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Investigating Provenance and Authenticity Using ICP-MS in the University of Wisconsin-milwaukee Art Collection: a Case Study of Luristan Bronzes

Hannah Rillie
University of Wisconsin-Milwaukee

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by

Hannah Rillie

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ABSTRACT

INVESTIGATING PROVENANCE AND AUTHENTICITY USING ICP-MS IN THE UNIVERSITY OF WISCONSIN-MILWAUKEE ART COLLECTION: A CASE STUDY OF LURISTAN BRONZES

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The University of Wisconsin-Milwaukee Art Collection (UWMAC) holds a group of supposed Luristan bronzes with limited provenances. The lack of provenance, archaeological or otherwise, coupled with the prevalence of forged Luristan bronzes across private and public collections introduced questions of authenticity regarding the UWMAC's collection of bronzes. To address these questions, the typical art historical and visual analyses were conducted to supplement the chemical compositional analysis done using inductively-coupled plasma mass spectrometry. Of the three artifacts successfully sampled and tested, *the Ibex Whetstone Handle* (1985.002.38) was determined to be iron while the *Master of Animals Finial for Standard* (1985.002.48) and *Hair Ornament* (1985.002.45) were bronze. The *Master of Animals Finial* conformed closely to the canon of Luristan bronzes while the *Hair Ornament* had few comparanda from either excavated artifacts or those found via art markets. Most likely, the UWMAC "Luristan bronzes" have a mix of authenticities.

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BAMI – Belgian Archaeological Mission in Iran

ICP-MS – Inductively-coupled plasma mass spectrometry

IWH – Ibex Whetstone Handle

MAF – Master of Animals Finial

SHP – Spiral Headed Pins

Introduction

Bordering Iraq in the western region of Iran lies Luristan, where the Zagros Mountain range divides the province longitudinally into the Pusht-i Kuh and Pisht-i Kuh regions (Fig. 1).[1] The plains and valleys of the mountain range are dotted with stone lined graves, remnants of an ancient culture that flourished in the first half of the first millennium BCE. A series of ancient bronze objects, called "Luristan bronzes" after the province, have supposedly been discovered in these graves and subsequently circulated throughout the global art market, finding their way into museums and private collections. The bronzes exhibit many stylistic qualities of ancient Near Eastern art, but answers to the question of who produced them remain incomplete and speculative. Indeed, the modern term "Luristan bronze" used to describe them is a function of modern scholarship and the many unknowns surrounding their production, date, and use persist to the point that their absence from survey art history textbooks is understandable. Very little provenance information can be reliably confirmed because the earliest examples that appeared in collections were brought to light as a result of looting. Likewise, because of the limited number of controlled excavations, only a small number of bronzes have been archaeologically confirmed to be from Luristan; the vast majority have appeared on the art market where they lack secure provenance and documentation rarely extends beyond the dealer. This sets the stage for collections around the world likely accessioning authentic objects and forgeries in equal measure.

The University of Wisconsin-Milwaukee Art Collection (UWMAC) includes seventeen objects that have been accessioned as Luristan bronzes, although there is little documentation to corroborate their authenticity, much less their archaeological provenance. The provenance history for UWM's bronzes is problematic: they came into the collection through two donations in 1985 and 1991 where the documentation reaches only as far back as the donor or the Chicago-

[1] Luristan has also been spelled Lorestan.

based department store Marshall Field's, respectively. An appraisal was taken of the 1985 donation in 1992 where "provenance" was notably left blank. The appraisal did provide references to catalogs and museums where similar items could be found.[2] That is where the collection information on these particular objects stops; as a result, modifiers like "supposed" or "said to be from" are used because there is little confidence in their authenticity. UWM's Luristan bronzes very well could be authentic, but there is little evidence to corroborate the claim. Determining their origins would allow staff to make informed decisions on how they use the bronzes for the purposes of the UWMAC's mission.

The UWMAC bronzes remain unpublished with little written about them beyond a white paper written by UWM Professor Emerita J. Waldbaum, who was of the opinion that they held no archaeological value because of their unknown provenance history and the fact that many were likely forgeries or pastiches. To define the terms forgery and pastiche, a forgery is an object manufactured in the modern period meant to be sold as an antique while a pastiche is an object that imitates another object or style. This thesis explores the authenticity of the UWM Luristan bronzes through art historical methods in formal and visual analysis coupled with scientific analyses using inductively coupled plasma mass spectrometry (ICP-MS). The objective behind conducting chemical analyses is to gather as much information as possible about the artifacts and provide crucial data for comparative studies that will enhance their pedagogical use for the UWMAC. Since their initial arrival, questions of authenticity and value have persisted; thus, this thesis aims to shed light on the bronzes' enigmatic origins and by doing so increase their utility as teaching objects in the collection.

[2] Eisenberg, Jerome M. 1960. *A Catalog of Luristan Bronze and Early Islamic Art.* New York: Royal Athena Gallery. Two appraisals were completed by two different appraisers, one for the 1985 Moebius donation and one for the 1991 Woodmansee donation. One commonality between the two appraisals was the citation of Jerome M. Eisenberg catalogs from 1960 and 1963. It was stated that similar objects could be found in these catalogues with some objects given specific catalog numbers to reference discrete objects. Interestingly, only one object in the entire collection of Luristan bronzes was noted to have its authenticity in question – the spouted vessel (1985.002.39).

UWMAC's bronzes will also be considered in a broader context of university art collections and issues surrounding collection practices and the challenges of unprovenanced objects. University collections are often donor-based and thus curators must rely upon the information provided by the previous owners. The quality and quantity of this information varies widely from donation to donation. More recently, strict museum acquisition practices and policies guide curators and directors as they navigate donations; however, such policies were less common when such collections were being formed resulting in a slew of suspicious, unprovenanced, and even fake objects making their way into collections. This thesis will introduce the UWM bronzes into this conversation and assess their value not only to the collection and the university, but also to the larger portfolio of Luristan bronzes populating museums and collections.

Chapter One will provide a historiography and art historical analysis of Luristan bronzes to help contextualize the UWM bronzes within this larger corpus. Chapter Two addresses questions of authenticity through the application of analytical chemistry. Using inductively coupled plasma mass spectrometry (ICP-MS), constituent material components of an object (e.g., alloying metals) will be identified and compared to studies of other similar objects that have undergone similar analyses and come from secure archaeological contexts. The final chapter of my thesis will synthesize the formal, art historical analysis provided in Chapter One with the chemical analyses documented in Chapter Two. These analyses will be used as the basis for a discussion on the authenticity of the objects and, furthermore, to produce actionable information and suggestions for the UWMAC and its future handling of the bronzes. These suggestions put forth here will consider the UMAC's status as a university art collection and the unique opportunities and challenges that can arise therein.

Chapter 1: Historiography and Visual Analysis

Introducing the Question of Authenticity

Luristan bronzes have intrigued scholars from their first appearance in western museums and have provided enough fodder for generations of scholars to consider their origins and implications. The continued debates concerning their origins have produced a controversial history that is often hard to divorce from an object once one is aware of it. It can cast a shadow over an object that does not have a verified findspot or secure archaeological provenance. Some can only be traced to previous owners; in the case of some of the UWM bronzes, they were purchased and sold by department stores. As noted, very few Luristan bronzes can be traced back to a specific archaeological excavation. The bronzes' appearance in western museums predates their discovery through scientific excavations; in fact, their presence in museums spurred archaeological efforts to discover them *in situ* and mediate the debates surrounding their origins.

What makes the discourse surrounding the bronzes difficult is the fact that the people and culture of ancient Luristan remain elusive. Ethnological inquiries into ancient Lurs are ill-fated quests because of the paucity of textual or archaeological evidence. Despite this dearth of evidence, scholars formed a general consensus in the 1970s about who produced the bronzes, and this remains the state of scholarship to date. One of the most recent publications interpreting the finds from the Belgian Archaeological Mission in Iran (BAMI) excavations in the Pusht-i Kuh concluded that the ancient Lurs were nomadic due in large part to no observed settlements and the fact that tombs were discovered at random.[3] P. Ackerman made an astute observation when she said that Luristan bronzes gave scholars a better idea of the metalsmith

[3] Haerinck, E. and Overlaet, B. 2010. "Early Bronze Age Graveyards to the West of the Kabir Kuh (Pusht-i Kuh, Luristan)" *Luristan Excavation Documents*. vol. VIII. Acta Iranica.

rather than the ancient Lur or their religion.[4] A breadth of influences and cultural indicators have been attributed to an understanding of the material culture that emerged from the study of objects from excavations and in museums, yet a definitive association to a specific cultural group in the region remains out of reach.

What further exacerbates the question of origins for Luristan bronzes is the prevalence of forgeries and pastiches in museums and galleries. A frequent voice on the matter of forgeries is O. W. Muscarella whose book, *The Lie Became Great: The Forgery of Ancient Near Eastern Cultures,* opines on the authenticity of a number of specific object groups. One section is dedicated to Luristan where Muscarella laments the failure of scholars to complete their due diligence when accepting provenance claims by both dealers and other scholars to be true.[5] Muscarella rightfully separates the objects that were properly excavated from what Muscarella calls "bazaar archaeology."[6] Bazaar archaeology describes the phenomenon of discovering objects of historical and archaeological value in bazaars or the marketplace rather than in controlled excavations, rendering their provenance at the mercy of the rhetoric of merchants and their tales of discovery. To a gullible buyer, the rhetorical assertions of the dealer become fact despite the lack of supporting excavated evidence.

Bazaar archaeology has provided an alternative art history for Luristan and the Ancient Near East that can be difficult to wade through. The material culture of Luristan happens to have fallen deep into that particular quagmire. The number of forgeries and pastiches is unknown, and scholars have made varying claims that tend to contradict each other. For example, Calmeyer claimed pastiches outnumbered forgeries while Muscarella claims the opposite.[7] Regardless, the fact that scholars argue over pastiches versus forgeries and their respective

[4] Ackerman, P. 1940. *The Luristan Bronzes*, edited by Barbara M. Kaerwer, Iranian Institute of America. First edition. ed. New York: New York : Iranian Institute, 12.
[5] Muscarella, O.W. 2000. *The Lie Become Great: The Forgery of Ancient Near Eastern Cultures*, 81.
[6] Muscarella, 2000, 83.
[7] Muscarella, 2000, 82.

frequency is enough to cast at least a shadow of a doubt on objects said to come from Luristan without an archaeological provenance.

Early Scholarship

The history of scholarship concerning Luristan bronzes is emblematic of the myriad problems that arise when trying to ascertain the authenticity of a supposed Luristan bronze. The aggressive guesswork at the start of the 20th century underwent a course correction in methodology in the 1970s and 1980s when a canon was established from the artifacts excavated in Luristan. These finds shed light on the corpus of bronzes that populated collections and suggested that not all that glitters is gold. Scholars were having to contend with the unreliability of their material evidence. Thus, later scholarship exhibits more caution than its earlier predecessors and it is still grappling with the ramifications of integrating the archaeological finds with bronzes circulated by the market.

Research was first published at the beginning of the 20th century starting in museum settings and then eventually in archaeologically focused contexts. Many of the early secondary sources regarding Luristan bronzes are catalogue reviews or remarks on collections containing some bronzes. They discuss discrete examples but often preface their remarks with the state of scholarship and prevailing theories surrounding the bronzes. In other words, they set out to lay bare all of the caveats one needs before turning to the bronzes at length to inform the reader of the very precarious position that Luristan bronzes sit within Near Eastern art. Luristan rarely makes it into broader discussions of the ancient Near East unless they are written by a scholar that had explored the bronzes before. However, Luristan bronzes have intrigued scholars from their first appearance in European and North American museums.

In the mid to late 1800s, the bronzes started to show up in western European museums, such as the British Museum and the Louvre, where reports were written regarding the

museum's new acquisition. At this time, the bronzes were given attributions outside of Luristan. By 1918, the first publication of a Luristan bronze was written by C.H. Read, a British archaeologist and curator, who discussed two horse cheekpieces in the British Museum.[8] Read theorized that the pieces came from Armenia, which conflicts with the story given by the original owners who had sold the pieces to the British Museum donor. The original owners were Parsee[9] and claimed that the cheekpieces had been in their family's possession since before they left Iran and immigrated to Bombay. Read, however, doubted their function, origin, and date thus cited W. Budge, a British Museum curator, as an authority to support his Armenian attribution. Budge's support was not enough for the museum to officially situate the bronzes in Armenia because, after Read's report, the bronzes in the British Museum and others in the Louvre were labelled as having been found in Cappadocia, an area in central Turkey.

The next major scholar to mention the Luristan bronzes was M. Rostovtzeff, a Russian historian, whose scholarship is usually met with some incredulity by later scholars looking back on the historiography of Luristan bronzes. In his 1922 article "Some Remarks on the Luristan Bronzes*,"* Rostovtzeff accepted the earlier attributions made to Cappadocia but insisted on a connection to Scythian bronzes and "ascribed them tentatively to the Thraco-Iranian population of Cappadocia and Armenia."[10] Both, Muscarella and P. R. S. Moorey express their confusion regarding the basis of Rostovtzeff's Scythian claims. Moorey speculated that the publication *Mission en Cappadoce* by E. Chantre in 1898, which showed a wide variety of zoomorphic bronzes, influenced Rostovtzeff, but I posit that Rostovtzeff's own background in Scythian metalworks provided the basis for his claims.[11] In his book *Iranians and Greeks in South Russia,* Rostovtzeff explores the diffusion and evolution of the Animal style, which is very much present

[8] Read, C.H. 1918. "Two Bronzes of Assyrian Type." *Man* 18: 1-3.
[9] Parsees are a sect of the Zoroastrian community who fled to the Indian subcontinent from Persia in the 7th century to avoid persecutions by Muslims. Bombay has a particularly high population of Parsees.
[10] Rostovtzeff,M. 1931. "Some Remarks on the Luristan Bronzes." *IPEK*: 46.
[11] Chantre, E. 1898. *Mission en Cappadoce, 1893-1894: Recherches archéologiques dans l'Asie occidentale.* Paris: E. Leroux.

in Luristan bronzes. He traces the style from the Sumerians to South Russia where he says it arrived by three different currents: Assyro-Perisan, Ionian, and Scythian.[12] Luristan is situated geographically central to the Scythian and Assyro-Perisan currents so it is logical to consider the influence Scythians had on Luristan. In fact, the dismissal of Rostovtzeff has limited the scope of later publications on the Luristan bronzes, especially in light of how little is known about the people and culture of the region that produced these metalworks.

Read and Rostovtzeff set the stage for the 1930s when an uptick in publications regarding Luristan coincided with controlled excavations being initiated in the region. It was generally recognized that the provenance records for the bronzes in the museums and collections were not sufficient enough for scholars, so efforts were made to corroborate the existing evidence. Two competing campaigns were launched in the early 1930s by A. Goddard, a French archaeologist, and A. U. Pope, an American archaeologist. At the same time, F. Stark, an Anglo-Italian explorer and travel writer, embarked on travels through the region of Luristan guided by locals. While not an archaeologist, her accounts described the modern Lurs' method of finding graves as "thoroughly elaborated and has evidently come from much practice."[13] They would skewer the ground with poles to try and find the stone lined graves that would have held caches of goods.

In a critique of Goddard and Pope, Rostovtzeff rightly questioned Pope's reliance on dealers' notoriously untrustworthy information.[14] Because Goddard avoided these pitfalls, Rostovtzeff found him more credible. Goddard travelled to Luristan and compiled his findings into his 1931 *Les bronzes du Lūristān*. Moorey cites this as a fundamental text in the 1970s though Muscarella only gives it a passing mention in the 1980s.[15] Significantly, Goddard and

[12] Rostovtzeff,M. 1922. *Iranians & Greeks in South Russia.* Oxford: Clarendon Press. 193.
[13] Stark, F. 1932. "The Bronzes of Luristan; the Bronzes of Luristan." *The Geographical Journal* 80 (6) 500.
[14] Rostovtzeff, 1931, 45.
[15] Moorey, P.R.S. 1971.*Catalogue of the Ancient Persian Bronzes in the Ashmolean Museum*. Oxford: Clarendon Press. 5. Muscarella, 1988, 113.

Pope are the first authors to assign the bronzes to Luristan. E. Herzfeld, a German archaeologist, had gotten close to an Iranian attribution in 1929, but he ascribed the bronzes to the Nihavand area to the northeast of Luristan instead.[16]

Goddard put forth his theory that the bronzes were products of Kassites who had left Babylonia and migrated to the Zagros mountains at the end of the second millennium BCE and whose style merged with the Achaemenids five to six centuries later and then disappeared.[17] Stark described Goddard's theory as "authoritative," but it also sparked future scholars to argue against the Kassite attribution.[18] Moorey cautioned that it should not be assumed that the Kassites who had been usurped in Babylonia had a direct connection with those that *may* have been in Luristan. Indeed, there is little in common between the material culture of the Kassite period in Mesopotamia and Luristan from ca. 1200 to 900 BCE. Furthermore, Moorey noted that the Kassites did not, in fact, leave Babylonia; rather, they likely integrated into the existing population since there is no evidence that the succeeding rulers persecuted or expelled the Kassites.[19]

Moorey is not the only scholar to push back against Goddard's theory. R. Ghrishman, a French archaeologist and contemporary of Goddard, put forth a competing theory predicated on a very particular set of circumstances. He posited that Cimmerians were the actual craftsmen behind the bronzes by arguing that a specific set of bronzes had originally been looted from temples across Babylonia and Elam where they had been placed as votives by Cimmerian mercenaries employed by the Neo-Assyrian king Sennacherib during campaigns in 689 BCE. Not many scholars accepted Ghrishman's theory. Moorey called it "difficult to sustain" and preceded to give a detailed account of Cimmerian occupation in western Asia to contest

[16] Muscarella, 1988, 113.
[17] Godard, A. 1931. *Les Bronzes du Luristan.* Paris.
[18] Stark, 1932, 504.
[19] Moorey, 1971, 10.

Ghrishman.[20] Morrey concluded that the Cimmerian presence was limited to the late history of Luristan bronzes, which discredits them as the initial craftsmen. Moorey went even further to say there is “no reason to suppose that the Cimmeri ever penetrated into Luristan as a recognizable group.”[21]

Early scholarship concerning the Luristan bronzes is an example of how convoluted the discourse can become when one cannot rely on trusted provenance records for the origin of objects removed from their original context. Read completely dismissed the word of the original owners of the cheekpieces and steered the discussion away from Iran to Armenia. Scholars later course corrected back to Luristan, but it took the efforts of multiple people over many years to come to a scholarly consensus concerning where the bronzes originated.

Archaeological Excavations

Early scholarship concerning Luristan bronzes (e.g., Read, Rostovtzeff, Goddard, Ghrishman, Pope, and Stark) dealt with objects that had come into European museums through various art markets rather than controlled archaeological excavations. When referring to controlled versus uncontrolled excavations, I mean to differentiate between the looting of graves by unnamed individuals (uncontrolled) versus the sponsored archaeological digs led by trained archaeologists (controlled). The Luristan bronzes that initially flooded the market and ended up in museums and private collections were products of uncontrolled excavations. After the few examples were highlighted and written about by the scholars previously mentioned, a period of mass plundering commenced. Although its start date is debated among scholars, they all generally assign the moment between the late 1920s to early 1930s after which the collecting of these bronzes became popular.

[20] Moorey, 1971, 10.
[21] Moorey, 1971, 10.

The acknowledgement of questionable provenances proliferates the scholarship concerning Luristan bronzes. Scholars bookend their theories and chronologies with the disclaimer that the bronzes they are analyzing do not have findspot records. And even when they do, they are usually based on the word of dealers who are notorious for attributing objects to areas that are relevant to the current collection trends rather than their true findspots. Moorey advocated for "excessive skepticism rather than liberal acceptance."[22] This uncertainty has become one of the lasting characteristics of Luristan bronzes and has spawned multiple excavations to be conducted in Luristan.

After it was clear that the material that was being looted from tombs in the area was abundant, the Iranian government tried to stop those efforts, but they did not hold much authority over the active tribal leaders of the Lurs.[23] Attempts were made by the Iranian Archaeological Service, of which Goddard was the director, to control illegal excavations by granting commercial excavation permits. The first serious attempt to excavate and survey was made by the British archaeologist A. Stein in 1936 in the eastern part of Luristan known as Pisht-i Kuh.[24] While he did not find any bronzes (apparently due to some false counsel given by the grandson of one of the tribal leaders who controlled the illicit trade of bronzes), he was able to locate various cemeteries.[25]

Soon after Stein, E. Schmidt, a German-American archaeologist, directed two expeditions in eastern Luristan organized by the American Institute for Persian Art and Archaeology in New York, of which Pope was the director, during the 1930s. But Schimdt's findings were barely known until 1989 when the University of Chicago published an extensive

[22] Moorey, 1971, 3.
[23] Overlaet, B. 2016. "Luristan Bronzes i. The Field Research," *Encyclopædia Iranica.*
[24] Stein, A. 1940. *Old routes of Western Iran, narrative of an archaeological journey carried out and recorded by Sir Aurel Stein*, London.
[25] Overleat, 2016.

report of his findings.[26] The most significant site excavated by Schimdt was Surkh Dum, where sanctuary architecture was discovered and the number of bronzes uncovered was apparently in the hundreds; still, only twenty-five had been published as of 1988.[27] Initially, Schmidt had only published summaries of his findings and preliminary reports. He detailed the diplomatic and administrative preparations that needed to be made to break ground and mentioned the general success of the excavations. In advance of setting out into the unexplored valleys and plains of the Zagros Mountains, Schmidt (along with a sizable crew) conducted an aerial survey of Luristan to locate hot zones of potential archaeological activity.

This exploratory aerial survey was repeated for the second excavation and hundreds of sites were plotted. The situation turned dower as the team hit the ground to find these sites, as Schmidt puts it, were "thoroughly plundered […]. Almost every spot in Luristan that showed any surface indications of burials had been dug."[28] Despite this, Schmidt was able to uncover human remains and pottery sherds. The highlight of this second excavation season, however, was the site of Surkh Dum.

A month prior to Schmidt's arrival, some rains had come to the region, exposing objects that commercial diggers were keen to obtain as well as search the area for more. The government effectively prevented such uncontrolled excavations and guided Schmidt to explore that area. What Schmidt found was a jackpot. He concluded that "the plan of the building uncovered at this spot and the fine condition and type of the objects found here indicate that the Surkh Dum ruin was a sanctuary, a temple of the first half of the first millennium BC, hence contemporary with the Assyrian Empire."[29] Here is where the bulk of the material was found. Objects proliferated the rooms, and some were even found in the walls of the structure itself.[30]

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[26] Schmidt, E. et al. 1989. *The Holmes Expeditions to Luristan.* Chicago: Oriental Institute of the University of Chicago.
[27] Muscarella, 1988, 114.
[28] Schmidt et al., 1989, 33.
[29] Schmidt et al., 1989, 34.
[30] Schmidt et al., 1989, 34.

