

Myth Busting Prometheus

Carl Power and John Rasko argue that the Greek god Prometheus is not the poster boy for regenerative medicine that some make him out to be.



The Greek god Prometheus is the poster boy of regenerative medicine. Countless articles on the science of regeneration—especially liver regeneration—begin with his story, or at least its most gruesome episode. As punishment for defying Zeus, Prometheus was bound to a crag in the Caucasus Mountains where, each day, an eagle feasted on his ever-renewing liver. It's a terrible image, one that has inspired artists throughout the ages. In recent times, it has also become a great emblem for regenerative medicine because the liver, as we now know, has a remarkable capacity for self-repair. But many doctors and scientists think that the Prometheus myth is more than just an emblem. They take it as evidence that the ancient Greeks actually knew about the liver's regenerative powers. If so, then they glimpsed a natural marvel that would not be scientifically verified until the late 19th century and which, today, stem cell research is just beginning to explain. That the Greeks were prescient in this matter is a very appealing idea. But to decide how plausible this is, we must explore the origins of Greek myth and medicine.

READING THE LIVER

How might the Greeks have learned about liver regeneration? An answer frequently given concerns the art of liver augury, also known as hepatoscopy, which was widespread in the ancient world. Whenever the Greeks sought the favour of a god, they would sacrifice an animal—often a sheep—and then carefully inspect its liver for some sign of the god's intentions. For instance, if you were soon to go into battle, liver augury might tell you whether one or other god was on your side; from this, you could gauge the likelihood of your victory or defeat. Archaeological evidence suggests that the Greeks borrowed hepatoscopy from their neighbours in the Near East, from whom they probably also borrowed elements of the Prometheus myth. The famous bronze liver of Piacenza, Italy, (3rd century BC) bears a remarkable resemblance to more ancient clay livers (1900 BC) of Mesopotamian origin. These liver models were designed to help seers practice and teach their craft. While the Greeks may not have used such models (so far, none have been found), their literature and iconography prove that they held hepatoscopy to be a major form of divination.

It has been said that the science of anatomy began with the careful and repeated inspection of livers for divinatory purposes. Even so, the art of augury has in-built limits which would have prevented its practitioners from

discovering the liver's regenerative powers. Hepatoscopy focuses exclusively on the surface of the liver. It does not delve into the organ's interior. Nor does it disclose the liver's vital function. This is not just because *post-mortem* examinations are generally insufficient for the study of physiology. More importantly, the whole art of hepatoscopy depends on *not* viewing the liver in naturalistic terms. Divinatory expertise blocks scientific inquiry. In the eyes of a Greek seer, the liver was a divine text in which the will of the gods was written. An irregularity in its shape, structure, or colour was understood not as an effect of past natural causes (eg the sheep having previously suffered and survived some injury to its liver), but as a sign of what the gods planned for the future. For this reason, we very much doubt that a Greek seer would have been able to recognise the evidence of liver regeneration even if it were right before his eyes.

FROM THE BATTLEFIELD TO THE DISSECTION TABLE

If hepatoscopy is unlikely to have revealed the truth of liver regeneration, what about Greek medicine? On this topic, the best evidence comes from the early poets, particularly Homer (8th century BC). His famous Trojan War epic, the *Iliad*, depicts war wounds in striking detail, including several liver-injuries—all of them fatal. Historians once credited Homer with the knowledge of a skilled anatomist, but nowadays a less extravagant view prevails. Homer and his contemporaries had a very limited understanding of anatomy. They could name the main organs, and they knew how to injure them, but little more. Their knowledge came not from the dissecting table, but from the battlefield, the sacrificial altar, and the kitchen. In fact, apart from those relatively rare occasions when the Greeks desecrated the bodies of their enemies, they did not cut open cadavers. Human dissection was taboo. And it remained so long after Homer's era—which is also when Hesiod composed the first literary version of the Prometheus myth (though the myth itself was probably much older). That is why the Greek pioneers of anatomy, such as Aristotle (384–322 BC), were able to give only fanciful descriptions of the human liver. They had to rely on educated guesses based on the dissection of animals. It was not until the 3rd century BC that Greek physicians living in the frontier colony of Alexandria dared to map the human interior. Members of the Alexandrian school, like Herophilus and Erasistratus, felt less constrained by the Greek taboo against dissection. Moreover, their passion for anatomy was encouraged by an Egyptian king who supplied them with

OPPOSITE: Detail from Prometheus Bound, by Peter Paul Rubens, 1612–8. Courtesy of the Philadelphia Museum of Art.

