

◆ CHAPTER 7 ◆

HEPHAESTUS

DIVINE DEVICES AND AUTOMATA

ONLY ONE GOD in Greco-Roman mythology has a trade. Not only does this god engage in strenuous physical labor; he even breaks a sweat. This same god possesses great intelligence, and his technological productions evoke universal wonder. The hardworking god is Hephaestus, supreme master of metalworking, craftsmanship, and invention.

An outsider among the other divinities, the blacksmith Hephaestus was lame and by some accounts had no father. Both his mother, Hera, and his wife, Aphrodite, rejected him; he was even cast out of Mount Olympus for a time. Yet all the gods and goddesses were in awe of Hephaestus. They called on the smith god whenever they required something of beautiful or clever design and sublime craftsmanship. Hephaestus created the divinities' gold and marble palaces secured with unbreakable locks. He made special weapons, armor, and equipment for gods and heroes: a partial list includes arrows for Apollo and Artemis; the Medusa shield for the hero Peleus; armor for Heracles, Achilles, Diomedes, and Memnon; Athena's spear and Apollo's chariot. He made an ivory replacement shoulder blade for the hero Pelops. For King Aeetes, Medea's father, he made the fire-snorting bronze bulls, and he engineered four fabulous fountains that provided wine, milk, oil, and hot and cold water. Against his will, Hephaestus was ordered by Zeus to make the chains that shackled Prometheus on the mountain, and the smith god forged Zeus's dread lightning bolts, depicted in art as a stylized bundle of metal projectiles hurled like a javelin. Zeus's scepter was another of his works—this was said to have been given to the mythical King Agamemnon of Trojan War fame. The scepter was displayed in a

temple in Chaeronea, one of the several artifacts attributed to Hephaestus seen by Pausanias (9.40.11–12).¹

The earliest description of Hephaestus at his forge appears in an extended passage in the *Iliad*. In the scene, the goddess Thetis seeks out Hephaestus to create a glorious set of armor for her son, Achilles (fig. 7.1). She finds the smith “glazed with sweat,” working at his anvil in his abode made of bronze, where he is aided by various automated devices. Hephaestus wipes his brow with a sponge, sets aside his project, stores his tools in a silver chest, and greets his guest.

Thetis requests a bronze helmet, a richly decorated shield, and chest and leg armor more fabulous than any other ever made. Elaborate



FIG. 7.1. Hephaestus in his forge, showing Thetis the marvelous armor for her son, Achilles. Red-figure kylix, from Vulci, about 490–490 BC, by the Foundry Painter, F 2294. Bpk Bildagentur / Photo by Johannes Laurentius / Antikensammlung, Staatliche Museen, Berlin / Art Resource, NY.

descriptions of the individual pieces of armor follow. The shield is the centerpiece, made of “fine bronze, tin, silver, and gold” and “forged in five layers” with a “triple-ply rim.” Homer’s detailed description of the sophisticated technology of the shield’s construction attracts the attention of modern engineers, such as Stephanos Paipetis. Paipetis notes that Hephaestus uses composite materials to make “successive metal laminates with very different properties.” The god’s craftsmanship represents the ideal perfection of a human smith’s knowledge of “dynamic mechanical properties of laminated composite structures,” either observed in Homer’s own day (eighth century BC) or perhaps transmitted from earlier times in oral traditions.²

Later in the *Iliad*, on the battlefield at Troy, Achilles and his companions admire the magnificent armor intricately embossed with dazzling panoramas that seem alive. The scenes on the divinely wrought shield reflect a marvelous “artificial world complete with motion, sound, and lifelike figures.”³ As if in a “movie in animated metal,” the people on the shield’s scenes are “vigorous and moving; they can sense, reason, and argue,” and they have voices, “like living mortals.” Homer’s description is reminiscent of the eerily true-to-life images that frightened Odysseus in the Underworld and prefigures the “virtual reality” *phantasia* productions by the artist Theon of Samos (fourth century BC), which incorporated sounds, music, and lights (chapter 5). In the curious and paradoxical *Iliad* passage, Homer stresses the astounding realism of the scenes on the shield, specifying the different metals and techniques that Hephaestus used to “construct the various figures” while “calling attention to their crafted realism.” The description causes one to wonder, “Could this verbal description have achieved any of this precision without referencing some visual artifact?”⁴



Before we move on to Hephaestus’s other marvels and his artificial life projects, it is worth pausing to recognize that metal armor was one of the earliest artificial human enhancements (chapter 4). Bronze armor was designed to make warriors’ bodies less vulnerable. But what is most striking about the bronze armor of classical antiquity is its form. The main piece of armor, the cuirass or chest plate, was molded to look like an idealized



FIG. 7.2. Muscle cuirass, bronze, Greek, fourth century BC, 92.180.3 © The Metropolitan Museum, Art Resource, NY. Greaves, realistic leg armor, fourth century BC, Archaeological Museum, Sofia, Bulgaria. Erich Lessing / Art Resource, NY.

male physique cast in bronze. The “anatomical” armor, also called the “heroic” or “muscle” cuirass, first appeared in archaic Greece and became widespread by the fifth century BC. It was cast in two pieces, front and back, attached by straps. The hammered bronze cuirass was made to fit a man’s upper body, with realistic details in relief to mimic the bare torso of a “hero,” with nipples, navel, and impressively sculpted pectoral and abdominal muscles, resembling those of the mythic strongman Heracles. The greaves, bronze shin guards, were also shaped to delineate the knee and calf muscles.