However substantial Schmidt's findings were, they do not contribute much by way of the equestrian culture that has so come to typify ancient Luristan. Schmidt found no objects representing horses nor any equipment associated with their handling. Schmidt attributed the Surkh Dum sanctuary site to sedentary people with fields lying below in the plains and a trading partnership with distant Assur in Iraq.[31] Further analysis of the excavated material by M. N. van Loon and H. H. Curvers led to an interpretation of Surkh Dum as a sanctuary of a "mistress of the mountain" or mistress of nature due to the low quantities of weapons and high quantities of zoomorphic pins or ornaments, which suggests a female deity.[32] Schmidt's emphasis on a sedentary culture was minimized by van Loon and Curvers to accommodate for a more nuanced population. They suggest that Surkh Dum may have been one of the very few or even only administrative centers in Iron Age Luristan due to architectural remains adjacent to the sanctuary, an abundance of jars and pins that may have been evidence of economic and administrative functions, as well as the site's location on a major migration route that would have been a biannual stopover spot between summer and winter pastures.[33] While Schmidt's discoveries are significant, they did not receive full consideration prior to the publication of the full report in 1989.

Few controlled excavations have been conducted since the 1960s due to the inaccessibility of the region. Iran presents topographical challenges due to its numerous uninhabitable regions like the salt desert in the east, so population centers are clustered in the mountains and foothills. Furthermore, Luristan lies in one of the most inaccessible parts of Iran with high mountain ranges and very few, if any, trails navigating the various tributaries and high plains. Beyond the difficult terrain is the political implications of western archaeological missions coming to Iran. Geopolitically, Iran experienced a revolution in 1979, which strained its

[31] Schmidt et al., 1989, 35.
[32] Schmidt et al, 1989 vol 108, 485.
[33] Schmidt et al, 1989 vol 108, 489. Van Loon and Curvers do note that these hypotheses are speculative.

relationship with the West where the majority of archaeologists studying Luristan bronzes have lived and worked. The ensuing political situation compromised the safety of archaeologists working in the Zagros Mountains and limited, even halted, archaeological activity for some time.[34]

As a result, the most active period for archaeology in the region was in the 1960s with the Danish mission led by J. Meldgaard and H. Thrane, the English expedition led by C.M. Goff in Baba Jan, and lastly the Belgian Archaeological Mission in Iran (BAMI), which conducted eight campaigns in conjunction with the Iranian Archaeological Service.[35] L. vanden Berghe, a Belgian archaeologist, directed the BAMI team in the Pusht-i Kuh, starting in 1965 with principal sites at Tattul Ban, Kallah Nissar, and Bard-i Bal just to name a few (Fig. 2) . Much like Schmidt, vanden Berghe's publications consisted of preliminary reports or brief overviews of his findings. The final excavation reports for the BAMI mission were not published until 2010, seventeen years after vanden Berghe's death.[36] However, his 1973 publication provides a comprehensive overview of his excavations, compiling some of his results and outlining his methodology for cataloging the types of bronzes that populated collections as well as those from his own excavations.[37]

Vanden Berghe's methodology evolved over the years working on the excavation. Vanden Berghe found that the label "Luristan bronze" was being used indiscriminately and erroneously. To bring some order to the corpus he established three, increasingly restrictive,

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[34] Political relations between Iran and the West are complicated and extend beyond the scope of this historiography. However, the geopolitical situation should be considered in how it affected the archaeological efforts and its detriment to the advancement of scholarship. It may be interesting to explore the Western view of Iran and how that shaped the early conversations around the bronzes especially considering some of the market cities where the bronzes were sold were in Iran and Westerners were having to rely upon the word of Iranian dealers.

[35] Belgian expedition: Thrane, H. 1970. "Tepe Guran and the Luristan Bronzes: Tepe Guran and the Luristan Bronzes." *Arcaheology* 23 (1): 35; English expedition: Goff, C.M. 1978. "Excavations at Baba Jan: The Pottery and Metal from Levels III and II." *Iran* 16: 29-65.

[36] Haerinck, E. and Overlaet, B. 2010. "Early Bronze Age Graveyards to the West of the Kabir Kuh (Pusht-i Kuh, Luristan)." *Luristan Excavation Documents*. vol. VIII. Acta Iranica.

[37] vanden Berghe, L., et al. 1973. "Bronzes from Luristan." *Bronzes: Iran-Luristan Caucasus.* Le Bronze Industriel et Jean Liénard.

categories. The first category designated bronzes *found* in Luristan. This first group can be thought of as a corpus of all the myriad forms and styles vanden Berghe excavated and those bronzes that are generally accepted to be from Luristan already in museums and collections with material dating from the third millennium to the first millennium BCE. Vanden Berghe also included objects of foreign provenance that had been deposited in Luristan. The next category is delineated as bronzes *made* in Luristan. This group is solely populated by excavated materials and seeks to filter out the objects of foreign provenance.

The third group includes bronzes deemed *typical* of Luristan. This applies to only the "most characteristic bronzes with no comparanda."[38] This final group exemplifies original forms and unique iconography that do not have obvious parallels in other cultures and civilizations, thus "[having] sets of attributes that are both characteristic and common [to Luristan]."[39] Typical Luristan bronzes make extensive use of the Animal style through their primary subject matter: horses, cattle, and birds of prey. Their stylization ranges from naturalistic to geometric. This stylization and subject matter prompted Rostovtzeff to suggest a Scythian connection to Luristan bronzes. However, Vanden Berghe does not follow Rostovtzeff's line of thinking and only mentions Scythians as part of his chronology of possible occupations in the Luristan region.

Vanden Berghe's three categories have formed the basis for further discussions concerning the characteristics of Luristan bronzes. Muscarella called for a refinement of these categories in 1988 when he found that some types listed in the *found* category should also be listed in the category that delineates bronzes *typical* of Luristan.[40] I find these categorizations to be fluid yet distinct. An object could occupy all three categories or only one. They merely provide a vernacular for scholars to use when speaking about the bronzes. Vanden Berghe presents these classifications as definitions rather than explicit categories; this was his effort to

[38] vanden Berghe, 1973, 73.
[39] Muscarella, 1988, 115.
[40] Musscarella, 1988, 114.

provide specific vocabulary for scholars to bring nuance and recognize the complexity of using the broad title of “Luristan Bronze.”

Vanden Berghe’s intentions were noble, but they created new questions and definitions that need clarification. The most problematic of his categories is the second: made in Luristan. Vanden Berghe designated the second category as “[applying] to those made in the region itself.”[41] A better delineation of the region would have proven helpful as it is unclear whether he is referring to excavation sites that specifically qualify as Luristan (e.g., Kallah Nisar or Bard-i Bal) or those in the greater, surrounding areas in Iran and Elam as well. Vanden Berghe gives a list of bronzes “reputed to be of Luristanian origin” which is quite extensive but also notes that there have been similar objects found in the surrounding areas of Mesopotamia, Elam, and Amlash.[42] But how vanden Berghe determined whether a bronze was actually produced in Luristan rather than in the surrounding regions, especially in light of the fact that no bronze metalworking center like a forge has been excavated, is unclear.[43] The only real evidence of bronze metalworking specific to Luristan are the bronze objects themselves. Trade routes can shed some light on the bronze industry in Luristan by comparing the metallurgical practices in cultures that had contacts with Luristan and the bronzes that survive today. If they had similar practices that should be reflected in the archaeological record. Scholars mostly focus on ancient trading patterns between Luristan and the west or Elam to the south and base their theories on looted materials. Moorey argued for the consideration of the mobility of objects in antiquity and

[41] vanden Berghe, 1973, 71.
[42] vanden Berghe, 1973, 71.
[43] Schmidt’s excavation in Kamtarlan I found a pavement of iron slag in plot M, which may be evidence of iron smelting. Stratigraphic evidence dates this pavement to 1000-700 BCE, which coincides with the later years of vanden Berghe’s timeline. It is clear that metalworking technologies were in use during this time but no specific bronze working artifacts have been found. Settlement architecture is often only mentioned in passing with the reference to Surkh Dum. This is primarily due graveyards and mounds being the primary find sites. However, if more is to be known about the ancient Lurs it would behoove scholars and archaeologists to focus efforts on the little settlement architecture that has been found. It is obvious that the dream for archaeologists focused on Luristan would be to find any type of settlement architecture. The most relevant for the study of Luristan bronzes would be those associated with metalworking. Holland, 1989, 17.

how that can affect the relationship between a findspot and attribution.[44] Several questions have been raised over the decades concerning the methodology used for studying, but also writing about the Luristan bronzes. Vanden Berghe acknowledges ancient trade routes in his first category but his method for determining what objects were made in Luristan is not explained in a satisfactory manner.

Muscarella's most interesting comment on vanden Berghe's categories considers what vanden Berghe did not: modern trade routes. Much confusion has stemmed from the omission of modern trade routes as stray bronzes of general Near Eastern types have been assumed to be derived from Luristan rather than consider the possibility that such bronzes had been brought to market cities after having been plundered in neighboring areas or elsewhere in Iran. Muscarella expresses his frustration with his colleagues who issue warnings against including such bronzes with no findspots in the Luristan corpus, but then go on to state that they are from Luristan anyway.[45] His concerns are valid as it makes it harder or even impossible to determine whether the Near Eastern types in fact derive from Luristan because the evidence does not exist outside of the marketplace.

Vanden Berghe's publications provide an excellent example of how controlled archaeological efforts can propel the scholarship surrounding Luristan bronzes forward and his research contributed significantly to the discussion around the chronology of Luristan bronzes. Particularly, archaeological data can provide insight into the chronology of objects based on their stratigraphic positions.

[44] Moorey, 1973, 3.
[45] Muscarella, 1988, 115. Muscarella served multiple roles in the Department of Ancient Near Eastern Art at the Metropolitan Museum of Art, including that of Associate Curator. In this role, he took special interest in the museum's and other curator's roles in acquisition policies in light of the UNESCO convention in 1970 that dealt with the illegal trade of antiquities. His subsequent work had a special focus on the presence of forgeries in museum collection and the responsibility museum professionals had for their acquisitions.

Chronology

Since the civilizations of the ancient Near East span such a long period of time with a revolving door of occupations, establishing a chronology gives scholars a much-needed framework for analyzing the Luristan bronzes. Many of the ancient Near Eastern kingdoms reigned over regions near and around Luristan rather than explicitly ruling over the province itself. The scholarship surrounding the Luristan bronzes has demonstrated how central the questions of chronology and provenance have been for those who interact with the bronzes, especially scholars and curators.

Dating the bronzes has elicited numerous speculative ranges that have the same general idea but slightly different start and end dates. As Moorey puts it, "virtually all commentators before the Second World War accepted a date in the early first millennium for the greater activity of the Luristan bronzesmiths, varying only in the range of dates they proposed."[46] The most general dates place activity broadly during the second and first millennia BCE. Most dates were based on comparanda from the surrounding areas; for example, J.A.H. Potratz related Luristan bronze horse bits to parallel types outside of Persia. Herzfeld argued that iconography could be directly linked between Luristan and that of other Mesopotamian sources in the second half of the second millennium BCE citing the major active period as 1400 - 1000 BCE.[47]

A more comprehensive effort to establish a chronology may be found in French archaeologist C.F.A. Schaeffer's 1948 work where the Luristan bronzes were considered as part of a stratigraphic study of the Near East in the later third and second millennia BCE.[48] The most typical of bronzes were dated between ca. 2300 to 1200 BCE, which is a significantly earlier

[46] Moorey, 1971, 6.
[47] Moorey, 1971, 6; Potratz, J.A.H. 1966. *Die Pferdetrensen des Alten Orient*. Rome: Pontifium Istitutum Biblicum.
[48] Schaeffer, C.F.A. 1948. *Stratigraphie comparée et chronologie de l'Asie occidentale, III et II millénaires.* London.

date range than those proposed in the 1930s. Schaeffer believed the earliest phase of Luristan bronze production was directly tied to the influence of the Late Sumerian traditions in the iconic Animal style that began to emerge in the early second millennium BCE. The proposed time was divided into "Luristan ancient et moyen," which ranged from ca. 2300 to 1700 BCE, and "Luristan récent," which ranged from 1500 to 1100 BCE.[49] However thorough this study may have been, later scholars have noted three major oversights.[50] One, Schaeffer ignored comparisons with Scythian or Achaemenid metalwork that other scholars like Rostovtzeff had drawn. Another was his dating of a rare Luristan bronze found outside of Luristan, a spouted vessel found on the island of Samos in the Aegean Sea that was argued to be dated ca. 750-600 BCE.[51] However, Schaeffer placed this vessel in the late Bronze Age ca. 1250-1100 BCE. The final critique does not apply to Schaeffer alone. There was a difficulty in reaching a consensus amongst scholars due to the question of whether to include bronzes, primarily weapons, from the third and second millennia BCE. Schaeffer obviously thought the inclusion was necessary, but his timeline did not extend into the Achaemenid period ca. 550 to 330 BCE, whereas other scholars like American archaeologist H.J. Kantor posited a significant overlap with the Achaemenid period.[52]

Some nuance is introduced into the chronology when one tries to give a date range that takes into account when the *floruit* occurred. Potratz and Moorey considered both the beginning, as well as the *floruit*, to have occurred in the first millennium.[53] In 1964, Austrian-American art historian and archaeologist E. Porada identified four main phases of development in the bronze industry of ancient Persia based primarily on art historical analyses.[54] The first consisted of

[49] Schaeffer, 1948.
[50] Moorey, 1971, 7.
[51] Waldbaum, J. 1973. "Luristan Bronzes," *Record of The Art Museum Princeton University* 32 (2): 8-15.
[52] Kantor, H.J. 1946. "Embossed plaques with animal designs," *Journal of Near Eastern Studies,* v, Chicago, 234 ff.
[53] Moorey, 1971; Muscarella, 1988, 117.
[54] Porada, E. 1964. "Nomads and Luristan Bronzes." *Dark Ages and Nomads c. 1000 B.C.,* ed. M.J. Mellink, Istanbul, 1964, 9.

Kassite and Mitannian influences in the years around 1000 BCE and was assigned to inscribed objects of the Second Isin Dynasty and contemporaneous Elamite rulers, as well as the earliest animal finials. The second was restricted to the ninth and eighth centuries BCE, where more elaborate pieces were created using the lost-wax casting method and individual styles developed under Elamite inspiration for animal finials. The third phase was during the eighth and seventh centuries BCE, where trends continued to develop to the increasingly elaborate horse cheekpieces and Master of Animals finials. The fourth and final stage signaled the transition into the Achaemenid period in the seventh and sixth centuries as the style became more naturalized in anticipation of the Achaemenid forms to come.[55]

Others like Herzfeld and Schaeffer considered the *floruit* to have occurred solely in the second millennium.[56] Another group of scholars placed the beginning in the second millennium BCE and terminate production before the Achaemenid period.[57] This last group includes scholars such as Godard and French archaeologist R. Dussuad who used links between Etruscan and west Persian metalworks to construct their timeline.[58]

Vanden Berghe also argued for a date range from the second millennium BCE to right before the Achaemenid period. He contributes concise date ranges for the phases of metalwork in the region. He even supplies a helpful graphic entitled “Chronology Board,” which compares occupations and regimes in Luristan and the surrounding areas (Fig. 3). The timeline is broken down into different ages starting with the Early Bronze Age, followed by the Middle and Late Bronze Ages, before transitioning into the Iron Age. Even though the Early Bronze Age technically starts at 3000 BCE, vanden Berghe found no examples prior to 2600 BCE.[59]

[55] Porada, 1964, 9.
[56] Herzfeld, E. 1941. *Iran in the Ancient East: Archaeological Studies Presented in the Lowell Lectures at Boston.* New York. Schaeffer, 1948.
[57] Godard, 1931.
[58] Dussaud, R. 1930. “Haches à douille du type asiatique,” *Syria*, XI, 245 ff.
[59] vanden Berghe, 1973, 78.

Chronologies such as vanden Berghe's have given future scholars a framework to use in their own studies. However, it does not answer all questions concerning the producers of the bronzes. According to vanden Berghe's chronological table, the most stable presence throughout the *floruit* of Luristan bronzes is the Elamite empire, but that does not necessarily mean the bronzes were produced by Elamites. It can hint at an enduring stylistic influence or trade partner but not necessarily the creators. So little is known about the actual creators that a chronology can really only inform scholars of the major players in the region and situate these bronzes in a broad cultural milieu.

Identifying Creators

The biggest question surrounding Luristan bronzes is who produced them and where did those people come from. Modern Iran is a melting pot of ethnic groups, which may reflect its ancient past. The habitable parts of Iran lie in its mountain ranges, which keep groups isolated and slow to incorporate outside cultural influences. The Luristan bronzes may be material evidence of one of these small ethnic groups enduring in the Zagros Mountains. However, scholars are not ready to identify by name the creators of the bronzes and instead focus on the history of occupations in regions surrounding Luristan.

The earliest known occupations in Push-ti Kuh are in the third millennium BCE by raiding tribes such as Gutis and Lullubis. Vanden Berghe traced the occupations through the Elamites, the Kassites, the first Iranian tribes, Urartians, Medes, and Aramaeans— all of which previous scholars had designated as creators of the typical Luristan bronzes at one time or another. But firm and confident claims cannot be made at this time due to the lack evidence remaining in the archaeological record. Any attempt at specific claims must remain speculative. Valiant efforts have been made by scholars to determine the creators of these bronzes but only the most cautious make the caveat that their claims are hypothetical as material evidence is lacking.

Meanwhile, the most cavalier make their claims based off unexcavated material and do not deign to inform the readers of this status.

Despite this dearth of evidence, scholars formed a general consensus in the 1970s about who produced the bronzes that has continued to be the state of scholarship since. One of the most recent publications of documents concerning the excavations in Pusht-i Kuh concluded that the ancient Lurs were a nomadic people due in large part to no observed settlements and the fact that tombs were discovered at random suggesting the lack of assigned burial spaces like cemeteries.[60] Certainly the scattering of graves and the lack of settlement architecture implies a degree of nomadic activity. However, it does not answer the questions of how these complex bronzes could have been manufactured or how an economy could accommodate a transhumant community. The degree of nomadic activity may shed some light on the bigger picture of ancient Lurs, especially in light of Schmidt's discovery of Surkh Dum and the possibility of a sedentary population. It is certainly an avenue that can be pursued through further excavations and analyses.

P. Ackerman, American art historian as well as Pope's wife and collaborator, articulated an interesting distinction that the bronzes tell more about the metallurgist than the people or their religion. She dubs the bronzesmiths as the "most competent technically and talented of the whole ancient East."[61] Their open metalworks speak to their precision as the majority of bronzes were produced using the lost-wax casting method and reworked by hand to finish off the piece. Repoussé was rarely used and its use may have been unique to a school of metallurgists in Kuh-i-Dasht.[62]

Moorey extrapolates that the presence of such skilled metallurgists points to a distinction between those based in urban centers such as Hulailan, Tarhan, and southern Kurdistan and

[60] Haerinck & Overlaet, 2010, 33.
[61] Ackerman, 1940, 12.
[62] Ackerman, 1940, 12.

those of nomadic smiths. He surmises that the metallurgists of the urban centers were responsible for the elaborate, sophisticated works, while the nomadic smiths were relegated to simpler everyday equipment.[63] This theory is based on the activities of modern nomadic metallurgists in conjunction with features common to ancient societies with strong metallurgical traditions where the metal industry was controlled and supported by a small minority of aristocracy who would have had the means to equip and maintain a horse. This aristocracy, according to Moorey, "may be seen as the ruling members of the larger, permanent settlements in the lower western plains or of citadels in the higher eastern plains dependent on agriculture, horse-breeding, and perhaps control of the north-south trade route, for their prosperity."[64] Moorey's focus on the maintenance of a horse is valid because of the multitude of horse trappings designated as Luristan bronzes. When trying to construct the ancient Lur society, it is imperative that horses be considered.

Moorey paints a portrait of a people with relative wealth and power. Beyond just the control of trade routes is the control of the raw materials, which is exemplified in the variety of bronzes that have been discovered. Different sheens and colors tell of the various alloying concentrations, which would have been discovered through increasing familiarity with the material. Few early scholars paid close attention to the chemical composition of the bronzes as the technology to render that data efficiently was not available until the 1970s. However, phenological analyses can be done as bronzes with high tin contents have a more silver color than those that do not. Early copper alloys included lead, antimony, arsenic, and tin in varying quantities. Determining alloying materials can broaden the scope of scholarship and our understanding of ancient Luristan as deposits for certain materials do not occur in the Zagros Mountains. Sources of tin, in particular, are a highly contested topic. Some maintain that tin is

[63] Moorey, 1971, 290.
[64] Moorey, 1971, 290.

an example of an alloy whose deposits are rare and generally far from Luristan.[65] However texts from the third millennium BCE suggest that the lands of Zabšali in the Zagros Mountains near Khorramabad and a host of other sites in northwestern Iran could have been sources of tin for Sumer and other Mesopotamian kingdoms.[66] The kingdoms of Mesopotamia often looked to the Zagros Mountains and beyond into the Iranian Plateau for resources that were not found in their region.[67] Overland trade routes through the Zagros Mountains were maintained to gain access to those sought-after resources. The third millennium is quite early in regard to Luristan bronzes and tin sources may have changed between the third and first millennium BCE when the *flourit* for Luristan bronzes occurred. However, a recent study by The Circle of Ancient Iranian Studies suggests the site of Deh Hosein to the north of Luristan in Iran as a primary tin supplier to the creators of Luristan bronzes.[68] The occurrence of copper-tin alloys gives a glimpse into the trading networks flowing in and out of Luristan, but also supports the possibility of a local scene of production that did not rely on far flung lands like Afghanistan for its sources of ores.

Material can influence chronology specifically in terms of the use of iron. Luristan bronzes span the Bronze and Iron Ages so the transition between the two is interesting to analyze, especially as it influences vanden Berghe's categories. Beginning in the Iron Age III (750-600 BCE), weapons and tools began to be made of iron while adornments and ceremonial objects like pins, idols, and horse bits continued to be made of bronze.[69] This is reflected in the differentiation in the bronzes *made* in Luristan and those *typical* of Luristan. Weapons and tools experienced a transition into iron, which effectively excluded them from being considered typical

[65] vanden Berghe, 1973, 81.
[66] Muhly, James David. 1973. *Copper and Tin: The Distribution of Mineral Resources and the Nature of the Metals Trade in the Bronze Age."* New Haven: Connecticut Academy of Arts and Sciences, 289.
[67] Muhly, 1973, 290.
[68] Nezafati, Nima, et al. 2006. "Ancient Tin: Old Question & A New Answer." *Antiquity,* vol 1, no. 308, Jun3 2006.
[69] Nezafati et al, 2006, 91.

bronzes. Personal adornments like pins were continuously made of bronze and have thus been catalogued as typical of Luristan bronzes.

The creators of the Luristan bronzes were an ancient people with great metallurgical talents who had access and knowledge of the natural resources in and around their region, yet their exact societal structure remains a mystery. The absence of urban planning and concentrated centers of populations has led scholars to find parallels for the ancient Lurs in the modern nomadic population of Luristan. However, Schmidt advocates for a sedentary population at Surkh Dum and Moorey contemplates the economic and systemic implications of having an equestrian culture has on a nomadic group. I believe degrees of nomadic activity should be considered in light of the arguments by Schmidt and Moorey. A broader picture can be constructed, which takes into account a blended society rather than one that is strictly nomadic or strictly sedentary.

