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The Swords of Shule

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Chapter 23
The Swords of Shule

The hill Ephraim is the location that king Shule "did moulten out of the hill, and made swords out of steel" (Ether 7:9). The inclusion of this particular incident in the Jaredite record is quite curious. Warfare occurred prior to this time among the Jaredites. The rest of the history of the Jaredites indicates regular, periodic warfare, and swords are also periodically mentioned. However, nowhere else is it mentioned that any other Jaredite swords were made of steel. The mentioning of this fact takes on increased meaning when one considers that Ether was in a direct line to Shule and the right to kingship from Ether's father, which was from Coriantor, who lived in captivity, and his grandfather Moron, who was deposed from the throne by a competing line from the brother of Jared (Ether 11:17–23) (see figure 97).

Why are steel swords uniquely manufactured at this point in the Jaredite narrative? And how does the manufacture of such swords relate to metallurgy among the Olmec?

Consistent with the Jaredite geography discussed previously, the location where Shule found himself in the Tuxtlas did not contain any natural sources of obsidian (Santley 2007, 127), and since he was an outcast to the kingdom controlled by his enemy, he may not have had any access to obsidian by means of trade. While perhaps counterintuitive, some volcanoes, such as those in the Tuxtlas, are virtually devoid of obsidian as it only forms in eruptions where the cooling of the appropriate volcanic material is rapid, avoiding the formation of crystals. Shule thus had to make do with what he had to create sufficient weapons to retake the kingdom, which may have added to his mythological status.

Ether was the keeper of the Jaredite lineage, the record of his royal ancestors, which presumably passed from father to youngest son. The records consisting of the 24 gold plates that Ether left were found together with swords "the hilts thereof have perished, and the blades thereof were cankered with rust" and breastplates which are "large, and they are of brass and of copper, and are perfectly sound."

It seems likely that the swords of Shule are the very same swords that were deposited with the gold plates of the Jaredites. No other mention of rust is made in the Book of Mormon other than as literary allegory. The only other mention of a steel sword in the Book of Mormon is the sword of Laban (1 Nephi 4:9), which was made of "fine steel." Nephi_1 used the sword of Laban in "defence" of his people (Jacob 1:10), as likewise did king Benjamin (Words of Mormon 1:13). The sword was then delivered to his son Mosiah_2 (Mosiah 1:16). The sword of Laban appears to have been maintained as a sacred ancestral object among the Nephites, similar to the practice with Goliath's sword in ancient Israel (1 Samuel 21:9).

Also consistent with the practice of the transfer of a sword as a sacred object, the Book of Mormon plates were also buried with a breastplate as were apparently the Jaredite gold plates. While not directly noted in firsthand accounts, the sword of Laban was also buried together with the Book of Mormon plates (D&C 17:1).