A Greek hoplite who donned the artificial human enhancement of bronze chest and leg armor was essentially donning an exoskeleton that replicated the outer appearance of an idealized, “heroically nude” bronze statue. Notably, the heroic bronze cuirass worn by ordinary Greek soldiers on ancient vase paintings (fig. 7.3) resembles the robust bronze body of the automaton Talos, painted yellowish white (compare figs. 1.3, 1.4, plate 1). The bronze chest plate and greaves transformed every soldier—no

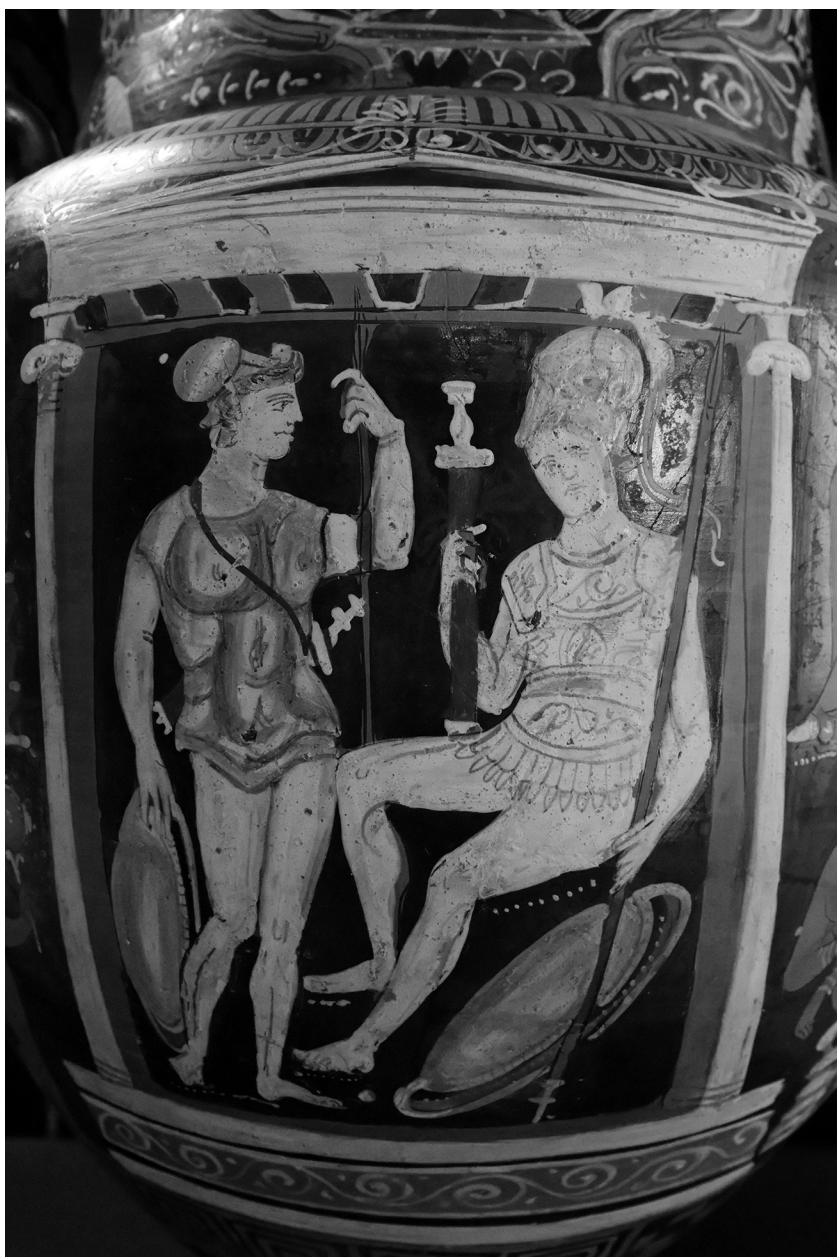


FIG. 7.3. Vase painting of “heroic” cuirass, 325 BC, National Archaeological Museum of Spain. Photo by Marie-Lan Nguyen.

matter what his body type—into a formidable, muscle-bound warrior. An advancing, clanking phalanx of Greek hoplite soldiers clad in muscle armor would present a living wall of superhuman bronze warriors.⁵

Later, the Romans took up the heroic cuirass molded to look Herculean. The Romans further embellished the ceremonial armor and sometimes included realistic silver face masks, which resulted in the appearance of a fully metallic superwarrior. Other military cultures fashioned armor intended to frighten enemies with the semblance of an army of iron men, for example, the eerie iron face masks of the Kipchak of central Asia (see chapter 4 for a medieval Islamic tale about Alexander’s iron cavalry). By the Middle Ages in Europe, full body armor as a metal exoskeleton had evolved into elaborate, heavy suits of armor, as knights dueled with swords and jousted with spears. As we saw in chapter 1, today’s military scientists are reviving a highly advanced exoskeleton idea, modeled on the mythic figure of Talos, to be further enhanced with computers and sensors.