Forgeries, Pastiches and the Importance of Terms

Luristan bronzes present an incomplete picture of an ancient people that is only complicated by the presence of forgeries and pastiches. Because the Luristan bronzes' rise to fame was through the marketplace rather than through archaeological discoveries, replicas and forgeries were produced to meet the commercial demands their supply created starting in the early 1930s and continued for decades after.[70]

Before embarking on a discussion of forgeries, it is prudent to define some terms. There are many terms for objects that are intended to pass as something they are not. Forgeries, in this context, are objects manufactured in the modern period meant to be sold as antiquities. Forgeries can be totally invented or derive from pre-existing compositions. Replicas can overlap with forgeries that copy ancient compositions depending on intent. If a replica is meant to be

[70] Muscarella, 1988, 119.

understood as an authentic ancient object, then it could fall in the forgery category. However, if a replica is meant to be understood as a modern facsimile, then it could be described as a pastiche which is an object that imitates another object or style. Pastiches present a problem for the study of Luristan bronzes precisely because they are imitations mediated by modern manufacturing, and thus make it difficult to parse out which elements of design are true to the ancient visual language and which are modern stylistic choices that would not have been found in antiquity. There is a fine line between a pastiche and a forgery, and it boils down to intention. It is completely acceptable to create a work of art in the style of an ancient culture, but to pass it off as an antique is counterfeit.

Authentic Luristan bronzes were not saturating the market to the satisfaction of dealers and collectors and thus forgeries began to make their way onto the world stage. Scholarship prior to the Second World War did not necessarily concern itself with these false artifacts. Some outright denied their existence.[71] Potratz was one of the first to acknowledge them.[72] Scholars like Moorey and especially Muscarella in the 1970s and 1980s, respectively, include the possibility of forgeries and their impact on research. Moorey outlined how forgeries are generally identified and the most popular types of forgeries present on the market.[73] The first clue is a technical one. Ancient metallurgists had different methods of producing objects that are often unknown to the modern craftsmen. The method of replication often determines whether a forgery is passable or not. Metals from ancient objects can be re-smelted to create a modern replica, thus creating a chemically identical object. If modern metals are used, however, corrosion and patina layers can simulate a facade of antiquity. It is possible to create these layers through modern scientific techniques, although advancements in metallurgical studies are able to help detect these forgery processes.

[71] Muscarella, 1988, 119.
[72] Muscarella, O.W. (2000). *The Lie Became Great: The Forgery of Ancient Near Eastern Cultures*. Groningen: STYX Publications. 81.
[73] Moorey, 1971, 34-35.

Moorey cites iconography as the greatest pitfall of a modern forger.[74] Inaccurate motifs or the language of inscriptions can clue a scholar to the inauthenticity of an object. Moreover, a reliable corpus of objects with which to compare a suspected forgery is essential to an accurate appraisal based on iconography. The last aspect comes from a stylistic standpoint and is the most subjective but nevertheless essential to the detection of modern forgeries, especially since Luristan has such a unique style.

Muscarella puts this methodology to work in his volume *The Lie Became Great: The Forgery of Ancient Near Eastern Cultures.*[75] He gathered specific items across collections and designated them as forgeries based on his own research.[76] In this list alone are 294 forgeries. This excludes the list of 64 which are classified as "Iran Generally" because they are strays that were attributed by dealers to various parts in and around Luristan.[77]

Antique dealers are often, with some merit, vilified in the narrative surrounding forgeries by scholars. Some keep dealers generalized and deal with them as an anonymous group, while others like Swedish archaeologist T. Arne specifically named the Tehran dealers that the bronzes were bought from in his museum catalog entry.[78] Dealers provide an integral part of the provenance history of objects coming into collections by means of donation or purchase. There are dealers of Luristan bronzes who are legitimate and follow standard industry practices, but they are also beholden to the available information about their wares— which is often scant. Even if there are no deliberate efforts to obfuscate the history of Luristan bronzes on the market, there are legitimate concerns of authenticity that collectors and buyers should consider when accessioning a Luristan bronze.

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[74] Moorey, 1971, 35.
[75] Muscarella, 2000.
[76] Muscarella has his own history of excavating in Iran, but the sites he excavated were to the north of Luristan and not in Luristan proper. He is sure to include Luristan in the broader picture of Iranian and Near Eastern material culture.
[77] Muscarella, 2000, 120.
[78] Arne, T.J. 1962. "The Collection of Luristan Bronzes." *Medelhavsmueet Bulletin,* no. 2. Stockholm: Museum of Mediterranean and Near Eastern Antiquities.

One of the most pressing problems concerning forgeries is the destabilizing effect they have on the foundation of scholarship for Luristan bronzes. This in turn presents a host of considerations future scholars have to make when conducting their own studies. They must focus their attention on the objects unearthed in controlled excavations. However, these are often not the ones that populate the collections of university collections and museums. The question of authenticity is often in the forefront of the mind when encountering a Luristan bronze in a collection and must be considered when conducting a study or before an acquisition.

Visual Analysis

Ancient Mesopotamia was a region of ever shifting borders and upheavals in power structures. As power changed hands, artistic production shifted to fit new agendas and new techniques developed that significantly altered the visual language of Mesopotamian art. However, there are some unifying characteristics that endured. For human figures, wide eyes and broad chests are common and have been interpreted as signs of piety.[79] Luristan bronzes are rarely anthropomorphic except for the Master of Animals finials that showcase a human figure flanked by animals. However, the impulse to dramatize and highlight particular features is also seen in depictions of animals. Animals, too, have bulging eyes and exaggerated features.

There is a sense of simplification to Near Eastern art. Details in human and animal figures are sometimes boiled down to abstract, simple geometric forms. Some works give only a vague impression of what they are depicting while others have a clarity to them that is quite striking. The style cuts across all media and can be found in stone, clay, and metal. Metallurgy developed significantly later than works in stone or clay so the forms found in the earlier media can be found in metal as well. For example, the basic form of a spouted vessel is found in stone

[79] Winter, I. J. 1989. “The Body of the Able Ruler: Toward an Understanding of the Statues of Gudea.” *Dumu-É-dub-ba-a: Studies in Honor of A.W. Sjöberg*. H. Behrens et al. (eds.). Philadelphia, The University Museum: 573-583.

in the Uruk period (4,200 - 3,000 BCE) and persists into the Iron Age as seen in the metal spouted vessel in Luristan (Figs. 4 & 5). There is a development of skill and finesse in metalsmithing that is found in the delicacy of castings rather than the implementation of realism and naturalism found in other regions of the Ancient Near East. Luristan's relatively stable visual culture is more akin to Egyptian art that wanted to communicate certain ideals, especially to their gods, so a consistent and comprehendible visual language was utilized. Much of Near Eastern art is state sponsored or for the glorification of and communication with the gods so a consistent and standardized visual language would have been important to develop in some form.

The UWMAC bronzes exhibit many of the unique characteristics of the Luristan visual culture. The next section will break down UWMAC's collection of bronzes by type: zoomorphic, vessels, spiral headed pins, and projectile points. Then the bronzes will be compared to the established canon of Luristan bronzes as well as in light of possible external influences.

Zoomorphic Types

Luristan bronzes are more often than not zoomorphic, especially if they fall under the general heading of personal ornament or pendant. The UWMAC holds two small animal charms, a snake-headed bracelet, and a few pins with animals at their finials. All of these have comparanda from excavated contexts and fit firmly within the Luristan bronze canon. There are two other zoomorphic artifacts that pose questions of authenticity: the *Ibex Whetstone Handle* (1985.002.38) (Fig. 6) and the *Master of Animals Finial for a Standard* (1985.002.48) (Fig. 7). Both are more elaborate than the other zoomorphic artifacts with less extant comparanda.

The unique stylization of Luristan bronzes is on clear display in zoomorphic compositions. Naturalism falls away to the highly stylized and simplified forms. The style traits are consistent with other ancient Near Eastern cultures but there is a competency and

consistency of form that speaks to the metallurgical culture of Luristan in particular. As noted earlier, some scholars have situated the Luristan style into the broader category of the Animal style. In 1922, Rostovtzeff traced the progression of the Animal style from its genesis in Mesopotamia, specifically Sumer, to its divergences in the Assyro-Persian, Ionian, and Scythian traditions.[80] Due to their location and *floruit*, Luristan bronzes would have most likely been influenced by the Assyro-Persian or perhaps the Scythian traditions. The general modeling of animals in Luristan bronzes are slender and spindly with the emphasis on identifying characteristics like antlers, beaks, or tails. Eyes are often large and the most prominent facial feature. The bodies are often accented with raised ribbings or bands that might represent artistic flourishes or a byproduct of the object's function.

Ibex Whetstone Handle

Ancient Lurs occupied the plains and foothills of the Zagros Mountains. Mountainous animals like ibexes were frequent subjects of charms, pendants, and adornments. Many depictions are condensed to the basic components of highly arched antlers and a slender head. The UWMAC cast bronze *Ibex Whetstone Handle* has two bumped antlers that curl out and away from the head next to the ears, only to circle back and reconnect at a singular point on the neck.

There are several extant examples of bronze whetstone handles terminating in an ibex from both controlled and uncontrolled excavations. The BAMI excavations found three examples, all from Bard-i Bal, in tombs from Iron Age I.[81] Each has a component found on the UWMAC handle (Fig. 6).[82] BB.2-8 (Fig. 8) has antlers that start out as separate at the top of the head but terminate at a singular point on the neck; although the antlers do not have the

[80] Rostovtzeff, 1922, 193.
[81] Haerinck E. & Overlaet B., 2003, "The Early Iron Age in Pusht-i Kuh, Luristan." *Luristan Excavation Documents. vol. IV*. Acta Iranica. 181.
[82] Haerinck & Overlaet, 2003, pl 157 & 158.

hemispherical bumps along the ridge like the UWMAC handle.[83] BB.68-12 (Fig. 9) has slender front legs that extend the length of the body of the ibex (or the actual handle). It also has a similar cylindrical snout.[84] BB.67-10 (Fig. 10) also positions the front legs as if laying down or kneeling like BB.68-12, but it also gives an indication of back legs making the handle a complete body while the other handles only allude to the front half. Both of the Bard-i Bal front legs look naturalistic and clearly allude to front legs while the UWMAC looks as if it has rods attached to the handle with little indication that they allude to a body part. One major diversion is the absence of a hole that would have been used to secure the whetstone. There is a spot on the UWMAC handle that looks as if the hole had been repaired due to the disruption in the ribbing.

None of the handles from Bard-i Bal have the bumpy ridged antlers that the UWMAC handle has, however numerous handles in museums and collections display them to vary degrees of exaggeration. These museum and collection examples are quite a bit more elaborate than those excavated at Bard-i Bal, which are more naturalistic and simpler in form. Haerinck and Overlaet explain this difference as emblematic of the progression from simple and natural shapes to elaborate and complicated designs, making the Bard-i Bal handles early examples of the type. Indeed, Haerinck and Overlaet date all three whetstone handles to Iron Age IB. The UWMAC handle could be in the transition period between the simple and the complicated because of the simple overall silhouette with the added complications of ribbing and prominent bumps along the antlers.[85]

The ribbing presents an interesting anomaly amongst many in the UWM Art Collection. Ribbing is a frequent feature in Luristan bronzes, but its execution is different than what is shown on the UWMAC handle, which is more akin to a modern soup can than the more rounded and raised ribbing found on other Luristan bronzes. Beyond the actual ribbing is the paucity of

[83] Haerinck & Overlaet, 2003, pl 207 & 208.
[84] Haerinck & Overlaet, 2003, pl 203.
[85] The UWMAC dates this handle to Iron Age II-III which corroborates this later assignment.

examples of ribbed whetstone handles. All of the ones from Bard-i Bal and most if not all of the handles in museums have a smooth handle. Its inclusion and execution raise flags concerning its authenticity.

Master of Animals Finial for Standard

The Master of Animals motif refers to a heraldic composition of a central humanoid figure restraining or wrestling two animals on either side. The term encompasses a myriad of variations on the main theme, including who is represented in the center and what creatures are being tamed. In Iran the motif has a long tradition dating back to the fourth millennium BCE with seal impressions. For greater Mesopotamia, the first appearance of the motif dates to the Uruk period and was utilized as a symbol of Sumerian royal power to protect sacred herds and the inhabitants of the kingdom.[86] The Mesopotamian variety traveled to Iran from Uruk to Susiana. It continued to promulgate through eras and media, but eventually faded towards the end of the seventh century BCE.[87] The profusion of this specific heraldic motif on Luristan finials is disproportionate to the appearance of the motif outside of the region, but the message of the motif was still present in Mesopotamian art. Dominion over animals and by extension the natural world was a powerful depiction for ancient cultures whose existence depended on their control over nature. Agricultural innovations were very real attempts to control the uncontrollable natural world. The Master of Animals motif showed humanoid figures in a battle with nature and winning.

One major departure the Master of Animals motif makes with Luristan bronzes, as opposed to other cultures, is the context in which it is found. In Mesopotamia, it is often linked

[86] Winckelmann, S. 2000. "Intercultural Relations between Iran, the Murghabo-Bactrian Archaeological Complex (BMAC), Northwest India and Failaka in the Field of Seals." *East and West*, vol. 50, no. 1/4 (December 2000), pp. 45. Istituto Italiano per l'Africa e l'Oriente.
[87] Frankfort, H. 1970. *The Art and Architecture of the Ancient Orient*, Pelican History of Art, 4th ed, Penguin (now Yale History of Art).

with “virile royal supremacy” like its emergence in Sumer.[88] In Luristan, it is found in religious contexts and more specifically in burial or death contexts. Most of the Luristan bronzes have been found in burials, specifically stone lined graves that dot the foothills and plains of the Zagros Mountains. Few Master of Animals finials have been found in controlled archaeological excavations; among those from excavations, only one was found beyond a fragmentary state. Very few settlement sites attributable to ancient Lurs have been excavated, but the site of Surkh Dum presents a relevant area of interest since it has been speculated to be a sanctuary.[89] No standard finials with the Master of Animals motif have been found at Surkh Dum, which might suggest a funerary function for the finials rather than active worship. However, this absence may be a result of prior looting. Nevertheless, the only finial to be found *in situ* was discovered in the early Iron Age III tomb at Tattulban in the Pusht-i Kuh region of Luristan (Fig. 11), but this late date positions the finial at the end of the stylistic development and popularity of the type.[90] Vanden Berghe, the director of the excavation at Tattulban, classified the standard as a funerary idol “of a composite type termed ‘taming of wild beasts.’”[91] He makes the further assumption that the standards were a function of a cult of the dead that was associated with a mythological antecedent to Zoroaster or the Iranian god of the dead.[92] Although vanden Berghe does not specifically name this Iranian god of the dead, in a study of Near Eastern symbols of deities, the god of the underworld Nergal is associated with a composition consisting of a central column with two lion-headed protrusions from the Neo-Sumerian to Neo-Assyrian periods (Fig. 12).[93] It is interesting to find a motif that emphasizes the effort humans put into controlling their

[88] Aruz, J. et. al. 2008. *Beyond Babylon: Art, Trade, and Diplomacy in the Second Millennium B.C.* New York: Metropolitan Museum of Art, 391.
[89] Schmidt et al., 34.
[90] Overlaet, Bruno. 2004. “Luristan Metalwork in the Iron Age*.” Persia's Ancient Splendour: Mining, Handicraft and Archaeology,*Deutsches Bergbau Museum, Bochum: 334.
[91] vanden Berghe, Louis, René Joffroy and Jean Liénard. 1973. “Bronzes from Luristan.” *Bronzes: Iran-Luristan Caucasus.* Le Bronze Industriel et Jean Liénard. 74.
[92] vanden Berghe et al., 1973, 74.
[93] Green, Anthony. 1995. “Ancient Mesopotamian Religious Iconography.” *Civilizations of the Ancient Near East,* vol III, ed. Jack M. Sasson. New York: Charles Scribner’s Sons.1838-39.

surroundings in a funerary context where humans ostensibly have no control either on Earth or where they believe their soul travels to after death. It raises the question of whether the motif was to evoke, purely, the notion of control or was it a more ominous portent to what they believed awaited them in the afterlife.

The Tattulban finial is of a complex style that is at least partly matched by the UWMAC finial. The stylistic development of these Master of Animals finials runs counter to the usual route from stylized to naturalistic as the most developed types are the most stylized and least naturalistic. As seen in both the UWMAC and Tattulban finials, features of both the human and the animals have been abstracted to geometric forms. Consider the face of the Janus-headed central figure whose only really discernible features are the prominent pinched nose with eyes either rendered with globular dots (in the Tattulban finial) or round disks (in the UWMAC finial) and the two simple outstretched arms and hands. In both examples, the legs are mixed in with those of the flanking creatures. The torso is only represented by a cylinder with ribbing that gives no impression of musculature or the bone structure beneath. The animals have minimal identifying features. The two protrusions at the hips have what seems to be cock's combs while the creatures at the shoulders have gaping maws but no other easily discernible features. Between the mouth and what could be ears or eyes are bumps that could be ears or antlers of some kind. Drawing on the array of popular animals used in Near Eastern art, these two animals at the shoulders are possibly lions. These examples of extreme stylization indicate the extent to which ancient Lurs developed their own artistic style.

As mentioned above, the prevalence of Master of Animals finials is drastically different in collections versus excavation finds. Just as the unknown provenance of the UWMAC bronze highlights the many routes objects can take to end up in collections, the similarities between the UWMAC finial and the Tattulban bronze could signal a forgery or pastiche. The finer, more delicate details of the Tattulban finial shows a greater mastery over the medium than the

UWMAC finial, but the overall composition is almost identical down to the animal connecting to the central figure on the left-hand side. To focus on the head of the animals at the shoulders of the central figure, both sets of heads have the same basic component parts yet the Tattulban finial shows a greater understanding of placement to achieve a coherent animal.

The image of the Tattulban finial was published in 1973 which allows for the possibility that a forger could have to smelted a bronze of a similar composition and sold it through the art market to end up in the hands of Mr. Moebius and, finally, the UWMAC through donation. The date of Mr. Moebius's acquisition of the finial is not available so it cannot be determined whether he bought the finial before or after the publication of the image of the Tattulban finial. The strong similarities between their compositions raises suspicions, nonetheless. A case could be made to account for the similar compositions by suggesting a production system interested in producing copies like what was found in Rome. Although there is no evidence to suggest a level of organization able to sustain that model beyond the observance of a unique Lur visual culture.

The appearance of the Master of Animals motif in Luristan bronzes could be attributed to the transmission of visual language between Mesopotamian and Iranian cultures, to the cultivation of a local motif that had started to develop in the fourth millennium BCE, or, most likely, to a fusion of the two. It also forges a potent and important connection between the iconography of Mesopotamia and the little known ancient Luristan. The Master of Animals is a widely observed motif in ancient Near Eastern art that infuses any item exhibiting the motif with a type of familiarity that would have been attractive to art dealers and the modern art market. Even if the UWMAC finial is not an authentic ancient Luristan bronze, it reflects the openwork smithing that makes Luristan bronze compositions so intriguing.

Vessel Shapes

Spouted Vessel

Spouted vessels are not unique to Luristan. The vessel shape can be found across the Near East as far back as the Uruk Period and in different media. Often shapes found in metal have precedents in ceramic or stone. The Holmes expedition uncovered a ceramic vessel similar to the UWMAC bronze vessel (1985.002.39) from the Iron Age among the pottery finds at Chigha Sabz (Fig. 13).[94] It does not have the knob between the spout and the body, but the shapes of the bodies are quite similar. The vessel in the UWMAC is a molded and hammered bronze spouted vessel (Fig. 5). The spout is formed by a sheet of bronze curled in on itself that juts out horizontally from a vertical cylinder that terminates in a significant knob. All over the knob is a pattern of circle and dots. The knob is attached to the vessel and at the joint are globular dots (rivets) that ring the knob. The vessel was made in at least two parts that is joined at the transition point between the shoulder and the body. The rim flares up and out from the shoulder. The entire interior is hollow, from the vessel to the end of the spout.

The spout and rivet joining can be found in other examples of spouted vessels from Luristan. An example can be found in the Ashmolean Museum (Fig. 14) where the spout is modeled in the same way as the UWMAC vessel, but the rivets are bigger in proportion to the spout. The body of the vessel has a similarly flared lip and rounded, globular bottom, but it also has an animal attached that may have functioned as a handle. A spouted vessel in the Metropolitan Museum of Art's collection (Fig. 15) is much more ornate than the UWMAC vessel, but the component of interest is the rivets surrounding the spout join.

An interesting element of the UWMAC spouted vessel is the dot-in-circle decorations on the knob. This decorative motif can be found around Iran during the Iron Age. A tube in the Metropolitan Museum of Art from the ninth century BCE site of Hasanlu (Fig. 16) clearly exhibits

[94] Schmidt et al, 1989, pl 139a.

the motif. The motif is not commonly noted or found in typical Luristan bronzes. However, a shell finger ring found in a tomb in Bard-i Bal presents one excavated example of the motif in Luristan (Fig. 17).

Beaker with Winged Figures (Situla)

The UWMAC classifies this vessel (1985.002.37) as both a beaker and a situla (Fig. 18). Muscarella notes that museums and collections often mislabel nipple-based beakers as situlae.[95] The UWMAC vessel would be more appropriately classified as a nipple-based beaker than a situla. The base is domed with a central nipple that corresponds to the center of an incised thirteen-petalled rosette that decorates the entire base. Clear comparisons can be made to the beakers housed in the Metropolitan Museum of Art in New York City (Fig. 19).[96] The beakers even exhibit similar geometric motifs that frame the figural scene and a similar guilloche motif encircling the vessel just above the base. The pairing of the guilloche motif and a band of tongues or horseshoes is commonly found on these beakers. Fragments of vessels with this pairing were found in the Holmes expedition at Surkh Dum (Fig. 20).[97]

The figural scene raises the most questions. The elements surrounding can be found on other existing bronzes, but the composition of the scene as a whole is strange. At the most general level, the type of scene is not uncommon. Figures standing face to face while clasping hands or raising hands were utilized to depict positive interactions. The right hand raised was considered a gesture of respect in the ancient Near East. The figures on the UWMAC vessel seem to have extended their right hands to touch in the space between them. They are not explicitly clasping hands, nor do they seem to be exchanging something, which would have been more typical of the scene.

[95] Muscarella, 2000, 100.
[96] Muscarella, 1974, pl 51.
[97] Schmidt et al, 1989, pl 190 (f & g).

The figures themselves present many component parts of common characters found in Near Eastern compositions, but do not necessarily equate to one specific creature. They most resemble winged geniuses, especially the figure on the right who is a bearded, long-haired man with wings stretching out behind him. The bodies pose the most obvious outlier. Winged geniuses are more often four legged creatures whose bodies resemble lions. The bodies on this vessel are more akin to a bird. Only one leg is shown and presumably the other limb is the one extended into the middle.

There is a human-bird hybrid found in Iran during the Iron Age in the form of the Persian god Ahuramazda. The god's standard depiction is a winged sun disk with legs. Sometimes a bearded man in profile wearing a hat, holding a ring in his left hand, and raising his right hand in a gesture of respect is rested on top of the sun disk. Perhaps the figure on the UWMAC beaker is Ahuramazda condensed and in profile, sans sun disk and hat. This conjecture does not account for the figure on the right who presents similar iconography with the exception of the beard.

