.4245+) and *Šurpu* VIII 85–87 above is, in fact, so equivalent that we can read *Šurpu* as a lexical list. For the present purposes it is it is worth pausing to compare how the two texts—CBS 6060 (dup. K.4245+) and *Šurpu* VIII 85–87—relate, and where one can elucidate the other. Of particular interest here is stone ^{na4}UD, translated "pure stone" above, which does not appear in the explanatory list CBS 6060. The table below compares the ingredients listed in *Šurpu* VII 85–87 in order, to the same ingredients in CBS 6060 9–25:

[250] *Šurpu* VIII 83–84
[251] Alasdair Livingstone, *Mystical and Mythological Explanatory Works of Assyrian and Babylonian Scholars* (Winona Lake, Indiana: Eisenbrauns), 180.

Comparison between ingredients listed in *Šurpu* VIII and the explanatory list CBS 6060 (dup. K.4245+) as they appear in order (items in **bold** indicate variation)		
***Šurpu* VIII 85–87**	**Ingredients**	**CBS 6060 9–25**
KÙ.BABBAR	silver	^{na4}KÙ.BABBAR
KÙ.SI$_{22}$	gold	^{na4}KÙ.SI$_{22}$
URUDU	copper	^{na4}URUDU
AN.NA	tin	^{na4}AN.NA
A.BÁR	lead	^{na4}A.BÁR
^{na4}GUG	carnelian	^{na4}GUG
^{na4}ZA.GÌN	lapis lazuli	^{na4}ZA.GÌN
^{na4}NÍR	chalcedony	^{na4}NÍR
^{na4}UD	**"pure"-stone**	
	***muššaru*-stone**	**^{na4}MUŠ.GÍR**
^{na4}BABBAR.DILI	*pappardilû*-stone	^{na4}BABBAR.DILI
^{na4}BABBAR.MIN$_5$	*papparminu*-stone	^{na4}BABBAR.MIN$_5$
^{na4}AD-*aš-mu*	*abašmu*-stone	^{na4}AD-*aš-mu*
^{na4}EN.GI.SA$_6$	*engiša*-stone	^{na4}EN.GI.SA$_6$
	Mār-bīti of Malak stone	**^{na4}DUMU É *ša ma-lak***
^{na4d}LAMA[252]	*lamassu*-stone	^{na4d}LAMA
^{na4}TUR$_7$.[MI.NA][253]	breccia	^{na4}TUR$_7$.MI.NA
^{na4}PA	*ajartu*-stone	^{na4}PA

The order of the ingredients enumerated in *Šurpu* VIII are nearly identical to those found on CBS 6060, with two exceptions: *Šurpu* lists a stone written ^{na4}UD, "pure stone," and CBS 6060 lists two stones unmentioned in *Šurpu*, the "*muššaru*-stone" and "*Mār-bīti of Malak* stone." Moreover, it is noteworthy to point to orthographic variation between the two sets of texts, namely, the use (and non-use) of the determinative for "stone," na4  in the writing of metals (to be discussed further in the next chapter).

[252] Note that *lamassu*-stone is written using two determinatives, na4 and dingir, in succession. This is unusual, but not unattested. I discuss the use of determinatives in material classification in the next chapter.

[253] Reiner reconstructs this broken line ^{na4}TUR$_7$.[MI.NA.BÀN.DA], but based on the equivalencies with CBS 6060 it is likely that the two lines are the same. See Reiner, *Šurpu. A Collection of Sumerian and Akkadian Incantations*, 44.

For the present discussion, however, it is the mysterious stone called "pure-stone" (na4UD, na4*ebbu*) that warrants focus. The "pure-stone" is not well attested and does not appear in explanatory stone lists such as *Abnu Šikinšu;* its purpose in *Šurpu* is to contextualize hermeneutically the long list of "pure" (*ellu* and *ebbu*) materials above. In this way, the "pure-stone" functions as a semantic and orthographic marker, a type of gloss. It is unlikely that there a stone called na4UD corresponded to a natural object used in ritual practice. It is unlikely that na4UD was ever a "real" stone out there in the world.[254] Scribes created such "imaginary ingredients"—*qūru*-wood in K.203+ included—to function as actors in a complex network of technical and ritual purification.[255] The stone na4UD, the "pure stone," is an important for its significance within cuneiform cultures rather than its presumed connection to modern geology.[256]

For cuneiform scribes at Nineveh, the sign UD  in the writing na4UD was associated with the sun god Šamaš (dUD) and the term for "day" (UD = Akk. *ūmu*), but in the present context, UD is to be read as logogram for the Akkadian adjective *ebbu*, a synonym for *ellu* (KÙ), or "pure," as previously mentioned.

To see these associations in action, we can turn to yet another contemporary lexical example, this one from the series *Antagal*,[257] a list known almost exclusively from Ninevite manuscripts,

K.5, rev. ii' 10'–12' (CT 19, pl. 30–32)		
Sumerian	Akkadian	translation
gu-ub**gub2** **za-gin3** **zabar** (UD.KA.BAR)	*el-lu* *eb-bu* *nam-ru*	to cleanse = pure lapis lazuli = pure bronze = shiny

In the excerpt above, scribes explored the three principal Akkadian terms for "pure" or "bright," and by extension, the orthographic and cultural associations of "pure" things. Just as in K.2054, which equated "pure knowledge" to "pure gold," many of the juxtapositions here make sense only within the cuneiform world. Take for example, the first line of K.5, which equates the Sumerian verb "to cleanse" (**gub2**) with the now well-known noun *ellu*, "pure." This line makes a great deal of sense in the context of *Šurpu* VIII 83–90, which explicitly instructs one to cleanse her transgressions in the waters of the Tigris and Euphrates, that passage, again:

***Šurpu* VIII, 83–85**

83. He is purified, cleansed, bathed, washed, cleaned,

[254] The same could be said of the "*Mār-bīti of Malak stone*," another hapax which appears to have been created for the explanatory list CBS 6060.

[255] In this way, we can add na4UD to our list of "imaginary" ingredients, which includes *quru*-wood and *apu*-straps. (For which, see chapter 1.2).

[256] A similar question may be asked of the "pure plant", *sikillu* plant (wr. úSIKIL); did such ingredients exist out in the world? Could any species of plant be made pure by means of orthography?

[257] K.5, rev. ii' 10'–12' (CT 19, pl. 30–32), for edition, see http://oracc.museum.upenn.edu/P365411

84. with the water of the pure Tigris and Euphrates, the water of the sea (and) [vast] ocean,
85. pure water, silver, gold, copper, tin, lead, carnelian, lapis lazuli, chalcedony, "pure"-stone …

In *Antagal*, the clearest associations occur along the Akkadian column. Here, the Akkadian *ellu* "pure," has two synonyms, *ebbu*, and *namru*. The term *ebbu* used most often to describe precious stones like lapis lazuli, written **za$_3$.gin** in Sumerian, thus "lapis lazuli = pure" in the second line, is a cultural association rather than strictly orthographic one; lapis lazuli is "pure" because the stone is used in ritual contexts such as Šurpu, but also because it is the most common stone used to adorn and describe divine statues. Note here, again, that lapis being pure, whether in *Antagal*, *Šurpu* or CBS 6060, has no relation to whether the stone was sourced from a mountain or made in a kiln.

Finally, we can turn to the final line of the *Antagal* excerpt, wherein *namru*, another synonym for *ellu* and *ebbu* is equated to bronze: "bronze = shiny." Here, the associative relations are once again orthographic. The sign UD first element in the writing "bronze" ZABAR (UD.KA.BAR), therefore just as lapis is pure (*ebbu*, UD), so too is bronze (UD.KA.BAR). We can return now, for a final, to *Šurpu* VIII, this time, focusing on the orthographies of stones in lines 85–86.

***Šurpu* VIII, 85–86**

85. A-MEŠ <KÙ-MEŠ> KÙ.BABBAR KÙ.SI$_{22}$ URUDU AN.NA A.BÁR ^{na_4}GUG ^{na_4}ZA.GÌN ^{na_4}NÍR ^{na_4}UD
86. ^{na_4}BABBAR.DILI (UD.AŠ), ^{na_4}BABBAR.MIN$_5$ (UD.AŠ.AŠ), ^{na_4}AD-*aš-mu* ^{na_4}EN.GI.SA$_6$ ^{na_4d}LAMA ^{na_4}TUR$_7$.[MI.NA]

Translation

85. pure water, silver, gold, copper, tin, lead, carnelian, lapis lazuli, chalcedony, "pure"-stone,
86. *pappardilû*-stone, *papparminu*-stone, *abašmu*-stone, *engiša*-stone, *lamassu*-stone, breccia …

Recall the two cuneiform signs most indicative of material purity: KÙ() and UD (). In just two lines, these signs account for the initial elements in the logographic of five materials: silver, gold, "pure"-stone, *pappardilû*-stone, and *papparminu*-stone—all written using either the signs KÙ (*ellu*) or UD (*ebbu*). Without setting so much as a foot in sculptor's workshop, lapis lazuli and bronze are made "pure" by means of lexical associations (principally, in this case, by the analysis of synonyms for "pure" in the Akkadian column). Whether lapis or bronze are "pure" in a metaphysical sense, is secondary to the fact that they are "pure" by virtue of their place in cuneiform scholarship.