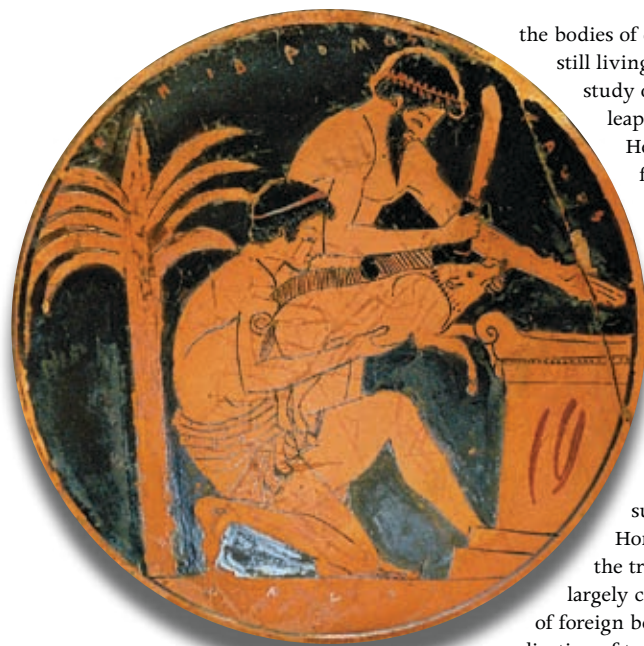
ABOVE: Babylonian clay model of a sheep's liver, 1900–1600 BC. Reproduced with permission from the British Museum. The Trustees of the British Museum.

This article is based on a more detailed and fully referenced work recently published by the authors: Power C, Rasko J. Whither Prometheus' Liver? Greek Myth and the Science of Regeneration, *Ann Intern Med.* 2008; 149(6): 421–26.

Professor John Rasko is a Haematologist who directs Cell and Molecular Therapies at Royal Prince Alfred Hospital and heads the Gene and Stem Cell Therapy Program at the Centenary Institute of Cancer Medicine & Cell Biology, University of Sydney.

Dr Carl Power works at the Gene and Stem Cell Therapy Program, Centenary Institute, where he undertakes research in the history of medicine.





Sacrifice of a young boar, with kalos inscription. Tondo from an Attic red-figure cup, ca. 510 BC–500 BC. The Louvre Museum.

the bodies of convicts—some perhaps still living. Not surprisingly, the study of anatomy took a great leap forward; and it is to Herophilus that we owe the first accurate description of the human liver.

Of course, one could argue that it wasn't necessary to know much about anatomy in order to discover the secret of liver regeneration; surgical experience might be enough. But here again the available evidence suggests otherwise. In

Homer and Hesiod's time, the treatment of wounds was largely confined to the removal of foreign bodies, washing, and the application of topical remedies. The early

Greek healers certainly knew how dangerous internal injuries could be—they knew, for instance, that wounds to the liver bled profusely and usually resulted in death—but they lacked the skills to undertake major surgery. Centuries later, in the era of rational medicine, the Greeks developed some surgical procedures for treating liver ailments. For instance, Hippocrates (460–370 BC) recommended the incision and drainage of liver abscesses and, in Alexandria, Erasistratus cut open patients in order to apply drugs directly onto the liver. Obviously, these treatments appeared far too late to have shaped the Prometheus myth. Moreover, even had they existed centuries earlier, it is very unlikely that they could have revealed the liver's regenerative powers. To appreciate this, you need only consider how recently liver regeneration was scientifically established and how much systematic labour this demanded. Jean Cruveilhier and Gabriel Andral accumulated a vast amount of anatomical and physiological knowledge before they were prepared, in the 1830s, to speculate about the liver's capacity for self-repair. These conjectures lacked proof until the end of the nineteenth century when experimental scientists like Tillmanns, Gluck, and Ponfick succeeded in performing liver resections on rabbits and other animals.

