CONDEMNED
Copper Production &

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 Damnatio ad metallam—condemned to the mines!  
Tantamount to a death sentence.

For the past 20 years, we have been exploring  
these mines about 30 miles southeast of the Dead  
Sea in the Faynan district of Jordan." In ancient  

"See Thomas E. Levy and Mohammad Najjar, “Edom & Copper: The  
Emergence of Ancient Israel’s Rival,” BAR, July/August 2006.

times, these copper mines represented hell on earth  
to those condemned to work here. Today, the area’s  
stark natural beauty and unusual history, both metal-  
lurgical and social, draw researchers and eco-tourists  
from around the world.

The Faynan mines are some of the world’s best-  
preserved ancient mining and metallurgy landscapes.
In recognition of this and as part of the Dana Nature Reserve, the area has been declared part of a UNESCO Biosphere.

Faynan is located between the high Jordanian plateau, about 5,400 feet above sea level, and the Wadi Arabah, part of the Dead Sea Rift Valley, some 260 feet below sea level, and near the lowest spot on earth. In this middle position, the wadis in the Faynan area have been a major route for human and animal migration since the Paleolithic period more than 200,000 years ago. By the Pre-Pottery Neolithic period (12,000 years ago), people were attracted to the area by another factor—beautiful blue-green veins of copper ore.
The earliest Biblical mention of the site is in Genesis 36:41, where it is spelled Pinon (F and P are the same letter in most Semitic languages) and sited accurately geographically, as located in Edom. (The same reference is found in 1 Chronicles 1:52.)

On the ancient Israelites’ trek from Egypt to the Holy Land, they camped here, according to the Bible, although this time it is spelled Punon (Numbers 33:42).*

In earlier times, the most beautiful rocks were simply collected and the mineral pigments extracted to make jewelry, mostly beads.

In the Old World, the first attempt by people to work copper metal took place by the end of Neolithic period (7500–5700 B.C.E.) when a few copper tools were produced using native copper (probably meteoritic copper). This occurred in the “Eurasian metallogenetic belt”—the region that spans the Alps to the Himalayas, before it drops down to the Indian Ocean.¹ Native copper could be collected from the surface because of its shiny quality, and was perhaps then heated in a fire and hammered (while hot) into a desirable shape.

The first smelting of copper—where heat is used to extract metal from ore—occurred in the Chalcolithic (Copper–Stone) Age, around 4500–3800 B.C.E. This was a major advance in pyrotechnology, involving the intentional use and control of fire and marking the beginning of the copper revolution in the ancient Near East.² Israel and Jordan are home to some of the earliest copper smelting sites in the world.

Knowledge of smelting seems to have evolved locally in the southern Levant after several thousands of years of experimentation with pyrotechnology in the Pre-Pottery Neolithic to create lime from crushed limestone, essentially by burning it. At this time, the lime produced was used to coat stone building surfaces as well as skulls of the deceased before they were buried beneath the floor of houses.

*In the annotated index to the authoritative English translation of Eusebius’s Onomasticon, the site is spelled Phainon, but the entry notes that the site is also known as Phin, Phinon, Fenum, Fin, Fenon, Pinon, Punon, Phaisnon and Feinan. Today, following modern Arabic, it is also spelled Faynan.
By smelting ores, the Chalcolithic craft workers produced a variety of metals from gold to copper. The copper they produced was both pure copper and copper alloy. The alloys consisted of 90 percent copper with 10 percent of other metals such as arsenic, lead and tin. Researchers still don’t know where the non-copper alloys were obtained in this early period. These added metals altered the physical properties of the copper; through these additives, the hardness as well as the color of the tools was controlled.

In the Faynan district where we’ve been working, two geological strata (or units) of copper-ore deposits have been identified: the Massive Brown Sandstone (MBS) stratum and the Dolomite Limestone Shale (DLS) stratum, referred to locally as the Burj Dolomite-Shale formation. The MBS stratum includes copper ores such as malachite (a green ore especially prized for ornamental items) and cuprite (a copper ore variously colored from red to brown to black). The second common stratum, the Burj formation, contains primarily copper silicates and malachite. Based on analyses of copper objects from the Chalcolithic period, it seems that the MBS stratum was the first to be exploited for smelting purposes and later reopened extensively in the Roman period. However, the Burj ores were the more important source during most periods because Burj ore was not only more abundant but this ore tends to smelt quickly and form slag more readily. And, the copper ore from this stratum naturally contains manganese ores that provide a fluxing agent that lowers the temperature necessary for the reduction of the ores into metallic copper.