Šurpu and *Antagal* inform the glassmaking recipes insofar they contextualize the production of pure stones, they reveal the broader purpose for generating and employing these relations of material purity. Once these connections are made evident, the task of tracing the purifying properties of stones in cuneiform technical scholarship becomes expansive. Equally, more well-represented specialties of cuneiform

scholarship, such as the vast number of extant medical recipes. For example, the following Neo-Assyrian medical remedy lists a number of *abnu* (wr. NA4), i.e. real and/or artificial stones:

> **BAM 237 (KAR 194), i 4'–8'**[258]
> You thread these nine stones: *ḫaltu*-stone, right handed *šubû*-stone, left-handed *šubû*-stone, male and female *šû*-stone, blood red carnelian, *kapāṣu*-shell, *ianibu*-stone (and) *zibtu*-stone on red-dyed wool, lapis wool, carded wool, tendons from a dead cow, tendons from a male and female gazelle, male *ašlu*-rush (and) *daʾmātu*-clay which you have twined together. You tie seven and seven knots. You wind "lone plant" and *tullal* seed into burls with red-dyed wool between the knots and the stones. You recite the recitation over it three times and bind (it) on her hips.

Were these incredible lists of stones, so typical in medical and ritual literature made of glass, as Eleanor Robson suggested?[259] The semantic and orthographic multivalence of the texts render such distinctions ambiguous. Scribes did not state explicitly whether the stones used in ritual or medical purification were made in the kiln. This ambiguity, a source of controversy for earlier scholars (3.1), enriches the intellectual scope of the recipes and associated corpora of technological texts; it also blurs the ontological line between the natural and technological, between what makes a thing either genuine or artificial. Adding to this complexity is the inability to know whether the rituals prescribed in magical and medical texts, and the ingredients listed therein, had physical correspondences in reality. How many of the ingredients were "imaginary,"[260] existing only on the cuneiform tablet? As in the glassmaking recipes, scribes working within the medical text tradition employed a number of hermeneutical techniques in composing and copying medical procedures, although a great deal more research will need to be conducted in this subfield in order to determine the frequency of similar occurrences.[261]

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[258] JoAnn Scurlock, *Sourcebook for Ancient Mesopotamian Medicine*, Writings from the Ancient World (Atlanta: SBL Press), 577–78.

[259] Robson, "Technology in Society: Three Textual Case Studies from Late Bronze Age Mesopotamia," 50ff.

[260] I explore this briefly in chapter 1 wherein I discuss the hapaxes *quru*, and *apu*—a type of wood and strap respectively—as "imaginary" materials generated by means of scribal hermeneutics.

[261] Of interest here, for example, is the strategy of employing nouns designating ingredients and materials without obvious natural referents; these found throughout the corpora of Assyrian procedural texts. In an alternate recipe for the aforementioned affliction of the head, we find:
"[If a man is afflicted with *sankidabbû* ("lit: a seizing of the head")]…on the 9th day of Ayyaru you bind *imḫur-līm* plant, *imḫur-mē* plant, lupin, *elikulla* plant, […] and *ḫašūtu* plant which has 7 heads from the cult platform of Marduk's temple, with the tendon of a dead cow…and place it on his neck; the head-stone you tie onto his forehead"
Here, the *ḫašūtu* plant, while problematic as an isolated noun, is descriptive and salient in the above context. The plant is associated with the temple of Marduk, the principal deity of Babylon and the month of Ayyaru; it is also associated with the "tendon of a

The Assyrian glassmaking texts and related technical procedures have been considered, since their discovery, esoteric craft manuals. But based on the evidence presented above, the glassmaking texts are to be read not solely as windows into ancient craft, but rather as products of a scribal culture, whose interest in the language of craft was key to the production of the texts as epistemic objects. In sum, they are to be read as scholarly texts that can in fact be better understood conceptually in comparison to later technical scholarship such as alchemy. Cuneiform scholarship of the material world and technology interfaced *techne* and *episteme* and made no distinction between these two spheres of knowledge. Thus, we can think of the division between *techne* and *episteme* as anachronistic, and ultimately incommensurable with technical knowledge production at Nineveh. Nevertheless, it is worth revisiting and providing a systematic rendering of what those differences of knowledge types look like. That is, if we define scribal technical knowledge, *nēmequ*, as the interface of knowing *how* and knowing *that*, is important to lay out the differences between those knowledge components in order to more accurately define the nature of their relation:

> **Knowing *How*** to achieve purity in technological contexts was both a physical and metaphysical act. Glassmaking texts instruct the practitioner to: select a specific day of the month, burn special types of woods, ignite a smokeless fire (for up to seven days), invoke purification Kusu/Kubu-deities, offer libations, incense, sheep sacrifice, pray to dead masters of yesteryear, continually wash and cleanse the silica ingredients for glass production, and use a variety of alkali plants as fluxing agents. These instructions above were only partially expressed in the Akkadian language. How hot should the fire be? How many Kubu/Kusu deities should be invoke and how often? When an incense is burned in the construction of a kiln, what aromatic were to be used; what is the proper scent? Color terminology is equally ambiguous. As is the technical terminology that distinguishes between different species of salicornia (with and without "horns," *qarnanu*). These are not trivial concerns. These are the central components of a proper procedure. Indeed, Polanyi's statement that "we can know more than we can tell," is nowhere clearer than in attempts by scribes to translate craft expertise and somatic knowledge—*techne* and know how—into written language. Attempts by modern scholars to reconstruct glassmaking know how—are sure to render a fictional account of ancient practice, deeply bound to culturally contingent concepts of purity. More importantly still, such an attempt would circumvent the epistemological component of glassmaking. For scribes, knowing how to make a pure stone required knowing that the cuneiform writing system could discover in the material world, certain relations of meaning otherwise invisible to those unable to read cuneiform.

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dead cow." In the cuneiform script, the god Marduk is written ^{d}AMAR.UTU, the sign AMAR means "calf" in Sumerian; the month Ayyaru is written ^{iti}GU$_4$, the Sumerogram for "ox". The *hašūtu* plant with seven heads from the cult temple of Marduk, served as an associative link to the month of Ayyaru, and the "tendon of a dead cow," all of which elicit bovine references at of the cuneiform writing system.

Knowing *That* a process was adequately "pure" was highly dependent on *linguistic* rather than hands-on technical knowledge. Scribal generated associative relations internal to the cuneiform writing system (scribal hermeneutics). Knowing *that* a process is pure, that a desired result would be achieved—be it the production of colored glass or the purification of an ethical transgression—was dependent on *knowing* that scribal hermeneutics could generate technical knowledge. That, in other words, one could learn about glassmaking, wool dyeing, or making perfume, by analyzing how those materials and processes manifested in writing. In the present case, this meant having knowledge of the graphic, semantic (and by extension, cultural) associations of the sign KÙ.

In addition to knowing signs (graphemic knowledge), scribes produced associative relations by means at the level of lexemes including, in the examples presented above, the terms: *ellu*, *ebbu*, and *namru*, all of which could signify "pure" materials. Only by means of the cuneiform writing system does it makes sense to say, as in as in K.2054, that knowledge = gold. From the vantage point of scribal culture, material purity was explored most explicitly on the cuneiform tablet, rather than, as earlier studies assumed, in the glassmaker's workshop.

The claim that *techne* (knowing *how-to*) and *episteme* (knowing *that*) were inseparable in cuneiform cultures warrants repetition. The breakdown above is therefore artificial; it is meant to instruct us moderns what it was like to think about technology like scribes.

We arrive then, at a critical juncture, having at our disposal any number of frameworks within which to re-interpret the Neo-Assyrian glassmaking recipes. But in broadening the intellectual landscape of these texts, one is left with the question of how the recoupling of *techne* and *episteme* at work in the glassmaking recipes changes the current picture of cuneiform scribal knowledge. It is time, in other words, to conclude.

3.4 What Kind of Knowledge is "Pure" Knowledge?

> Can anything more than profound confusion be indicated by this admixture of diverse fields and concerns?
>
> Thomas Kuhn, *The Structure of Scientific Revolutions* (1962)

Chapter 1 cautioned against the maintenance of modern demarcations;[262] that chapter began with a discussion of Oppenheim's 1966 "Mesopotamia in the Early History of Alchemy," with the aim of revisiting—as well as casting doubt upon—whether the boundary between genuine and artificial materials was of obvious value to cuneiform scholars. The present chapter, in turn, has traced the genealogy of Assyrian glassmaking in the twentieth century and the ways in which modern scholars have characterized the corpus of Assyrian glassmaking recipes as either "chemical" or "alchemical." Concomitantly, it has asked whether the epistemic hierarchy that places abstract (*episteme*) above technical knowledge (*techne*), was clearly articulated in the corpus of glassmaking recipes, and whether all these epistemological debates could be

[262] Sections 1.1 and 1.4 in particular.

subsumed by considering the glassmaking recipes, as part of a larger scribal thema focused on "technological purity." While episodic in structure, each of these concerns—historiographic, philological, epistemological, and thematic—is related. Indeed, in each case, the exercise and the aim has been the same, to answer the question: What kinds of knowledge are represented in the Neo-Assyrian glassmaking recipes?