As a god, Hephaestus was capable of workmanship and engineering superior to what could be achieved by mortal artisans. His works displayed prodigious creativity and skills, surpassing those of his earthly parallel, the legendary Daedalus. But like Daedalus and the Titan Prometheus, Hephaestus was imagined using implements and methods resembling those used by real smiths and artisans. And like Daedalus and other craftsmen, in ancient art and literature Hephaestus was portrayed at work surrounded by his tools and half-completed devices and statues. Generic scenes of smiths and sculptors at work closely mirrored the typical scenes of Hephaestus at work in his forge, in Greek vase paintings and in Roman frescoes (Hephaestus was called Vulcan in Rome).⁶

Many of the items of Hephaestus’s manufacture were made expressly for gods and goddesses. To enable the divinities to drive their chariots with ease in and out of their Olympian abode, for example, he made gates that swiveled “on their hinges of their own accord, *automatai*”—thus, jokes classicist Daniel Mendelsohn, “anticipating by nearly thirty centuries the automatic garage door.”⁷

Two cunning devices were wielded against Hephaestus’s unfaithful wife, Aphrodite, and his uncaring mother, Hera. In one myth, Hephaestus



FIG. 7.4 (PLATE 4). Blacksmith at work, with tools, red-figure kylix, late sixth century BC, 1980.7. Bpk Bildagentur / Photo by Johannes Laurentius / Antikensammlung, Staatliche Museen, Berlin / Art Resource, NY.

fashioned a nearly invisible net of incredibly fine but strong metallic mesh to ensnare Aphrodite in bed with the war god Ares. To take revenge on Hera for rejecting him, Hephaestus presented his mother with a golden throne cleverly devised to include a trap set with some mechanism, perhaps a spring or lever, to restrain her as soon as she sat down. Hera was stuck until Hephaestus released her. The scene of Hera on the throne is depicted on several ancient vase paintings. In one, Hephaestus is shown actually releasing the fetters.⁸

Hera, lacking her son's technology, deployed a supernatural creature named Argus as a sentinel against her husband, Zeus. Argus's special powers could be seen as a form of divine artificial enhancement. In a fragment of a Hesiod poem, *Aegimius*, and subsequent texts, Argus was a giant guardian sent by Hera to defend the nymph Io when she was in the form of a heifer being pursued by Zeus. Called *Panoptes* ("all-seeing"),



FIG. 7.5. Top, blacksmith tools, about 250 BC, Museum für Vorgeschichte, Asparn, Zaya, Austria. Erich Lessing / Art Resource, NY. Bottom, ancient blacksmith tools, from the Byci Skala cave, Czech Republic, sixth–fifth century BC, Naturhistorisches Museum, Vienna. Erich Lessing / Art Resource, NY.

Argus never slept and could see in all directions with his many eyes, ranging from four to a hundred depending on the source. On vases painted in the sixth to fourth century BC, the body of Argus Panoptes is shown entirely covered with eyes, as described by the mythographer Apollodorus. A fine wine jug (*lekythos*) of 470 BC by the Pan Painter was recently discovered in ancient Aphytis, northern Greece (fig. 7.6). The body of the humanoid Argus is covered in eyes and has a janiform head looking in opposite directions.⁹



FIG. 7.6. Argus with many eyes and janiform head. Attic red-figure lekythos from Aphytis, by the Pan Painter, about 470 BC. © Hellenic Ministry of Culture and Sports, courtesy of Ephorate of Antiquities of Chalcidice and Mount Athos.

The ancient myth of a hypervigilant watcher that never sleeps and observes from all angles inspired Jeremy Bentham's eighteenth-century panopticon designs for institutions and prisons, heralding the proliferation of banks of surveillance cameras ubiquitous in the modern world. Accordingly, numerous security providers operate under the name "Argos/Argus." The computerized exoskeleton TALOS suit to augment soldiers' senses to be developed by US military scientists also features multiple "eyes" like Argus's (chapter 1), while other military scientists seek ways to create soldiers who can forgo sleep, like Hera's sentinel (chapter 4).¹⁰



The most captivating devices created by Hephaestus were those described as exceedingly lifelike and/or as self-moving automata that mimicked natural bodily forms and possessed something like mind. We have already met some of Hephaestus's artificial animated creatures: the bronze guardian Talos of Crete, the *Khalkotauroi*, fire-breathing bronze bulls wrangled by Jason, and Zeus's torturing Eagle. Other lifelike animals made by Hephaestus include horses, dogs, and a lion. Except for Talos, the animating mechanisms or inner workings of these metallic wonders are not described in any surviving texts.¹¹ But it is telling that they are made by the inventor god, the same god who forged Talos and other automata via *techne*.

Most of the accounts of Hephaestus's animal-shaped devices are very ancient. An exception is a story by the late Byzantine-era epic poet Nonnus (*Dionysiaca* 29.193), who imagined Hephaestus creating a pair of animated bronze horses to draw the adamantine chariot of his sons, the Cabeiroi. As with the brazen bulls, flames shoot from the horses' mouths. "Their bronze hooves beat the dust with a rattling sound," and the equine automata even emit a "dry whinnying sound from their throats." By the time of Nonnus, the fifth century AD, a number of inventors had been building actual self-moving devices for several centuries (chapter 9). Some of these real creations may have inspired Nonnus's vision of the flame-snorting horses as a kind of poetic double of the ancient myth of the bronze bulls.

Much earlier—but puzzling—artistic evidence for a horse made by Hephaestus appears on a unique Etruscan mirror made in the fourth

century BC. The horse statue and inscriptions engraved on the bronze mirror have stumped Etruscan scholars and classical art historians. The Etruscans, as we know, told their own oral versions of Greek mythology. The scene on the mirror shows a realistic metal horse statue (labeled *Pecse*) being created by *Sethlans*, the Etruscan Hephaestus, and an assistant named *Etule* wielding a smith's hammer (fig. 7.7, plate 8).

