

## THE HEART OF STEEL: A METALLURGICAL INTERPRETATION OF IRON IN HOMER

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The *Iliad* and the *Odyssey* co-evolved with the use of iron, and so a detailed examination of iron in the Homeric poems has the potential to flesh out a “fuller cultural history” (1) of the Greeks: what they considered the properties of iron objects, and how iron acquires these properties. I believe the texts distinguish three types of iron: bloom iron, wrought iron, and steel, despite the fact that most translations simply use the English word “iron” for all three, and thus render anemic both our appreciation for ancient Greek culture and the poetic richness of the texts themselves. This paper is an attempt to fortify both.

I hope this survey will contribute to the narrative of early chemistry, since the epics appear well after the earliest applications of chemical technologies, as revealed by archaeology and physical anthropology, and before theories of Hellenic, Indian, and Chinese philosophers of the first millennium B.C.E. (2, 3). According to the “composition-in-performance” model of epic transmission, the Homeric texts grew over a thousand-year period, from the time bards began singing tales of the Trojan Wars in the second millennium, when iron was an odd rarity and Greek writing unknown, to the standardization of written texts in the second century B.C.E., when iron was ubiquitous (4). Because the two epics flowered simultaneously, contemporary scholars do not attempt to fix either the *Iliad* or the *Odyssey* as prior in composition and feel free to use the texts to interpret each other (5, 6).

In this paper I summarize all references to iron in both the *Iliad* and the *Odyssey*, using the “iron heart” metaphor to illustrate that a fuller appreciation of the complexity and variety of references to iron is important on a poetic level, as well as historical (7). My method has depended heavily upon the Perseus Project, a digital library of ancient texts at Tufts University, where the *Iliad* and *Odyssey* appear in the original Greek and in several English translations. This library includes a searchable word frequency tool, which tells the reader how many times, in what form, and where in the original Greek text words with a particular root occur (8). In the discussion that follows, literary quotations are taken from Fagels’ translations of the *Iliad* and *Odyssey* (9, 10), except where noted. Line references refer to the chapter and line where the term for iron appears in the original Greek texts, as displayed by the Perseus Project. For brevity, I assume a reader who is familiar with the plots of both epics.

### As Hard as Iron

Most references to iron are just what the reader would expect. Many prosaic objects in the *Iliad* and *Odyssey* are made of iron (*sidēros* in Greek). These include weapons, like blades (Od. 19:13 and Il. 18:34), a club (Il. 7:136 and 142), and the axe heads of the suitor’s contest in *Odyssey* 21. While not as glorious as arms made with bronze, gold, or silver, iron objects are tough and serviceable. Hera’s war chariot may have wheels, railings, and yoke of glittering precious metals, but the axle, the

hidden part of the chariot that must bear her considerable weight, is iron (Il. 5:722). Athena boasts to Telemachus that Odysseus can scheme his way out of any impossible situation, even if he is chained in iron bonds (Od. 1:203). The massive gates of Tartarus are iron (Il. 8:13).

The poems invoke iron's familiar hardness to depict nonmetallic things. In the *Iliad*, the noise of war is an "iron din" (17:425) and Patroclus' funeral pyre burns with the "iron rage of fire" (23:177). In the *Odyssey*, Eumaios and later Odysseus observe that the infamy of the suitors spreads to the "iron skies" (15:328, 17:564), evoking images both of the sky as an inverted metal bowl and of the divine order as impervious to injustice.

People are juxtaposed with iron in interesting ways. In one instance, human flesh is explicitly *not* iron, for it cannot resist the cutting bronze (Il. 4:509). In several others, people, or their parts, are iron-like. The disguised Odysseus, upon seeing Penelope weep, keeps such composure that his fixed eyes are like iron (Od. 19:211). Similarly, the nurse Eurykleia describes herself as iron for her firm resolve (Od. 19:493). Finally, Odysseus (Od. 4:292), Penelope (Od. 23:172), Achilles (Il. 22:357), and Priam (Il. 24:205 and 608) all are described as having "iron hearts" beating in their chests. These references to iron are easily disregarded: iron hearts are strong. But not all forms of iron are equally hard. Some are soft or brittle, and this raises the novel possibility that iron in the texts is not always synonymous with toughness and impregnability.