Necessarily, we are limited, once again, by the matter of boundaries, by the demarcations of what does or does not constitute a particular type of knowledge or genre familiar to our own research. There is no way around these margins, not, at any rate, at the macro level. As Lloyd has remarked, "[w]e cannot, on pain of distortion, impose our conceptual framework. Yet we have to."[263] That, at least, is the sense once gets from afar. Focusing on the history of interpretation of the glassmaking recipes shows that this imposition of conceptual frameworks was

A shift in perspective, a closer look at both the texts and margins of cuneiform technical recipes, might afford us a different perspective, a sufficiently close reading might bring us closer to the "hybrids of old," to once again echo Latour. Deconstructing epistemological boundaries by means of close reading is not deconstruction at all, but rather, quite simply, a shift in perspective. This perspectival shift requires swapping one's interpretative tools. From afar, using the telescope of historical hindsight, one can quite easily remark, following Eisler and Eliade, that the glassmaking recipes look "alchemical." And we can go one step further, in our effort to understand these forms of knowledge and offer a modified translation of Assyrian glassmaking texts. We can also generate, as R. Campbell Thompson did, a "chemical" interpretation. And, from the chemical framework, advance an experimental collaboration, as Oppenheim and Brill did in 1970. But all of these methods lack proximity to the texts. The margins separating that which makes a premodern technical text "chemical," "alchemical," or "ritual" are, to use an Akkadianism—*lā ellu*—impure. Perhaps unsurprisingly, Neo-Assyrian glassmaking, and even ritual texts like *Šurpu*, exemplify, for the modern interpreter, disciplinary admixtures.

Thompson, Eisler, Eliade, and even Oppenheim, used telescopes to read the introductory sections of the glassmaking recipes. The preceding chapter has attempted to demonstrate what occurs when we look through a microscope instead. Microscopes have the effect of making solid things look unsubstantial. The consequence of this change in perspective makes the walls that separate genres and epistemic hierarchies (such as *episteme*/*techne*) are porous, easily permeable, and ultimately anachronistic. Indeed, prior to the Enlightenment, it is difficult to justify strict adherence to particular disciplines. Describing the experimental methods Robert Boyle, Bruce Moran writes "[y]ou didn't have to be Cartesian or Paracelsian, or to decide absolutely between alchemy and chemistry, in the seventeenth century. It was possible to combine traditions of several sorts."[264] If chemical knowledge could successfully develop within an environment of interdisciplinarity during the Scientific Revolution, should we not seek to identify similar disciplinary admixtures in cuneiform cultures, wherein technical

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[263] G. E. R. Lloyd, *Ancient Worlds, Modern Reflections : Philosophical Perspectives on Greek and Chinese Science and Culture* (New York: Clarendon Press), 2.
[264] Bruce T. Moran, *Distilling Knowledge: Alchemy, Chemistry, and the Scientific Revolution* (Cambridge, MA: Harvard University Press), 142.

knowledge of glassmaking could interact with the literary and scholarly cultures that produced *Antagal*, and *Šurpu*?

Three conclusions warrant iteration, the first, to follow the order of the prose, is the methodological claim that the modern historiography of textual interpretations shapes how we frame our questions in the present (either tacitly, or explicitly). The second is the observation that the cuneiform script, when employed in technical contexts, can stratify meaning—analogical, metaphorical, orthographic, phonemic—in ways unfamiliar that may appear vague or even inaccessible to modern readers accustomed to alphabetic writing. Understanding and taking seriously the polyvalence of the cuneiform script as a knowledge-making device is essential to engaging meaningfully with cuneiform scholarship. Third, and finally, the concept of purity in technical knowledge extended well beyond the confines of technical procedures, and manifested in a scholarly pursuit of technologies of purification. Material and epistemic purity was central to Assyrian ritual scholarship; the thematic overlap, between the glassmaking recipes and *Šurpu*, analyzed in the final part of the chapter, open up new possibilities for the contextualization and integration of technical recipes into more well-researched areas of cuneiform scholarship.

Collectively, these conclusions substantiate the argument that the corpus of glassmaking procedures does not constitute an isolated or esoteric text category. Rather, glassmaking procedures and the technical procedures with which they are associated are part of a normative Assyrian intellectual project. This conclusion supports Robson's statement that "for the scholars it remained important to maintain a codified tradition of that [glassmaking] knowledge, couched in a textual structure and technical language familiar to them from other genres of their works."[265] On this account, technical procedure texts provide evidence of scribal attitudes towards expertise, technological processes, and medical knowledge—and as such, constitute an essential component of scribal knowledge (*nēmequ*). Lexical lists like K.2054 (wherein knowledge becomes gold), purification rituals like *Šurpu*, and glassmaking recipes, provided textual frameworks within which scribes could generate, consciously or unconsciously, an epistemology of technology via the medium of cuneiform writing. Read as intellectually normative documents, rather than unusual technical treatises or mere esoterica, cuneiform procedural texts offer an untapped resource for the study of intellectual history in the early Middle East. It bears restating that the textual genre of procedural texts, of which glassmaking recipes are a part, lasted for over two thousand years; the longevity and success of this intellectual format cannot be overstated.

A close scrutiny of the language of glassmaking procedures suggests that the most fruitful analytic tool for understanding these "how-to" manuals is not necessarily to replicate—in any explicit way—the practical steps that they provide. As with later alchemical manuals, the historian has to contend with the issues of technical language and its relation to practice and tacit forms of knowing. Remarkably, the ways in which cuneiform scribes described what we may regard as chemical purity was echoed in the use of signs and demonstrated, in particular, by the introductory sections that employ the phonemic value /ku/, the Sumerian term meaning "pure." Before lapis lazuli is even mentioned in the recipes, the associations between *ellu*, *ebbu*, and lapis lazuli

[265] Robson, "Technology in Society: Three Textual Case Studies from Late Bronze Age Mesopotamia," 53.

(^{na4}ZA.GIN$_3$) are already foreshadowed by means of lexical association (and we can demonstrate how these precise associations were made in the lexical series *Antagal*). The corpus of Assyrian glassmaking procedures demonstrates with little doubt that cuneiform scribes, like later alchemists, treated technical texts as a framework within which they could conceal and layer meaning and knowledge regarding the material world and its transformation via seen and unseen processes. Without access to instrumentation that could grant access to the microscopic world of nature and its impurities, cuneiform scribes depended on the most exacting instrument that they knew: the cuneiform script. Only by means of fine tuning that instrument could they innovate scholarship in technical frameworks, and enter—to quote Hacking's description of the microscope—"new worlds within worlds."[266]

Beyond the surface of the cuneiform glassmaking procedures, we find hidden unusual treatises on the transformation of the material world, bound by and in dialectic with the language games of scribal cultures, whose technical knowledge was in continual dialogue with cuneiform polyvalence. Cuneiform procedural recipes are hermeneutically rich and, in addition, philosophically complex, suggesting a closer kinship between the glassmaking recipes and more well-known categories of cuneiform interpretive scholarship, including commentaries from the same period. Frahm, in his description of a medical commentary to the series Sa-gig, enumerates the very same interpretative mechanics described here, stating:

> Ingeniously establishing new meanings through the use of (near) homonyms of words or syllables, as well as through graphemic association and other forms of analogy, they [i.e. scribes] would produce explanation after explanation and regard all of them as equally valid.[267]

Are the Neo-Assyrian glassmaking recipes technological commentaries? Perhaps scribes would have seen them as such. Certainly they were scholarly enough to warrant membership within royal archives; these glassmaking recipes would, within the hermeneutical circles of scribal knowledge, have been familiar to scribes already entrenched in the linguistic and material processes of purification (as exemplified in the series *Šurpu*, or in other texts in which purity is a central theme). In the twentieth century, Thompson, Zimmern, Oppenheim, Eisler, and Eliade, breathed new life into these texts. With a rising interest in the history of the ancient science, particularly as it regarded the origins of modern scientific knowledge, Neo-Assyrian glassmaking became chemical, and alchemical. Along the way, this excitement to decipher the Assyrian table of elements distanced even the most discerning Assyriologists from engaging with a close reading of the texts themselves. Making pure knowledge in a kiln is both a technological and epistemological activity that few texts in cuneiform scholarship exemplify as well as the Neo-Assyrian recipes for making glass, which, as we have seen, ingeniously paired technical knowledge (knowing *how-to*; *techne*) within an epistemic

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[266] Ian Hacking, "Do We See Through a Microscope?," in *Images of Science: Essays on Realism and Empiricism, with a Reply from Bas C. van Fraassen*, ed. Paul M. Churchland and Clifford A. Hooker (Chicago: University of Chicago Press), 152.
[267] Frahm, *Babylonian and Assyrian Text Commentaries: Origins of Interpretation*, 40.

framework (knowing *that*; *episteme*). Within the scholarly milieu of seventh century BCE Assyria, gold, silver, and lapis lazuli are as pure as knowledge itself. Without feeling beholden to the margins that demarcate chemistry, alchemy, nor the intuitive wall that separates technology from knowledge, our interpretive tools for analyzing these procedures should, at the very least, attempt to imitate the level of sophistication scribes demonstrated two and a half millennia ago.