The horse labeled *Pecse* has been identified by some scholars as the Trojan Horse, but questions arise with that interpretation. *Pecse* is the Etruscan name for Pegasus, but the horse on the mirror has no wings, and in the Greek myth Pegasus was born from the Gorgon's decapitated head, not forged by Hephaestus. This horse has no wheels; the Trojan Horse is wheeled in the earliest Greek artistic images.¹² No known Greek myths associate Hephaestus with the Trojan Horse. According to Homer (*Odyssey* 8.493), the Trojan Horse was constructed of wood by a Greek craftsman named Epeius, not by Hephaestus, and it was either made with Athena's help or else dedicated to Athena (see fig. 5.4, for this scenario on an Athenian vase by the Foundry Painter).

Who is *Etule*? It is possible that Etule is meant to be Epeius, but if this is an Etruscan version of the Trojan Horse story, he was inspired or guided by Hephaestus, instead of Athena. Epeius did have an Italian association: he was the mythic founder of the Greek colony Metapontum (in southern Italy), and it was said that the citizens displayed his tools in the temple to Athena there.¹³

On the Etruscan mirror, Sethlans/Hephaestus is doing something with some lumpy material around the horse's neck. In his right hand he is holding some of the same material. He appears to be removing or applying clay or making a plaster mold, like those used in ancient bronze casting techniques. A comparable scene appears on an earlier red-figure Athenian vase painting of about 460 BC. This vase has an unusual scene of a god other than Hephaestus actually working to make an artificially lifelike being. Figure 7.8 (plate 9) shows the goddess Athena, the patroness of Athenian craftsmen, making a clay model of a horse (the Trojan Horse). The hind leg is unfinished and its body is still rough. Behind Athena are tools like those used by Daedalus and Hephaestus and ordinary craftsmen in their workshops: a saw, drill, and bow drill. There is a mound of clay at her feet, and she is applying a handful of the clay to the horse's head. This classical vase image of Athena making a horse with



FIG. 7.7 (PLATE 8). Hephaestus (Sethlans) and assistant (Etule) making an artificial horse (Pecse), Etruscan bronze mirror, fourth century BC, from Orvieto, BnF Cabinet des Médailles, Bronze.1333, photo Serge Obouhoff © BnF/CNRS-Maison Archéologie & Ethnologie, 2011. B. Woodcut of mirror, Victor Duruy, *History of Greece* (Boston, 1890), redrawn by Michele Angel.



FIG. 7.8 (PLATE 9). Athena making a clay model of a horse; she is holding a handful of clay and there is a pile of clay at her feet. Above left, a saw, drill, and bow drill. The horse's back leg is unfinished. Athenian red-figure wine jug, about 460 BC, F 2415. Bpk Bildagentur / Photo by Johannes Laurentius / Antikensammlung, Staatliche Museen, Berlin / Art Resource, NY.

clay is remarkably similar to the image of Sethlans/Hephaestus molding clay on the horse's neck on the Etruscan mirror.¹⁴

Looking more closely at the image on the Etruscan mirror (fig. 7.7, plate 8) one notices that the lively-looking artificial horse is chained by its front foot to a rock hobble. This is an odd detail for a lifeless statue. Odd, that is, until we recall the ancient Athenian jokes about needing to tether or bind “living statues” to prevent them from running away (chapter 5). The chain on the horse’s leg could emphasize how realistic the artificial horse is—or it could indicate that Sethlans/Hephaestus and his assistant are making an animated statue of a horse, apparently illustrating an unknown Etruscan tradition.



Besides the bronze *phylax empsychos* (“animated guard”) Talos, Hephaestus fashioned two other gifts for Minos. One was magical—a quiver full of arrows (or a javelin) that never missed their mark. The other item is more interesting: a supernaturally swift hunting dog that never lost its prey (the dog’s image appears on the other side of coins of Crete depicting Talos). Sometimes viewed as an automaton hound, and sometimes as a wonder-dog with enhanced natural abilities, this mythic canine creation had many adventures. Often called Laelaps, the dog features in a story (part of a lost Homeric epic, the *Epigoni*) that begins with Minos.

His wife, the witch Pasiphae, we recall, had cursed Minos with scorpion ejaculations to keep him faithful (chapter 4). Minos is finally cured of that malady with a reverse spell cast by another witch, named Procris. Minos gives the special hound Laelaps to Procris in gratitude. Then Procris’s husband, Cephalus, takes Laelaps to Boeotia, in Greece, to hunt the Teumessian Fox, a monstrous fox that could never be caught. This fantastical hunt sets up the sort of paradoxical conundrum that was so popular in Greek mythology and philosophy. The dilemma of a hound that cannot fail to catch prey and a fox that cannot be caught is resolved when Zeus transforms both hound and fox to stone. A pair of rock formations in the shape of the two animals was a famous ancient attraction near Thebes.¹⁵

Confusingly, the hound of Crete/Laelaps story is entangled with the myth of the Golden Hound. Rhea, Zeus’s mother, set this animated hound made of gold to guard the infant Zeus when he was hidden on Crete from his murderous father, Cronus. Who made this golden watchdog? Some say the Golden Hound was made by the metalworking gnomes or daimons called Kouretes or Dactyloi, who were charged with protecting the infant Zeus on Crete. (They were associated with the Telchines, who made the fabled living statues of Rhodes; chapter 5). But other sources say the Golden Hound was made by Hephaestus. At any rate, when Zeus assumed power on Mount Olympus, he ordered the Golden Hound to continue to guard the sacred site of his infancy at his temple on Crete. According to one mythic thread, Pandareus stole this precious Golden Hound from Zeus’s temple, but the god Hermes recovered the Hound for Zeus. The rescue of the Golden Hound was illustrated on an archaic vase painting of the early sixth century BC (fig. 7.9).