### Bloom and Wrought Iron

The Homeric poems refer to iron in ways that seem to differentiate bloom iron, wrought iron, and steel, and thus part of the poems' composition occurred when all three types of iron objects were in wide use. Ironworking likely originated from the process of smelting copper to make bronze (11, 12, 13). The techniques for making bronze appeared around 3200 B.C.E., and rely on the fact that copper melts at 1200°C, while iron melts only

above 1530°C. Copper ores were heated in a furnace, along with fluxing additives like hematite, an iron-containing ore that was needed to adhere to impurities. At the temperatures attained by charcoal furnaces, the copper melted and sank to the bottom of the furnace, while slag, the solid, iron-containing waste, floated on top.

After recovery of the molten copper, artisans made a bronze alloy suitable for casting by the addition of ~10% tin. The slag was discarded. At some time, someone discovered that the solid waste could be worked within a fire, rather than simply thrown away. Although archaeologists have found plenty of iron ornaments or their rusted relics from Bronze Age sites in the eastern Mediterranean and Southwest Asia, bronze artifacts are far more numerous (14, 15). The wealthy classes preferred bronze over iron because bronze could be easily cast and was hard enough to hold a cutting edge. Iron could only be worked in the solid form and was softer than bronze in its wrought form. Because bronze was so expensive and the potential utility of iron was unrealized, most common people relied on stone tools for ordinary use (16).



*Greek Warrior*

During the Bronze Age, iron appears to have been valued more as a curiosity than a commodity. During the reign of Hammurabi in Babylonia (c.1792–50 B.C.E.), iron was approximately thirty times more valuable than silver, and more than fifteen times more valuable than copper (7). The crude miniature headrest and wrought iron tools found in the tomb of Tutankhamen (c.1350 B.C.E.), show that the metal was valuable enough to place with the Pharaoh's funerary trove and rare enough that the Egyptian artisans were unaccustomed to working it (17). Tutankhamen's treasure also included an exquisite dagger with an iron blade, the only artifact of its kind discovered in a Bronze Age site (13).

The Mediterranean Iron Age starts in earnest about 1200 B.C.E., when trade routes for the copper and tin needed to make bronze were disrupted. Locally found iron ores (hematite, limonite, magnetite, and pyrite) were used to make inexpensive iron objects, and within a few centuries iron eclipsed bronze, stone, wood, and bone

for utilitarian purposes. The smelting of iron required little beyond the techniques required for bronze production. The iron ores were first heated in the reducing atmosphere of charcoal furnaces, which reached a maximum temperature of about 1200° C. Since iron does not melt below 1530° C, the result was a solid “bloom,” a spongy mixture of iron and slag. To make wrought iron, the smith heated and hammered this lump over and over, in order to fuse the bits of metallic iron together while forcing out the slag. The smith welded the iron into useful objects by heating the metal until it glowed red-hot and then pounding it into shape (18).

Bloom and wrought iron are distinguished in the Homeric poems. During the funeral games for Patroclus, Achilles produces a “lump of pig iron” (Il. 23:827) for the warriors to throw (19). The Greek word used thrice in this scene is *solos*, which likely refers to the bloom, or unwrought iron, for it bears the adjective *autochoônos*, or rudely fashioned. Elsewhere in the passage the lump is the more common *sidêros*, but the massive size and formlessness of *solos* seems to refer to either a deliberately smelted bloom of iron or perhaps an iron-rich “bear,” the aggregate of waste left over from the smelting of copper or lead. Achilles challenges his men to compete for this heavy prize:

An ingot big enough to keep the winner in iron for five wheeling years. Though his rich estates lie far away in the country, it won't be want of iron that brings his shepherd or ploughman into town—he'll be well-stocked at home. (Il. 23:834)

The bloom is clearly meant to be hauled home by the winner and wrought there into ploughshares that will be superior to the plow of wood traditionally used to turn the fields (20). This highlights the localized nature of the manufacture of uncarburized iron implements: smithing of wrought iron was not a very specialized business, and every estate probably had a worker who could do the job.

In contrast to the *solos autochoônos*, mentioned only in this scene in *Iliad* 23, wrought iron appears throughout both poems. In the *Odyssey*, treasure is depicted by the formula, “bronze and gold and plenty of hard wrought iron” (*chalkos te chrusos te polukmêtos te sidêros*) (14:322 and 21:9) (21). The same formula appears again in the *Iliad* when warriors attempt to purchase their lives (6:47, 10:378, 11:132). This phrase emphasizes the toil expended upon the wrought iron, turning it into such a useful metal that its value stands alongside bronze and gold. Iron is no longer the rustic

raw material for a plowman or shepherd, but a nobleman's ransom—well wrought arms and armor.