4
CONCLUDING REMARKS

> *The claim to attention of an ethnographic account does not rest on its author's ability to capture primitive facts in faraway places and carry them home like a mask or a carving, but on the degree to which he is able to clarify what goes on in such places, to reduce the puzzlement—what manner of men are these?*
>
> Clifford Geertz, *The Interpretation of Cultures* (1973)

> *In their capacity as poets, or as secretaries of state, the scribes could create gods by intellectual revolutions… As a kind of reward…the scribes instituted and popularized their own patron and prototype, the divine scribe Nabu, as Marduk's secretary, thus projecting their self-image into the cosmos.*
>
> Benno Landsberger, *City Invincible* (1960)

If knowledge had a shape for the modernists it might look a great deal like one of Le Corbusier's radiant city, neatly compartmentalized and exceedingly rational.[268] From the heights of these ideal edifices, the ancients were barely visible. Mesopotamians, and even the Greeks and Romans, became mere artifacts of an irrational past. In looking forward, modernist architects sought a clean break from the irrationality of ancient knowledge, ultimately, with little success.

Between the mid and late twentieth century, with E.R. Dodds and others, the Greeks embraced their irrationality.[269] With the continual decipherment of cuneiform texts, and with the increasing influence of cultural anthropology, Babylonians and Assyrians began to speak in their own tongues, without reference or reliance on biblical scripture or Orientalist fantasy. In the 20th century, with figures like Samuel Noah Kramer—a Sumerologist and great popularizer of Mesopotamian literature—the "land between the two rivers" took the form of a historical laboratory, the pristine setting of nearly all of history's firsts.[270] Thereafter, the shape of Mesopotamian knowledge, ever in flux, became a waterway, A. Leo Oppeneheim's "stream of tradition."[271] In just our immediate past, knowledge of the ancients has been sculpted into any number of forms.

But what shape did knowledge take for cuneiform scribes? And where, in the morphology of that structure, do we find technological knowledge? Perhaps we need not look very far beyond the find spots of the texts themselves. The locus of scholarship, the "city"—*alu* in Akkadian and **iri** in Sumerian—was a disproportionately powerful concept, difficult to divorce from the intellectual history of cuneiform itself. Although

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[268] "The Radiant City" (*Ville Radieuse*) refers to an unrealized utopian project initiated by the architect Le Corbusier; for the architect's musings on modernist (utopian) architecture and city planning, in which, incidentally, he uses ancient Babylon as an example, see Le Corbusier, *The City of To-morrow and its Planning* (Cambridge, Mass.: M.I.T. Press).

[269] E.R. Dodds, *The Greeks and the Irrational* (Berkeley: University of California Press).

[270] Samuel Noah Kramer, *History Begins at Sumer: Thirty-Nine Firsts in Recorded History* (Philadelphia: University of Pennsylvania Press).

[271] See 2.0.

recent excavations have shown that cuneiform administrative and pedagogical practices spread as far the marshlands of southern Iraq, the historical and cultural connection between writing, the city, and the gods is undeniable. Indeed, the intellectual history of the "Mesopotamian city" resembles a rapidly changing series of inkblots on a map of the Middle East—a Rorschach test for the modern historian.[272]

Thus if knowledge had a shape for cuneiform scribes, that shape was decidedly urban. And if Le Corbusier's city of the future was symmetrical and "radiant," the Mesopotamian city was "invincible."[273] The proper rites and instructions for maintaining that invincible city gave rise to a range of didactic and explanatory texts. Brick structures eroded, the lapis eyes of the gods lost their luster, wools their vibrancy. And even if scribes themselves could not produce perfume or colored glass, they could commit to writing procedures, lexical and explanatory lists; they could, in other words, *study* technological expertise with the philological and historical insights that characterized cuneiform scholarship. Akkadian procedures provided in their very use of second person verbal forms, a direct way for the cuneiform scholar—for "you"—to enter into a dialectic with the urban intellectuals of the distant past. Knowledge transmission—including procedural knowledge—was not a matter of conservatism as past scholarship argued (2.0), it was, plainly, a constant and ever changing discourse with the past.[274] We should not be surprised, therefore, to find even in the procedures of Babylonian astronomers, a historian's sensibility.[275]

The thesis of this work—that technology, broadly construed, constituted an integral part of what cuneiform scribes considered knowledge—is as much a methodological thesis as it is a claim regarding the early intellectual history of technology. Methodologically, this work has emphasized the contingency of scribal knowledge, how local contexts (chapter 2) and themata (chapter 3) shaped the research program of Assyrian scholars, and how, moreover, we can more productively generate meeting points between modern intuitions and ancient systems of knowledge by abandoning the dichotomy that sets theory and practice in opposition (chapters 1, 3). Technical recipes constitute sources that inform and interact with the construction of knowledge at the local level. Depending on one's research questions, glassmaking recipes can function as literary or ritual texts focused on purity, perfume recipes can be read as cultural windows into the roles of female experts during the rise of the Assyrian territorial state, and even a solitary tablet containing wool dyeing recipes can expand our cognitive and cultural appreciation of the role of garments in first millennium Babylonia.

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[272] For more on this subject, see Marc Van de Mieroop, *The Ancient Mesopotamian City* (Oxford: Clarendon Press).

[273] Benno Landsberger, "Scribal Concepts of Education," in *City Invincible: A Symposium on Urbanization and Cultural Development in the Ancient Near East Held at the University of Chicago, December 4–7, 1958*, ed. Carl H. Kraeling and Robert M. Adams (Chicago: The University of Chicago Press).

[274] For the latest on knowledge transmission as it relates to concepts of canonicity, see Francesca Rochberg, "Canon and Power in Cuneiform Scribal Scholarship," in *Problems of Canonicity and Identity Formation in Ancient Egypt and Mesopotamia*, ed. Kim Ryholt and Gojko Barmamovic (Copenhagen: Museum Tusulanum Press).

[275] See Escobar and Pearce.

The plasticity of genre can be found throughout the corpora of cuneiform scholarship. Just as an excerpt from eighth tablet of the series *Šurpu*, can be read as lexical list (3.3), so too can we interpret technical recipes as a branch of lexical scholarship. All such texts could function as explorations of material knowledge. The fluidity of textual genres and the lack of epistemic hierarchies (between *episteme* and *techne* in particular), should challenge us to embrace these unfamiliar systems of knowledge, particularly at a time when such hierarchies have generated an intellectual culture that separates the sciences from the humanities. Benno Landsberger exclaimed that Mesopotamian ways of knowing were so fundamentally different from our own as to be nearly incommensurable—an "alien" civilization he called it.[276] But we need not go back as far as Mesopotamia to find historical "aliens," as the Ian Hacking has stated in his *Historical Ontology* (2002), the feeling of incommensurability is as recent as Paracelsus:

> The historian who seeks origins has found in Paracelsus anticipations of all sorts of more recent chemistry and medicine. The herbalist can still comb this work for plant lore that we have forgotten. But the tone of Paracelsus is better suggested by interminable passages that go like this: "Nature works through other things, as pictures, stones, herbs, words, or when she makes comets, similitudes, haloes and other unnatural products of the heavens" (Paracelsus 1922, 460). We can come to understand this world of similitudes better, but there is, in a fairly straightforward way, no common measure between these writings and ours. One cannot but feel the incommensurability."[277]

That feeling of incommensurability with cuneiform cultures can begin with the simple observation that we know, still, very little about the uses of a basic unit of the cuneiform writing system: the determinative.

Bats are birds, glass and metals are stones (incidentally, a plant can be a "stone" too); turtles and lizards are fish, man-made canals and natural waterways are both "rivers"; and the list goes on:

[276] Landsberger, *The Conceptual Autonomy of the Babylonian World*, 1.
[277] Ian Hacking, *Historical Ontology* (Cambridge, MA: Harvard University Press), 99.

Sign	Determinative	Semantic Categories
	NA4 “stone”[278]	stones, glass imitations of precious stones, shells,[279] precious stone beads (genuine and/or artificial),[280] metallic beads, plants
	Ú “plant”	plants, grasses, herbal remedies
	ŠIM “aromatic”	herbs, aromatics, resins and saps
	DINGIR “divine”	gods, celestial bodies, statues, rivers, metals, certain kings
	ÍD “river”	rivers, man-made canals
	MUŠEN “birds”	birds, flying things (including bats)
	GIŠ “wood”	trees, lumber, wooden items and furniture
	KU6 “fish”	fish, [281] aquatic mammals, crustaceans, turtles, lizards
	MUŠ "snakes"	snakes, lizards[282]

[278] The semantic scope of the determinative NA4 is fairly vast, and includes some perplexing instances, such as "alabaster", written ^{na4}GIŠ.NU11.GAL appears to double up on material categories, using NA4 “stone” and GIŠ “wood” in sequence; whether this orthographic relation reflects on the visual similarity between grain of wood and grain of stone is more conjectural than demonstrable.

[279] Quartz is often sourced on beaches in the vicinity of shell, so this particular association is not surprising; moreover, when glass is struck, it breaks like obsidian or flint, producing “conchoidal (shell-like) fractured facets”; shell, obsidian, and glass, therefore, *react* similarly. Henderson, *Ancient Glass: An Interdisciplinary Exploration*, 4.