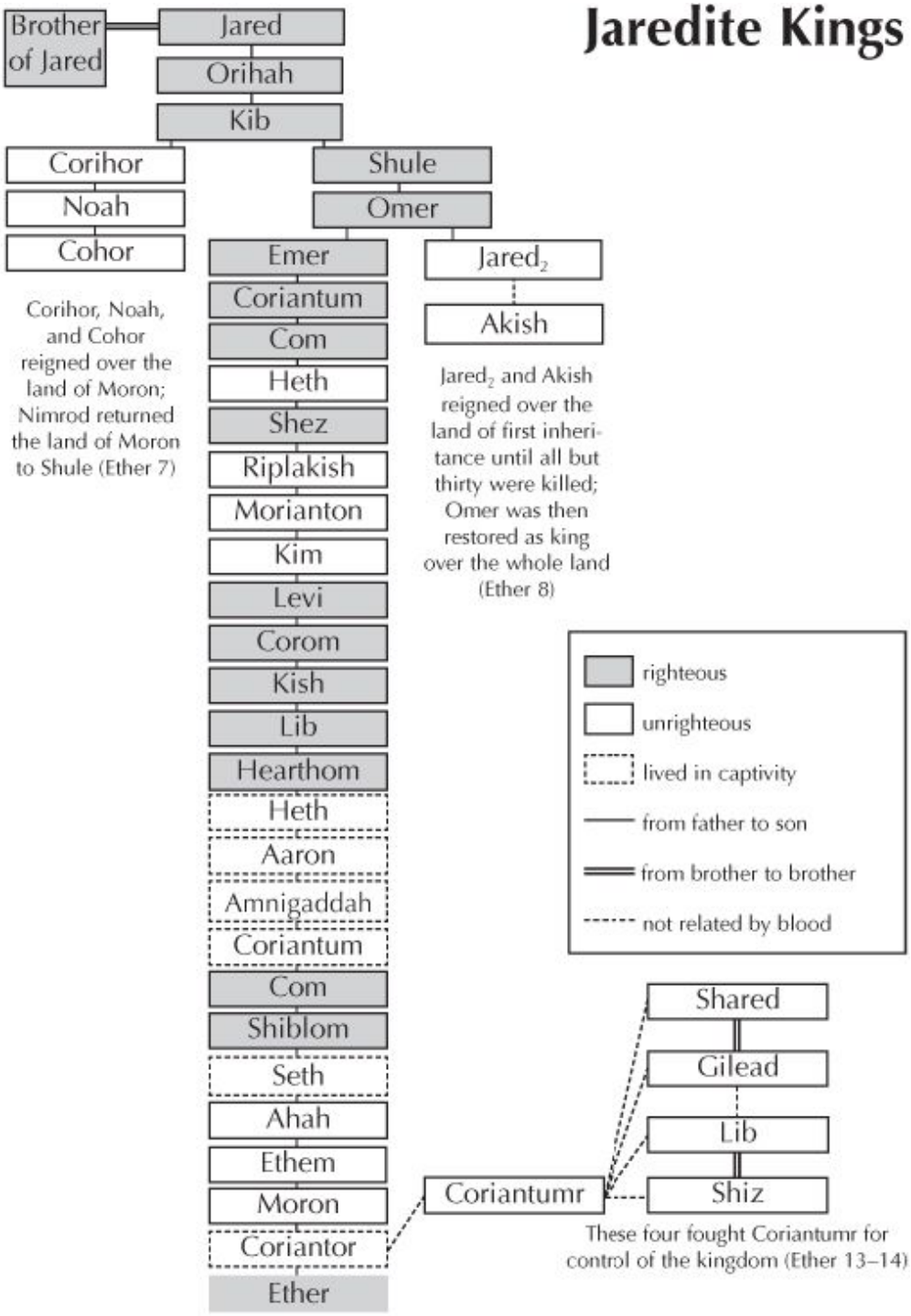


Figure 97. Lineage of Jaredite kings. (BYU Studies 2015b)

Etymology of the Name Shule

As previously noted one etymology for the name Shule is the Sumerian word *šelu* meaning "a metal" from the ED IIIa period (2600–2375 BC) (The Pennsylvania Sumerian Dictionary 2006).

Metallurgy of the Swords of Shule

No other references to swords in the book of Ether identify the swords (or any other weapon) as steel, so the identification of the swords of Shule as made from steel could be best interpreted as an anomaly. There is no mention of steel in later references to metals that the Jaredites had (Ether 9:17, Ether 10:7, Ether 10:12, Ether 10:23). In fact, given the fact that these swords were part of a Jaredite sacred bundle, the story of Shule seems to have an almost mythological element to it (forming metallic swords out of a volcano). The genesis of the swords and their singular uniqueness would be why the swords would be included in the sacred bundle, so there would be little expectation that other metallic, or at least steel, swords were present anywhere else in Jaredite history.

The language used pertaining to the method of manufacture of the swords of Shule is a bit peculiar. It states that Shule "did moulten out of the hill, and made swords out of steel." In other parts of the text where *moulten* is used, the Book of Mormon refers specifically to "ore" of some sort.

> 1 Nephi 17:9
>
> And I said: Lord, whither shall I go that I may find ore to moulten, that I may make tools to construct the ship after the manner which thou hast shown unto me?
>
> 1 Nephi 17:16
>
> And it came to pass that I did make tools of the ore which I did moulten out of the rock.
>
> Ether 3:1
>
> And it came to pass that the brother of Jared, (now the number of the vessels which had been prepared was eight) went forth unto the mount, which they called the mount Shelem, because of its exceeding height, and did moulten out of a rock sixteen small stones; and they were white and clear, even as transparent glass;
>
> Ether 3:3
>
> Behold, O Lord, thou hast smitten us because of our iniquity, and hast driven us forth, and for these many years we have been in the wilderness; nevertheless, thou hast been merciful unto us. O Lord, look upon me in pity, and turn away thine anger from this thy people, and suffer not that they shall go forth across this raging deep in darkness; but behold these things which I have moulten out of the rock.

In the other instances of moultening, it is only the ore that is moultened, and then only iron or a rock to extract the 16 stones. In the case of the hill of Ephraim, Shule did "moulten out of the hill," so something a little different seems to be going on.

It is also important to understand what is meant by the word *ore* in the Book of Mormon. The terms for the native metal and the ore of the metal are sometimes used interchangeably. An example is illustrated when the set of 24 Jaredite plates were described as "plates which are filled with engravings, and they are of pure gold" (Mosiah 8:9), and "plates of gold." At another place in the Book of Mormon the very same plates are described as "plates of ore" (Mosiah 21:27). All indications of metallurgy in the Book of Mormon do not necessitate the assumption that complex smelting or metallurgy is taking place; in fact, the references and textual construction indicate that one is dealing with simple ores (essentially native metal) and not complex ores, which is why the terms for ore and the

metals can be sometimes be used interchangeably. The term *ore* in the Book of Mormon is essentially the native metal as mined. This metal—or, ore—would typically include inclusions of other materials that required additional refining, which meant crushing, grinding, hammering, cold working, and with perhaps some low-heat processing In a few instances, higher levels of heat are required, and this is where the term "moulten" is used. In the case of the 24 plates, the likely reason they are referred to as "plates of ore" is because the native ore used required little refining. $Nephi_1$ did not refer to the plates he made as "pure" but also called them "plates of ore," which likely indicated that the native ore used was relatively pure. That is why they are referred to as "pure gold" as well. The mention of brass in one passage in Ether might seem to indicate higher temperature alloying, but there are other reasonable interpretations of this term that do not require smelting that will be discussed later.

The language used here to "moulten out of the hill" does not imply any sort of mining. In the context of a volcano, it seems to indicate that the molten material from the hill was utilized in some fashion to make the swords. Meteoric iron (derived from meteorites) was already used before the beginning of the Iron Age to make cultural objects, tools, and weapons (Waldbaum 1980). Since Shule was only four generations removed from the arrival of the Jaredites, it is possible that there was still some retention of iron metal working. The edge of obsidian is much sharper than metal weaponry, so given the availability of obsidian in Mesoamerica, a low quality steel weapon would not be an advantage.