The differing facial hair suggests two distinct characters. Likewise, the figures are not at the same height. The bearded figure is taller than the bare-faced one. This can be more clearly seen in the portion of the scene opposite the outstretched hands where only the tips of the wings and the back ends of their bodies can be seen. One set of wings extend up further than the other even though their bodies are of equal height.

Examples found on other beakers or cylinder seals would lead one to expect some type of vegetation or other object to occupy the space between the figures. The UWMAC beaker leaves this space empty, making the composition feel a bit unfinished or unbalanced. The bronze beaker from the Metropolitan Museum of Art (Fig. 19) has a similar composition with two winged creatures facing other, but there are sprigs of vegetation that occupy the unused space.

Spiral-Headed Pins

In the UWMAC collection are three double spiral-headed pins (1985.002.44, 1985.002.45 (Fig. 21), 1985.002.46) which are denoted in the UWMAC catalogue as hair ornaments. Although the spiral motif is a rather simple and common pattern found all over the world across time, there are few extant Luristan examples in museum collections. The British Museum holds a "spectacle shaped" copper alloy pendant purchased from E. Herzfeld that has two spirals (Fig. 22). A bracelet and an open-work disc pin from the Louvre Museum also have spiral finials. The bracelet (Fig. 23) is the most similar to the UWMAC pins because their spiral is made by the bending of a strip of bronze rather than indentations into a disc to give a spiral in relief like what is found on the disc pin (Fig. 24). The pin was purchased from Jacques Coiffard, the French ambassador in Tehran, in 1958 and the bracelet was purchased in 1931 from Godard.[98] Each has Luristan as its place of discovery in the Louvre's catalog entries.

Most spiral headed pins that are attributed to Luristan only occupy private collections and were circulated through the market. Even in the market through dealers or auction houses, double spiral pins like the ones in the UWMAC are attributed to cultures around the Mediterranean like Greece and Terramara. A rather striking comparison can be made to a Greek bronze hair or cloak pin from the Artemis Gallery in Louisville, Colorado (Fig. 25). However, even this pin has a provenance that only extends to a private collection in Orange County, California, that had acquired it before 2000.[99]

However, scant the evidence is for the use of the spiral in Luristan, the Scythians make heavy use of it in their metalworks. Rostovtzeff needled a stylistic thread between Luristan and Scythia through the Animal style, but it can also be seen through the spiral or swirl motif shown

[98] "épingle." *Musée du Louvre.* 24 Jun 2020. Accessed 21 Jul 2021. https://collections.louvre.fr/en/ark:/53355/cl010237948. "bracelet." *Musée du Louvre.* 12 Apr 2019. Accessed 21 Jul 2021. https://collections.louvre.fr/en/ark:/53355/cl010236321.
[99] "Rare Greek Bronze Double Spiral Cloak or Hair Pin." *LiveAuctioneers.* Accessed 12 Jan 2021. https://www.liveauctioneers.com/en-gb/item/60996585_rare-greek-bronze-double-spiral-cloak-or-hair-pin.

on these pins. It is a relatively simple shape so putting too much emphasis on its appearance should be cautioned, but it should not be ignored. A particularly poignant example of the swirl motif can be seen in multiple examples from Professor J. Haskin's slide collection at the University of Pittsburgh (Fig. 26). It is possible that two highly migratory, metallurgically-inclined cultures could come into contact and pass simple motifs from one to another. The spiral is certainly not a motif that is typical or frequent in Luristan bronzes, so an outside influence could explain its scarcity.[100]

Projectile Points

The UWMAC has a small collection of projectile points. Common visual characteristics among the four projectile points is a raised spine spanning the length of the blade to varying degrees. Otherwise, there are several elements that are present in some but not the others. All but one have curved shoulders resulting in barbs in varying degrees of severity. The odd one out (1991.002.05) (Fig. 27) has straight, flat shoulders. The swelling on the tang below the shoulder marks another point of difference among the objects. Two are straight with no or minimal swelling while the other two have significant swelling. Yet even the swelling is not consistent. In one arrowhead (1991.002.09) (Fig. 28) there is a degree of definition and transition between the tang and the edged portion of the arrowhead that marks a significant stylistic divergence from the other (1991.002.06) (Fig. 29), which is so much less defined that it hardly registers as a stylistic choice.

The curve of the edges and point differs for each one. The width disparity between the shoulder and the point varies as well as where the edge starts to curve and bow out. Interestingly, three of the projectiles have the same width of 0.75 inches (1991.002.06, 1991.002.09, 1991.002.10) yet none have the same point of departure for the curve that gives

[100] Presuming that the spiral headed pins are in fact genuine ancient artifacts from Luristan and not misinformation from the bazaar.

the sense they have equal widths. For example, the bowing of the edge starts farther from the point of the project in 1991.002.06 than it does for 1991.002.10 (Fig. 30) so it gives the illusion of being narrower. The severe tapering due to the stunted height of the arrowhead found in 1991.002.09 exacerbates the width disparity between the point and the shoulder making the arrowhead on a whole seem wider. The obvious outlier is 1991.002.05 which is labeled as an arrowhead but looks more like a spearpoint or dagger due to its heft, doubled width, and considerable length. The tapering on this projectile point is gradual and begins closer to the point than any of the other examples in this category.

In *Luristan Excavation Documents* vol IV, Overlaet broke down their bronze arrowhead finds into typological groups. Group 4 is described as small tanged and barbed, characteristics that can be found in the smallest arrowhead in the UWMAC (1991.002.09). Particularly strong comparanda for the UWMAC example was excavated from Kutal-i Gulgal (Fig. 31), but the barbs are less pointed than the UWMAC example. Other excavation sites that found examples of the Group 4 Typological Group were Tang-i Hamamlan and Surkh Dum in Pish-i Kuh. It was noted that this group was unusual for the Pusht-i Kuh.

Each of the bronzes in the UMAC exhibits a characteristic of canonical Lursitan bronzes. The UMAC bronzes range from faithful copies of extant Luristan bronzes like the Master of Animals finial to derivative, general motifs that are not necessarily typical of Luristan like the spiral-headed pins. In order to investigate the authenticity of UWMAC's bronzes, a number of bronzes were selected to undergo trace element analysis. Chapter Two will document the testing methodology used and report the resulting data.

Chapter 2: Path to Authentication: Implementing ICP-MS

The scarcity of documentation coupled with the dubious provenance information for this particular artifact group situates the UWMAC's Luristan bronzes in a precarious position. Archaeologically, they have little value without context. Art historically, they *may* offer examples of typical Luristan artifact types and iconography to study and compare, but questions about authenticity linger. Pedagogically, they serve as cautionary tales about the pitfalls of early collecting practices rather than exemplars to exhibit. However, the bronzes are still accessioned objects in the UWMAC and for that reason it is worth trying to obtain as much information about them as possible. This thesis takes an interdisciplinary approach rather than rely solely on a traditional provenance investigation to follow a scant paper trail. To that end, this chapter explains the methods employed to investigate the UWMAC bronzes and reports the resulting data. Chapter Three will discuss the implications of these results.

Scientific studies of material culture have a dense, albeit relatively recent, history. Techniques and instruments develop at a rapid pace. There are many instruments of analysis that can answer questions about the composition of an object, but they range in precision and method. For the testing of material culture, one of the first decisions that must be made is whether the test will be destructive or non-destructive. Destructive testing refers to methods that do not leave the sample intact after processing. Non-destructive testing is a broader category that encompasses testing that does not require any removal of material from the object, as well as testing that requires a sample to be removed but it is not destroyed after processing. Non-destructive samples take the form of mounted shavings on a microscope slide, for example.

For the purposes of this thesis, identification of the ancient bulk, core metal composition was the primary target. This requires the sample to be free of the altered composition found in the surface layers of the patina that developed after being exposed to various environments. Sometimes the ancient bulk material can be estimated by working backward from the patina, but

the object's burial conditions need to be known for that sort of analysis. The easiest and more precise way of ascertaining the ancient composition is to drill past the patina to the un-corroded interior. For some objects, this is impossible due to the severity of the corrosion or the thinness of the material.

Several of the bronzes in the UWMAC have enough extant material to access their bulk material. Most of the bronzes are, however, either highly corroded or significantly patinated. Because of this, a surface analysis method like XRF (x-ray fluorescence), while convenient, relatively cost-efficient, and non-destructive, was ultimately deemed unhelpful because the depth of its probe would not have reached to the bulk material. As a result, destructive methods that require sampling were considered.

Inductively coupled plasma mass spectrometry (ICP-MS) is an elemental analysis tool capable of detecting most of the periodic elements at trace levels, down to the parts per billion. With respect to bronze, this allows for the percentages of the constituent parts of the metal alloy to be determined. The application of ICP-MS on Luristan bronzes has been one of the most recent and successful applications of scientific analysis used for understanding ancient metallurgy in first millennium BCE Iran. Because the chronology of Luristan bronzes spans the development of metallurgy in Iran, the percentage of copper, lead, and other alloying materials offers an idea as to which stage in the development from the Bronze Age to the Iron Age a particular object could fall. However, determining the composition of a metal alloy is not a definitive method of authenticity because metals are repurposed and re-smelted both in antiquity and in modern times. A metal can keep its composition over multiple workings. So, while the composition of a metal may reflect similar practices used in antiquity, it does not give a definitive indication of the date of the object it forms.

Although ICP-MS is a form of destructive analysis, it allows for the testing of the un-corroded bulk material lying at the core of artifacts and therefore has the potential to yield data

relevant to the original material's composition that is simply not possible when relying on non-destructive methods that offer limited depth and accuracy.[101] The benefits of conducting ICP-MS outweigh the costs of retrieving the relatively small sample required. Samples can be extracted from areas on the object that are not readily seen and will not impact its ability to be exhibited. Even if public display is not a concern, the sampling area is so small that the aesthetic quality of the object is not severely compromised (Figs. 31-34). The future of the object in a collection and how it will be used greatly impacts the decisions made around sampling.

ICP-MS is often utilized to measure isotope ratios, particularly those of lead. It is an extremely sensitive form of analysis and is able to measure elements according to their isotopes, which in turn allows for a deeper understanding of the material. Geographic regions have particular isotopic fingerprints that can be detected on objects smelted from ores originating from mines in those regions. In some elements, the isotope ratios are not stable, and the fluctuation can be an indicator of age. A recent study by Nickel et al. explores the correlation between the isotopic ratio of tin and the date of the corrosion layers on bronze objects in an effort to determine if the corrosion layer was developed over time or was a modern application to a forgery.[102] The sensitivity of ICP-MS generates an abundance of data to answer a variety of research questions with limited sampling.

The application of ICP-MS on Luristan bronzes has a brief history. Most studies have been published by Omid Oudbashi in the Department of Conservation of Historic Properties, Faculty of Conservation at Art University of Isfahan in Iran. Oudbashi and his coauthors have conducted archaeometallurgical studies on excavated bronzes from the necropolis of Marlik

[101] There is an alternate version of ICP-MS called ICP-MS-LA that does not have the same sampling process. The "LA" refers to laser ablation. In this method, an object could be mounted, and the laser would then sample directly from the object.
[102] Nickel et al. 2012. "Identification of Forgeries by Measuring Tin Isotopes in Corroded Bronze Objects." *Archaeometry* 54, 167-174.

(2017) and Baba Jilan (2018).[103] The objects from Marlik were primarily blades and vessels, while the team analyzed more ornamental objects from Baba Jilan like pins, buttons, beads, and a bracelet. Since these studies examined excavated objects, their focus was on the development of bronze alloying in the region rather than concerning itself with the authenticity of the objects. These studies present excellent comparison data in terms of the alloy compositions and ratios because of their breadth and variety.

To investigate the objects from Marlik and Baba Jilan, the team extracted samples using a diamond saw and then dissolved them in *aqua regia* (a mixture of nitric acid and hydrochloric acid).[104] ICP-MS measures isotopes in a certain range and reports their intensity in counts. The intensity is then converted into weight percentages through a series of equations. All of the object's samples were confirmed to be true tin bronze with the percentage of tin ranging from 4.00% to as high as 11.16%.[105] Oudbashi's studies are more expansive than the present study and employ a variety of techniques to form a fuller picture of how the objects were worked and their composition. The other main form of analysis used by Oudbashi and his team was metallography, which employs a microscopic look at the structure of the bronze to find evidence of the methods used to make the object like annealing and cold working. Metallography provides a glimpse into the work of shaping the objects and could be employed in future analyses of the UWM Luristan bronzes.

Even though there are few ICP-MS studies on Luristan bronzes, the results obtained from this instrument can be compared to other methods like proton-induced x-ray emission (PIXE) spectrometry and inductively-coupled plasma optical emission spectrometry (ICP-OES)

[103] Oudbashi, Omid and Morteza Hessari. 2017. "Iron Age tin bronze metallurgy at Marlik, Northern Iran: an analytical investigation." Archaeol Anthropol (2017) 9:233-24. DOI 10.1007/a12520-015-0280-1; Oudbashi, Omid and Ata Hasanpour. 2018. "Bronze alloy production during the Iron Age of Luristan: a multianalytical study on recently discovered bronze objects." Archaeol Anthropol Sci (2018) 10:1443–1458. DOI 10.1007/s12520-017-0466-9.
[104] Oudbashi and Hasanpour, 2018, 1444.
[105] Oudbashi and Hasanpour, 2018, 1447. Oudbashi and Hessari 2017, 241.

because their results can also be reported as weight percentages. Metallurgical compositional studies were conducted on a selection of finds from the BAMI excavations directed by Vanden Berghe in the early 2000s. A 2005 report compiled multiple studies done by the Museum Applied Science Center for Archaeology (MASCA) at the University of Pennsylvania as a part of their "Mesopotamian Metals Project" throughout the 1980s.[106] Much like the Oudbashi studies, the BAMI report used the compositional data to form a timeline of production practices because excavated objects were tested rather than acontextual finds from collection holdings.

Relevant to this thesis is a 2008 study, which compared the compositions of BAMI excavated bronzes to bronzes held in the Louvre's holdings that were bought and collected from Iran prior to any scientific archaeological excavations.[107] The study employed optical atomic emission spectrometry (AES) and neutron activation analysis (NAA) to determine the amounts of antimony, arsenic, cobalt, nickel, silver, and tin in each collection of bronzes. Those data sets of both excavated and market bronzes were compared and it was concluded that there were "no significant systematic differences between [the two groups]."[108] The authors state that, according to their study of the material, the Louvre's bronzes are made of "Luristan" bronze, but do not dismiss the possibility of a modern forgery using ancient metals.[109]

The Louvre study and this thesis have the same goal: to determine the composition of a collection's supposed Luristan bronzes and compare the data to excavated Luristan bronzes to determine if the bronze is similar enough to make an informed decision about whether or not the bronzes can be considered genuine artifacts from Luristan with the understanding that there is a possibility that they are modern forgeries using ancient metals or metal in the style of antiquity.

[106] Fleming et al 2005, 35.
[107] Begemann et al 2008. "An Archaeo-Metallurgical Study of the Early and Middle Bronze Age in Luristan, Iran." *Iranica Antiqua* 43 (January 2008): 1–66. doi:10.2143/IA.43.0.2024041.
[108] Begemann et al 2008, 1.
[109] Begemann et al 2008, 1.

Artifact Selection

Five objects from among the UWMAC Luristan bronzes were chosen for testing using ICP-MS: the *Master of Animals Finial for a Standard* (1985.002.48), *Hair Ornament* (1985.002.45), *Vessel with Spout* (1985.002.39), *Arrowhead* (1991.002.09), *Handle with Ibex Head Finial* (1985.002.38). *Hair Ornament (1985.002.45)* is part of a trio of pins; thus, one was chosen as a representative for the whole group. Each object presented its own unique questions concerning form and style, which made them ideal candidates for testing.

The Master of Animals finial is a type rarely found in excavations but has a significant presence in collections. Based on Vanden Berghe's categories this finial is the most characteristic of Luristan bronzes in the UWM collection. Its close adherence to the visual style of canonical Luristan bronzes and the texture of the patina were the two main factors in selecting the finial for testing. The texture of the patina is very smooth, so much so that it looks painted.

The hair ornaments, hereafter referred to in this thesis as spiral headed pins, are provocative, even upon initial viewing. Rather than the style of the pins, it was their construction that posed the biggest questions. Luristan bronzes were most often made using the lost wax technique, which did not involve the implementation of an inner wire armature like the UWM pins, which possess a small gauge wire at the center with a thick outer casing of metal. There are sections of the outer casing that have detached from the object, exposing the wire within. Upon viewing, the pins do not look as if they would weigh much; however, they have a significant heft most likely coming from that thick outer casing. The visual qualities of the corrosion on the pins are unique among the UWM bronzes. While the others keep a relatively even surface, the pins exhibit severe cracking or cleaving. Besides the surface layer, the majority of the outer casing is a reddish terracotta color (Fig. 21).

Mesopotamia has a long history of spouted vessels and there are many extant vessels to compare to UWM's vessel. The fact that the UWM spouted vessel comprised at least three sheets of metal was especially interesting as the vessel type as history across a variety of media. However, the fact that it was made of sheet metal reduced the overall thickness of the material and made access to the bulk material minimal except for on the foot of the vessel.

Of the bronzes chosen from UWM's collection for sampling, the arrowhead comes from the donation made by Woodmansee and is one of several in the UWM Art Collection that are thought to have been purchased from a Marshall Fields catalogue. It is also the only weapon to be selected. Personal ornaments and weapons have different timelines in regard to the transition in the use of bronze to iron in the early Iron Age. The arrowhead was selected to bring in a possible point of departure from the other bronzes which had more domestic contexts.

Finally, the *Ibex Whetstone Handle* prompted many questions about its authenticity based on its form and its (dis)similarity to other whetstone handles from Luristan. The UWM handle contains many of the requisite elements of form and iconography, but the overall impression given by the object is not consistent with the ancient Luristan style. Several aspects of the UWM object were notable: the handle, the rods imitating legs, the ribbing, and the joins.

Sampling Strategy

After selecting the objects to be tested and getting approval from the Director of the Emile H. Mathis Art Gallery and UWMAC, Professor David Pacifico, each object needed to be examined for areas of potential sampling.[110] The main considerations taken into account were the efficacy of the potential sample, the placement in regard to the structural integrity of the

[110] See Appendix B for Request for Scientific Testing.

object, and the cosmetic result. Areas with the least amount of surface corrosion were primary targets in order to avoid unwanted contamination. Ancient bronzes have been found to be heterogenous copper alloys, so multiple sites of sampling on one object would be the most illustrative of the object's composition. Furthermore, sampling focused primarily on the core metal composition rather than the patina to ascertain the ancient alloy as closely as possible. As a general rule, in keeping with best practices in archaeological testing, samples were taken on surfaces and in areas that least impacted the object visually, such as breaks, undersides/backs, or "hidden" areas. For example, samples of the *Ibex Whetstone Handle* were taken on the underside of the handle, hiding the sampling sites from view, if the object were ever to be displayed. Likewise, sample sites did not target areas that might jeopardize artifact stability like joints or delicate finials. In general, the impact of sampling on each object was indeed minimal.

Before sampling, photographs were taken of each object with special attention paid to specific areas that were potential sampling sites. These areas were determined primarily based on three factors: relevance, durability, and visibility. Presumably, the entirety of the object is made of bronze, but there were certain areas on some of the objects that raised specific questions. Those relevant areas were targeted where possible. Excluded were sites that could not handle a drill hole, like delicate finials or significant joins or thin sheet metal. Lastly, location of the sample site needed to be inconspicuous enough so the object could be exhibited. This made the main target areas the feet and undersides. However, if an object did not necessarily have a foot or a bottom, the side with the accession label was used.

Next, an action plan, which indicated where the sample would be taken and what method of removal was planned was submitted.[111] This action plan was reviewed and approved by Pacifico, Curator of the Mathis Gallery and UWMAC Leigh Mahlik, and UWM Professor of

[111] See Appendix C for the action plan.

Chemistry Joseph Aldstadt, who graciously arranged and oversaw the ICP-MS testing. The proposed method of removal was by a Dremel rotary drill equipped with 0.9 mm diamond coated or tungsten carbide drill bits. The primary attachment used to clear the surface patina layer was a diamond coated conical sanding and polishing bit. Spiral diamond coated steel bits were used to bore into the bulk material. Obtaining actionable samples proved to be difficult for a few of the objects. It was a process of trial and error to see what drill bits were able to produce successful samples.

Spiral Headed Pins (SHP)

The spiral headed pins presented an alternate method of construction to the common practice of Luristan, the lost-wax technique. Here a wire worked as an armature for the thick outer casing where the decorative elements were worked. The goal was to take samples from the inner wire and the outer casing of the pin to address all constituent parts of the object (Fig. 33). However, samples were only able to be taken from the outer casing. The diamond coated 0.9mm steel bit attempted to bore into the inner wiring; however, instead of producing a sample, the wire began to heat up and stripped away at the diamond coating on the drill bit. The surface of the wire started to turn orange and the drill's contact point turned a dark color. The outer casing retained some of the heat accumulated through drilling. As the wire heated up, the places where it was in contact with the plastic weight boat started to melt, as well as the wax paper underneath. Since the bit was not able to produce any type of usable sample and the weighing apparatus was compromised, no samples of the core wire were taken.

Samples of the outer casing of the pin were far easier to achieve. Initially, tungsten carbide drill bits were used. They easily cut through the surface patina layers and could bore through the outer casing but did not make any progress into the core wire. The tungsten carbide

bits were not efficient at producing enough of a sample to test from just one bore site. Instead, a diamond coated conical sanding and polishing bit was employed. Enough filings were obtained to produce a testable sample.

When exposed to nitric acid, the samples from the outer casing initially turned black with slight foaming before settling into an aqua color- like a more saturated copper sulfide color. The sample labelled SHPα.1 was much more saturated and cloudier than SHPα.2, but that may be due the ratio of solid sample to acid. Also, sample SHPα.2 was focused on collecting the green surface patina layer rather than the terracotta-colored interior of the casing which may have affected the color of the sample when exposed to the acid.

Arrowhead (ARW)

When the pin did not respond well to the tungsten carbide drill bits, the arrowhead was chosen to compare the effectiveness of the sampling tools. Much like the core wire of pin, the metal heated and melted the weigh boat beneath, and no sample was able to be obtained. The initial layers containing the patina were easily eliminated but there was no progress into the deeper bulk material with either the tungsten carbide or the diamond coated bits. Even less filings were produced from the arrowhead than the pin.

Spouted Vessel (SPV)

Unfortunately, no samples were able to be taken from the spouted vessel. There were many points of interest on the spouted vessel— particularly the spout itself and the globular adornments where the spout joins the body. However, both of those spots were determined to be too vulnerable, on the one hand, and too visible, on the other hand. Two spots on the

underside of the foot near the accession number were polished in preparation for sampling. The patina layer was so thin that no sample was obtained. It would have required polishing a significant portion of the foot to obtain enough material. Unfortunately, no samples were able to be obtained from the prepared spots via drilling. The diamond coated spiral steel bits were not able to bore into the material much like they were not able to with the arrowhead and the pin.