Wrought iron can be identified in the texts by its color. Axe heads used in archery contests are described as *ioeis sidêros*—dark violet iron (Il. 23:850) or the more common *polios sidêros*—grizzled or gray iron (Od. 21:9 and 24:164). Although bloom iron is also grayish, in this context the color gray likely indicates that the axe heads are well tended and polished after use with animal fat to keep away the red tinge of rust. Indeed, *polios sidêros* is part of Achilles' war booty, along with “gold, ruddy bronze, [and] women, sashed and lovely” (Il. 9:365), that he has won at Troy.

## Steel

These iron treasures are so valuable that it is possible they depict not wrought iron, but carburized iron. In the case of the grizzled, gray objects, it seems unlikely, for another type of iron appears in the Homeric texts: *aithôn sidêros*—the gleaming or shining iron more resembling flashing steel. Athena adopts the guise of a sailor trading copper for “gleaming iron” (Od. 1:182). In the *Iliad*, Telemonian Ajax cuts down Simoisius with shining iron (4:485). “Gleaming iron” is brought to a feast, along with bronze, cattle, and slaves (7:472). Finally, Hector vows to fight Achilles, even if Achilles' rage be “burnished iron” (20:371). *Aithôn sidêros* has the appearance of steel and could be what is referred to by the formula “*polukmêtos te sidêros*” (hard wrought iron), since steel, while toilsome to produce, makes a far superior weapon than simple wrought iron.

Archaeological evidence indicates that the advent of consistent, deliberate steeling of iron occurred by 1000 B.C.E., and that production of carburized iron objects increased rapidly after 900 B.C.E. (22). Thus it is likely that audiences hearing the Homeric poems at any time after the 9<sup>th</sup> C B.C.E. would be able to distinguish the three principal types of iron as well as, or better than, modern readers (23).

Steel, an alloy of carbon and iron, and harder than bronze, is made in three stages: carburization, quenching, and tempering. To make carburized iron, the smith places wrought iron in an oxygen-poor, white-hot fire (above 800° C). The higher the temperature and the longer the iron sits in the fire, the more carbon diffuses into the iron. While cooling in air, the steel adopts a pearlite microstructure, referring to the tiny, alternating layers of ferrite (pure iron) and iron carbide. The smith

then cold-hammers this steel in order to harden it: hammered steel with 1.2% carbon is about twice as strong as bronze (14).

Steel is made even harder by quenching, i.e. plunging the white-hot iron into water. Iron carbide cannot form when iron is cooled so quickly; rather, the carbon is simply frozen in solution in the ferrite, producing the needle-like microstructure called martensite. Martensite is the hardest but most brittle steel (24). Brittleness is not a problem for small objects like arrowheads, which do not need to withstand much force. Nor is brittleness a problem for thick objects like axe heads, for though the exterior turns to martensite—brittle but strong—the interior cools more slowly, producing a pearlite microstructure that reduces the tendency for the thick object to fracture.

The problem of brittleness is the most acute for the sword, a long and thin weapon. The brittleness of a sword is reduced by tempering, or reheating the iron at a relatively low temperature (under 725° C) after quenching. This causes some carbon to fall out of solution as diffuse iron carbide, a modified pearlite. The higher concentration of pearlite reduces both brittleness and hardness at the same time. Tempering is an inexact technology, since the temperatures required for tempering are lower than red or white heat. Without a visible color change of the metal, the ancient smith would have gauged the temperature of the forge and the optimal tempering time by trial and error, and such understanding would then be passed down from master to apprentice in the family trade.

The process of producing steel objects must have seemed miraculous to the ancients. Not only did the results vary according to apparent chance (the time and temperature of carburization being difficult to quantify), but also the process relied on the elements fire and water. The element fire was difficult to understand in the ancient world, since it works in so many different ways: it reduces or oxidizes ores, depending upon conditions; it fuses glass and clay but

breaks down gypsum and limestone. As Pliny wrote in the first century C.E.: “Fire is a vast unruly element, and one which causes us to doubt whether it is more a destructive or creative force” (11, 25).