FIG. 7.9. The Golden Hound made by Hephaestus, recovered by Hermes, after it was stolen by Pandareas. Black-figure cup, about 575 BC, Heidelberg Painter, Louvre A478. © RMN-Grand Palais / Art Resource, NY.

In the second century BC, the poet Nicander of Colophon interwove threads of these various tales to praise the origins of the marvelously swift real-world Molossian and Chaonian hounds admired by Greek hunters: “They say these dogs are the descendants of a dog” that Hephaestus manufactured. Hephaestus, he wrote, “cast it in Demonesian bronze and set a soul (*psyche*) in it.” This animated hound, recounts Nicander, was passed from Minos to Procris to Cephalus, and ultimately was turned to stone by Zeus. The poet’s folklore phrase “they say” imagines that an animated dog of metal could copulate with a living dog and have offspring. Nicander plays with the idea that an artificial animal could be so “real” that it could even procreate, much as some later Roman-era writers pretended that Galatea and Pandora—neither one born of biological parents—were so “human” that they could reproduce. Nicander employs this poetic conceit to confer a divine pedigree on the best hunting hounds of antiquity, much as Athenian craftsmen claimed Daedalus as their ancestor (chapter 5).¹⁶

The earliest known story of animals wrought in metal by Hephaestus appears in Homer’s *Odyssey* (7.91–98). The scene describes the pair of dogs, one silver and the other gold, that defended the splendid palace of the mythic king Alcinous of the Phaeacians, a mysterious advanced culture. Odysseus admires these ferocious watchdogs, “fashioned with cunning skill,” standing guard at the richly decorated entrance gates.

Homer describes the ever-vigilant hounds as “deathless and ageless.” Some interpret the myth to indicate that the mastiffs could move to attack and even bite intruders, but that is not clear and Homer does not say how. Another mythic tradition says these same gold and silver dogs had once helped the god Poseidon, who then gave them to Alcinous.¹⁷

Three versions of a previously unknown mythic tradition about a bronze lion constructed by Hephaestus to guard the island of Lesbos came to light in 1986. The accounts appear in a badly damaged fragment of papyrus from the second century AD. The earliest source in the fragment appears to be from the third century BC. According to the papyrus, this bronze lion was hidden on the coast of Lesbos to defend against attacks from mainland Anatolia. The story comports with the ancient and medieval belief that bronze statues could serve as guardians and “magic shields” (chapter 1), and some statues, like Talos and the Golden Hound, were further imagined as “animated” (*empsychos*).

The lion statue of Lesbos was made in a two-step process, recalling the “soul” placed in the bronze dog mentioned by Nicander. In this case, Hephaestus cast the hollow lion and then placed *pharmaka* (powerful substances) inside it. The “animating” *pharmaka* were “beneficial to mankind.”¹⁸ This process brings to mind Medea placing powerful *pharmaka* inside the hollow bronze statue of Artemis in chapter 2, and the internal life force inside Talos in the form of ichor (chapter 1). One might also note that the artificial lion “animated” by powers “beneficial to mankind” seems to anticipate the science-fiction author Isaac Asimov’s first law of robotics (1942): A robot may not harm humans. That rule—broken by Talos and other ancient automata—still resonates with modern experts who work on the ethics of robotics and Artificial Intelligence. In the “23 Asilomar AI Principles” for ensuring ethical human values in Artificial Intelligence (set forth by the Future of Life Institute in 2017) the final rule states that “superintelligence should only be developed . . . for the benefit of all humanity.”¹⁹



When the goddess Thetis interrupts him at his forge, Hephaestus is engaged in a project of “inspired artistry.” Forging twenty bronze cauldrons on tripods mounted on golden wheels, he is in the act of riveting the

handles, which have not yet been attached. Bronze tripods, three-legged stands for basins or cauldrons, were ubiquitous everyday furniture in classical antiquity. Ceremonial, ornate tripods were often dedicated in temples or presented as prizes and gifts. When completed, this very special fleet of tripods invented by Hephaestus could travel of their own accord, *automatoi*, delivering nectar and ambrosia to banquets of the gods and goddesses on command and then returning to Hephaestus (Homer *Iliad* 18.368–80). Unlike the ancient descriptions of Talos, no internal mechanism for the tripods was given by Homer, but they fit the definition of machines in that they can travel on their own and change direction.