Basaltic lava can range in temperature from 1,832 to 2,282 degrees Fahrenheit. Anciently, iron was not melted or cast. The earliest known examples of casting liquefied iron are from China in the fourth century B.C. The melting point of iron is 2,800 degrees Fahrenheit, so it would not be expected that there was any sort of smelting going on with regard to Shule.

According to R. Madden (1977) there were two forms of ancient "steeling" of iron: 1) quenching and 2) carburizing through taking heated iron and hammering the iron and folding it so carbon molecules from the charcoals were beaten into the iron. Generally, the iron must be in contact with a carbon source in a way to exclude byproducts of combustion. Temperatures over 1,380 degrees Fahrenheit are necessary for carbonization to occur and over 1,650 degrees to produce a useful thickness of carburized skin. One technique that is not mentioned in those sources that would be well within the capabilities of early Mesopotamian metalworkers (and presumably Shule) is the technique of steeling butcher knives used during the American colonial period of rubbing the blade with tallow and then heating it evenly, adding more tallow, reheating, and continuing this process multiple times (Moorey 1999, 284).

A reasonable reading of the making of the swords of Shule would entail the use of meteoric iron formed and polished to a blade, with the carburizing heat provided by the magma. It is naturally very hard, keeps a good edge, and is resistant to tarnish. It is mostly composed of two different alloys of iron and nickel: kamacite and taenite. Meteoric iron produces extremely unique structural and decorative features when polished (see back cover of book).

Essentially, based on the legendary story of Shule found in the Book of Ether, it is likely that meteoric iron was hot worked in conjunction with high volcanic temperatures to create the steel for the swords of Shule. There have been other works by LDS authors on ancient possibilities for steel (Hamblin 2017; Sorenson 2013), both from a linguistic and technological standpoint. The purpose of this work is to provide a few new insights, so we will not repeat the findings for the possibilities of steel here.

Other Jaredite Metals

The other references to Jaredite metals and the timeframe are as follows:

> Ether 9:17
>
> Having all manner of fruit, and of grain, and of silks, and of fine linen, and of gold, and of silver, and of precious things;

This took place during the reign of Emer in approximately 2300 BC.

> Ether 10:7
>
> Wherefore he did obtain all his fine work, yea, even his fine gold he did cause to be refined in prison, and all manner of fine workmanship he did cause to be wrought in prison. And it came to pass that he did afflict the people with his whoredoms and abominations.

This took place during the reign of Riplakish in approximately 2050 BC.

> Ether 10:12
>
> And it came to pass that Morianton built up many cities, and the people became exceedingly rich under his reign, both in buildings, and in gold and silver, and in raising grain, and in flocks, and herds, and such things which had been restored unto them.

This took place during the reign of Morionton in approximately 1375 BC.

> Ether 10:23
>
> And they did work in all manner of ore, and they did make gold, and silver, and iron, and brass, and all manner of metals; and they did dig it out of the earth; wherefore they did cast up mighty heaps of earth to get ore, of gold, and of silver, and of iron, and of copper.

This took place during the reign of Lib_1 in approximately 1000 BC.

> Mosiah 8:9
>
> And for a testimony that the things that they had said are true they have brought twenty-four plates which are filled with engravings, and they are of pure gold.
>
> Mosiah 8:10
>
> And behold, also, they have brought breastplates, which are large, and they are of brass and of copper, and are perfectly sound.
>
> Mosiah 8:11
>
> And again, they have brought swords, the hilts thereof have perished, and the blades thereof were cankered with rust.

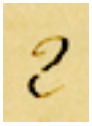
It is not known precisely when the breastplates or swords were made, but the supposition is that the swords were likely the swords of Shule previously discussed. The breastplates may have been produced during the final stages of Jaredite history, approximately 500 BC to 400 BC, but they could have been produced earlier. The 24 plates were written by Ether, so it would have been from around 500 BC to 400 BC as well.

Before looking at specific metals, it is fairly obvious that the reference to gold, silver, and precious things as a phrase is a generic term for wealth used throughout the Book of Mormon (1 Nephi 2:4, 2:11, 3:22, 3:44; Jarom 1:8; Mosiah 11:8, 11:9, 19:15, 22:12; Alma 1:29, 4:6, 15:16; Helaman 12:2; and 3 Nephi 6;2). In addition to the verses just cited, the words gold and silver rarely appear separately but also as a generic term couplet (1 Nephi 3:16; 2 Nephi 12:7, 12:20, 23:17; Jacob 1:16, 2:12; Mosiah 2:12, 4:19, 11:3; Alma 17:14, 31:24; Helaman 6:31, 7:21, 12:2, 13:28; 3 Nephi 24:3, 27:32; 4 Nephi 1:46; and Ether 9:17, 10:23).

What the generic term that includes “gold,” “silver,” and “precious things” means is not that gold and silver were unknown to the Nephites or Jaredites; instead, it means that when this phrase is used it should not be presumed that any gold and silver are involved. It is a generic term for “valuables.” Since gold and silver are used together,

this is likely indicative that it is referring to native gold that contains silver (as is the norm). The purity of gold of most ancient native gold ores is above 70 percent (Forbes 1950, 153). The later Nephites did have native silver as well, as the Nephite exchange system does utilize silver separately from gold in establishing exchange standards.

This alternate meaning is supported by the *gold* glyph C-185 found in the Caractors Document (Grover 2015):

C-55  gold

This is a somewhat straightforward form of the Egyptian demotic character for the word *nb*, which is translated as "gold" (Chicago Demotic Dictionary 2014, N (04:1), p. 57).