We find no images of tempering in the Homeric poems, and so cannot infer anything about how fire’s action upon iron is understood. We can, however, approach the element water, since the *Odyssey* employs a famous simile of a smith quenching iron. In this simile, iron is compared to the hot, charred spike of olivewood Odysseus and his men ram into Cyclops’ one eye:

as when a man who works as a blacksmith plunges a screaming great ax blade or plane into cold water, treating it for temper, since this is the way steel is made strong, even so Cyclops’ eye sizzled about the beam of the olive. (9:393) (26)

Stanford notes that in the Greek of line 393—*pharmassôn: to gar aute sidêrou ge kratos estin*—there

is a tension between water’s act of hardening iron compared with its more familiar solvent action. *Pharmassôn* “possibly. . .implies an almost magical result of the treatment, a trace of the many early superstitions about iron” (27). Elsewhere in the *Odyssey*, the noun *pharmaka* appears in a medical context, modified by both positive and negative adjectives (4:230), so that it seems not such a great leap to infer that the verb *pharmassô* connotes a “doctoring” of the metal. If so, then the use of *pharmassôn* in Book 9 indicates that water is at least as puzzling an element as fire. Sometimes water softens and dissolves, as in the cooking of food or the washing of dirt from fabric; and sometimes water hardens, as in the miraculous toughening of iron. Although the journeyman smith may

not have thought much about water’s mystical action upon iron, the puzzlement preserved in the quenching metaphor may have influenced Plato’s theory that metals are “fusible kinds of water” (28).

The mysterious powers attributed to fire and water by ancient authors may be less a true reflection of first millennium B.C.E. technological theory than a poetic preservation of the mythology of earlier generations (29).



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Archaeological sites in the Mediterranean show evidence of centuries of experimentation with iron during the era of merging of the Homeric texts, resulting eventually in a “broadly based iron economy” (30) with highly skilled artisans. The high regard given to such artisans is implied in two Homeric scenes in which royal or divine metal workers bring the tools of ironworking to fashion precious metals (7). In *Odyssey* 3:432-435, Nestor’s goldsmith assembles hammer, anvil, and tongs to gild the horns of a sacrificial ox, when simply wrapping the horns with gold leaf would do. In *Iliad* 18:468-477, Hephaestus fashions Achilles’ arms and armor out of gold, bronze, and tin, using impressive but superfluous ironworking tools. If the association of ironworking with royal sacrifice and divine artistry is intentional, the honor given to ironworking in these passages is due to recognition of the exceedingly useful nature of steel, the wondrous technology of its production, or both. Certainly, the association of ironworking with religious ritual is not confined to the Homeric poems. The location of 10<sup>th</sup> C B.C.E. iron artifacts from Taanach, in Palestine, suggests that smithing or repair of iron objects had a sacred dimension (12), resulting perhaps from some mystical understanding of the metal or from the simple desire of those in power to control a lucrative product.

### The Heart of Well-wrought Iron

Why should we care about the complexities of iron in the Homeric epics, other than to satisfy historical curiosity? Reading the *Iliad* and the *Odyssey* with a nuanced awareness of iron enables us to recognize iron’s metaphoric richness. Iron is a metal that transforms, shedding some attributes and gaining others under the alchemical influence of fire and water. Iron, like the human heart, can change under the influence of outside forces.

In most instances, “iron-heartedness” calls upon the qualities of hard-wrought iron: strong, impervious to blows. In the *Odyssey*, Telemachus, Calypso, and Odysseus all invoke the iron heart to describe endurance (4:292) or lack of compassion (5:190 and 23:172). Such iron hearts recall the *polukmêtos sidêros*, in that hardness or immovability can be, in many situations, exceedingly valuable. In *Odyssey* 23, for example, Penelope’s iron resolve not to yield until she tests Odysseus is as heroic as Odysseus’ ability to keep his temper and his beggarly disguise.

The wrought-iron heart is applied to Priam twice in *Iliad* 24. As Priam announces his plan to ransom the

body of Hector from Achilles, Hecuba vehemently objects:

How can you think of going down to the ships, alone,  
and face the glance of the man who killed your sons,  
so many fine brave boys? You have a heart of iron!  
(24:205)

Priam’s heart shows the quality of unchangeable resolve, but also a shadow of thoughtlessness; Hecuba implies that wisdom requires a certain pliability of heart, the ability to contemplate a situation from several sides in order to make a prudent choice. In Achilles’ camp, Priam’s audacious supplication wins Achilles’ pity (31). Achilles marvels:

Poor man, how much you’ve borne—pain to break  
the spirit! What daring brought you down to the ship,  
all alone, to face the glance of the man who killed  
your sons, so many fine brave boys? You have a heart  
of iron. (24:521)

Priam meets the terrible warrior Achilles without bursting into vengeful anger or shrinking from the risk of violent death. Priam’s heart has been wrought like iron: the heat of war and the battering losses of his sons have given him heroic endurance.