The passages about the tripods and the automatically opening gates of Olympus (*Iliad* 5.749 and 18.376) are the earliest appearances of the ancient Greek word αὐτόματον, *automaton*, “acting of one’s own will.” In the fourth century BC, Aristotle quoted the Homeric verse and referred to the tripod-carts as *automata* (*Politics* 1.1253b). Notably, Philostratus (AD 170–245) reported that the peripatetic sage Apollonius of Tyana saw many amazing sights in India in the first or second century AD (*Life of Apollonius* 6.11). Among the *thaumata*, “wonders,” were *tripodes de automatoi* and automated cupbearers that attended royal banquets. As many modern historians have remarked, the self-moving tripods serving the Olympian gods call to mind modern self-propelled, laborsaving machines, driverless cars, and military-industrial robots. Homer’s myth reminds us that the impulse to “automate” is extremely ancient.²⁰

Wheeled tripods do not appear in surviving ancient Greek art, and archaeological examples are unknown. However, many ornately decorated four-wheeled bronze carts for transporting cauldrons have been excavated in Mediterranean sites, dating to the Bronze Age (thirteenth to twelfth century BC). Today, one might speculate about tracks, springs, levers, strings, pulleys, weights, cranks, or magnets as plausible operating systems for self-moving tripods that behaved something like those in Homer’s passage about Hephaestus. Indeed, a hypothetical working model of an automatic wheeled tripod can be viewed in the Kotsanas Museum of Ancient Greek Technology (near Pyrgos, Greece). The model uses millet grain, weights, ropes, and transverse pins, applying techniques developed by later historical engineers working in Alexandria, Philo and Heron (chapter 9).²¹

By the third century BC, Alexandria, Egypt, with its grand library and museum, had become a center for mechanical innovations. Perhaps inspired by Hephaestus's wheeled serving tripods in the *Iliad*, Philo (a Greek engineer born in Byzantium, but living in Alexandria) invented an automaton in the form of a woman who served wine. This robot was stationary but it could easily have been placed on wheels to move on an incline, using a simple design that would have been possible with materials, skills, and technology available in classical antiquity.²² Just such a wheeled female servant automaton is described in the later Arabic treatise of AD 1206 by al-Jazari (b. AD 1136), a prolific practical engineer during Artuqid rule in eastern Asia Minor. In this design, liquid is poured into a vessel at the top and trickles into a basin until the basin tips and fills a cup in the servant's hand. The weight in the cup then causes the wheeled servant to roll down an inclined plane toward the drinker (many more historical self-moving devices and automata are discussed in chapter 9).²³

The salient point about the self-driving tripods and similar fictions in Greek mythology about self-moving devices made by Hephaestus is that—in the time of Homer, more than twenty-five hundred years ago—ingeniously designed self-propelling carts manufactured by a super-smith were at least thinkable in the realm of mythology, even though the technology was not specified or known.²⁴

Rolling tripods are absent in ancient Greek art, but there is a striking image of a *flying* tripod. It appears on a beautiful vase painting made in about 500–470 BC by the talented and prolific artist known as the Berlin Painter (fig. 7.10). The scene shows the god Apollo seated on a winged tripod flying over the sea above leaping dolphins. Everyone knew that the priestess of Apollo at the Delphic oracle sat on a special tripod while in a prophetic trance. A legend circulated in antiquity about a beautiful golden tripod, made by Hephaestus and owned by Helen of Troy, designated by the Delphic oracle for “the man most wise.” According to the oracle, the tripod would travel on its own to the wisest man. The golden tripod passed among the Seven Sages and ultimately was dedicated to Apollo.²⁵ Could this curious legend be somehow related to the vase scene of Apollo’s tripod “transformed into a fantastic flying machine”? The image is unique and the myth it illustrates is unknown.²⁶ Such a device would have been crafted by Hephaestus, who made the golden tripod, the special chair for his mother, and the fleet of self-propelled tripods to serve the gods. Indeed, plenty of



FIG. 7.10. Apollo seated on his tripod flying over the sea with dolphins and other marine creatures. Attic red-figure hydria, about 500–480 BC, Berlin Painter, Vatican Museums, Scala / Art Resource, NY.

literary and artistic evidence shows that the idea of flying “machines” in the form of wheeled chariots was current in archaic times.

Three of the many vase paintings depicting these flying chairs/chariot-cars are by the Berlin Painter, while the earliest known example is a vase of about 525 BC attributed to the Ambrosios Painter. The scene shows Hephaestus himself seated in a wheeled chair or chariot-car with wings, illustrating another unknown story (Hephaestus, we recall, was lame). Several other vases portray Triptolemus, associated with Demeter and the Eleusinian Mysteries, seated in or about to mount his flying wheeled chair-chariot (fig. 7.11). In this myth, the goddess sends Triptolemus to



FIG. 7.11. Triptolemus in his flying chair, with Kore, red-figure Attic cup found in Vulci, by the Aberdeen Painter, about 470 BC, Louvre G 452, Canino Collection, 1843, photo by Marie-Lan Nguyen, 2007.

disperse knowledge of agriculture over the earth, traveling in an airborne chair. Among the many ancient sources is a fragment of Sophocles's lost play about Triptolemus (468 BC) that describes him flying about in his special chair. Wings were not mentioned in the written sources—the wings were added later by vase artists as a way of indicating flight. We can guess that wings were attached to the flying machines of Apollo and Hephaestus for the same reason, to show that the wondrous vehicles were self-moving and capable of flight.²⁷



The tripods created by the blacksmith god were mindless machines. But Hephaestus also fabricated wondrous automata in the shape of human beings with special abilities. One example appears in a fragment of a lost poem by Pindar. The scrap of poetry tells how Hephaestus made a bronze temple for Apollo, god of music, at Delphi. The pediment of the temple was graced by the *Keledones Chryseai*, “Golden Charmers,” six golden statues of women who could sing. In the second century AD, the Greek traveler Pausanias (10.5.12) investigated the existence of the singing statues. He visited the site but learned that the bronze temple and the statues had long ago either toppled into a chasm during an earthquake or melted in a fire.²⁸