[280] As argued in 1.1, real/artificial is a dichotomy that makes more sense to our modern frameworks than it did for cuneiform scholars. Scribes, especially during the late second millennium BCE, made clear distinctions between lapis lazuli “from the mountains” (i.e., the “real” thing), and lapis lazuli “from the kiln” (i.e., the “artificial” glass imitation). But there are two issues with this point. First, the distinction reflects a differences in text categories and research motives—epistolary and administrative (economic) sources discuss the material world in terms entirely distinct from scholarly texts. Second, the Neo-Assyrian glassmaking recipes never make an orthographic or scholarly distinction between real/artificial stones.

[281] An unprovenanced list of fish, see http://oracc.org/dcclt/P433618; Hh XVIII (MSL VIII/2) indicates some degree of collaboration between the editors of MSL and the Division of Fishes at the Chicago Field Museum, for which see Benno Landsberger, *The Fauna of Ancient Mesopotamia*, vol. VIII/2, Materialen Zum Sumerischen Lexicon (Roma: Pontificium Institutum Biblicum), 81.

[282] A Late Babylonian copy of Hg, BM 36177 (edition: http://oracc.org/dcclt/ X499118) provides evidence for the fact that turtles and lizards, *ṣurāru* (wr. eme-ŠID), appear in close proximity and are often difficult to distinguish.

	KUŠ "leather"	commodities made of hide, mineral-based tanning materials[283]

The table above, by no means exhaustive, serves to illustrate the semantic range covered by determinatives. Determinatives are unpronounced markers that, in the cuneiform writing system, precede and provide information regarding the semantic grouping of particular nouns, but they also provide clues regarding attitudes towards the material world and its properties. In more ways than one determinatives "determine" or constrain the functional and semantic possibilities of materials, as Rochberg has stated,

> Determinatives offer up a kind of nomenclature devised to indicate or "determine" the taxonomic category to which a written word, and the thing (or idea) it represents, belongs. As such, determinatives afford a look into some of the fundamental organizational categories of a conceptual world as it existed for the ancient scribes, as a well as the criteria they may have used to create such categories.[284]

If classificatory concepts are to be identified in cuneiform cultures, then determinatives mark the most obvious starting point. Evidence for the use of determinatives is found throughout the cuneiform intellectual tradition, in procedural texts, in literature, omens, in administrative records and astronomical texts. Future research will examine how determinatives functioned, why they changed, and what they can tell us about notions of classification.

For now, even a deceptively straightforward task like identifying ingredients in cuneiform recipes can carve out a path towards questions of scribal epistemology. Recall, for example, the term *quru* "kiln-wood," a hapax with no clear correspondence in nature that appears only in the introduction to the glassmaking recipes (1.2). By any empirical measure there is no reason to believe that such *quru* tree from which *quru* wood derived existed. Yet this imaginary ingredient is part of a complex network of scribal hermeneutics, of technical knowledge-making, that set epistemology (of writing) and the technical imagination on equal footing. As in lexical lists, truth value of claims made by the senses were, for cuneiform scribes, on equal footing with those derived by orthography and (often tacit) cultural associations. Granting epistemic privilege to "genuine" woods like cedar (Akk. *erēnu*), over "artificial," or imaginary woods like *quru*, betrays the fact that the glassmaking recipes were themselves, as we have seen, a scholarly exploration of these very ambiguities. Where we see margins, scribes saw possibilities for orthographic, semantic, and epistemological expansion. What might be deemed merely "scribal games," or "puns" are far closer, in the Wittgensteinian sense, to the concept of *meaning as use*.[285] What may seem a scribal obsession with lists of

[283] E.g., *dušû*-"quartz".
[284] Rochberg, *Before Nature: Cuneiform Knowledge and the History of Science*, 93.
[285] See 3.3 in Biletzki, Anat and Matar, Anat, "Ludwig Wittgenstein", *The Stanford Encyclopedia of Philosophy* (Fall 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/fall2016/entries/wittgenstein/>.

materials—to paraphrase Moorey[286]—provides, in fact, our clearest window into the relationship of cuneiform to material knowledge.

Technology, where and when it interacted with cuneiform scholarship, was, to put it simply: *nēmequ*, "knowledge." And *nēmequ*, in turn, represented an epistemic style, one that allowed for what may seem to us moderns, a purposeful interplay of theory and practice that can be found throughout the cuneiform scholarly output, from technical procedures providing physical instructions for mixing ingredients, to procedures that invoked the literary, the metaphorical, the metaphysical, the technological, and the cosmic—all of which can germinate from the seeds of a made up tree.

[286] See 2.0.

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APPENDIX I: DIGITAL EDITIONS

Accessing and Citing Digital Text Editions:

The table below lists the publication and museum numbers, as well as the genre, of the recipes that form the philological foundation of this work. Each edition has been reworked from the original publication, digitized, and lemmatized on ORACC (at http://oracc.org. The *Glass* project page, http://oracc.org/glass includes all of recipes tablets and fragments listed below. These digital text editions are searchable and contain period-specific glossaries which can be accessed at:
http://oracc.org/glass/hub.html
To reach an individual text, simply add the CDLI number (P######) to the project page web address; for an edition of perfume recipe KAR 220, for example, enter: http://oracc.org/glass/ P282617. Use this same address to cite the edition, being sure to provide an access date in your citation.

PUBLICATION & MUSEUM NUMBERS (*new fragment)	CDLI	GENRE	DATE
PKT pl. 5 (VAT 8711 = Assur 7111)	P282518	perfume	ca. 1239 BCE
KAR 220 (VAT 10165 + VAT 10445 + VAT12269 + frag.)	P282617		
KAR 222 (VAT 10178)	P282618		
KAR 140	P282611		
PKT pl. 6-8 (VAT 9659)	P282519		
PKT pl. 9,1 (VAT 9493)	P282520		
IM 56867 (ND 460)	P224557	perfume	ca. 9th century BCE
K.2520 + K.4290 + K.4731 + K.6246 + K.8157 + K.9477 + K.9492 + K.9800	P394484	glass	ca. 668–627 BCE
K.203 + K.3211 + K.4747 + K.5839 + K.5862 + K.6891 + K.9940 + K.10493 + K.13367 + *K.18490 + K.20141	P393786		
K.6964 + K.7619	P396928		
K.4266 + K.8976 + Sm 574	P395468		
K.6920 + K.8614 + K.13917	P396900		
K.4273	P395469		
K.3889	P395291		
K.7125	P397046		
K.9551	P398181		
K.10009	P398442		
K.13326	P400231		
K.6523	P396602		
K.11314	P399221		
K.7942 + K.8167	P397390	metalworking	ca. 668–627 BCE
BM 62788 + *BM 82978	X000001	wool dye	ca. 6th century BCE

APPENDIX II: SEMANTIC INGREDIENT NETWORKS

Semantic Ingredient Networks:

Rather than limit the present analysis of technical terms to dogmatic one-to-one correspondences or etymology, my analysis of technical ingredients aims to visualize what Wittgenstein described as the "complicated network of similarities overlapping and crisscrossing" that characterizes the contextualization of language. (*PI* 66) The semantic network approach has two benefits and at least one conspicuous drawback. First, the benefits: semantic networks map and measure the occurrence of unknown terms within a localized context (here, Assyrian technical recipes), rendering connecting rare terms to well-attested ones and (vice versa); second, semantic networks, when generated by means of close supervision, can reveal implicit connections otherwise unclear. These implicit connections between ingredients and processes, described further below, are represented in the visualizations by means of dotted lines (edges). Many of the entries will rely on modern archaeological and scientific analyses of materials for clarification. This method is aimed to find correspondences, where they can be found, but in highlighting as well the internal function of terms in context. The hope is that this approach will foster discussion and perhaps adoption for scholars working on historical recipes.

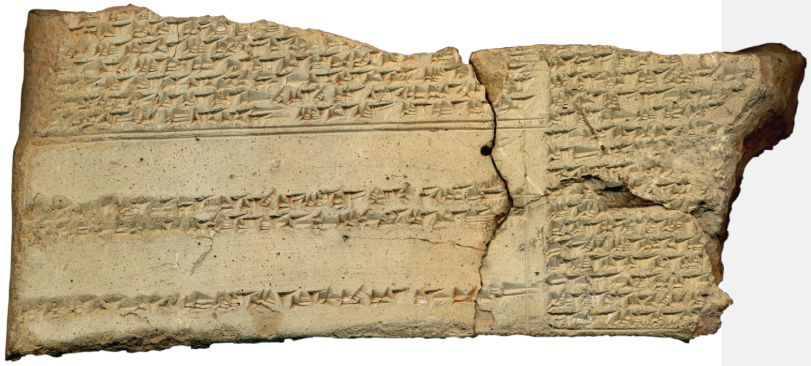
One drawback to such networks is that they are limited to semantic contextualization across an entire corpus and are not meant to represent temporal processes, i.e. one cannot use these two-dimensional semantic network visualizations to describe the order of step-by-step instructions, or which ingredient is employed first or second. Semantic networks are better understood as data-driven visual dictionaries, designed to demonstrate the semantic scope of important technical terms. Semantic networks take digital editions of cuneiform recipes from http://oracc.org/glass and reorganize the syntactic units (NPs, QPs, VPs) of those recipes into tabular data (node and edge tables). Visualizations are generated using Cytoscape, a tool designed for molecular biology, but easily adaptable to humanistic research. What follows is a brief introduction, a procedure of sorts, that will instruct the reader how to read semantic ingredient networks, and provide a glimpse at what lies ahead in the digital landscape of ancient recipes.