### Achilles’ Heart of Steel

We see Achilles’ iron heart transformed during the course of the *Iliad*. Before he dies, Hector begs Achilles to yield his corpse to Troy. Achilles refuses:

Would to god my rage, my fury would drive me now  
to hack your flesh away and eat you raw— such agonies  
you have caused me!

Hector laments Achilles’ iron, ruthless heart (22:357). Yet there is a subtle difference between Achilles’ heart and the other enduring hearts, which are fixed, immalleable and cool, as if all the iron working is done and we see the finished, hard wrought heart. Achilles’ heart is ravenous, as if we catch it being steeled—devouring carbon from the white-hot coal that is the life of his enemy.

Looking back through the epic, we see that the heart of Achilles who sulks by the ships is bloom iron, not well wrought at all, good only for resisting his comrades’ entreaties. This heart endures, but its purpose is without benefit to Achilles or his fellow Achaeans. With the death of Patroclus, the heart is hammered and the dross pounded out—it rages in red-hot, bloodthirsty grief, and even the battle with the waters of the Xanthus cannot cool it. This Achilles is wrought iron.

Achilles' heart then lives through the process of steeling. It is carburized and quenched in the blood of Hector, leaving such hardness and brittleness in Achilles' breast that he drags Hector's corpse around Patroclus' tomb day after day. Priam's supplication finally tempers the steeled heart, which gains the suppleness required for yielding Hector's body to Troy with honors. Tempering also imparts wisdom, for only a thoughtful heart recognizes the fragility of the rapprochement: Achilles warns Priam not to make him angry and likewise takes pains not to anger Priam. In other words, Achilles finally becomes aware of the larger environment of his actions, not only of the suffering his rage has inflicted on others, but of the "intertwining and colliding of fates" that unite Priam and Achilles (32).

This evocative image of a steeled heart is important, not only because it helps us deepen our interpretation of two canonical epic texts, but because it tells us something about the history of an important chemical technology. If "iron" in the Homeric epics refers not just to a single static metal, but rather refers to several different forms of iron, then it means that audiences during the so-called Dark Ages knew iron working well. During this period, before writing was invented, the epic stories were fluid, composed during oral performances by the bards, who showed their prowess by spinning skillful similes and metaphors, like the quenching simile in the *Odyssey* and the iron heart metaphors of *Iliad* 24. Oral composers invented these allusions because iron working was familiar enough to function in comparison with other actions or things, and novel enough that the comparison was vivid and lively. Later, with the spread of literacy during the Archaic Period, the role of the bard changed from composition to recitation, essentially freezing the epics—and the most recent similes and metaphors—in several forms that were later standardized. In other words, the metaphors and similes containing references to three types of iron date from the pre-literate, oral composition period, and are not insertions made during a later period. This model accords well with the generally accepted timeline of ancient Greek history: the production of steel is widespread by 900 B.C.E., and the Homeric epics are written in some form by 800 B.C.E. Sharpening our understanding of iron's chemical transformation enables us both to recognize the complexity and variety of references to multiple types of iron in two early literary masterpieces, and to fix the invention of these allusions to an era just prior to the writing of the epics in the ninth century B.C.E.

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7. For a meticulous comparison of Bronze and Iron Age artifacts with all Homeric references to gold, silver, bronze, iron, and tin, consult D. H. F. Gray, "Metal-Working in Homer," *J. Hellenic Studies*, **1954**, *74*, 1-15.
8. The *Iliad*, the *Odyssey*, and all search tools can be found at <http://www.perseus.tufts.edu>, under the link "Classics," followed by "Texts." I am also deeply grateful for the linguistic help of Professors Dana Burgess and Bernard Fenik, and the historical perspective of Professor Suzanne Martin.
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18. R. Tylcote, "Furnaces, Crucibles, and Slags," in T. Wertime and J. Muhly, Ed., *The Coming of the Age of Iron*, Yale University Press, New Haven, CT, 1980, 209.
19. "Pig iron" is a misnomer in Fagels' translation, since the term refers to ingots of cast iron from a blast furnace. The technology of intentionally melting and then