Master of Animals Finial for Standard (MAF)

As the most iconic object in the collection, the Master of Animals finial was of great interest to this thesis. There were many considerations taken into account when formulating a sampling strategy for the finial. The upper portions containing the most detail were avoided for cosmetic reasons, but also because they are the most delicate portions and thus at risk from the negative effects of drilling.[112]

As a result, sampling was focused on the lower portion of the finial where elements are thicker (Fig. 32). The central pole is hollow, and any drilling on one face would not affect the appearance of the other. Samples were taken from the foot of the central pole after polishing off the patina layers. On the underside of the foot, there was a significant buildup of material that was able to be sanded off and collected (MAFα.1) for testing. With the 0.9mm diamond coated steep spiral bits, three samples were able to be taken from the prepared spots. Sampling the finial did not have the same heating problems that the pin and arrowhead did. There was no noticeable change in color when the sample came in contact with the nitric acid.

[112] What had looked like a mended breakage on one of the phalanges in photos, seemed to be an outer edge of a join in person. In the sampling proposal, this breakage area was targeted because sometimes ancient fragments are restored to their full form with modern attachments to create an artifact more suited for the marketplace. This scenario still may be the case with this finial, but it was decided that the area would be avoided during sampling in order to not disturb any joins.

Ibex Whetstone Handle (IWH)

As opposed to the Master of Animals finial, the ibex whetstone handle is an object that does not adhere closely to the stylistic canon of Luristan bronzes. For sampling, the ibex finial was of less interest than the handle itself. The ribbing and the protruding rods present phenological anomalies that are of particular interest to this project. Often handles like this do not exhibit this type of ribbing nor is this ribbing stylistically similar to other Luristan bronzes. The rods present an interesting case because they do not add to the comfortability of the handle and seem to only be representations of the ibex's legs. Other similar extant handles depict the legs, but they are more integrated into the handle with less protrusion.

Three spots were prepared on the underside of the handle, one on the leg rod, one on the ribbing near the accession number, and one on the excess of material where the rod joined to the handle (Fig. 34). The rod and the ribbing, when polished, revealed a silver color metal beneath the patina. The join was a copper color. Samples were taken from the handle using 0.9mm tungsten carbide spiral bits. It was clear from their failure on the pin that the bits would not clear dense bronze, but they could possibly work on the silver metal of the handle. Samples were successfully taken from all the silver areas using the tungsten carbide bits. When the solid samples came in contact with the acid, there was initial fizzling and browning but the color of the acid did not change. Fortunately, the bits were also able to work through the copper-colored join. The drill was set at a slightly increased speed and steady and consistent pressure was used on this area that was more significant than on the silver areas. The color of the samples from the copper-colored area turned the same aqua shade as samples SHPα.1&2.

Method of Analysis

The filings were collected in plastic weigh boats to be weighed on an analytical scale. Then the filings were washed from the weigh boat into HDPE Nalgene 10 mL vials by using a pipette and 6M nitric acid (HNO_3) solution. The reaction the solid had to the acid was recorded. Then the vial was agitated to encourage acid digestion with a vortex machine. ICP-MS requires fully digested, liquid samples so the samples were left to digest. Between objects and sampling sites, the drill bits were put through a two-step nitric acid and pure water wash to avoid any cross contamination between samples.

The samples were later further diluted with 18MΩ water to allow the sample to be within the 0-500 ppb Cu calibration range of the instrument. 1 mL of sample was diluted with 14 mL of water to achieve a volume of 15 mL that would accommodate a three-replicate run through the instrument and a 2 mL sample archive. An indium internal standard was prepared at 100 ppb concentration. The multi-elemental standard was calibrated to arsenic (As), copper (Cu), iron (Fe), lead (Pb), and tin (Sn) at a concentration of 100 ppb. Measurements were conducted by a Shimadzu ICP-MS 2030.

Chapter 3: Discussion and Interpretation of Results

This chapter discusses the results of the testing presented in Chapter Two with two goals: 1) to offer thoughts on the authenticity of the tested objects based on the ICP-MS results in conjunction with the visual analyses in Chapter One and, based on these findings, 2) to offer some perspective on their future use as part of the UWMAC.

In total, thirteen samples were taken from three objects: seven from IWH, three from MAF, and two from SPH. Samples from both the patina and bulk material were taken from the IWH and MAF, while the SPH only had samples from its outer casing. The outer casing and the patina layers were labelled with the prefix "α" and the bulk material samples were labelled with the prefix "β." Each sample was run through the ICP-MS in triplicate with the three measurements being averaged. Tables 1 and 2 show the concentration of major elements for each sample, divided by object. The spectra visualize the same data by individual isotopes rather than whole elements (See Spectra 1-11). Elements were identified using a TJA Solutions™ Relative Abundances of Naturally Occurring Isotopes table. Major elements were determined based on the intensity of ^{115}In because indium was used as an internal standard. The intensity count for indium hovered around 20 so any element with a count 20 or above was considered a major element.

These objects were donated to the UWM under the impression that they were all bronze. The pin and the finial are, at least in part, bronze. However, the ibex whetstone handle is an interesting combination of materials. Two different materials are found on the main body— iron and copper. These two materials are discrete: iron is the primary element while copper is relegated to joins. Little of one is found where the other is most concentrated except for in the surface patina layers. A significant amount of copper was found along with iron in the patina, suggesting a copper or bronze coating on top of the bulk iron material. The idea of a surface copper or bronze layer is further evidenced by a polished section on the interior of the handle

(Fig. 35). Upon initial review of the handle, a spot near the rim of the handle was indicated as a site of a suspected repair because of a disruption of the ribbing found all along the length of the handle. Often whetstone handles have perforations in order to string a piece of thread to tie the handle to the whetstone itself. This area was not sampled due to its high visibility, but the patina layer was sanded away post-testing to see whether iron or copper lay beneath the surface. If it was copper, it could have been like the joining areas and therefore suggested later repairs. If it was iron, it could be assumed there was never a perforation and the handle was meant to be whole with the whetstone secured using some sort of adhesive, perhaps. What was revealed, however, was a heterogenous surface with both iron and copper or bronze present.[113] In fact, there is almost a marbling effect between to the two materials. I speculate that the handle was originally cast iron and then a thin layer of bronze or copper was used to cover the entire surface of the handle. It would be a similar effect to gilding, bronze alloy electroplating, or copper-bonded steel. Not only is the disruption in the ribbing a result of this alternative surface layer corroding rather than any repair, but copper-bonded steel, or a similar method, would account for the presence of copper in the IWHα.1 sample.

The major elements of the IWH were antimony, arsenic, barium, cerium, chromium, cobalt, copper, gallium, iron, manganese, molybdenum, nickel, silver, strontium, tin, and tungsten. This is an interesting list of elements to consider in the light of ancient metallurgy because of how much it deviates from what is expected. The presence of chromium, manganese, molybdenum, and nickel in an iron object suggests that the construction material is steel, not bronze or simply iron. However, it is important to note the marked difference of concentrations for certain elements in the surface layers (α samples) and the bulk material (β samples). Concentrations of zinc, tin, and lead are almost doubled or more in the surface layer

[113] I say copper or bronze because the color of the material is not as luminous or orange as the copper found at the joins. It is a more subdued, brownish-orange akin to bronze

than in the bulk material when comparing IWHα.1 (Spectra 5) and IWHβ.4 (Spectra 9), particularly. This disparity could suggest a surface layer of bronze covering a steel core.

Many aspects of the whetstone handle call its authenticity into question. Having a variety of materials on one object is not uncommon, but the way the iron and copper are distributed remains suspicious. Likewise, one must consider the fact that the bulk material of the handle is iron, and not bronze. All of the handles found in both the BAMI and Holmes expeditions were bronze. In my research I did not come across any references to iron whetstone handles said to come from Luristan. The information accompanying this handle in its catalog entry claims a 9th-7th century date of creation which situates it firmly in the Iron Age, straddling Iron Age II and III. In the analysis of the BAMI excavations, it was stated that "whetstones are no longer found in the Iron Age III tombs in the Pusht-i Kuh, which is not surprising since the armament is then made from iron."[114] Bronze weapons need whetting much more regularly than iron ones do. Most extant whetstones from archaeological contexts are from around the transitionary period between Iron Age IA and IB, around 1150 BCE.[115] This puts the UWMAC whetstone handle firmly outside the temporal bounds of extant excavated examples of the same type.

The confinement of the copper to joining sites implies that the material was used as an adhesive or repairing substance. This begs the question: were objects repaired with materials that differed from the primary material? What does this say about the manufacturer's aesthetic concerns? If authentic, it could just be a case of using what was available rather than being concerned about keeping a cohesive aesthetic. Most all the excavated examples of Luristan bronzes come from tombs and these handles are no exception. They were often found without the actual whetstone though, suggesting that these handles were valued for their decorative and

[114] Overlaet, 2003, 183.
[115] Overlaet, 2003, 216-217.

material value as well which would lend itself to caring about the visual qualities of object.[116] Taking into consideration the style of the object as discussed in Chapter One and the results of the analytical tests the *Ibex Whetstone Handle* does not appear to be an authentic Luristan object, much less a "Luristan bronze" as the compositional testing confirms that the object is primarily iron.

The significant elements present in the *Master of Animals Finial* match expectations for ancient bronzes from Luristan. Copper is the most concentrated, tin the second most, and right after tin in intensity is lead. One study noted that the presence of lead is usually an impurity in the ore rather than an intentional additive to the alloying recipe.[117] Secondary elements with a significant presence are antimony, arsenic, barium, bismuth, cerium, chromium, cobalt, copper, gallium, iron, silver, tin, and zinc. Many studies on ancient bronzes report the presence of antimony, arsenic, cobalt, silver, and zinc secondary to copper and tin. The *Master of Animals Finial* is no exception as testing revealed traces of these secondary elements. Without the elemental weight percentages, it is hard to compare the bronze of the UWMAC Master of Animals finial with other tested examples of finials from Luristan. However, the color of its bronze is a golden hue, which usually indicates below 15% tin content since high tin bronze is silvery in tone. Nevertheless, there are some conclusions that can be surmised from the collected data.

There are many aspects of the Master of Animals finial that are in favor of being a genuine Luristan bronze. There are numerous extant examples of finials with similar forms and motifs that firmly place the UWMAC finial in the visual language of Luristan. Of course, there is some variety in the execution of the common Luristan motifs even among excavated examples.

[116] It is unknown what the thought process was when selecting burial goods and if utility in the afterlife was taken into account like the Egyptians or if goods were buried primarily as a sign of wealth. However, the exclusion of the whetstone itself suggests less emphasis on utility and more on materiality and decorativeness.
[117] Oudbashi, 2018, 1449

As discussed in Chapter One, the UWMAC finial and a finial excavated by vanden Berghe (Fig. 11) are quite similar in form, apart from a few components is simply a tight conformity to the visual language that was developed? There is no literature to suggest there is such a culture for one-for-one reproduction, but there is little evidence of the metallurgical scene in Luristan beyond what objects have survived. The fact that there is a visual language at work here implies a replication of forms and iconography, but among the extant bronzes there are no known *exact* replicates. So, it begs the question of whether the similarities between the UWMAC finial and the BAMI finial can be attributed to a close adherence to Luristan's visual language in antiquity or to a modern forger copying a published Luristan bronze but changing a few components as to not completely replicate the existing bronze.

Nevertheless, the visual qualities of the object coupled with the typical bronze chemical composition suggest that the UWMAC *Master of Animals Finial for Standard* is likely to be an authentic Luristan bronze. The lack of recorded findspot or additional provenance information nevertheless potentially undermines this conclusion and will always introduce doubt. There are a number of scenarios that would end with an iconographically sound and chemically typical bronze to be a modern forgery or in the very least a pastiche. Since the chemical concentrations could not be converted into actionable numbers like weight percentages, it is difficult to extrapolate further on certain aspects of the object, like date, that would provide a firmer conclusion. Despite the reasonable doubt, the *Master of Animals Finial for Standard* is an excellent example of a Luristan bronze and should be utilized as such.

The spiral headed pins are most likely bronze. Weight percentages were not calculated because the copper intensity could not be calculated from the known information. Both copper isotopes exceeded the calibration range so the calculations used to estimate the copper and the iron in certain samples of the IWH and MAF could not be carried out here. Consequently, no spectra were generated from the SHP samples. Significantly, however, since the copper

intensity was indeed beyond the calibration range, copper can therefore be recognized as the most concentrated element in those samples. The second most concentrated element is tin - leading to the conclusion that the pins' outer casing is bronze. The bronze outer coating raises questions about metal casting and construction methods utilized in the Near East in the first millennium BCE. When metal is cast, molten metal is poured into molds, which were most commonly made of baked clay, stone, or sand. In the particular investment casting method called the lost-wax technique, a wax model is produced then a clay is packed around the wax to create a mold (Fig. 36). The wax is heated and leaked out of the mold to make it hollow. Molten metal can then be poured into the hollow clay mold so when the clay is stripped, a metal object in the shape of the wax model remains. There are lost-wax processes that employ a core, but the core is usually made of disposable materials, not copper wire. If authentic, these spiral headed pins would be significant outliers in the metallurgical practices of antiquity. Hypothetically, they could represent another method of casting bronze or perhaps be evidence of the trials and errors of developing the lost-wax casting method.

Moreover, Luristan bronze pins often take on a different form than the spirals exhibited in the UWMAC spiral headed pins. In fact, the UWMAC has pins that conform to the canon of Luristan bronzes.[118] They are topped with small animal figures and the shaft of the pins are far more extended. Not found in the UWMAC, but in other collections, are disc pins. They are discs of bronze often with repousse decorations (Fig. 37). Both of these types of pins are typical of Lursitan and can be found in great numbers across a multitude of collections. The spiral motif does not typically take the form of pin but can be found on other objects like pendants and bracelets. Moreover, the extant spiral headed pins found in collections are usually from different cultures, not Luristan, so there is a possibility of these pins being traded goods if they are indeed ancient. However, between the form of the objects and the casting methods used, I

[118] See 1985.002.42 and 1985.002.43 in Appendix A.

would hesitate before asserting that these pins are from Luristan or ancient. The spiral motif is relatively rare in the Luristan canon and does not usually manifest in the form of a pin. In regard to the construction of the pins, I recognize that casting methods are not uniform within a region or era nor are their developments linear, but the uniqueness of the method used for the spiral headed pins dissuades me from supporting a Luristan origin.

A number of the samples were too concentrated to be measured within the calibration range.[119] The instrument was calibrated to measure between 0 and 500 ppb, so any intensity beyond that range is quite significant. In the spectra for IWHβ.1, the iron isotope ^{56}Fe was too concentrated to be enumerated, so its intensity count was estimated using the next abundant isotope, ^{54}Fe. This same estimation was used for the ^{63}Cu values in samples where ^{65}Cu was also in range (IWHβ.5, IWHβ.6, and MAFα.1). Since both isotopes were out of range, the intensity for copper in the samples for the spiral headed pin was not able to be estimated.

Usually, ICP-MS findings are reported in weight percentage (%wt.). First a calibration model would be constructed using a least square's regression line of the initial calibration standard readings. Using the generated equation, the intensity counts of the unknown samples would be converted into concentration in parts per billion (ppb). These concentration calculations were done, and their findings can be found in Tables 1 and 2. The concentration values can be then converted to weight percentages using a series of formulas:

$$concentration\ \left(\frac{\mu g}{L}\right) \times\ volume\ of\ sample\ (L) = weight\ of\ element\ in\ sample\ (\mu g)$$

$$weight\ of\ element\ in\ sample\ (\mu g)\ \div mass\ of\ original\ solid\ sample\ (\mu g)\ \cdot 100 = \%wt$$

[119] To avoid hyper-concentrated samples, a more uniform sample weight and acid volume should be adhered to. This would mitigate variances amongst sample-to-acid ratios that affect the concentration of the liquid sample. If variances were to occur, they could be compensated for at the initial acid digestion. With the preserved sample archive, the hyper-concentrated samples could be diluted and measured again.

These calculations were attempted, but a majority of the results exceeded 100%. Further work would need to be done to smooth out the mathematics of data processing, which may include using the sample archive to run the ICP-MS again or even taking new samples. For now, it can only be estimated what the major elements are and their intensity in the sample. This superficial data, however, helps progress our understanding of the objects in the UWMAC in a material way.

Conclusion: Future Considerations

The future of the so-called Luristan bronzes in the UWMAC is promising. Since the UWMAC is part of an academic institution with a mission expressly focused on pedagogy, deaccessioning will not be suggested for any of the objects. While these bronzes hold almost no archaeological value without any excavation records, they serve as provocative teaching and learning tools that could be utilized at any level of engagement, be it undergraduates in a survey course or graduate students pursuing a thesis.

This thesis is evidence of the pedagogical value of these objects, and it only skimmed the surface of their potential. There were bugs to be worked out regarding sampling consistency and data processing. There is a sample archive that would allow for another run of the ICP-MS without further drilling or sampling, but some of the data processing problems that are present in this thesis would probably persist.[120] The relevance of this thesis to the corpus of literature about Luristan bronzes is diminished by its failure to report data that is consistent in format with past studies. However, the publication of more supposed Luristan bronzes from private collections that were donated to the public sector is significant. It further validates the canon of Luristan iconography as well as introduces anomalies that may be present in other collections.

One of the major hinderances to fully realizing this project was the inability to drill into and obtain samples from a majority of the objects. Sampling strategies in other studies have sawed off pieces from the edges of the object rather than attempting to bore into the bulk material. However, this strategy is more suited to fragments than complete objects. To bore into the object, it may have been better to use diamond bits rather than just diamond *coated* bits because the coating was quickly stripped from the main steel bit. Another alternative would be to use a drill press rather than a handheld rotary tool. A press would be able to apply more and consistent pressure that may have more aptly handled the dense material. A more effective

[120] The sample archive is currently located in Professor Aldstadt's lab in the Chemistry Building on UWM's campus.

sampling strategy could be developed for further testing on the objects that were not able to be tested within the timeline of this thesis.

Further study on these supposed Luristan artifacts is certainly possible. First and foremost is the retrieval of data that is able to be reported in weight percentages in order to more directly compare the UWMAC objects to those in other institutions like the Louvre. However, the angle of this thesis took is only one of the plethora that one could employ. There are many aspects about Luristan bronzes that could serve as fodder for other theses or objects of study for coursework. One angle in particular focuses solely on collection practices and the archaeological campaigns conducted by Americans and Europeans in Iran. Schmidt and the other archaeologists who excavated in Iran were often involved in other excavations, like Persepolis, and had acrimonious relations with the government and people of Iran. The circumstances under which these ancient cultural artifacts were found and subsequently whisked away from their cultural context has profoundly affected the current state of scholarship about these cultures and their artifacts today as well as their status in museum and private collections. The current climate regarding repatriation and the effects of colonialism in the world's art collection would be interesting to discuss alongside the modern history of Luristan bronzes which starts when they first entered the art market at the turn of the 20th century. As much as the verb plunder is used when discussing the retrieval of artifacts from tombs and other archaeological dig sites by the local Lurs, the same could be said from a certain perspective of the American and European archaeologists who excavated whole ancient cities in the name of their country or for their own profit.[121]

In the context of an academic institution, these so-called Luristan bronzes would be excellent pedagogical tools for a variety of classes. Obviously, they could be used in a course devoted to the art of the Ancient Near East. The *flourit* of Luristan bronzes is often

[121] For further discussion on this topic, see: Majd, Mohammad Gholi. 2003. *The Great American Plunder of Persia's Antiquities 1925-1941.* Lanham: University Press of America.

overshadowed by the Achaemenid Persians, but it would be interesting to expand the scope of the class to include Luristan bronzes, especially when discussing the archaeologists associated with the region. Luristan bronzes could be stimulating and thought-provoking subjects for foundational courses. They touch on the more practical considerations of art history and museum studies, particularly collection practices and the development of art history scholarship. The evolution of the scholarship concerning Luristan bronzes exemplifies how approaches to artifacts change from generation to generation as methodologies develop and improve.

Forgeries seem like a niche or taboo subject within the art history community that is not touched upon adequately in the classroom. Studying suspected forgeries teaches one to question sources and develop a healthy sense of skepticism that can be applied to all aspects of academic work. The so-called Luristan bronzes in the UWMAC would be good conversation starters for students just starting out in the field of art history. They would prompt probing questions that in turn fosters a research process that considers all facets of the object. There is a more holistic view that encompasses the entire life of the object, from creation to discovery to the present day.

Admittedly, many of the current questions about Luristan bronzes as a whole are more anthropological or archaeological in nature and would require an interdisciplinary approach. However, art history is built to accommodate other disciplines under its umbrella. In the end, the works of art are the center of the conversation, and any tangential field is in service of further understanding the world in which the objects were created and used. The fact that the UWMAC has a probable mix of authenticities only helps further their pedagogical mission because it gives a variety of scenarios for students to explore. This thesis can serve as a starting point for future students to continue interrogating these objects, especially if their questions reflect upon the contemporary world.

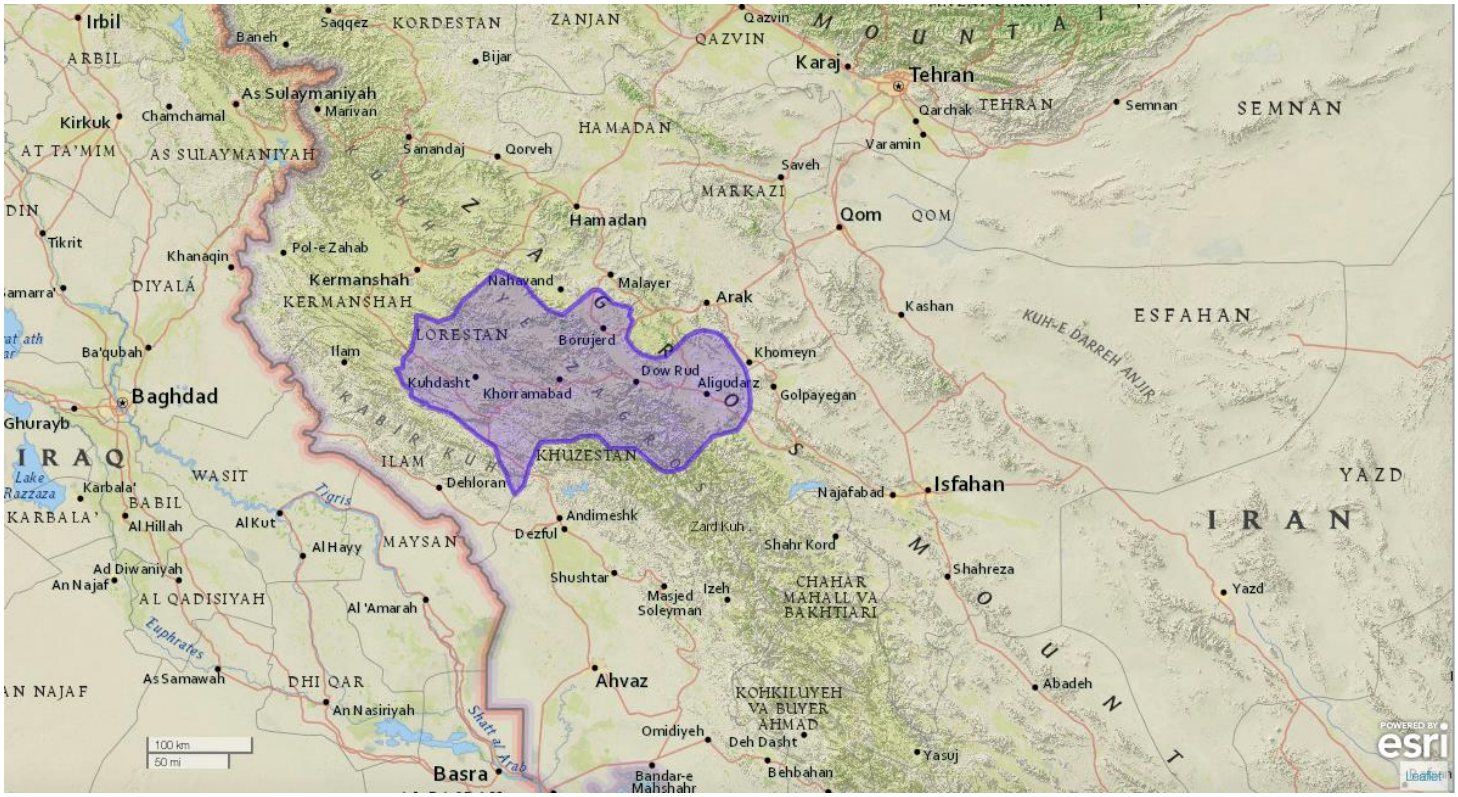


Figure 1 (above): Map of the modern Iranian province Luristan (highlighted).