The work of creating a digital dictionary of Akkadian technical terms using network (and other forms) of visualization is an ongoing task, of which the following pages represent only a glimpse. In what follows, I outline how a cuneiform recipe (in this case, MA perfume recipe KAR 220) becomes a semantic network. Thereafter, I provide two sample semantic network entries: *murru* "myrrh" and *abāru* "lead", with the aim of showcasing how both well-connected ingredients like *murru*, and rarely attested terms like *abāru*, can benefit from such visualizations.



KAR 220: AN ASSYRIAN PERFUME-MAKING RECIPE

KAR 220 is an early perfume recipe from 13th century (ca. 1239 BCE, see Chapter 2) Assyria that describes the process of infusing oils with floral and herbal scents by maceration and both cold and heated infusion. Once the base oil was adequately infused with the desired aromatics, it was filtered through various containers or vessels, varying in shape and size (e.g., a *hirsu*-vat could carry +/- 40 litres). The following passage is preserved on the obverse of the tablet:



"If you want to process aromatic cane oil: (take) 2 seahs worth of cane, along with their *tubāqu*-roots (i.e., the whole cane). Once you have washed them, you set down a fire-resistant *diqāru*-vessel and heat *tābilu*-aromatics with fresh, high-quality water from a palace well of Aššur. You transfer (the mixture) into a *harû*-vessel. You (then) pour on top of this liquid mixture, within the *harû*-vessel: 1 liter of *hāmimu*- aromatic, 1 liter of *jaruttu*-aromatic, (and) 1 liter of myrtle, good-quality (and) sifted. These are your measurements, to be apportioned according to the amount of water taken. You perform (the steps prescribed) at sunset and nightfall. (The mixture) is to steep overnight. At dawn, when the sun rises, you filter the liquid and these aromatics through a *sūnu*-cloth into a *hirsu*-vat. You clarify the mixture (by filtering it) from this *hirsu*-vat into another *hirsu*-vat."

Remarkably, the text preserves a colophon asserting that the knowledge contained herein comes "from the mouth of *Tappūtī-belet-ekallim*, the female perfume-maker" (Akkadian *muraqqītu*), providing a rare glimpse into the role of women in the intellectual life of ancient Iraq.
A text edition of KAR 220 can be found at:
http://oracc.org/glass/ P282617

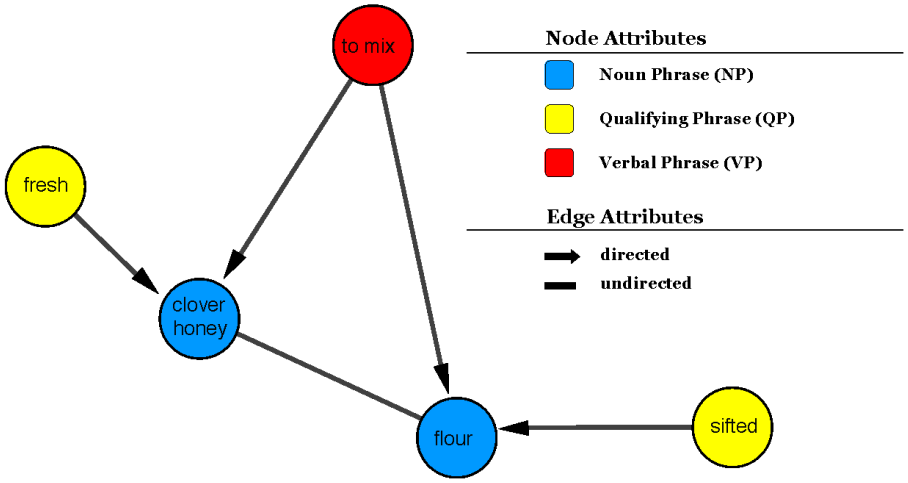
KAR 220 is one of six partially preserved perfume-making procedures from ancient Assyria. Although the corpus of perfume-making procedures is modest, the use of technical terms and instructions contained therein provide a rich and challenging dataset for the intellectual history of technology.

CUNEIFORM PROCEDURES AS SEMANTIC NETWORKS

Semantic networks analyze Akkadian procedural texts for semantic relationships between ingredient noun phrases (NP), and modifiers that are either verbal (VP) or qualifying phrases (QP). For example, in the simple instruction "**you mix fresh clover honey and sifted flour**," the following five semantic relationships may be identified:

Source	Target	Attribute
clover honey (NP)	flour (NP)	undirected
to mix (VP)	clover honey (NP)	directed
to mix (VP)	flour (NP)	directed
fresh (QP)	clover honey (NP)	directed
sifted (QP)	flour (NP)	directed

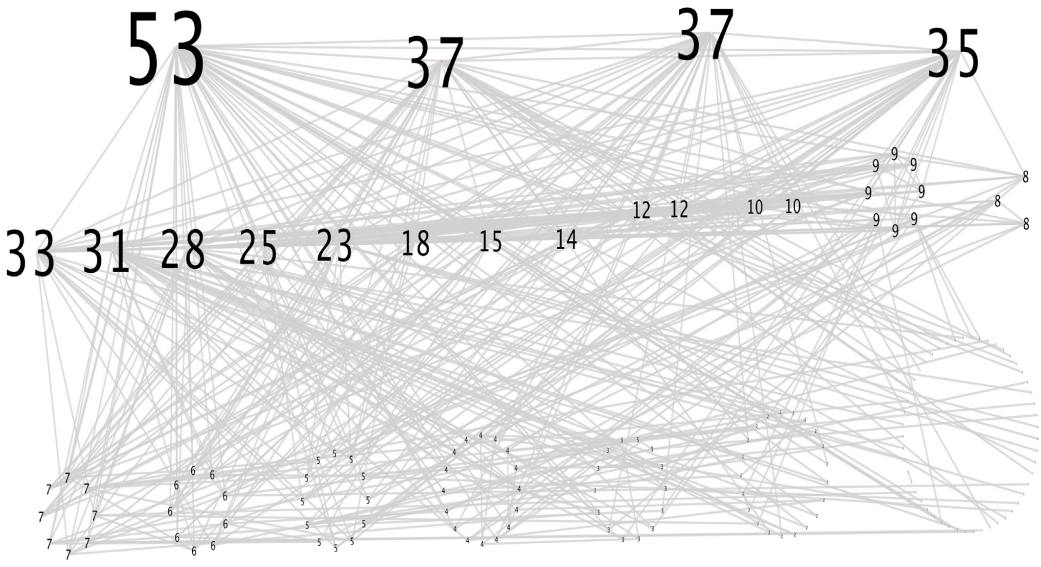
The table above, known as an "edge list" provides the basic framework for semantic analyses. The data generated from edge lists such as these can be used to produced data-driven visualizations using network analysis tools such as Cytoscape. For example, we can visualize the phrase "**you mix fresh clover honey and sifted flour**" as follows:



In the visualization above, each term in the network represents an actor or "node". The relationships between those nodes, called "edges," are defined as either "directed" or "undirected." Undirected relationships represent co-occurrences of ingredients in a recipe. Here, clover honey and flour co-occur. Directed relationships, in turn, are used to represent the ways in which these ingredients can be modified: here, clover honey and flour are mixed, clover honey can be described as "fresh," and flour is "sifted." Depending on the number of times these relationships are repeated throughout the procedures, the edge weight (thickness of the line) and node size will vary.