Demotisches Glossar (Erichsen 1954, 213)

C-185  gold (became wealthy)

This glyph does not appear to have the small visible gap like the previous character for gold (C-55); however, it is possible that this is a copyist error given the small size of this glyph, but it may signify a difference in meaning.

Gold and Silver

As mentioned, it is likely that gold and silver as a couplet is referring to the naturally occuring native gold alloy that also contains native silver. The early references in 2300 BC, 2050 BC, and 1375 BC indicate the possession of gold and silver, but no mention is made to mining of the material. These items may have been obtained by trade. The mention of the "refining" and the accompanying reference to "fine gold" is an indication that the native gold was worked to remove impurities to produce a "fine gold." With regard to metallurgical terms in the Book of Mormon, only the word "moulton" implies some use of elevated heat. The terms "melt" and the dozens of uses of the term "fire" in the Book of Mormon are never used in the context of refining. 3 Nephi 24:2 does refer to the refiner's fire, but this is a quotation of Malachi from the Old Testament.

In ancient Egypt, refined gold took two forms: 1) dust or powder from alluvial workings, and 2) ring-shaped ingots cast from the smelted gold produced in the mines (Notton 1974, 54). The Egyptian dust or powder did have final chemical and low heat processing, but the principal process of refining was crushing, pounding, grinding, and washing. The term "dross" is used a couple of times in the Book of Mormon (Alma 32:3, Alma 34:29), but no reference to it being a byproduct of heat or smelting is inferred, so it could just be the gangue and non-metallic material generated during the crushing, pounding, grinding, and washing process. The Book of Mormon description and reference to refining that took place is consistent with low temperature working or cold working; smelting is not implied.

Refining and working of gold is mentioned in 2050 BC. The other two references don't indicate any utilization or working of gold, just that it was a sign of prosperity. Gold may have been merely a possession. The 2300 BC reference utilizes the generic "valuables" term, which could mean there was no presence of gold or silver.

Gold and silver so far have not appeared in the archaeological record in the appropriate Jaredite timeframe in the Olmec area, which is the location where most Mesoamerican models place the land of Nephi. As indicated in the Book of Mormon, the use of gold and silver was not utilitarian; rather, it was strictly decorative, so no gold or silver

in great amounts would be expected to be present. In fact, since specific timeframes and specific locations are the only places where gold and silver are mentioned in the Jaredite record, it is a distinct possibility that it was anomalous and may have been produced only during certain timeframes and at certain locations, and in most instances, it may have been a trade item.

The fact that it may have been principally in gold dust form when owned for purposes of wealth would have limited its presence in the archaelogical record. In addition, where precious metals are involved, there are plenty of archaeological instances where the archaeological record lacks evidence of precious metals even when historical records clearly document their existence.

For example, Corinthian Bronze is described in ancient Latin, Greek, Hebrew, and Syriac texts. Pliny indicated that Corinthian Bronze was valued “before silver and almost before gold” (Pliny, AD 77a). Cicero and Plutarch also commented on the uniqueness of Corinthian Bronze (Cicero 45 BC, Plutarch AD 100). Early Jewish authors of the Classical period, including Josephus, were impressed by the Corinthian Bronze doors of the Nicanor Gate in the Temple at Jerusalem (Josephus AD 79; Jacobsen et al. 1992). Syriac sources for Corinthian Bronze include the Syriac “Peshitta” version of Ezra 8:27 datable to around AD 200 (Weitzman 1999), a Syriac text attributed to the alchemist Zosimus composed between the seventh and tenth centuries AD (Jacobsen et al. 1992), and a lexicon composed in the tenth century AD by the Syriac scholar Bar Bahlul (Duval 1901).

Despite this historically well-documented and somewhat widespread precious metal, so far not a single example of Corinthian Bronze has ever been located in the archaeological record or otherwise.

Another example of the absence of precious metals in the face of direct historical texts is the precious metals of the Fatamid Caliphate. The Fatimad Caliphate was a Shia Islamic caliphate that existed from 909 to 1171 AD, which covered a large area of North Africa, from the Red Sea in the east to the Atlantic Ocean in the west. The dynasty ruled across the Mediterranean coast of Africa and ultimately made Egypt the center of the caliphate. At its height, the caliphate included, in addition to Egypt, varying areas of the Maghreb, Sudan, Sicily, the Levant, and Hijaz.

> Without a doubt, the problem of the origin of the inlaid-bronze and brass industry in the Arab world is much more difficult than in Iran. The reason is simple: the virtual lack of precious-metal objects attributable to the Fatamids. Because of this, there is no question of comparing silver and base-metal products. Of course precious-metal objects existed, and existed in huge quantities, as the description by al-Maqrizi of the treasures looted from the Fatimid palace in Cairo makes abundantly clear. Included in his catalogue we find monumental sculpture in precious metal – a silver ship, a golden palm tree, a golden gazelle, a golden hen and a golden peacock – and literally thousands of vessels in silver or gold, enameled or gilded, encrusted with jewels, or inlaid with niello – dishes and inkwells, cups and jugs, lamps and trumpets, flower vases and boxes – and precious-metal fittings, for knives, for swords, for standards and parasol handles, for tent poles and the royal barges. Apart from odd items of gold jewelry, only one Fatimid object even partially of precious metal has so far been identified, and that is a bronze mirror with a silver back! (Allan 1982)

Our knowledge of western Islamic metalwork prior to the rise of the Ayyubbids and the Mosul school is extremely scant. A few articles on the Fatimid treasury or on single items, odd entries in the occasional exhibition catalogue, and some pieces in catalogues of private or public collections have left the subject obscure (Allan 1986).