Yet another group of automata wrought by Hephaestus represents a stunning “evolutionary leap forward” in replicating lifelike humanoids.²⁹ In the *Iliad* scene of the visit of Thetis to Hephaestus’s forge, Thetis observes something astonishing: a staff of self-moving, *thinking* female automata who assist Hephaestus. These female assistants surpass the functionalities of the automatic gates, the traveling tripods, the singing statues on the roof at Delphi, and even Talos, the bronze guard who seemed to possess a kind of agency and consciousness. “Fashioned of gold in the image of maidens, the servants moved quickly, bustling around their master like living women” (*Iliad* 18.410–25). As the writer Philostratus remarked several centuries later (*Life of Apollonius* 6.11), “Hephaestus constructed handmaids of gold [and] made the gold breathe.”

These humanoid helpers are not merely ultrarealistic “living statues” of gold with the ability to move, however. Hephaestus “built

the mechanical serving girls” and then placed “within them mind, wits, voice, and vigor” (*noos, phrenes, aude, sthenos*) as well as the skills and knowledge of all the immortal gods.³⁰ So these golden assistants of Hephaestus are not only spontaneously mobile, but they anticipate and respond to his needs. And they are endowed with the hallmarks of human beings: consciousness, intelligence, learning, reason, and speech. (The people on Achilles’s fabulous shield were endowed with the same capabilities, above.) “Hephaestus’s Golden Maidens set the standard for artificial life,” remarks a scholar of classical and modern science fiction. With “human intelligence and bodies indistinguishable from the real thing,” the Golden Maidens are exceptional “divine artifacts in that they are composed of metal but have human-like abilities.” The mythic gold helpers seem to presage modern notions of thought-controlled machines and AI. Like other automata made by Hephaestus, however, their inner workings are cryptic “black boxes.”³¹

Yet the human-like qualities of the Golden Maidens could be seen as an ancient version of “Artificial Intelligence.”³² In effect, they are endowed with what AI specialists term “augmented intelligence,” based on “big data” and “machine learning.” In what might appear to be a case of mythic overkill, the *Iliad*’s female androids are described as a kind of storehouse of all divine knowledge.³³ In modern contexts, AI entities destined for specific tasks usually require no more information than would be needed for efficiency in problem solving. They need to be able to access useful knowledge but do not require a massive and indiscriminate “data dump.” But just as it is difficult for modern AI developers to anticipate exactly what knowledge could be relevant to complex tasks or might become necessary down the road, the Homeric myth imagines that the gods would naturally wish to imbue Hephaestus’s marvelous automata with a wealth of divine knowledge.³⁴



The automata described in the *Iliad* are not the only self-moving entities in ancient literature imagined as possessing some form of intelligence and agency. In the *Argonautica*, for example, a supernatural oak beam in Jason’s ship, the *Argo*, can speak and prophesy. Even more compelling in terms of an ancient vision of “Artificial Intelligence,” however, are the

remarkable ships of the Phaeacians, inhabitants of the technologically marvelous land encountered by Odysseus, in Homer's *Odyssey* (7–8). Phaeacian ships require no rudders or oars, no human pilots, navigators, or rowers, but are steered by thought alone. The Homeric myth envisions the vessels as controlled by some sort of centralized system, with access to a vast data archive of "virtual" maps and navigation charts of the entire ancient world. King Alcinous boasts that his unsinkable ships can travel very long distances under any weather and sea conditions and return to his port on the same day. The ships themselves "understand what we are thinking about and want," explains Alcinous, "They know all the cities and countries in the whole world and can traverse the sea even when it is clouded with mist, so there is no danger of being wrecked or coming to any harm." To transport Odysseus back to Ithaca, the ships simply "need to be told his city and country and they will devise the route accordingly." Odysseus marvels at the steady course of the pilotless Phaeacian ship, as swift as a falcon, as it carries him across the sea to his home island. The analogy to modern Global Positioning Systems (GPS) and automatic pilot and navigation systems is inescapable.³⁵

Incidentally, a group of ancient Egyptian tales describe ships powered by artificially animated oarsmen. The texts are found in fragments of demotic papyrus pages dating to the Ptolemaic-Roman period (fourth century BC–fourth century AD). Set in the historical time of Ramses II, these stories tell how evil sorcerers make wax models of ships and rowers and command the figures to carry out tasks. It is interesting that the rowers are not only animated but apparently capable of independent thought and actions while completing their missions.³⁶



Hephaestus's self-moving tripods and automated female servants have piqued the interest of historians of robotics. Their glamor overshadows yet another set of automated objects that have received less attention, although they too perform specialized labor in Hephaestus's forge.³⁷ Invented in antiquity to deliver more air to increase combustion and heat, real bellows technology was crucial in the development of metallurgy, which requires extremely hot fires. Later in the *Iliad* scene (18.468–74),

Hephaestus sets in motion twenty bellows that are self-operating and self-adjusting according to his needs. In the scene, Hephaestus “turns the bellows toward the fire and gives them their orders for working. The bellows begin to blow on the crucibles, blasting forced air from all directions wherever he required hotter or lower flames, following him as Hephaestus goes to and fro, working on his great anvil with his ponderous hammer and tongs.” Like the automated doors of Olympus that open and close on their own, the traveling tripods, and the Golden Maidens, the bank of automatic bellows to stoke the blacksmith’s fires were imaginary mechanical, laborsaving machines, doing work that would otherwise be done by living assistants or slaves.³⁸