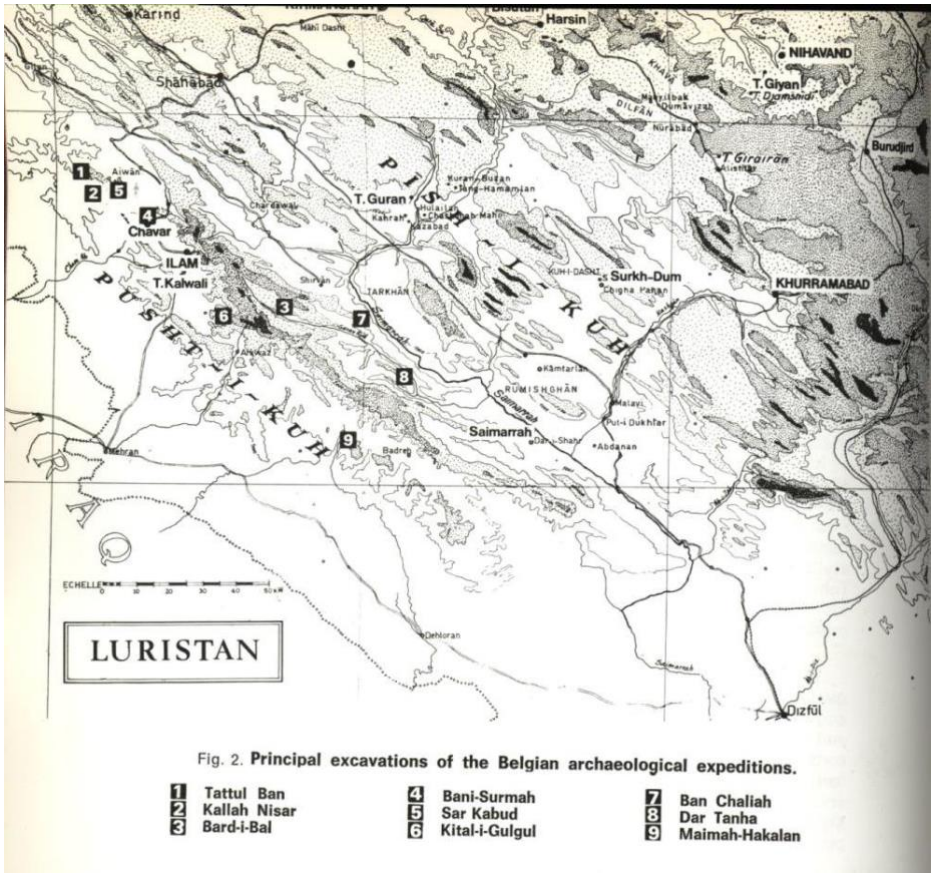


Fig. 2. **Principal excavations of the Belgian archaeological expeditions.**

1 Tattul Ban
2 Kallah Nisar
3 Bard-i-Bal
4 Bani-Surmah
5 Sar Kabud
6 Kital-i-Gulgul
7 Ban Chaliah
8 Dar Tanha
9 Maimah-Hakalan

Figure 2 (left): Map of principal excavations of BAMI. Vanden Berghe, 1973.

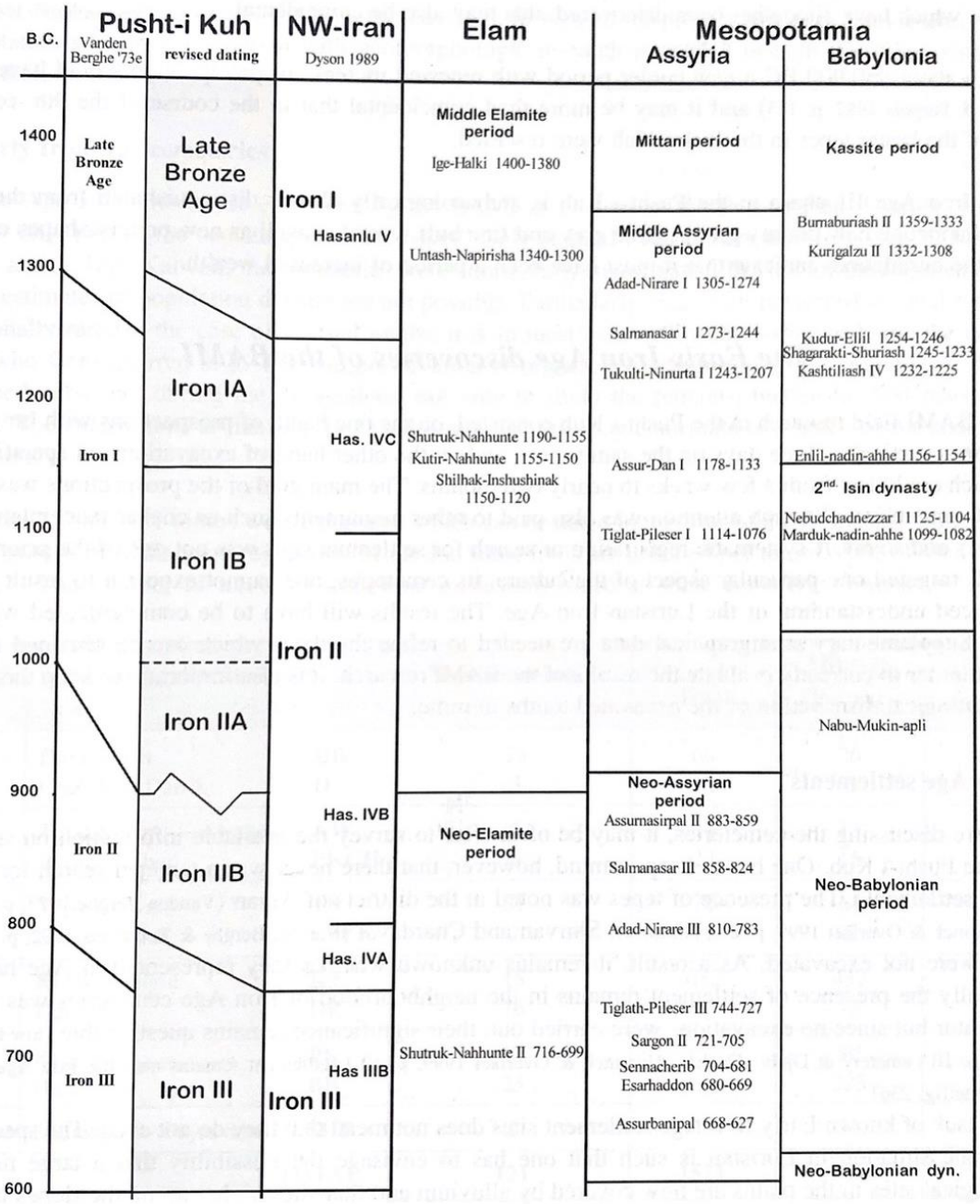


Figure 3: Pusht-i Kuh chronology provided by Overlaet, 2003, 9.

Figure 4: Spouted stone vessel from Uruk, ca. 3,000 BCE. Image from: Iraq Museum Database hosted by Oriental Institute at the University of Chicago.

Figure 5: Spouted vessel from UWMAC (1985.002.39).

Figure 6: Ibex whetstone handle from UWMAC (1985.002.38).

Figure 7: Master of Animals Finial for a Standard *from UWMAC (1985.002.48).*

Figure 8: Whetstone and bronze handle found at Bard-i Bal, Luristan. pl 157 LED vol IV, BB.2-8.

Figure 9: Bronze whetstone handle found in tomb 68 at Bard-i Bal, Luristan, pl 208 LED vol IV, BB.68-12.

Figure 10: Whetstone and bronze handle found in tomb 67 at Bard-i Bal, Luristan, pl 203 LED vol IV, BB.67-10.

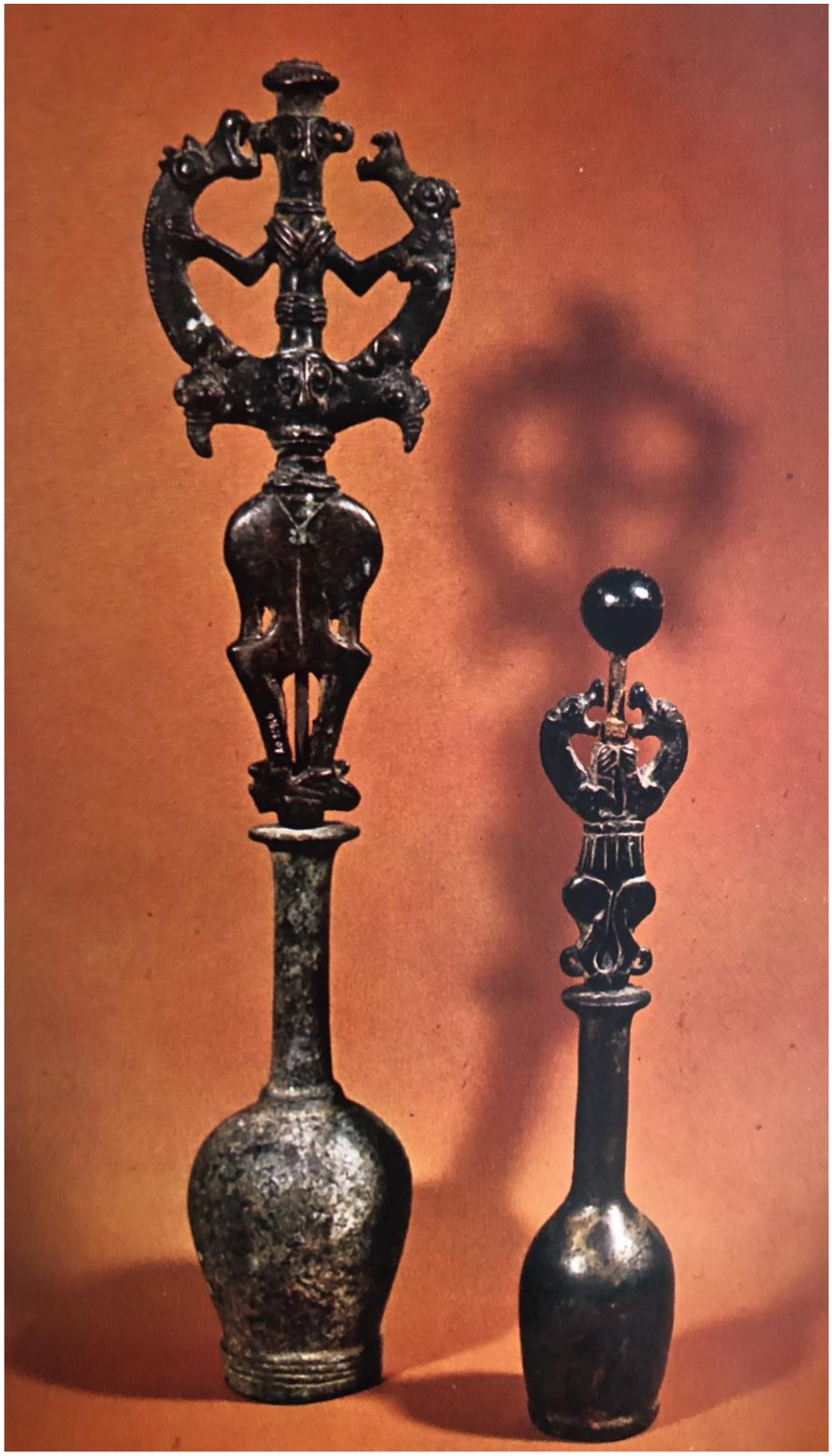


Figure 11 (left): Standard or idol, vanden Berghe, 1973, pl. XXXI.

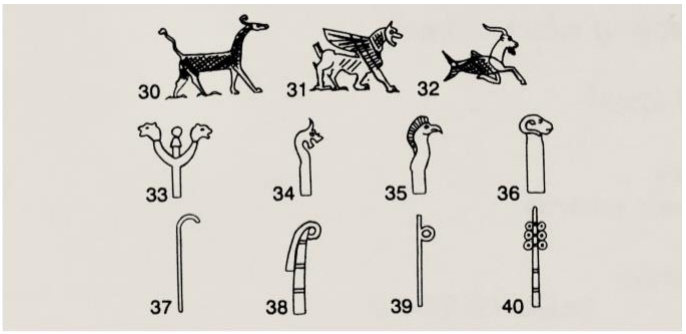


Figure 12: Principal symbols of deities, #33 associated with underworld god Nergal, Green, 1838.

Figure 13: Hemispherical Spouted Jar, Hissar IIIB Iron Age, pottery, Schmidt et al, 1989 pl 139a

Figure 14: Spouted vessel, Luristan, ca. 800-650 BCE, copper alloy, Ashmolean Museum, AN1951.332.

Figure 15: Spouted Vessel, Iran, ca. 9th-8th century BCE, bronze, Metropolitan Museum of Art, 47.32.1.

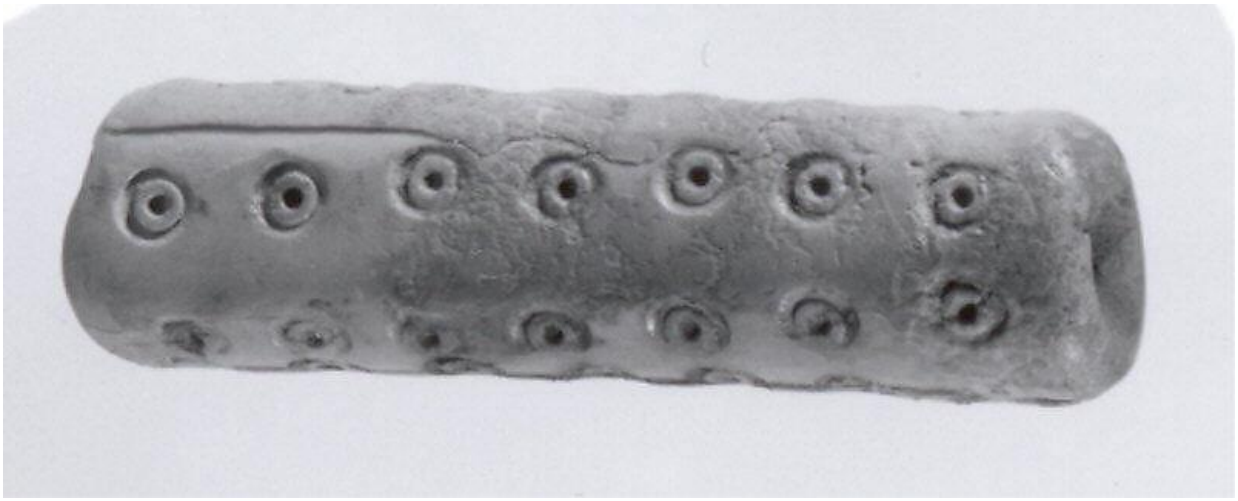


Figure 16: Tube, Hasanlu, Iran, ca. 9th century BCE, bone, Metropolitan Museum of Art, 1976.233.7.

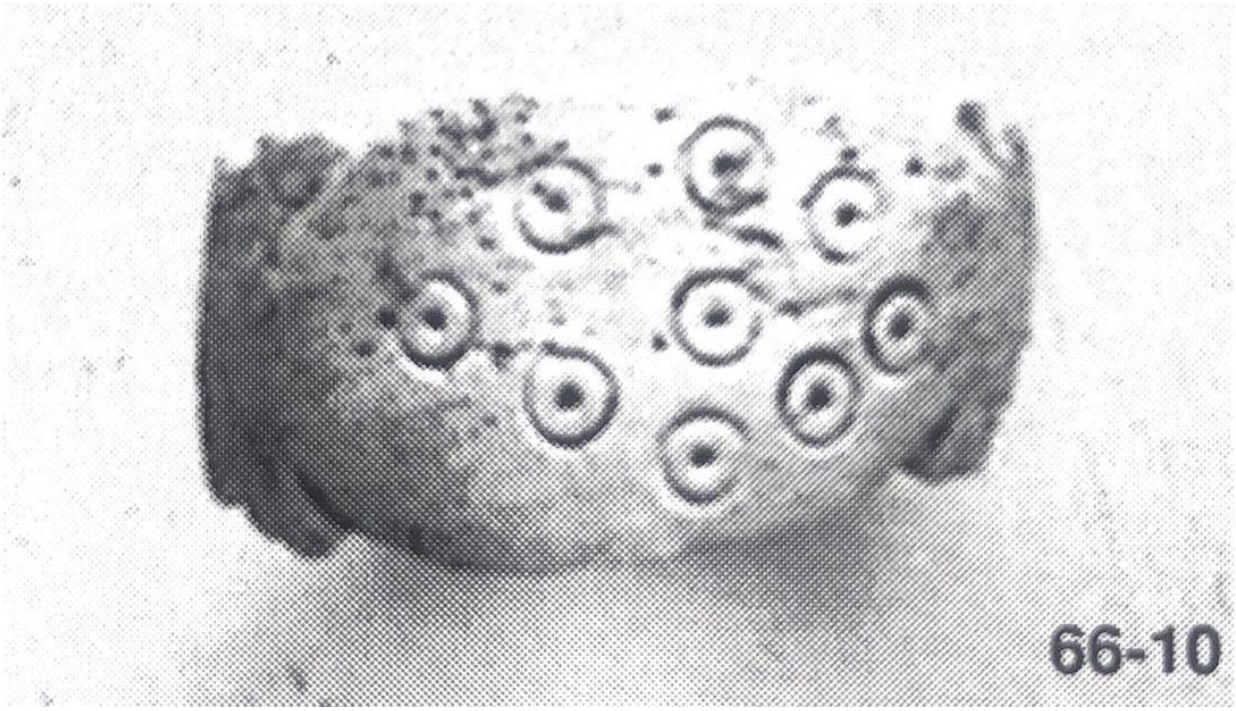


Figure 17: Shell finger ring from Bard-i Bal, Luristan, Overlaet, 2003, pl 202.

Figure 18: Beaker with winged figures (Situla), ca. 10th-9th century BCE, relief mold bronze, UWMAC (1985.002.37).

Figure 19: Beaker with winged human-headed bulls flanking a stylized tree, ca. 10th-9th century BCE, Iran, bronze, Metropolitan Museum of Art, Rogers fund, 1971.129.

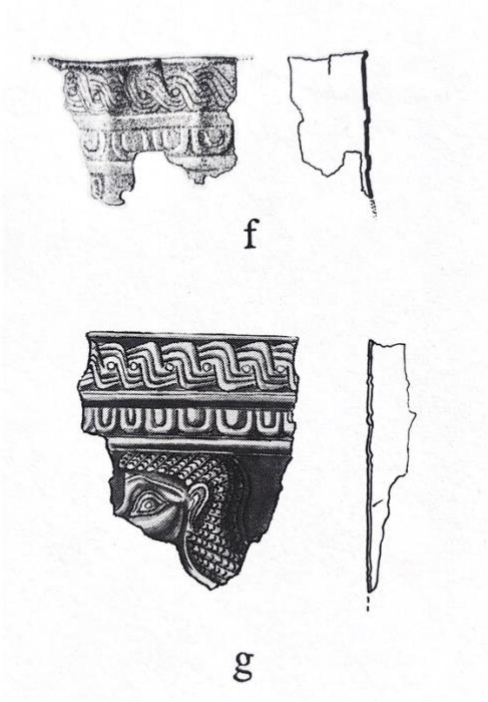


Figure 20: Fragments of beakers from Surkh Dum (f)Sor 185, (g)Sor 1647, Schmidt et al., 1989.

Figure 21: Hairpin with Double-Spiral Finial, ca. 1500-1100 BCE, bronze, UWMAC (1985.002.45).

Figure 22: Copper alloy pendant, Luristan, bronze, British Museum, 1936,0613.126.

Figure 23: Bracelet, Luristan, bronze, Musée du Louvre (AO 13943).©2014 Musée du Louvre / Antiquitiés orientales.

Figure 24: Pin, Luristan, bronze, Musée du Louvre (AO 20846). © 2015 Musée du Louvre / Antiquitiés orientales.

Figure 25: Greek bronze hair or cloak pin, ca. 1st millennium BCE, Artemis Gallery.

Figure 26: Scythian metalworks from the slide collection of Professor J. Haskins at University of Pittsburgh, Qiao.

Figure 27: Arrowhead, ca. 1000-800 BCE, hammered bronze, UWMAC (1991.002.05).

Figure 28: Arrowhead, ca. 1000-800 BCE, hammered bronze, UWMAC (1991.002.09).

Figure 29: Arrowhead, ca. 1000-800 BCE, hammered bronze, UWMAC (1991.002.06)

Figure 30: Arrowhead, ca. 1000-800 BCE, hammered bronze, UWMAC (1991.002.10).