Beyond the example of the absence of precious metals in archaeology where historic texts are involved, in the case of pre-Columbian gold in Columbia, archaeology failed to locate any workshop sites despite the fact that there were over 28,000 collected pieces in the Gold Museum in Bogatá and despite descriptions and direction to the locations in general terms from early explorers (Bray 1978).

One reason cited for the inability to discover evidence of mining and smelting sites in Central America is that European invaders, miners, and mining companies prospected for metallic ore sources in precisely the places where local people had been mining ore, smelting it, and probably working the metal. These later activities destroyed or changed the evidence of the earlier extractive metallurgy and processing technology (Hosler 2013).

The indicated use of all metals as merely ornamental (except for plates and the swords of Shule) is evidence in and of itself that there was probably not any smelting going on, and that the metallurgy was limited to cold working and perhaps some lower temperature hot working of native metals.

Gold in Ancient Palestine Previous to 600 BC

Canaanite Period

Despite extensive archaeological excavations that have occurred along the coastal strip of Israel, only a very few early Canaanite gold artifacts have been discovered. There is archaeological evidence that gold was available for jewelry production in Canaan from 1800 BC to 1200 BC. At that time the main sources of gold were Egypt and Arabia. The Midianites, a nomadic Semitic people who lived along the Red Sea coast in the Gulf of Aqaba and in the northwest of the Arabian peninsula, were the chief agents in gold trade with Arabia. They also mined and processed copper in Tymna (Altman 1979). Gold foil was used by the Canaanites for gilding bone and bronze objects.

Phoenicians, who would be differentiated from the general mass of Canaanites during the latter half of the second millennium BC, obtained gold from Ethiopia, Arabia, and Asia Minor. While there is no evidence that Phoenicians were smelting gold, they were experts in gold, silver, and gold gilding. Gilding was applied to metal, wood, and ivory, and the latter two were used to decorate walls and furniture. Wooden objects have not survived, but some examples of gilded ivory have been found.

Israeli Culture

In the Bible, gold is the most frequently mentioned of all metals but almost no gold objects have been found from the Israeli period of Palestine (1200 to 587 BC). Large quantities of gold were obtained by King Solomon and dedicated to the construction of the First Temple in 967 BC (1 Kings 6:20–35, 7:46–51). Only a few hoards have been found in Gezer, Akhsiv, and in Beth Shemesh, and they have consisted of relatively simple gold earrings, beads of various shapes and sizes, and discs with dots and holes apparently intended for sewing onto garments.

The Bible mentions Arabia, Sheba, South Arabia, and Ophir as sources of gold; Ophir is surmised to be situated between Mecca and Medina. The impression gained from the Bible and from modern research is that the use of gold for decoration was reserved for royalty and cultic purposes. Hebrew inscriptions on gravestones of the eighth and seventh centuries BC indicate that it was not the custom to put objects of value into the burial caves, and there seems to have been very little gold in private hands (Paul et al. 1973). The main accumulation was in the Temple and an indication of the size of the collection is given in a description of some of the treasure returned by Cyrus 50 years after the destruction of the first temple in 586 BC (Ezra 1:9–11).

Mesopotamia

In Mesopotamia, where extensive archaeology has occurred, the same paucity and large gaps in metal discoveries have been noted:

> By the sixth millennium B.C. melted native copper, perhaps already producing “arsenical coppers,” and smelted copper were employed in northern Mesopotamia.
>
> Evidence for metallurgy in Mesopotamia between 5000 and 3500 BC is extremely poor, amounting to no more than a handful of copper ornaments and isolated pieces of lead… There is no evidence for the use of gold, electrum, or silver

> before 4000–3500 BC. In two cemeteries of that period in the south, at Eridu and at Ur, there is no metalwork in the graves. At present, we must assume, as the pattern of finds has now been consistent for over half a century, that this reflects a real situation in which even base metals served a minor, essentially decorative role in society.
>
> Stone and clay were the raw materials predominantly used by all prehistoric communities of farmers and craftsmen for their tool kits and for their weapons in war. Therefore copper tools were not needed to increase the efficiency of food production or of carpentry in the relatively small, self-contained villages of Iraq before 3500 BC. Indeed, at this stage stone tools were probably more efficient than copper and were easily made of accessible materials. There was no incentive to increase the potential supply of copper, even if there were the means, nor to improve the range and strength of copper tools. Metal was neither vital for subsistence nor yet valued as a prestige commodity. Brightly colored semiprecious stones, such as turquoise and lapis lazuli, or imitations of them in blue-glazed dark stones or faience served that purpose. Distance from the sources of such stones does not appear to have restricted their supply. (Moorey 1985)

In the case of Mesoamerica, where there is a high concentration of volcanos and associated volcanic deposits, obsidian was available and ubiquitously traded. The sharp edge of obsidian is much superior to any cold- or even hot-worked native metal.

Another reason for the lack of archaeological evidence of precious metals in certain areas of Mesopotamia at certain times is that historical texts indicate that metals were often rigorously controlled by the bureaucracy and were regularly recycled (Moorey 1985). While we don't have much in the way of early Olmec texts, the archaeological record clearly shows that at the large Maya archaeological site of Kaminaljuyu there was wholesale recycling of carved monuments (Henderson 2013, 129–133). It would certainly be expected that whatever small amounts of precious metal there may have been would also be collected and recovered.