- casting iron did not arise until the 4<sup>th</sup> C B.C.E. in China and the 14<sup>th</sup> C C.E. in Europe (J. Needham, "Iron and Steel Technology in East and Southeast Asia," in T. Wertime and J. Muhly, Ed., *The Coming of the Age of Iron*, Yale University Press, New Haven, CT, 1980, 539).
20. H. Hodges, *Technology in the Ancient World*, Alfred A. Knopf, New York, 1970, 155.
  21. In the oral phase of epic composition, singers would perform some sections of the well-known stories by heart, relying on epithets, or formulaic descriptions, for familiar people and objects. These phrases, sprinkled throughout the surviving text, reflect the common stock of language and folklore that each singer would improvise upon, like a jazz musician who improvises upon standard tunes.
  22. Carburization is determined by observing the microstructure of artifacts by optical and scanning electron microscopy. Intentional steeling of iron implements is indicated if an object can be shown to be uniformly carburized on all sides, and if a group of similar objects from a site shows the same patterning (Ref. 12).
  23. Moderns may be less likely than the ancients to be able to identify the stuff of daily objects, beyond such generics as "wood," "plastic," or "metal." First, it is just too difficult to keep track of the incredible variety of materials, both natural and synthetic, we use for buildings, furnishings, and tools. Second, manufacturing processes are not done domestically; most of us have never seen a blacksmith's shop or a sawmill firsthand.
  24. P. Craddock, *Early Metal Mining and Production*, Smithsonian Institution Press, Washington, DC, 1995, 126.
  25. F. Habashi, "Zoroaster and the Theory of Four Elements," *Bull. Hist. Chem.*, **2000**, 25, 109-115.
  26. The translation of this passage is Lattimore's (R. Lattimore [trans.], *The Odyssey*, Harper Colophon, New York, 1975). It is important to emphasize that the process described in the Cyclopeia is *quenching* (rapid cooling) not *tempering* (reheating), "a point that has been hopelessly confused by modern translators" (J. Muhly, "The Bronze Age Setting," in T. Wertime and J. Muhly, Ed., *The Coming of the Age of Iron*, Yale University Press, New Haven, 1980, 67). A quick survey of the bookshelf proves Muhly's point. "Temper" or "tempering" is used in the translations of this passage by Lattimore, Rouse (W. H. D. Rouse [trans.] *The Odyssey*, Mentor Books, New York, 1937), and Fagels (Ref. 9). Fitzgerald avoids this terminological pitfall: "In a smithy/one sees a white-hot axe head or an adze/plunged and wrung in a cold tub, screeching steam—the way they make soft iron hale and hard. . ." (R. Fitzgerald [trans.], *The Odyssey*, Vintage Books, New York, 1990).
  27. W. B. Stanford, Ed., *The Odyssey of Homer*, Macmillan, London, 1965, 361.
  28. Ref. 2, p 60.
  29. For example, the quenching simile in *Odyssey* 9 likely originated from an older version of the Cyclopeia, a folk tale in which iron played an explicit role (D. Page, *The Homeric Odyssey*, Clarendon Press, Oxford, 1955). According to Page, the Polyphemos episode is one of many universal folk tales woven into the *Odyssey*. The story of the man-eating, giant shepherd has been found in at least 125 versions from diverse cultures, and it is unlikely the *Odyssey* could be the source of all of them. Page identifies certain elements of the tale that are true to the basic plot, and certain elements that are unique to the *Odyssey*. In many traditional versions the giant is blinded with a metal roasting spit, most recently used to cook the hero's companions, rather than the stake of olive wood, as in the *Odyssey*. Page hears an echo of the older tale in the description of the stake that "glowed through terribly" (*diephaineto d' ainôs*, Od. 9:379). An iron spit, he argues, could certainly glow red or white-hot, but a green olive trunk could not, no matter how long it was turned in the fire. The metalworking simile may have existed in the earlier folk tale and been retained, or the iron spit of folklore suggested the vivid image of quenching to the singer or poet, even though he changed the iron spit into a green olive trunk.
  30. A. Snodgrass, "Iron and Early Metallurgy in the Mediterranean," in T. Wertime and J. Muhly, Ed., *The Coming of the Age of Iron*, Yale University Press, New Haven, CT, 1980, 335.
  31. See J. Kim, *The Pity of Achilles: Oral Style and the Unity of the Iliad*, Rowman & Littlefield, Lanham, MD, 2000.
  32. D. Hammer, "The *Iliad* as Ethical Thinking: Politics, Pity, and the Operation of Esteem," *Arethusa*, **2002**, 35, 203-235.

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