Andreas Hauptmann, who has coordinated excavations of ancient mines in the Faynan (as codirector with Gert Weisgerber of an expedition sponsored by the Deutches Bergbau Museum), suggests that by the third millennium B.C.E., a change in the flow patterns of the wadis in the Faynan district created by stronger seasonal floods probably exposed copper ores in the Burj stratum and that this contributed to the intensification of mining activities in the Early Bronze Age. This, in turn, laid the groundwork for industrial mining and metallurgy in the Iron Age (the Biblical period) and Nabatean/Roman period.

The varying intensity of metallurgical activity in different time periods also reflects different forms of social organization. The native copper (ready for use) was available in a very restricted geographic zone; it had little or no impact outside of this limited area. Only in the Chalcolithic period does copper start to become a metal commodity of interregional trade. The smelting seems to have been controlled, however, by elite chiefs living in regions far from Faynan, such as the Beersheba Valley in the northern Negev desert. In this formative period, the copper objects were mostly prestige items such as crowns, scepters and mace heads.
In the Early Bronze I period (c. 3600–3300 B.C.E.) copper was smelted locally in Faynan for the first time. Brick-shaped crucibles for containing the copper have been discovered in Faynan houses in sufficient numbers to cover both domestic and export needs.

Although the beginning of the Early Bronze Age saw a decline in social complexity, by the Early Bronze Age II–III (c. 3000–2200 B.C.E.), the first “urban revolution” had occurred in the southern Levant, and Faynan metallurgy took on an almost mass-production quality. The Middle East’s largest Bronze Age metal manufactory has recently been excavated on a large scale in Faynan at Khirbat Hamra Ifdan.5

Only in the Iron Age (c. 1200–900 B.C.E.), however, does copper production peak with the first industrial revolution. At this time the Faynan district became the hub of an ancient metallurgical production landscape. Networks of mines fed copper ore to production centers in Faynan such as Khirbat en-Nahas (Arabic for “Ruins of Copper”) where the ore was smelted into ingots. These ingots were objects of trade westward to the Mediterranean coast and southward to the Gulf of Aqaba/Eilat. At Khirbat en-Nahas an Iron Age fortress and more than a hundred buildings were devoted to different aspects of the copper-production industry.

Scholars still do not understand why metal production ceased in Faynan at the end of the ninth century, but it did. It did not re-emerge until Hellenistic-Roman times (c. fourth–first centuries B.C.E.). Coins from this period have been found in the Faynan district in general and at Khirbat Faynan and other copper-bearing sites such as the Wadi Abu Khusheibah and Wadi Abu Qurdiyah.6

But in the Nabatean/Roman period (c. first century B.C.E.–fourth century C.E.) and the Byzantine period (c. 324–638 C.E.) copper production resumes at an industrial scale. According to Professor David Mattingly of Leicester University and Dr. Nana Friedman of the Oxford Roman Economy Project, who have studied Faynan administration during the Roman and Byzantine periods, areas rich in copper ore were imperially owned. Both the mining and metallurgy industries were an imperial monopoly.7 British researchers have surveyed the Roman and Byzantine landscape of the central Faynan valley in great detail and show how it was a landscape organized to produce food and copper under imperial rule.8

By the first century C.E., Semites (probably Arab) from the southern Levant and northwest Arabia had evolved into the Nabateans whose socioeconomic capital emerged in the hidden desert valleys of Petra, about 25 miles southeast of Faynan. The Nabatean kingdom extended westward into the Negev desert of Israel at impressive sites such as Shivta, Avdat and Nessana, and southward into the Hijaz desert in Saudi Arabia at the magnificent site of Mada’in Salih.9 Like others before them, the Nabateans produced metallic copper from copper ores in nearby Faynan. Most of the mines in Umm al-Amad high above the Wadi