Plundering and tribute taking also affected the metal supply in Mesopotamia. A famous Sumerian epic poem from the Early Dynastic period describes how an expedition from Uruk into Iran seized not only precious metals but also the artisans skilled in working it with their tools, including molds for casting (Wilcke 1969). Probably the largest example of wholesale historical pillaging of metals (and everything else) was the Spanish conquest of Mesoamerica.

In addition, archaeology focuses on the excavation of temples, graves, and habitation sites. There is no mention of burial practices that would include any or all of the precious metals mentioned in the Book of Mormon. There is also no real indication that the possession of precious metals was widespread; it was probably limited only to the elite, just as occurred in Israel.

Notably, in the South American production of gold, there is a gap of nearly 1,000 years between the first discovery of worked gold together with gold-working tools (1500 BC) and the next most recent discovery (500 BC) (Scott 2000). No one doubts that there was gold being worked during this 1,000-year timeframe despite the complete lack of archaeological evidence.

It is also important to remember that the Jaredites were only one cultural subset of the entire Mesoamerican area. Gold and silver in their culture is only discussed at a few points in time and locations in their history. It cannot be extrapolated that all Mesoamerican cultures had precious metals (or even had an interest in them) from what is indicated in the Book of Mormon. Preferences for luxury materials in pre-Columbian America to some extent rely on the availability of the resource, but ultimately it is a cultural choice. For example, the classic Maya displayed little interest in gold despite its extensive use by its neighbors to the south (Pillsbury 2017, 3–4).

While indications of ancient mining for gold at the time of the Jaredites in the Olmec heartland or areas of influence has not yet been located, modern lode gold and copper deposits are known and have been explored and

deveoloped by modern mining companies. Minaurium Gold, Inc. currently has two projects with gold ore in the Olmec area and the Santa Marta project also contains copper (see figure 98).

Figure 98. The Aurena gold and Santa Marta gold/copper deposits in the Isthmus of Tehuantepec (Caesars Report 2017).

Various low-grade, gold placer deposits are historically known in Olmec territory in the Isthmus of Tehuantepec at the headwaters of the Coatzacoalcos River, on the Malatengo River, Juinuapa River and Chicapa River (Shufeldt et al. 1872, 46, 105). In the situation of low grade placer deposits, this would be consistent with casting up “mighty heaps of earth to get ore,” as indicated in Ether 10:23, and would also not be expected to have any archaealogical trace given the location near a meandering river.

Iron

Iron is mentioned among the Jaredites at approximately 1000 BC. While pure metallic iron would not be expected to survive in an archaelogical setting, the Jaredite reference does not identify the form of the iron metal. There is excellent archaealogical correspondence at the correct timeframe for the mining of iron among the Olmec. An Olmec mining colony has been identified in the Cintalapa valley. Among items excavated were partially worked blocks of ilmenite (form of iron oxide) and magnetite (magnetic iron oxide) and a fragment of an iron mirror, together with tools and San Lorenzo-style ceramics. These remains date to around 950 BC (Diehl 2004, 133). Among the products produced from this material were Olmec mirrors, which were formed from polished iron, beads, and figurines (Diehl 2004, 93). At the Olmec site of Las Bocas in Puebla, a particularly fine mosaic mirror was recovered that was dated to around 1000 BC (Carlson 1981).

The reference to iron in Ether is in relation to the great city that Lib_1 built, which I have identified as La Venta. As of 1981, seven iron mirrors have been excavated at La Venta (Carlson 1981). Tomb A at La Venta is one of the oldest formal tombs in Mesoamerica, dating to about 600 BC. Among the funerary offerings of this elite burial was a highly

polished magnetite (iron) mirror; it also contained the figurine of a seated female who wears an obsidian mirror on her chest. A total of seven concave mirrors were excavated from Complex A at La Venta; they were fashioned from hematite, ilmenite and magnetite (all forms of iron) (Diehl 2004, 70–71, 93). These are counted among the most outstanding examples of iron ore workmanship that the Olmecs produced. This certainly is consistent with the statement about the great city of Lib_1 in Ether 10:23 discussing iron and other materials that indicates that "they did work all manner of fine work."

Ilmenite and magnetite cubes with drill holes in them have been found at various places in the Olmec heartland, including San Lorenzo. While the ultimate end use of these items is still debated, it is another example of iron being worked (Pool 2007, 104–105).

Brass

The question of brass in the Book of Mormon has been explored to some extent by John Sorenson (2013, 335–6) with linguistic conclusions that the biblical term for brass and bronze are to some extent interchangeable. Sorenson has also documented the pre-Columbian presence of brass and bronze. While the reference to brass by the Nephites included the standard concept of brass (an alloy of copper and zinc) or bronze (an alloy of copper and tin), the reference to brass in the Jaredite record (and perhaps later among the Nephites) is likely referring to pyrite, which can have the appearance of brass or bronze.

Before commencing research into historical metals, it is necessary to understand that unlike our modern technological world of defined chemistry and exact international standards of metals and alloys and their definitions, the historical and ancient world was not so organized. Broad terms were used to include a variety of types of metals and alloys. Sometimes metallurgy was as much a religious and medicinal endeavor as it was a material science. Further confusion is created because, for the most part, the historians themselves are not metallurgists, and so they are trying to describe something for which they may have no firsthand knowledge of process or terminology. Complicating things further is the translation of these ambiguous terms into another language, which itself may have less than specific terminology. A good illustration of this is found in the writings of Pliny the Elder, Gaius Plinius Secundus (AD 23–79), a Roman of Equestrian rank who wrote a 37-volume set entitled *Natural History*.