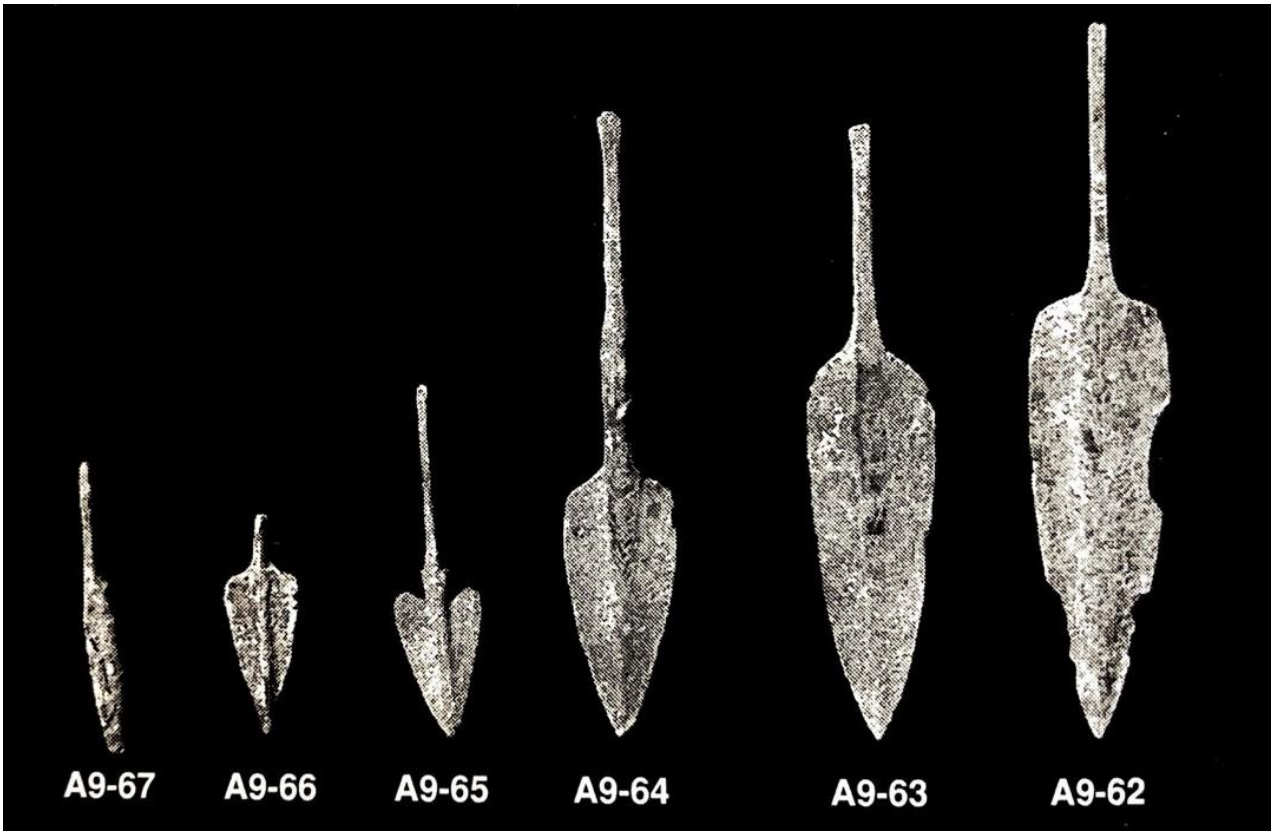


Figure 31: Arrowheads from Kutal-i Gulgul, tomb 9, Overlaet, 2003, pl 89.

Figure 32: Polished sampling area of the Master of Animals Finial *(1985.002.48).*

Figure 33: Sampling area of the Hair Ornament *(1985.002.45).*

Figure 34: Sampling sites on the Ibex Whetstone Handle *(1985.002.38) after drilling.*

Figure 35: The sanded areas of the Ibex Whetstone Handle (1985.002.38) to expose the surface of the object. Also seen is the handheld rotary tool with conical diamond coated sanding bit.

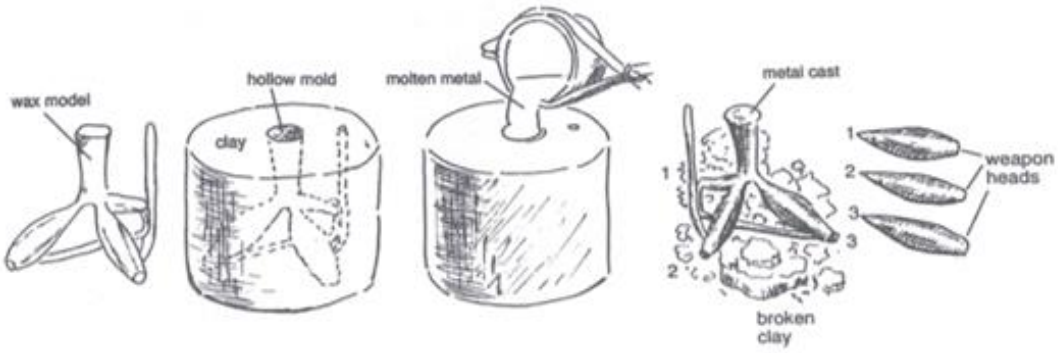
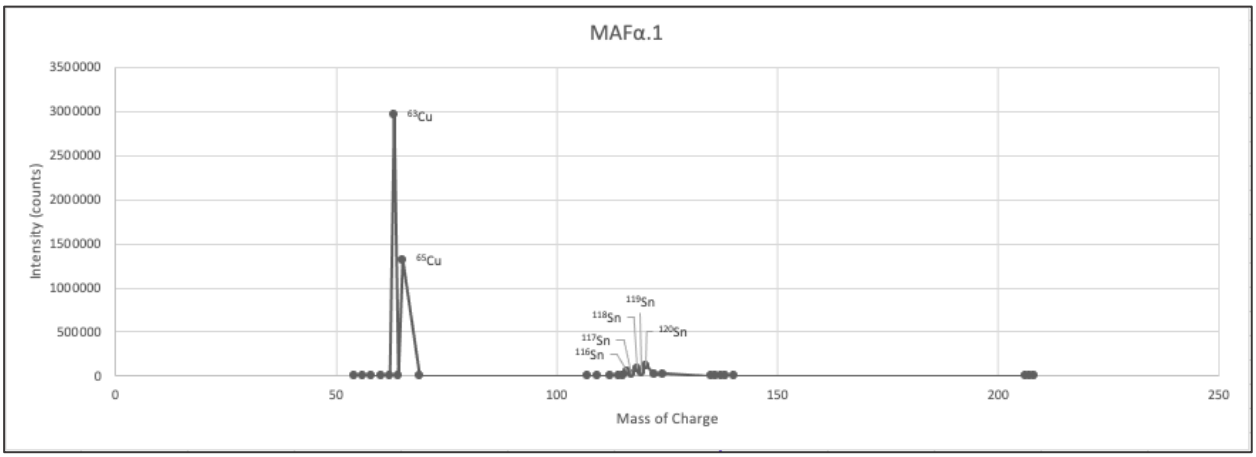


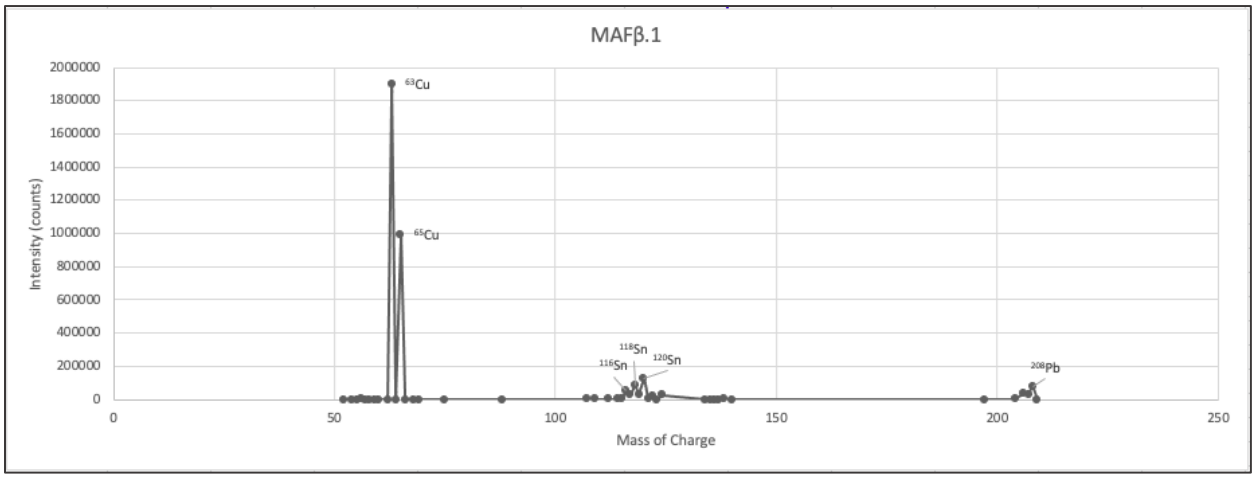
Figure 36: Reconstruction of lost-wax casting technique, Gunter 1995, 1547.

Figure 37: Disc-headed pin, ca. 8-7th century BCE, Iran, bronze, The Metropolitan Museum of Art (39.96.1).

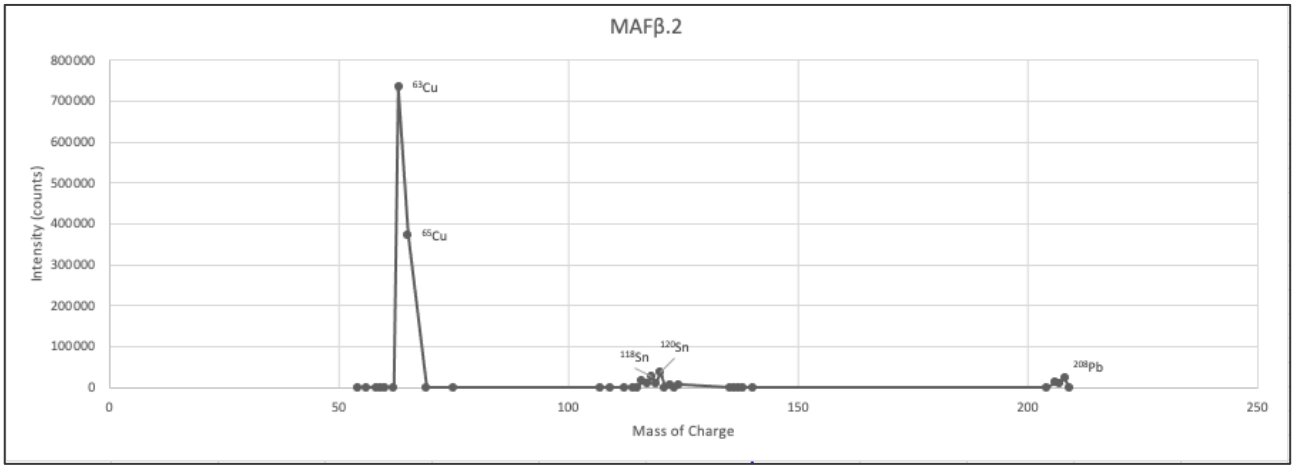
Spectra 1- 11: ICP-MS raw intensity counts by isotope. Only major elements were charted.



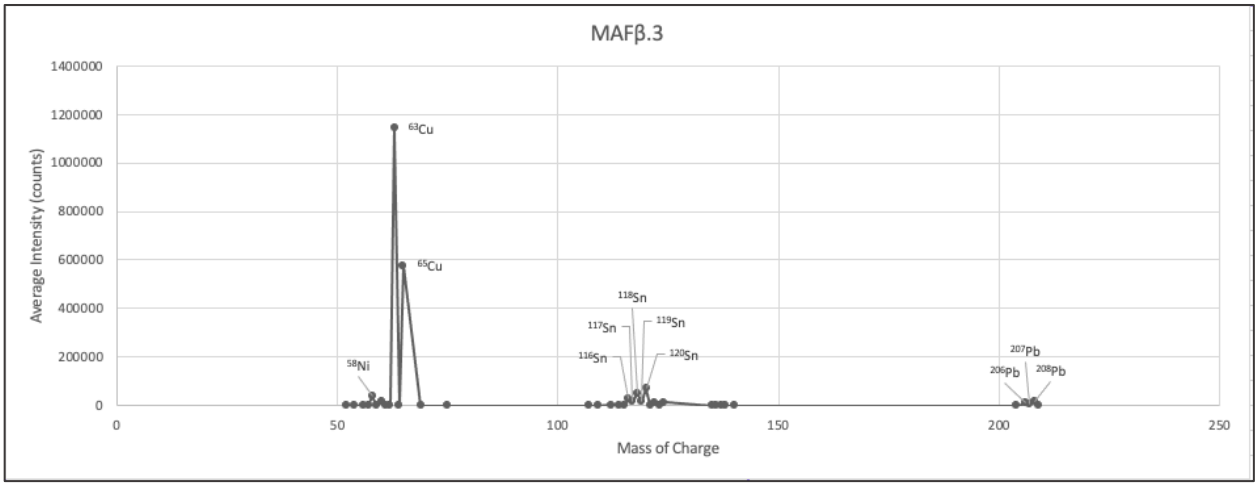
Spectra 1: Intensity of isotopes in sample MAFa.1.



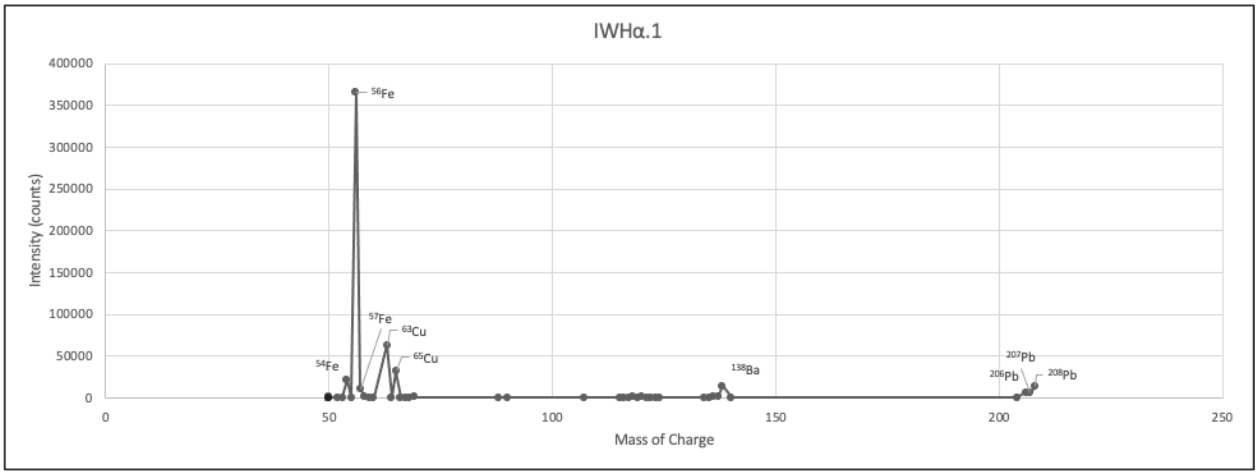
Spectra 2: Intensity of isotopes in sample MAFb.1.



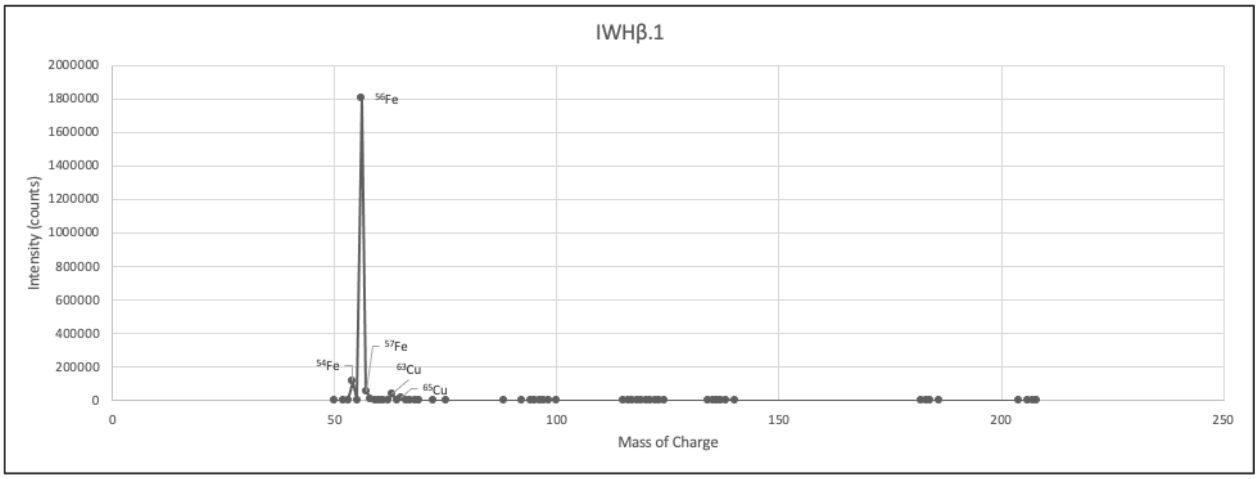
Spectra 3: Intensity of isotopes in sample MAFb.2.



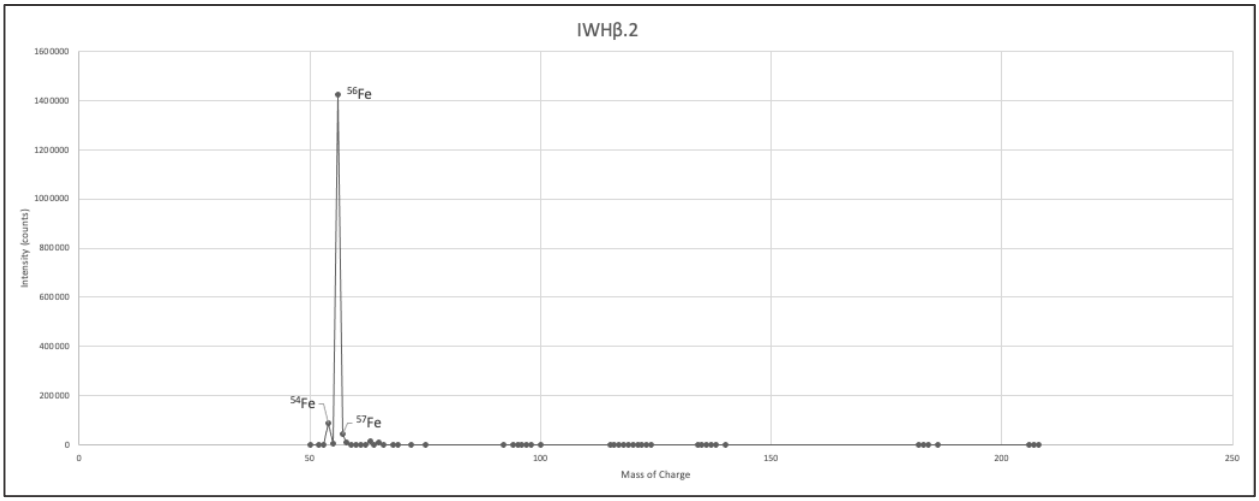
Spectra 4: Intensity of isotopes in sample MAFb.3.



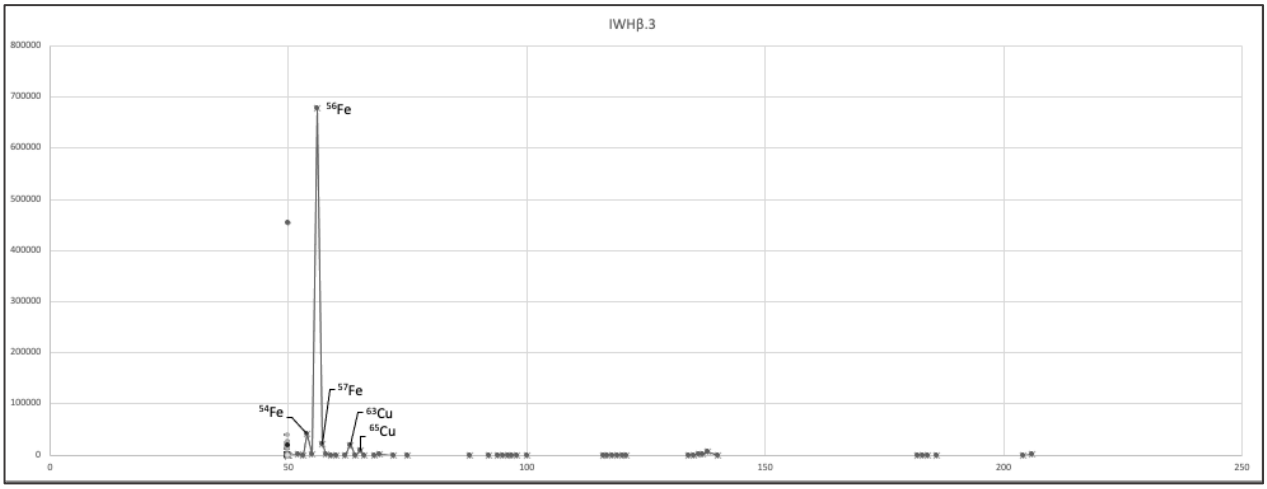
Spectra 5: Intensity of isotopes in sample IWHa.1.



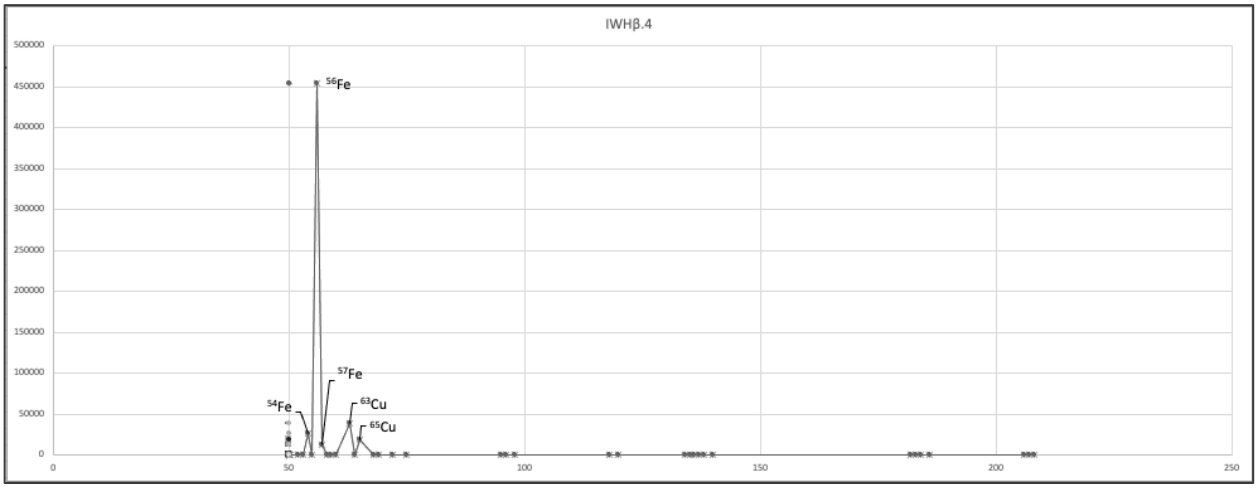
Spectra 6: Intensity of isotopes in sample IWHb.1.