CONNECTING INGREDIENTS IN A NETWORK:
USING DEGREE METRICS TO DEFINE RESEARCH QUESTIONS

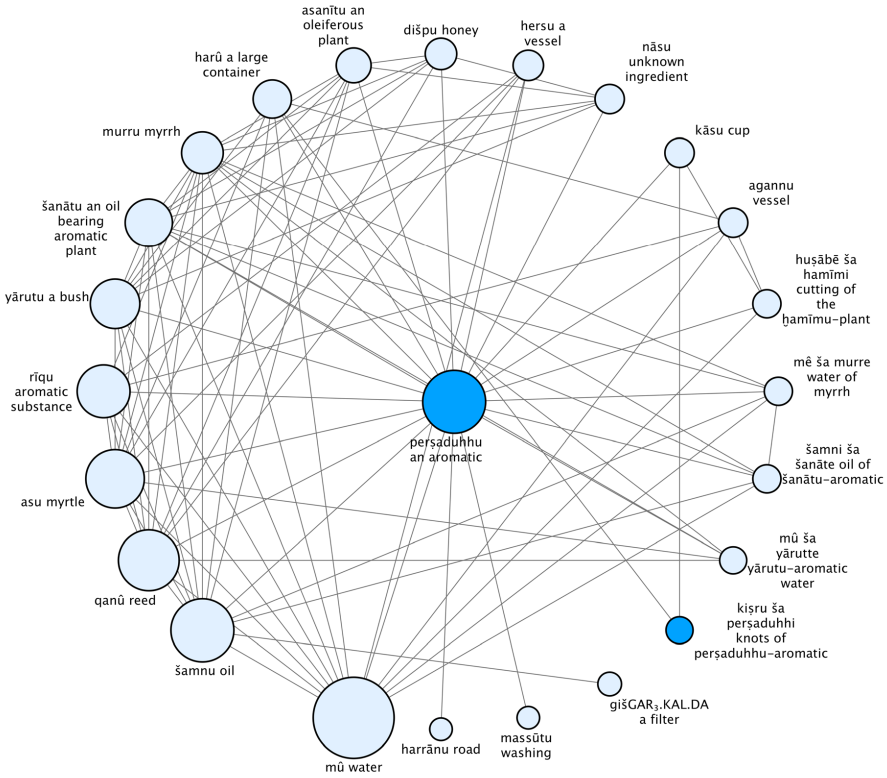
In this visualization, we have arranged ingredients (nodes) from a corpus of Assyrian perfume-making recipes according to their frequency of connections. In network analysis, **degree** metrics account for the number of connections a node has within any given network. Those ingredients that are the most popular within the network have the highest degree. The numerical data are based on careful semantic analyses of recipes, wherein the objects of verbs often remain implicit. For example, in the phrase: "you mix it", "it" might represent a list of implicit ingredients mentioned earlier in the text; as a result, *degree count may be higher than word count*. So which ingredients are the most popular?



ASSYRIAN PERFUME-MAKING: TOP FIVE INGREDIENTS

Degrees	**53**	**37**	**37**	**35**	**33**
Akkadian term	*mû*	*šamnu*	*perṣaduhhu*	*qanû*	*asu*
English trans	water or liquid mixture	oil or fat	unidentified aromatic	cane oil	myrtle

As one might expect, water and oil are among the most popular ingredients in perfume-making. In Assyria, perfumes also made frequent use of cane oil and myrtle. Notice, however, that among the top five ingredients is also an aromatic called ***perṣaduhhu*** with a degree count of 37. In order to analyze what this ingredient might be, we must take a closer look at its full semantic network.



CONTEXTUALIZING UNKNOWN INGREDIENTS:

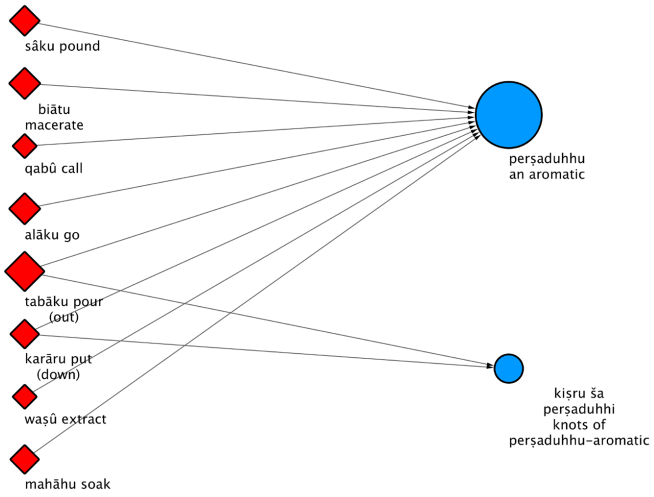
WHAT IS *PERṢADUḪḪU* ? (1/3)

Perṣaduḫḫu figures among the top five most important aromatic ingredients in the corpus of perfume recipes, yet it remains problematic within dictionaries of Akkadian. Semantic network analyses allow us to visualize ***perṣaduḫḫu*** and other unknown terms within their full linguistic context in a specific corpus; this project parses semantic networks into three types:

1. **Noun Phrase (NP) co-occurrence networks** map the relationships between co-occurring ingredients and vessels
2. **Verbal Phrase (VP) networks** show the range of verbs governing the ingredient in question
3. **Qualifying Phrase (QP) networks** show the ingredient in relation to its qualifiers

Let's analyze ***perṣaduḫḫu*** within these three semantic networks types. In the NP network above, we find ***perṣaduḫḫu*** plotted in relation to other ingredients in the perfume-making texts, including myrtle and myrrh. This is the basic NP network, where circular nodes represent ingredients arranged hierarchically according to degree count. (Note that the darker nodes represent the ingredient(s) in question.)

MODIFIER (VP & NP) NETWORKS:
WHAT IS *PERṢADUḪḪU* ? (2/3)

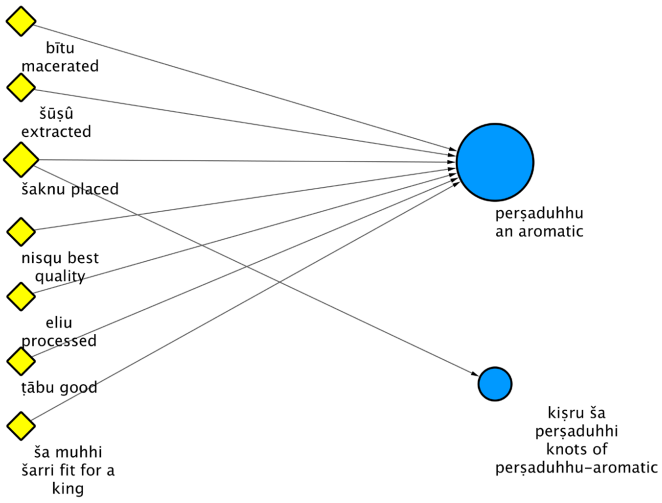


The first type of modifier network is the Verbal Phrase (VP) network. VP networks visualize the range of verbs that modify particular ingredients. Here, we find that ***perṣaduḫḫu*** can be modified by 8 distinct verbs. Note the size of the verbal nodes; the largest node reprsents the most commonly used verb, *tabāku*, "to pour." The ingredient can also be extracted and crushed, and soaked overnight in a large vessel called a *harû* (see previous NP network).

Below, we find the second type of modifier network, which maps qualifying phrases (QPs) alongside the ingredient in question. The QP network pictured below plots all known qualifiers used by scribes to describe our mystery ingredient ***perṣaduḫḫu***, which they characterized as "fine, macerated, extracted, and fit for a king!"

Having examined ***perṣaduḫḫu*** in its three semantic subnetworks, the following points may be highlighted:

- In the **NP network** it is described as taking the form of "knots"
- In the **VP network** it is processed by means of crushing and maceration with up to 14 additional ingredients;
- In the **QP network** it is one of the principal aromatic scents (or "head notes) that characterizes the Assyrian perfumed oil that is



THE ARGUMENT FOR SWEET MYRRH (OPPOPANAX):

WHAT IS *PERṢADUḪḪU* ? (3/3)

Historical records indicate the economic—and by extension, elite—value of the ingredient. For example, in a letter discovered at a Middle Assyrian outpost in the Khabur region of Syria known as Sabi Abiyad, we find the following warning: "I heard they are bringing ***perṣaduḫḫu*** , (if) any ***perṣaduhhu*** is missing, your life will be in danger!" [source: Wiggermann, *CAD* P, s.v. *pirṣaduhhu*]

The letter is contemporaneous to our perfume-making recipes, which, too, take great care not to be wasteful with the ingredient. Indeed, unlike other ingredients within the corpus of perfume-making procedures, which are measured in liters, ***perṣaduḫḫu*** is carefully measured in small cups (*kāsātu*). Moreover, the scribe describes explicitly that the scent is suitable for trade among royals:

> "These are the preparations for 10 silas of oil (appropriate) for the road, extracted from *perṣaduhhu*-aromatics. You clarify it through a wooden-GAR_3.KAL.DA. You then gather it in a *šappu*-vessel. You allow it to rest (lit: cool down) for a full month. After a full month you lift it out (the processed oil) and return it to a *diqāru*-vessel. After 40 "washings" (i.e., filterings) you will extract *perṣaduhhu* (oil), that is processed, (and) which they call "fit for a king" (ša UGU MAN)." (KAR 140, rii 4–8)



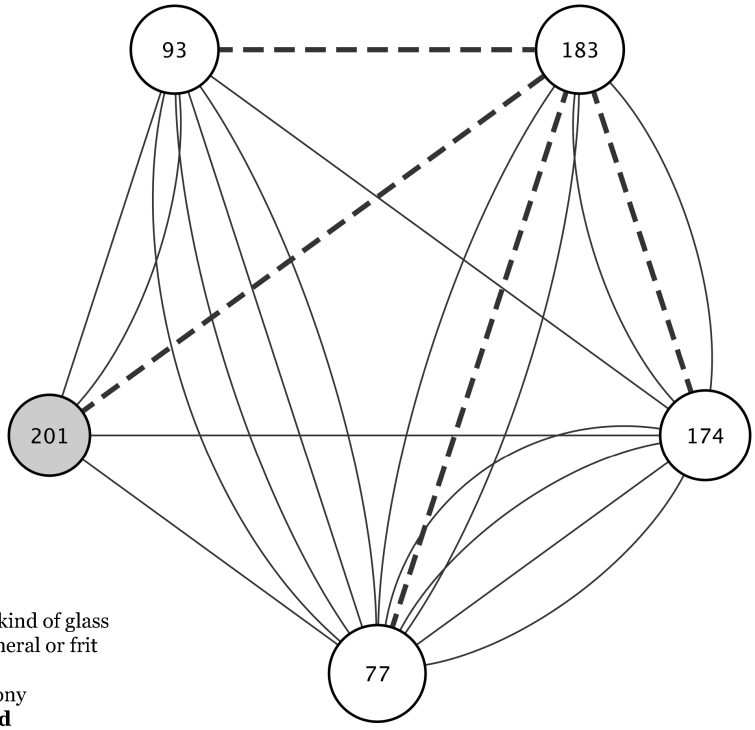
What then, might this ingredient be? Key to the semantic argument for this identification is presence of *perṣaduhhu*, "knots" where "knots" are understood to be a physical description of sap clumps, which can often have the look of wood knots. Moreover, there is a notable co-occurrence of ***perṣaduḫḫu*** with myrrh (murru) in the NP network, which suggests that the two scents, ***perṣaduḫḫu*** and myrrh, complement one another.