Figure 99. Pliny the Elder. (The Famous People 2017)

In attempting to describe a metal of his time, Pliny used the term *aes* in Latin (Pliny 77a). *Aes* in Latin can mean *bronze*, which modern scientists define as an alloy of copper and tin. The term can also mean *brass*, which modern scientists consider an alloy of copper and zinc. Some modern translators have translated the *aes* term of Pliny's to be brass, not bronze (Pliny 77b). Most ancient *aes* also contained lead. While that may seem vague enough, Pliny goes on to describe the three types of Corinthian bronze (*aes*), which he also defines, by their relative content of gold and silver, which means that *aes* can also be defined as an alloy with those metals. The term *bronze* or *brass* (perhaps especially Book of Mormon *brass*) are terms that should be approached with caution when attempting to identify any historical or ancient alloy, as they often are catch-all terms for the various alloys of copper and are often defined by their appearance and color, not by the metals contained in the alloy.

Ancient metallurgy involved proven techniques or recipes used by specific craftsmen or guilds, more so than any specific chemistry, since chemistry as we know it did not exist. The composition of the finished metal itself was often determined by the ore body utilized. Even today, since ore bodies vary widely in chemical composition, various tests and pilot plants are used to determine the best extractive process technique for a particular metal in a particular ore body. The same extractive challenge caused by differences in ore bodies existed for ancient metallurgists as well.

The twelfth-century Upper Mesopotamian writer Ibn al-Razzāz al-Jazarī, who was a metalworker by profession, in his *The Book of Knowledge of Ingenious Mechanical Devices*, refers to the cast bronze doors of Āmid as being of brass, which is very unlikely when compared to the surviving portions (Rogers 1976).

> Muslim artists and artisans used basically the same metals and alloys as their Roman and Byzantine predecessors: gold, silver, and alloys of copper, tin, lead, and iron. Exact information about these metals is scanty. Our ignorance stems from a number of reasons. Most Islamic metal objects have not been properly analyzed, and as a result terms like 'bronze' or 'brass' are used indiscriminately in museum or exhibition catalogues and other scholarly publications. Moreover, the medieval Islamic terminology for metals and their alloys is often ambiguous and therefore difficult to evaluate. For instance, no clear distinction was made between bronze and brass, the term ṣufr being used for both. (Baer 1983, 1)

In addition, when dealing with ornamental metals (which seem to be the primary use of Jaredite metals) the ancient metallurgists (often alchemists), for the most part, were trying to produce a particular color or finish. The alchemists in particular were attempting to produce gold or gold gild (or at least the look of gold) from lesser metals. As a result, the ancient name of the metal or alloy may only be a representation of surface color, not of composition. Pyrite has been typically described as "brassy yellow" (Rickard 2015, insert).

With regard to the word *brass*, at least for the earliest Jaredite use, Sorenson (2013, 336) indicated that the text of Ether 10:23 is supportive of an alloy of copper (either bronze or brass) because the Jaredites did not have to dig up "heaps of earth to get ore" to get brass like is mentioned for gold, silver, copper, and iron, thus implying that it had to be smelted. However, there are two other reasons why brass may not have been mined by the Jaredites. It may have been a trade item and mined by someone else, or it may have been easily available on the surface, giving the Jaredites no need to dig up "heaps of earth" to get it.

Pyrite crystals sometimes form in deposits that with differential weathering leave pyrite crystals available on the surface without much excavation necessary (see figure 100).