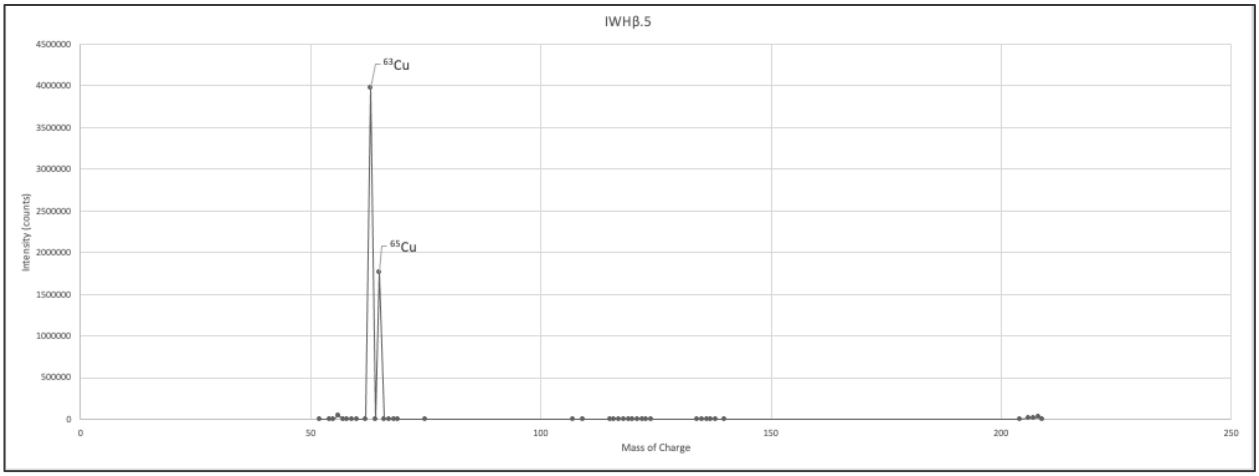
Spectra 7: Intensity of isotopes in sample IWHb.2.



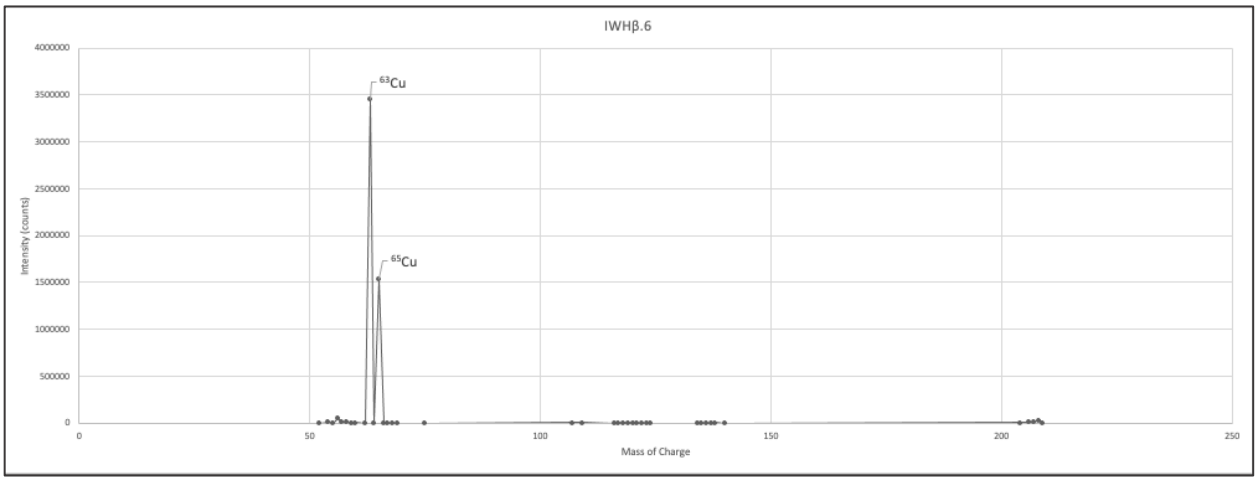
Spectra 8: Intensity of isotopes in sample IWHb.3.



Spectra 9: Intensity of isotopes in sample IWHb.4.



Spectra 10: Intensity of isotopes in sample IWHb.5.



Spectra 11: Intensity of isotopes in sample IWHb.6.

Table 1a: Total concentration of major elements of the *Master of Animals Finial* in parts per billion (ppb).

Sample Name	Chromium	Iron	Cobalt	Nickel	Copper	Zinc	Arsenic
MAFα.1	11.22	25.35	11.56	30.20	88542.55	12.95	11.36
MAFβ.1	12.03	240.42	17.49	29.88	6828.12	16.41	12.21
MAFβ.2	14.06	29.88	13.97	26.88	22000.74	26.88	14.04
MAFβ.3	11.13	55.56	17.56	1637.21	34247.05	23.31	12.37

Table 2a: Total concentration of major elements of the *Ibex Whetstone Handle* in parts per billion (ppb).

Sample Name	Chromium	Iron	Manganese	Nickel	Cobalt	Copper	Zinc	Arsenic
IWHα.1	32.61	10945.70	27.37	47.18	14.27	1888.87	40.33	11.32
IWHβ.1	59.20	71551.37	163.31	377.69	20.09	1148.47	19.26	13.08
IWHβ.2	46.02	42713.89	127.12	301.44	18.03	446.10	15.15	12.64
IWHβ.3	53.02	678207.70	65.67	82.55	18.18	613.32	15.39	11.98
IWHβ.4	36.37	13602.60	29.92	55.11	15.46	1158.46	12.99	11.69
IWHβ.5	13.03	1250.50	12.04	43.32	13.66	119005.90	31.70	15.24
IWHβ.6	12.41	1292.80	11.73	41.99	13.87	103254.23	23.62	14.34

Table 1b: Total concentration of major elements of the *Master of Animals Finial* in parts per billion (ppb).

Silver	Antimony	Tin	Gold	Lead	Bismuth
19.07	19.07	3575.38	11.11	15.54	11.24
50.31	51.26	3842.92	16.54	2432.28	24.50
22.57	26.21	1157.72	11.62	767.34	14.92
27.40	49.30	2070.29	11.58	539.38	14.26

Table 2b: Total concentration of major elements of the *Ibex Whetstone Handle* in parts per billion (ppb).

Strontium	Molybdenum	Silver	Tin	Antimony	Tungsten	Lead	Bismuth
14.55	13.85	12.28	42.83	12.50	11.15	419.91	11.22
12.29	42.78	12.26	23.98	15.13	19.67	140.22	11.42
11.49	36.30	11.59	21.52	14.46	20.56	30.18	11.12
0.36	18.99	11.65	13.67	12.37	17.44	171.48	11.21
11.57	15.62	11.59	13.36	11.88	16.18	30.30	13.13
11.57	11.58	44.26	46.63	21.54	12.12	1015.21	13.98
11.49	11.45	30.38	27.90	19.30	12.35	820.75	13.41

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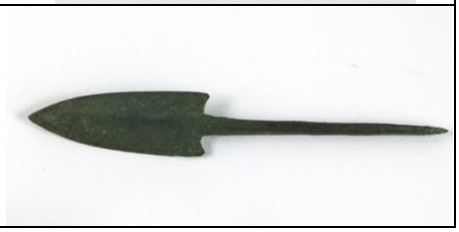
Appendix A: Catalogue of Luristan Bronzes in UWM Art Collection

Accession Number	Title	Category	Recorded Medium	Image
1985.002.37	Beaker with wings figures (situla)	Kitchenware	Relief Molded Bronze Sheet Metal	
1985.002.38	Handle with Ibex Head Finial	Zoomorphic	Cast Bronze	
1985.002.39	Vessel with Spout	Kitchenware	Hammered Sheet Metal	
1985.002.41	Bracelet with Snake's Head Finials	Personal Artifact	Bronze	

1985.002.42	Pin with Horse-Shaped Finial	Personal Artifact	Bronze	
1985.002.43	Pin with Bird-Shaped Finial	Personal Artifact	Bronze	
1985.002.44	Hairpin	Personal Artifact	Bronze	
1985.002.45	Hair Ornament	Personal Artifact	Bronze	

1985.002.46	Hairpin with Double-Spiral Finial	Personal Artifact	Bronze	
1985.002.47	Ibex Figurine	Zoomorphic	Bronze	
1985.002.48	Master of Animals Top for standard	Master of Animals Standard	Cast Bronze	
1991.002.05	Arrowhead	Weaponry	Hammered Bronze	

1991.002.06	Arrowhead	Weaponry	Hammered Bronze	
1991.002.07	Animal Charm	Zoomorphic	Cast Bronze	
1991.002.08	Encrusted Bowl	Kitchenware	Hammered Brass	

1991.002.09	Arrowhead	Weaponry	Hammered Bronze	
1991.002.10	Arrowhead	Weaponry	Hammered Bronze	

Appendix B: Request for Scientific Analysis of Objects in the UWM Art Collection

Requested By: Hannah Rillie, Master's degree candidate in the Department of Art History, UWM

List UWMAC Object Accession number(s) with brief object description(s):

1985.002.38	Handle with Ibex Head Finial
1985.002.39	Vessel with Spout
1985.002.45	Hair Ornament
1985.002.48	Master of Animals Top for Standard
1991.002.05	Arrowhead

Project description with rationale explaining primary research goals, desired outcomes, and the significance of your proposed research techniques.

The objective behind testing a selection UWM's Luristan bronzes is to accumulate as much information about them as possible seeing as the provenance records are less than illuminating. Their authenticity and value to the UWM collection has come into question before and this project aims to shed light on the bronzes' enigmatic origins.

Forgeries and pastiches of Luristan bronzes have populated museums and collections since the early to mid 1900s. Their status was confirmed through the analytical testing and comparison of suspect and excavated bronzes. This project aims to do much the same with the UWM bronzes by conducting a compositional analysis using inductively coupled plasma mass spectrometry (ICP-MS). Although it is a type of destructive analysis, it allows for the testing of the uncorroded bulk material lying at the core of the statue. To rely solely on non-destructive methods would be to limit the depth and accuracy of any attempts at assessing the composition of the original material.

However, determining the composition of a metal alloy is not a definitive method of authenticity because metals are repurposed and re-smelted both in antiquity and modernity. A metal can keep its composition over multiple workings. So, the composition of a metal may reflect similar practices used in antiquity, but it does not give an indication of the date of the object it forms. To tackle this question of authenticity, this project aims to examine the different corrosion products present on the UWM bronzes. One of the ways in which modern forgeries come to look ancient is through the production of artificial corrosion and patinas. Samples of the corrosion layers itself would be taken and run through the ICP-MS as well as scrutinized under a microscope in a metallographic exercise.

All of these tests are efforts to obtain a clearer picture of what exactly compromises UWM's Luristan bronzes and how they compare to confirmed Luristan bronzes. At the moment, the bronzes hold a tenuous spot in the collection as the questions they raise seem to outweigh the pedagogical value they could provide.

Scientific testing relies on the repeatability of a test. An outcome of this testing process would be the development of a protocol for the UWMAC to use for possible future testing on objects in the collection. This form in and of itself if the first step in producing this desired outcome but the project aims to expand upon it and develop a thorough and repeatable protocol in which the UWMAC could adopt.

Description of technique(s) to be used, including justification for why this the most appropriate specimen for this analysis.

Inductively coupled plasma mass spectrometry is an elemental analysis tool capable of detecting most of the periodic elements at the scale of milligrams to nanograms per liter. In

terms of bronze, this allows for the percentages of all the constituent parts of the metal alloy to be determined. The application of ICP-MS on Luristan bronzes has been one of the most recent attempts at understanding the metallurgy of Iran in the first millennium BCE. The timeline for Luristan bronzes spans across the development of metallurgy in Iran and the percentages of copper, lead, and other alloys can give hints as to which stage in the development from the Bronze Age to the Iron Age a particular object falls.

This project's focus on corrosion lends itself to the use of metallography. Metallography is the study of the physical structure and components of metals. A sample of the metal is mounted and prepared for a slide to be viewed under a microscope. From there, the structure of the corrosion layers and the production pattern of the object can be viewed and analyzed. This is the most appropriate way of testing the corrosion because of its ability to keep the layers intact so the development of the layers can be determined.

A common section in scientific papers on metal objects is metallography. This highlights the ways in which a metal was worked (i.e., annealing and cold working) and starts to give a sense of how the object was created. What is most relevant to this project is the kind of samples used: cross sections. Cross sections can include the bulk material and all the intervening layers between it and the surface of the object. This can provide insight into the development of corrosion on an object. The samples for this can be obtained from the usually discarded initial shavings of the drillings for the ICP-MS samples. To avoid contamination of the bulk material, the first twists of the drill are discarded. For the purposes of this project, those shavings could be collected and mounted on slides to examine under a microscope. The micrographs taken of these slides can document and illustrate the corrosion layers of the bronzes.

In the case of destructive analysis, indicate:

Necessary sample size(s): 1.0 g (the ICP-MS needs at least 0.25g but a slightly larger amount is needed to account for corrosion and multiple runs of the ICP-MS)

Sample Removal method: Dremel rotary drill with 0.6-0.8 mm tungsten drill bit or Teflon tweezers

Sample location on object: Spots with the least surface corrosion will be the main target to avoid unwanted contamination and reduction in sample size. This would vary object to object. Ancient bronzes have been found to be heterogenous copper alloys so multiple sites of sampling on one object would be the most illustrative of the object's composition.

Documentation strategy: Before any sampling would be done, I will take preprocessing photos of the objects with special attention paid to areas of interest (i.e. sample sites). I then draw up an action plan which indicates where on the object I would take a sample and what method of removal is planned. I would label those sites and adhere them to the containers in which I plan to house the samples in before taking them to the lab.

Once at the lab, I would keep a log of my steps I took through preparing the sample for testing and all settings I used for the equipment. The data I produced would then be put into spreadsheets and processed via statistical analysis. My final data would be submitted in a report to the UWMAC and featured in my thesis.

Other considerations (re: material, fragility, sampling impact on object's state)

Some objects will not be considered for drilling because of their advanced corrosive state. These objects would be sampled using Teflon tweezers. The impact of sampling on an object would be minimal. Sample sites would not target areas of stability like joints or delicate finials. The bore holes from drilling would be small as the diameter of the bits (0.6-0.8 mm) would suggest.

Details regarding treatment of samples.

Process location:

The ICP-MS and microscopes are in the UWM Chemistry Lab. Samples can be taken in the UWMAC storage facility. The contained and labelled samples can then be transported to the lab.

Post-process condition:

ICP-MS: destroyed

Metallography: mounted on slide

Identify primary research team, list credentials and/or previous experience or prior projects similar or related to the analysis proposed.

Hannah Rillie: Master's degree candidate at UWM. Two independent studies conducted at Monmouth College concerning the methods of scientific analysis on material culture, specifically marble and pigments. Has taken to chemistry lab courses in a post-baccalaureate program.
Dr. Joseph Aldstadt: chair of the Department of Chemistry and Biochemistry at UWM with a focus in material science; prior research experience with Milwaukee Art Museum Conservation Lab.

Relevant bibliography (esp. analogous studies with respect to material or technique).

- Begemann, Friedrich, Emie Haerinck, Bruno Overlaet, Sigrid Schmitt-Strecker, and Françoise Tallon. 2008. "An Archaeo-Metallurgical Study of the Early and Middle Bronze Age in Luristan,Iran." Iranica Antiqua 43 (January 2008): 1–66. doi:10.2143/IA.43.0.2024041.
- Fleming, S. J., V. C. Pigott, C. P. Swann, and S. K. Nash. 2005. "Bronze in Luristan: Preliminary Analytical Evidence from Copper/Bronze Artifacts Excavated by the Belgian Mission in Iran." *Iranica Antiqua* 40 (January 2005): 35–64.
- Oudbashi, Omid. 2018. "Bronze Alloy Production during the Iron Age of Luristan: A Multianalytical Study on Recently Discovered Bronze Objects." *Archaeological and Anthropological Sciences*. 10, no. 6 (2018): 1443-1458.
- Oudbashi, Omid and Ata Hasanpour. 2018. "Bronze alloy production during the Iron Age of Luristan: a multianalytical study on recently discovered bronze objects." *Archaeol Anthropol Sci* (2018) 10:1443–1458. DOI 10.1007/s12520-017-0466-9
- Oudbashi, Omid, Ata Hassanpour and Parviz Davami. 2016. "Investigation on corrosion stratigraphy and morphology in some Iron Age bronze alloys vessels by OM, XRD and SEM–EDS methods." *Appl. Phys.* A (2016) 122:262. DOI 10.1007/s00339-016-9793-4
- Ooudbashi, Omid, S. Mohammadamin Emami, Mehrdad Malekzadeh, Ata Hassanpour, and Parviz Davami. 2013. "Archaeometallurgical Studies on the Bronze Vessels from 'Sangtarashan', Luristan, W-Iran." *Iranica Antiqua* 48 (January 2013): 147–74. doi:10.2143/IA.48.0.2184698.
- Stepanov, Ivan, et al. 2017. Methodologies for the investigation of corroded iron objects: examples from prehistoric sites in South-eastern Arabia and Western Iran, *STAR: Science & Technology of Archaeological Research*, 3:2, 270-284, DOI: 10.1080/20548923.2018.1424304
- Waldbaum, Jane. "Antiquities Without Pedigrees: UWM's Luristan Bronzes." unpublished report.

Anticipated deliverables.

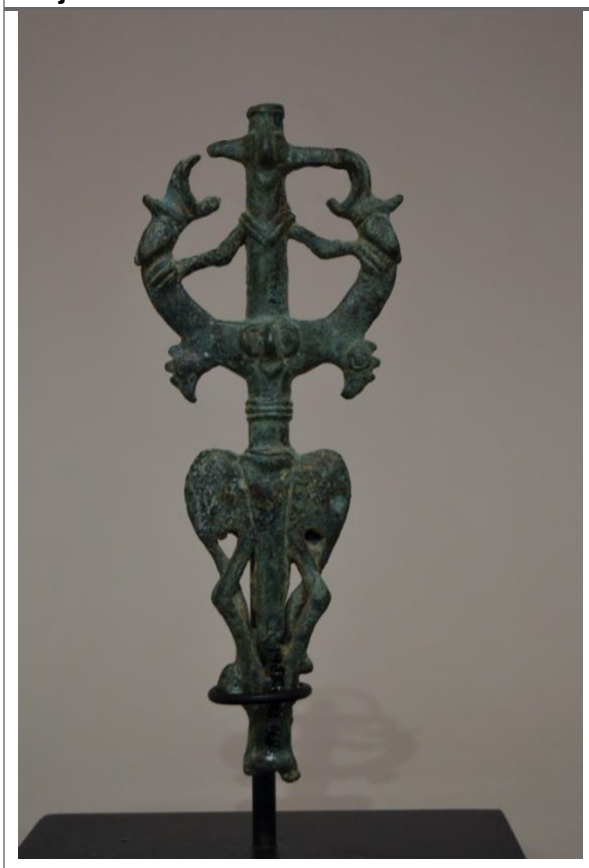
Data produced from the proposed testing would be published in three different documents. One would be my Master's thesis which is focusing on the UWM Luristan bronzes as a whole and the role of object's like them in university collections. An additional report will be written and

delivered to the UWMAC that presents the data as a whole and then breaks it down by object. This would be much like a lab report which details procedures, materials and methods, results, and a discussion of those results.

Furthermore, I plan to publish my findings in the Journal of Archaeological Science: Reports. This is a journal that focuses on the application of scientific methods to archaeological problems and debates. My study would be particularly relevant to the increase of articles being published about Luristan bronzes in similar journals (as seen in the provided bibliography). ICP-MS is a relatively recent development in the application of scientific methods on archaeological material. This study would build off of precedents while adding new datapoints to a growing effort to analyze the world's collection of Luristan bronzes.

Appendix C: Proposed Sampling Sites for Composition Testing

Hannah Rillie
March 2, 2021

Object	Areas of Interest	Notes
	Main Areas: - Central Pole - Phalanges Patina: There is a fairly uniform patina across the entirety of the object, which makes it less of a consideration than structural integrity. Specific Sites: For the central pole, a sample will be taken in the lower portion near where the accession number has been placed. For the phalanges, there is a visible mended break on the left-hand side between the lower face and the bird's head. It might be illuminating to sample on either side of the break.	The upper portions containing the most detail will be avoided for: (1) cosmetic reasons and (2) they are the most delicate portions and most prone to negative effects from drilling. Focus will be placed on the lower portion where elements are thicker. The central pole is hollow, and any drilling will not affect the appearance of the verso. Modern attachments may have been adhered to an ancient core to create an artifact more suited for the marketplace.
	Main Areas: - Tang Patina: There is a fairly uniform patina across the entirety of the object so that is less of a consideration than the structural integrity or the visibility of the drillholes. Specific Sites: A variance of placement would be ideal: close to the point and further down the tang.	The tang presents the thickest portion of the projectile and has the greatest chance of preserving the ancient bulk material at the core.

	Main Areas: - External coating - Internal wiring Patina: These pins are particularly corroded, and their testing is more focused on the patina/corrosion products rather than the ancient material. Specific Sites: The area in focus in the provided image will be the major focus. It provides unfettered access to the internal wiring that the other pins do not (except for one where the wire is exposed at the tip of the pin).	The construction of these pins is particularly interesting. Luristan bronzes are most often cast using the lost-wax method; having an internal wiring armature like this is odd. It would be interesting to ascertain whether the internal wiring is a different material than the external coating. The patinas on them are obviously rather different- is that due to exposure or different materials?
 	Main Areas: - Handle rather than delicate finials - Suspected repair Patina: Compared to the other bronzes, this patina is particularly light in hue and has a significant number of tan spots. There are interesting deposits particularly on the underside with a unique texture that are of interest. Specific Sites: There is a disturbance in the ribbing near the opening of the handle that may indicate a repair. The added rods that allow the object to sit easily on flat surfaces are some of the thickest spots that present an opportunity to get at the bulk	The finial elements that are representational of the ibex are of less interest than the actual handle part where a hand would grip. The ribbing, suspected repair, and the protruding rods present anomalies that are of particular interest to this project. Often handles like this do not exhibit this type of ribbing nor is this ribbing stylistically similar to other Luristan bronzes. The suspected repair is of a pair of holes that would have had a string threaded through the handle and the stone to secure the two together. This whetstone handle does not have any

	material. However, the neck might provide a similar opportunity. The oddly textured bits mentioned in the patina section that rest between the two rods would present a good place to sample from.	such hole but there are indications of where the holes may have once been. The date of the repair is unknown. The rods present an interesting case because they do not add to the comfortability of the handle and seem to only be representations of the ibex's legs. Other similar extant handles depict the legs, but they are more integrated into the handle and do not protrude as much.
	Main Areas: - Foot - Spout Patina: The patina is consistent across the entire object with a particular patination at the joining sites. Since joints are to be avoided, those areas of differing patination will not be of great issue. Specific Sites: There are obvious signs that this vessel was cast in parts and joined together later. Keeping in mind the aesthetic quality of the vessel after testing and the thickness of the bronze, the underside of the foot would be the most likely place to find access to the bulk material. Another place would be the rivets surrounding the spout joint- assuming they are solid, globular	A consideration to take into account with this vessel is the, presumably, putty that sits at the bottom of the interior of the vessel. I think this helps allow the vessel to sit nicely on a flat surface but may need to be removed in the sampling process to ascertain just how thick the foot is. The walls of the vessel and the spout are thin enough that it would probably be impossible to access the bulk material- either it is completely corroded away or so small a sample that it is not worth the effort to extract it. The two proposed sites also provide to the opportunity to see if the bronze used is significantly heterogenous or not.

	shapes. There are rivets that are not readily seen that could be tested.	Significant differences in alloys may point to different casting dates.