EITHER ORE. Experts have identified two geological strata of copper ore deposits in the Faynan district: the Massive Brown Sandstone (MBS) stratum and the Dolomite Limestone Shale (DLS) stratum, or Burj formation. The photo at left shows copper ore nodules from the MBS stratum, which contains the highly prized green malachite as well as reddish-brown cuprite. The photo at lower left shows an ore fragment imbedded in dolomite from the Burj formation. Although the MBS ores appear to have been exploited for smelting earlier in history, the Burj ores became popular because they were more abundant and smelted more quickly.
Faynan and in the Wadi Abu Khusheibah are yet to be excavated, but judging from the abundance of Nabatean pottery sherds, these mines were probably operative during the Nabatean period. As it was in the earlier Iron Age, in the Roman period all the mines in Faynan were owned by the state. Ancient historical sources can tell us a lot about how the mines were operated. The copper was mined and smelted by slaves and war captives. They were supervised either by soldiers or by contractors to whom the slaves were leased. To prevent flight and even conversation between the supervising guards and the miners, garrisons of foreign soldiers with no knowledge of local languages were entrusted to guard the mines.10

In addition to slaves and war captives, at one point criminals were added to the work force. By this time, the best veins of copper had been exhausted. Equally important, by the third and fourth centuries C.E., the superior ores of Spain were exhausted. Naturally the demand for Faynan copper increased. Previously neglected poor ores from the MBS stratum in the Faynan area suddenly became more valuable. Earlier mines from the Chalcolithic through the Iron Age were reopened, enlarged and reworked. Even earlier slag was recycled to “squeeze” every drop of copper from it. To make the poor copper deposits of Faynan economically profitable, the condemned miners were simply pushed to the limit of human endurance—and beyond.

Greek and Roman philosophers considered mining “a violation of the earth,” and a search for wealth in the “home of the dead.” They believed that mining “sometimes [caused the earth] to split open or to shake.”11 Mining on the Italian peninsula was prohibited.12

Simultaneous with these developments in the third, fourth and even fifth centuries, Christians were often gruesomely persecuted, first by pagan Roman emperors and then by Christian emperors who regarded other Christian sects as heretics. Damnatio ad metalla—condemnation to the

SMELTING FOR STATUS. Copper smelting, the process of heating ore to extract metal, first occurred in the Chalcolithic period (c. 4500–3800 B.C.E.) and marked the start of the copper revolution. Israel and Jordan are home to some of the earliest copper-smelting sites in the world. Copper became an important trade commodity and was used in the Chalcolithic period mostly for “prestige items” such as crowns, scepters and maces. This copper scepter with ibex heads is part of the famous Nahal Mishmar hoard, a collection of largely copper artifacts from the Chalcolithic period that were discovered in a cave west of the Dead Sea.
mines—became a widely imposed punishment. Being condemned to the mines was apparently worse than scourging and carding, as the case of Silvanus, bishop of Gaza, illustrates. He was, according to Eusebius (c. 263–339 C.E.), a multiple offender. The first time his punishment was scourging. By the second time, he was an old man, and his punishment was “[carding] combs on his sides.” The third time he was sent to the copper mines. In another account, Eusebius identifies the copper mines where Bishop Silvanus was sent: “the copper mines in Phaeno.”

On one occasion, a mandate was issued, according to Eusebius, that “all those in the mines who had become enfeebled through old age or sickness, and those who were not able to work, should be put to death by the sword; and God’s martyrs, being all together forty in number, were beheaded all in one day.” Their leader was Silvanus, “a man truly blessed and beloved of God.”

Of all the copper mines, Faynan was especially feared, the worst in the whole Roman Empire. The reasons were many. First was the nature of the Faynan geology. The fragmentation of the ore deposits required oversized mine galleries; despite all efforts, the ceilings were unstable and miners were often crushed at work. Second, the inhuman treatment of the miners in Faynan contributed to its terrible reputation.

The Christian historian Theodoret, in the later fourth century, reports that 19 monks were whipped and tortured and then “sent to the metalla of Phenneusus [Faynan] and Proconesus.” Shortly thereafter, Theodoret reports that a deacon was similarly “sent to the mines at Phenneusus, which are copper mines.”