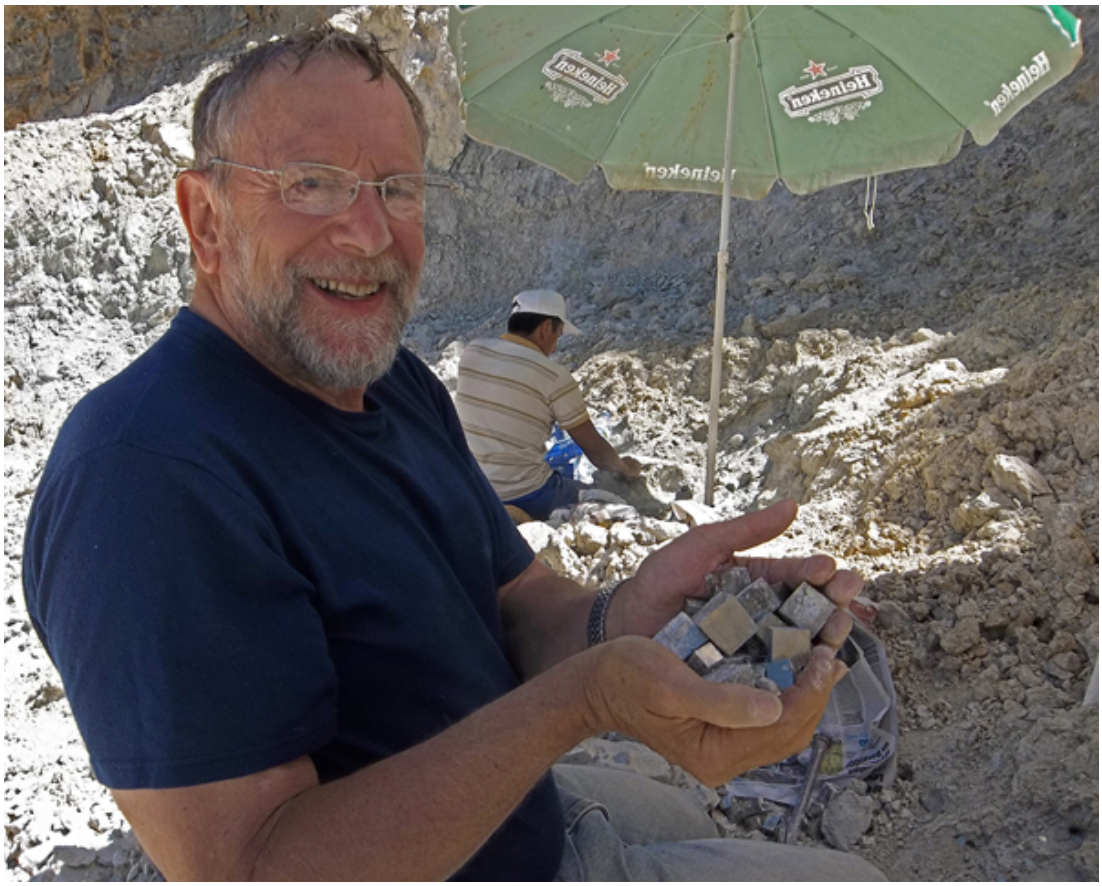


Figure 100. Collection of pyrite from surface at Navajun, Spain. (Treasure Mountain Mining, 2015)

More likely, the pyrite was a trade item not available in the Olmec area. In fact, the known pyrite sources for pre-Columbian pyrite are well outside of the area of the Olmec heartland, so it must have been a trade item (see Figure 101).

Pyrite was used by the Olmec to make mirrors and has been found at La Merced and other Olmec locations (Diehl 2004, 44). Similar to iron mirrors, it was decoratively used on other pieces that provide spectacular reflective qualities (Taube 2004, 66). As previously mentioned, these mirrors are depicted in Olmec items as being worn on the chest as a breastplate.

So the question arises linguistically as to why pyrite would end up translated as *brass* in the Book of Mormon. First of all, there is no indication of a separate word for pyrite in biblical Hebrew or that pyrite is specifically mentioned in the Bible. As just explained, early metallic terms sometimes became catch-all terms for metals that are similar in color or appearance.

Pyrite is an iron sulfide and when weathered oxidizes and reverts to a rusted iron oxide limonite. While not found in biblical Hebrew, the word for pyrite is found in Sumerian texts as early as 2000 BC (Rickard 2015, 7, 59). In Sumerian the term for pyrite would be *bil* "to burn" and *za* "stone" and looks to have some etymological relationship with the word for iron used in the Bible, *bar-zel'* (בַּרְזֶל) . This word is clearly a loan word adopted into biblical Hebrew and has linguistic equivalents in other Semitic languages: Akkadian, *parzilla;* Ugaritic*, brŏl;* Phonecian/Punic, *brzl*; Aramaic, *przl';* Arabic, *firzil*; Old South Arabic, *nāək*; Armenian, *anag*; and Coptic, *anok* (Mankowski 2000; Ellenbogen 1962). This word has been identified as an introduced word into biblical Hebrew from a Western source but has not been further delineated. It is considered non-Semitic and underwent borrowing

from one language to another (Khan, 2013, 640). Sumerian is a definite possibility, likely being borrowed into Akkadian initially.

Figure 101. Pre-Columbian pyrite sources. (Gallaga 2016)

The *bar* in *bar-zel'* corresponds with the independent lexeme *BAR* in Sumerian, which is utilized to designate various metals: AN.BAR, iron; ZABAR, bronze; and KUG.BABBAR, silver. The lexeme *bar* also directly corresponds to the early English Anglo-Saxon word *braes*, which became the modern English *brass*. In English, also connected to *bar* is the term *brazi,l* which denotes coal containing iron pyrite (Khan, 2013, 641).

In the Oxford English Dictionary (2017), under the section for *pyrite* there are examples where pyrite is referred to with the word *brass*, *brassy*, or *brasse ore*. Under the section for *brass* one of the actual definitions for it, specifically referring to mining, is iron pyrite, which is found in coal. Quoting the 1879 Cassell's Technology Educator, "(d)etached masses of pyrites … are called 'brasses' by the colliers."

Since the early Jaredite term for brass would have been initially interpreted into the Nephite language by use of the interpreters, with a likely original Sumerian/Jaredite etymology and lacking a biblical Hebrew term for pyrite, the use of the term *brass* for pyrite would certainly be reasonable and etymologically defendable. Alternatively, although pyrite is a known English term, *brass* is also an acceptable name for types of pyrite in Early Modern English.

Copper

Pre-Columbian copper work is known but has not yet been discovered in the archaeological record in the Olmec area during Olmec times. Native copper is known and reported in the Olmec area, so it is consistent with the

possibility that small amounts were mined and worked by the Olmec/Jaredites. Chivela Pass, centered in the Isthmus of Tehuantepec, has occurrences of native copper (Stevens 1869, 51). Copper ore has been mined in Tequisistlán in Tehuantepec in the San Carlos Yautepec mining district (Stevens, 1911, 1128). Although it is reported as argentiferous chalcopyrite ore, native copper can be present within the yellow zone and within veins in small amounts of porphyry type deposits. Similar to Tequisistlán, the Santa Fe mine in Chiapas near Palenque also contains copper in a complex ore and produced 370,483 pounds of copper in 1903 (Stevens, 1908, 1217). As previously mentioned, the Santa Fe mine is a current copper/gold deposit that is located in the Olmec area.