THE LIVES AND LIVERS OF THE GODS

To properly understand the Prometheus myth, it must be considered within its mythological and cultural context. Doing so provides further reasons to doubt that the ancient Greeks knew about liver regeneration. Here we will mention just two. First, the Greek gods were said to enjoy an immortal vitality. They could be wounded, weakened, tortured, imprisoned, put to sleep, even consumed by another god, but they could not be killed. Moreover, their immortality was often extended to their bodily parts. Take, for instance, the story of Dionysus who (according to the Orphic cult) was torn to pieces and eaten by the Titans. Fortunately, the goddess Athena rescued his heart and from it grew a whole new Dionysus. Greek mythology abounds in marvellous tales of regeneration. Viewed in this light, there is nothing remarkable about Prometheus' liver being able to regrow. On the contrary, it would have been astonishing

had the Greek myth-makers decided that his liver *lacked* this capacity. In other words, the Prometheus myth does not prove the Greeks believed the liver to possess a special regenerative power that made it stand out from the rest of the 'splanchna' (their word for innards).

Second, there are many ways to explain why the Greek myth-makers singled out Prometheus' liver for abuse. Scholars have been arguing about this for centuries, and the most plausible explanations they have come up with do *not* rely on the idea that the Greeks knew anything about liver regeneration. Some claim that the Greeks considered the liver to be the seat of life, a privilege they would later transfer to the heart. In that case, Zeus sent an eagle to feast on Prometheus' liver because he wanted to strike at the very core of his enemy's being. Others claim that the myth-makers regarded the liver as the seat, not of life, but of the passions. On this interpretation, when Prometheus defied Zeus, he committed a crime of passion, and his poetic punishment targeted the bodily source of his impulsive behaviour (though just which passion drove Prometheus to crime—spite, anger, or even oedipal lust—is itself a matter of scholarly debate). In our view, Jean-Pierre Vernant provides the best explanation. He argues that the whole myth of Prometheus is about sacrificial cuisine. Consider the two crimes for which Prometheus was punished. First, Zeus gave Prometheus the task of slaughtering a great ox and dividing it into two portions, one for the gods and one for men (women did not yet exist). With characteristic cunning, Prometheus gathered all the bones together and hid them beneath a beautiful, shiny layer of fat. All the meat and tasty innards went into the other portion which he wrapped in the ugly, slimy sac of the stomach. Prometheus was trying to trick Zeus into choosing the bones, and Zeus (though not fooled) went along with the deceit and thereby established a precedent. Henceforth, whenever an animal was sacrificed, the bones would go to the gods while men would keep the edible share. This was a fortunate outcome for humans, but it angered Zeus. So he deprived men of something previously available to them, something that the Greeks regarded as one of the hallmarks of culture—fire. Men could have meat, but they would have to eat it raw like wild animals. To avert this catastrophe, Prometheus stole fire from the heavens to give to men, thereby incurring Zeus' wrath. Because Prometheus had acted as a mediator between the gods and men, Zeus had him bound to the summit of a mountain, midway between heaven and earth. And because he had procured meat for men, he became meat for Zeus' eagle. But why did the eagle eat his liver? Like Prometheus himself, the liver was a kind of mediator: it was that part of the sacrificed animal in which the share of the gods overlapped with the share of humans. Having cut the animal open, the sacrificer would reach first of all for the liver, a delicious morsel that was also a message from the gods. Before it could be eaten, it had to be read.

THE VERDICT

When we began our research, we shared the popular view that the myth of Prometheus is not just a marvellous emblem for regenerative medicine, but proof that the ancient Greek myth-makers had somehow glimpsed the liver's remarkable powers of regeneration. Unfortunately, all the evidence we have uncovered points to the opposite conclusion, forcing us to declare this myth *busted*. *radius*