Essentially three methods of mining the copper were used at Faynan during the Iron Age and Roman period. The most common was the shaft-and-gallery technique. The miners would first dig a vertical shaft, the Romans often near an existing double-shaft Iron Age mine. The new shaft would go somewhat deeper than the copper vein. Galleries (tunnels) would then branch off the shaft in different directions. Once the copper-ore deposit at this level was exhausted, the shaft was deepened and new galleries at deeper levels were excavated. At Wadi Al-Abyad Andreas Hauptmann’s team found ten mines with four levels of galleries.
INTO DARKNESS. The most common method of copper mining in the Iron Age and Roman period was the shaft-and-gallery technique, in which a shaft was dug down and then tunnels, or galleries, branched out from these for mining the ore. Two of the shafts in this “triple-shaft” mine date to the Iron Age, but they were reopened and a third shaft dug during the Roman period.

Another type of mine was called the room-and-pillar gallery mine (also pictured on pp. 30–31). Here the mine began with a low, broad cave entrance in a hillside (right). The miners then enlarged the cave, following the ore deposits, until the mine resembled a large hall. They left pillars of uncut stone to support the roof and prevent collapse while they mined.

In 1989 the German expedition led by Gert Weisgerber and Andreas Hauptmann excavated a “triple-shaft” mine with two Iron Age shafts, a reopening of the mine in the Roman period, and a third shaft from the Roman period. Pottery and coins allowed the modern excavators confidently to date each of the shafts.

The second type of mining operation is known as a room-and-pillar gallery mine. This type of operation begins with a cave in the hillside that has a broad but shallow entrance area. The miners would then cut narrow galleries in different directions, following the veins of ore. As they expanded the cave, the miners would leave sturdy pillars to support the roof of the cave; hence the term “room-and-pillar.”

This type of mine was known to ancient writers as mining with “arched supports.” Pliny describes mines with “arched supports” at frequent intervals that could bear “the weight of the mountain above.” These caves look like halls filled with pillars. The Bedouin refer to one Roman room-and-pillar gallery mine in the rugged terrain above Faynan as Umm al-Amad, “Mother of the Pillars.”

Umm al-Amad was the first mine of this type to be documented—by the famous American explorer,
The surveyor and archaeologist (and also a rabbi), Nelson Glueck, in the 1930s.20 The German geologist Hans Kind discovered another set of these mines in the Wadi Abu Khusheibah in the 1960s.21 We visited these mines recently with University of California, San Diego, graduate student Erez Ben-Yosef, who is researching archaeometallurgy in Faynan.22

We have recently identified a third type of mine, which we call a copper-pit mine field. In our survey of the area, we found hundreds of plate-like depressions about 23 feet in diameter that we believe date to the early Iron Age (c. 1200–900 B.C.E.). These plate-like depressions are very similar to what Israeli archaeologist Beno Rothenberg found in the Timna copper mines in southern Israel just north of Eilat. They were excavated into the relatively loose earth at the base of slopes. The excavated earth included copper nodules from prehistoric times that eroded from copper ores formed in earlier eras. These pits were thus an easily accessible source of naturally broken copper ore.23

Once the miners of these depressions were...
finished with their work and left, the plate-like depressions gradually filled up with wind-blown loess sediment. This sediment now enables us to identify these pits rather easily because the color of the sediment markedly differs from the black dolomite rocks surrounding them. The pits also naturally collect surface runoff water during the rare winter rains, making the plate-like scars of the ancient mines suitable for small-scale gardening by semi-nomadic Bedouin, even in this extremely arid zone.24 These mines are similar to primitive pit mines used to extract gold and other minerals in the Congo today.

Mining in these pits during the Iron Age was far less difficult and far less hazardous than the shaft-and-gallery and room-and-pillar gallery mines of the Roman period—when Christians were condemned to the mines.