On the basis of semantic and historical analysis, we hypothesize that ***perṣaduḫḫu*** may be identified as "sweet myrrh," a gum resin called oppopanax, recognized as an essential scent ("head note") in both the ancient Middle East and the perfumery of today, which we can now recognize by its Akkadian name: ***perṣaduḫḫu***.

The three pages that follow briefly sample how semantic ingredient networks will look in practice, using the conventions introduced here.

Akkadian: ***abāru*** (*a-ba-ru*)
Translation: ***lead***
Node Id: **201**

Ingredient Co-Occurrence (NP Network)



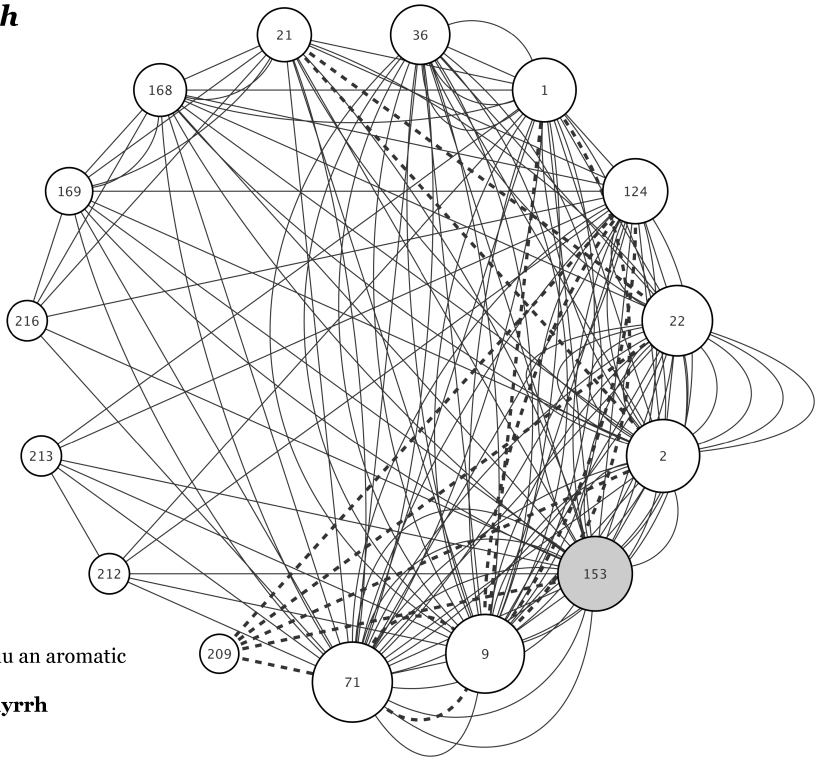
Id	Degree	Label
77	12	anzahhu a kind of glass
174	9	tuskû a mineral or frit
93	8	zukû a frit
183	8	lulû antimony
201	**5**	**abāru lead**

The term ***abāru***, "lead," occurs only twice in the glassmaking recipes (in text K.4266+) and only once is it completely preserved (written *a-ba-ru*) in the context of Elamite glassmaking recipes. The better preserved passage (K.4266+ rev. i 15'–17') provides three lines of text that instruct one on how to make "Elamite Carnelian" (*sāmtu elammēti*). There is good reason to believe that Elamite glass was opaque, based on the use of antimony (*lulû*). Antimony mines are located in what is now Iran (Moorey 1994: 241; Henderson 2013: 147), near Anarak and Birjand, suggesting a close connection between the lead, antimony, and the production of Elamite carnelian.

Abāru is most connected to *anzahhu* and *tuskû*. What is conspicuosly missing here is the inclusion of a plant ash flux, that is likely because "Elamite carnelian" is a secondary glass. Note as well that lead oxide-silica glass is not employed as a technology until the Islamic Middle Ages (Henderson 2013: 108ff)

Akkadian: ***murru*** (*mur-ra*)
Translation: ***myrrh***
Node Id: **153**

Ingredient Co-Occurrences (NP Network)

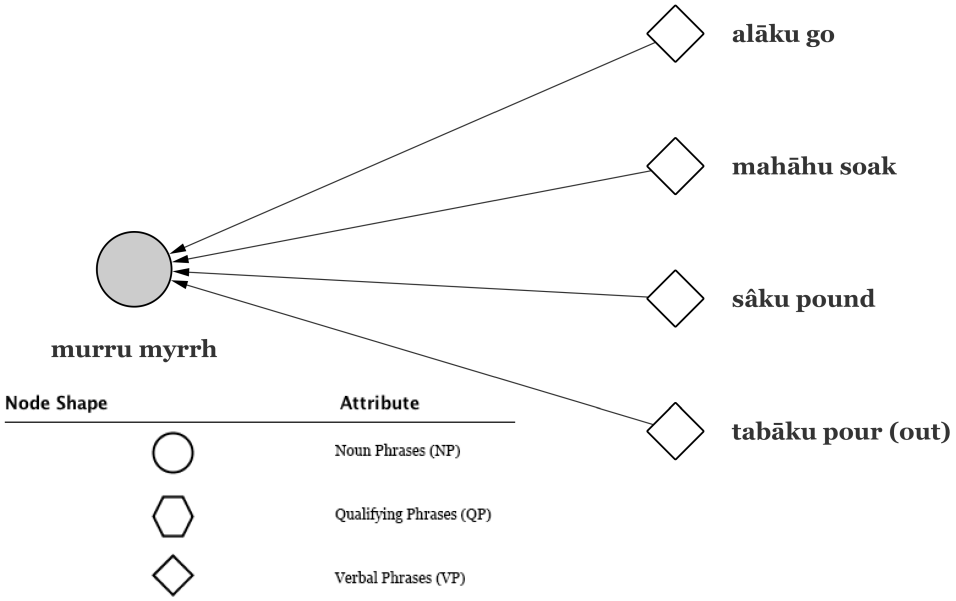


Id	Degree	Label
71	35	perṣaduhhu an aromatic
9	34	mû water
153	**31**	**murru myrrh**
2	30	qanû reed
22	28	asu myrtle
124	24	šanātu an oil bearing aromatic plant
1	23	šamnu oil
36	20	rīqu aromatic substance
21	16	yārutu a bush
168	15	asanītu an oleiferous plant
169	11	dišpu honey
212	6	šamni ša šanāte oil of šanātu-aromatic
213	6	mê ša murre water of myrrh
216	6	nāsu unknown ingredient
209	5	mû ša yārutte yārutu-aromatic water

An entire dissertation could be written on the uses of myrrh in the ancient Middle East. The term ***murru***, is one of the rare terms that has remained almost unchanged since it entered the Akkadian lexicon, and can be counted as one of the rare Akkadian calques that we still employ in the English language.
The *OED* lists "myrrh" as originating in the Latin murra via "Ancient Greek μύρρα is probably of Semitic origin, perhaps < Akkadian *murru* an aromatic used in medicine, ritual, perfumery, and tanning" (See *OED*, s.v., "myrrh, n.1"). In Western cultures myrrh is best known from the New Testament, where the ingredient appears, paired with frankincense, as one of the gifts brought by three Wise Men from the east. The cultural associations with myrrh and ritual are attested in cuneiform ritual and medical contexts.

Akkadian: ***murru*** (*mur-ra*)
Translation: ***myrrh***
Node Id: **153**

Ingredient Modifiers (QP & VP Network)



The ***murru*** NP network is filled with aromatics and infused oils, chief among them "sweet myrrh," "reed (cane)," (***perṣaduhhu, qanû, asu***, and ***šanātu***). The "water of myrrh" (*mû ša murre*) is curious. Myrrh does not dissolve naturally in oil, thus it is likely that "water of myrrh" refers to liquid infused with powdered myrrh. The term "water" is used with some flexibility in the perfume recipes and refers more generally to any "liquid mixture." By contrast, the QP and VP network shows its use in maceration--note the ingredient, which takes the form of a hard resin, needed to be crushed down (pounded) in order to be mixed into the perfume mixtures.