One of the essential motivations for the creation of machines and robots is economic. By performing mechanized labor, they relieve their masters of tedious toil. This line of thinking led Aristotle, in about 322 BC, to speculate about the socioeconomic implications of inventions like those described in Greek myths about automata (*Politics* 1.3–4). First, Aristotle compares human slaves to tools or automata that fulfill the wills of masters. To live well, he notes, one depends on “instruments, some of which are alive [and] others inanimate.” Thus, for “the pilot of a ship, his tiller is without life [and] his sailor is alive.” Aristotle continues, “A servant is like an instrument in many arts [and] a slave is an animated instrument—but a servant or a slave that can minister of himself is more valuable than any other instrument.”

Aristotle’s discussion is part of his defense of slavery. But then, in a remarkable passage, Aristotle engages in a thought experiment, suggesting a condition that might preclude slavery. If inanimate instruments could carry out their work themselves, he muses, then servitude might be abolished. “If every tool could perform its own work when ordered to do so or in anticipation of the need, like the statues of Daedalus or the tripods of Hephaestus, which the poet tells us could of their own accord move into the assembly of the gods,” and “if in the same manner, shuttles could weave and picks could play *kitharas* (stringed lyres) by themselves, then craftsmen would have no need of servants and masters would have no need of slaves.”³⁹

Today, the ancient speculative fantasy that machines could free many workers from drudgery and replace slaves has become a commonplace reality in many parts of the world. Ironically, however, industrial robotics technologies now threaten to abolish human wage earners' livelihoods, leaving masses of idle, unpaid workers.

Meanwhile, dystopian science fictions paint nightmarish scenarios of a new, rising "servile class" of automaton-slaves that ultimately will rebel. The idea that creations of superior masters might revolt against their makers is also quite ancient. More than two millennia before Karel Čapek coined the word *robota* (derived from "slave"), the link between slavery and robots was already evident in Aristotle's passages, above, and in Socrates's comments about tethering living statues lest they escape and become useless to their masters, like runaway slaves (chapter 5). The theme is taken up in Jo Walton's perceptive science-fiction trilogy set in classical antiquity, in which the goddess Athena establishes an experimental city based on Plato's *Republic*. Athena imports robots from the future to be mindless worker-slaves, but Socrates discovers that the robots not only possess consciousness but yearn for liberty.⁴⁰



Modern historians of robotics and artificial life have so far only superficially addressed the question of whether or not the mythic moving statues of humans and animals, the driverless tripod-carts, the singing statues and mobile servants made by Hephaestus and other bronze workers should be considered mechanical automata. For example, Berryman maintains that Hephaestus's golden handmaids and the tripods could not have been imagined as products of "material technology" because "the technology of [Homer's] day" was not advanced enough to contemplate the idea of self-moving automata. "It may be tempting to read accounts of [ancient] 'statues that move' as anticipating modern robots," she remarks, but this is "not warranted, unless there is evidence of technology available" already that could make such things conceivable (Berryman's argument omits the bronze automaton Talos).⁴¹ Truitt's history of medieval robots briefly discusses Hephaestus's tripods and golden assistants, but not Talos.⁴² In his discussion of the four categories of automata in Greek mythology, Kang mentions the self-moving tripods, but leaves out the

more relevant example of Hephaestus's female automata endowed with mind, strength, knowledge, and voice.⁴³

The imaginary automata in question are, of course, located in mythical material, and their workings are not fully described in the extant ancient texts, but it is appropriate to consider how such entities were conceived of and visualized in ancient literature and art. Admittedly, the written material about mythic automata that survives from antiquity is incomplete and often contradictory. And the artistic evidence that exists today represents a minuscule portion of what existed in antiquity. Even so, it is worthwhile to glean as much information as one can about automata from Homeric times to the late Roman era, to try to understand all the ways that artificial life could be envisioned by ancient people. Any animal and human forms that were described as manufactured—that is, made, not born biologically—were products of what can be termed *biotechne*, life by craft, and therefore they deserve serious attention as the earliest *imaginings* of artificial life. Moreover, the many visualizations of artificial life in the mythic writings were put to good use in antiquity, as provocative ways to think about alternative worlds, which in turn raised ethical and philosophical questions about agency and slavery.

The surviving literary and artistic evidence, even though only a fraction of what once existed, shows that as early as the very first Greek writings in the time of Homer and Hesiod, people were already dreaming up notions of animated statues and self-moving contraptions. The myths demonstrate that automata were *thinkable*, long before technology made them feasible. Some, but not all, lifelike facsimiles were willed to come to life by mystical divine forces, like Pygmalion's ivory maiden. But as we have seen, many other self-moving "machines" and artificial beings were produced by inventors of myth and legend who were renowned for their technological prowess and ingenuity with clay and metal. The evidence demonstrates that nearly three thousand years ago people could express in mythological terms the idea that some type of exceptional technology might be capable of manipulating familiar materials, tools, and processes to make animated objects that mimicked natural forms but with features and workings beyond anyone's ken.



Around the time that Homer was describing Hephaestus's intelligent Golden Maidens on Mount Olympus, the poet Hesiod was using similar language to describe their cousin, Pandora. She too was "made, not born." But this female replica was sent down to earth, on a mission from a god.