The tool kits of the condemned Christians included hammers, chisels and wedges to loosen the host rock surrounding the copper ore. Ropes for climbing and baskets for the ore were also provided. The miners worked with the aid of light from oil lamps and may not have seen daylight for months. The Greek historian Strabo reports, “In addition to the turmoil, it was especially dark inside. First-ever a vein of ore led. Because of the twists and turns, it was cut through the rock not in straight lines, but wherever a vein of ore led. Because of the twists and turns, it was especially dark inside. First-century Roman historian Strabo reports, “In addition to the turmoil, they say that the air in the mines is both deadly and hard to bear. Workers are continually consumed by sickness and death.”25

Ventilation in the underground facilities at Faynan was a serious problem. Because the shafts and galleries were narrow and the copper-ore dust was poisonous, most of the miners would either die naturally or be crushed when cracks, running in every direction, suddenly gave way. Ancient pollution studies of Nabatean, Roman and Byzantine copper mining and smelting activities show that in antiquity both producers and consumers (plants and animals) would have been subjected to potentially toxic heavy metals in Faynan.26 The tunnels were cut through the rock not in straight lines, but wherever a vein of ore led. Because of the twists and turns, it was especially dark inside. First-century Roman historian Strabo reports, “In addition to the anguish of the work, they say that the air in the mines is both deadly and hard to bear. Workers are continually consumed by sickness and death.”27

Damnatio ad metallum was a common sentence (especially during the Great Persecution of Christians in 303–311 C.E.). Shortly after his victory at the Milvian Bridge in 312 C.E. under what he said was the sign of the cross, the Roman emperor Constantine made Christianity a licit religion (although he himself was not baptized until his death bed). But this did not bring an end to Christian persecution.

As one scholar has written, “A variety of sources indicates that condemnation to mines and quarries for religious offense persisted at least through the fourth and fifth centuries.”28 Constantine soon ruled that those Christians he considered heretics were not “true” Christians. Damnatio ad metallum continued to be a punishment for being the wrong kind of Christian—especially on the wrong side of the Arian controversy regarding the true nature of Christ.

In the heat of summer, these thoughts are often on our minds as we explore the Wadi Faynan and its famous—or infamous—copper mines. It is ironic that today we researchers and our students love working in the Faynan mining district. We can’t wait to get back into the field next year.29

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2 T.E. Levy, Journey to the Copper Age—Archaeology in the Holy Land (San Diego: San Diego Museum of Man, 2007).
9 For overviews of the Nabatean kingdom in the Negev and Hijaz, see M. Babelli, Mada’in Saleh (Riyadh: M. Babelli, 2007) and M. Evenari, L. Shanan and N. Tadmor, The Negev—The Challenge of a Desert, 2nd ed. (Cambridge: Harvard Univ. Press, 1982).
11 Pliny, Natural History 33.1–3.
12 Id. at 3.138.
13 Eusebius, Martyrs in Palestine.
14 Eusebius, Ecclesiastical History 8.13.
15 Eusebius, Martyrs in Palestine; the account in Ecclesiastical History also recites that Sylvanus was beheaded at Phaeno.
17 Theodoret, Hist. Eccl. 4.22.28.
19 Pliny, Natural History 21.70.

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Copper Mines
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22 We thank Erez Ben-Yosef for organizing our short survey of the mines in Wadi Abu Khushiebah.
27 Strabo, Geography 12.3.40.

Excarnation
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2 I wish to thank the excavator of these sites, Michael Freiman of the Hebrew University of Jerusalem, for sharing this information.
7 Epstein, Chalcolithic Culture, pp. 334–337.

Goren
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1 Letter of June 16, 2003, from Professor Ronny Reich to Dr. Gideon Avni of the Israel Antiquities Authority.
2 Boaz Zissu and Yuval Goren, “The Ossuary of ‘Miriam Daughter of Yeshua Son of Caiaphas, Priests [of] Ma’aziah from Beth ‘Imri’,” Israel Exploration Journal 61, no. 1 (2011) [both of the “Miriam” illustrations were originally published here]. Only the “Scientific Examination” of the ossuary is attributable to Professor Goren.
3 The editio princeps calls it Hebrew. However, Boaz Zissu agrees with Christopher Rollston that the language is Aramaic.
4 The editio princeps reads “priests,” but Boaz Zissu agrees with Esther Eshel and Christopher Rollston, all three of whom came up with the conclusion independently, that the singular “priest” is more likely.
5 In somewhat more detail, “The lower film is a biopatina skin, which may be attributed to lichens, moss, fungi, bacteria, or algae. An overlying layer of calcitic patina resulting from the re-crystallisation of calcium carbonate from groundwater, was created on the stone surface.”

Sacrifice
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