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Sasanian Chemical Warfare?: a Scientific Re-Assessment

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A recent piece of news regarding the history of Iran surprised those of us involved in the study of history (<http://www2.le.ac.uk/ebulletin/news/press-releases/2000-2009/2009/01/nparticle.2009-01-14.8691982899>). Usually, when Iran/Persia gets mentioned, it is either in the form of nuclear “threat” currently providing fodder for news networks or in the shape of ghouls and monsters who get massacred in hundreds by a few brave and freedom loving Greeks, making puddles of blood in service of human rights and freedom. So, it was interesting to see that the only time the Persian history makes it to the main news (<http://news.bbc.co.uk/2/hi/science/nature/7837826.stm>) is still in connection with violence, particularly “gruesome” tactics against the beloved, civilised, freedom loving Romans who just killed their enemies by boring them to death, apparently.

To give it some background, the Sasanian Empire of Iran/Persia was founded by Ardashir I in 224 CE and it soon came to include not only Iran but also Iraq and parts of the Caucasus and Central Asia. It quickly expanded eastwards to the northern parts of India as well, replacing the Kushan Empire. In the west, it was met with the colonial power of Rome whose expansionist policies had taken it far from the Italian peninsula and into the Near East, the neighbourhood of the Sasanians and the domain of their political ancestors, the Achaemenids. From early on, the Sasanians and the Romans were involved in border skirmishes which never were decisively concluded in either side’s favour. However, in the middle of the third century, Shapur I, the son of the founder of the dynasty, succeeded in defeating and killing one Roman emperor (Gordianus III), defeating and imprisoning another one (Valerian, who died in Iran) and forcing yet another one to sign a humiliating treaty (Philip the Arab). So, at the time that the supposed “chemical warfare” in question was taking place, the Sasanians had the definite upper hand in the war with the Romans. This is again interesting, since comments such as “the Sasanian Persians were as knowledgeable in siege warfare as the Romans” (quite common when there is talk of ancient history) somehow imply that the Romans were the Americans of the ancient world, the most civilised, knowledgeable, and technologically advanced of all ancient peoples to whose exalted positions all others needed to aspire, despite constant reminders from those such as the Chinese that this could not be farther from the truth.

Regardless of whether there is any political meaning behind the news of the Persian use of chemical warfare and the current controversy regarding “weapons of mass destruction”, it is still interesting to see whether this new piece of research has any scientific value. For this, we turned to a colleague, Mr. Reza Yeganehshakib, who is a PhD student at the department of history, University of California, Irvine. Mr. Yeganehshakib comes to UCI with previous degrees in Chemical Engineering (BS) and Environmental Studies (MS). He has a strong understanding of the scientific processes that might have resulted in what has been reported in the news bit above. The following are his comments.

The Roman soldiers that were found could have been killed because of the lack of oxygen due to the blockage of the mouth of the tunnel, or possibly because of the collapse of the earth and the blockage of the mouth of the tunnel behind them. The dimensions of the tunnel, as described, must be precisely analyzed and compared to the material and texture of the soil and its mechanical properties to see if the Roman reinforcement and structures could resist the weight of the mass of the soil above it or not.

Roman and Persian miners would have needed some means of providing light in order to be able to see what they were doing. The sulphur crystal and bitumen, mentioned in the article, are among the chemicals that were commonly used in order to produce torch light at the time. The presence of these chemicals and burning them could surely produce hazardous gasses. Gasses like Carbon Monoxide (produced as a result of the lack of enough oxygen required for the complete combustion in the tunnel), sulphur oxides, and unburned Hydrocarbons are among the most lethal gasses produced by burning these chemicals to produce enough light. The accumulation of these gasses in either side of the tunnel was surely quite deadly. The accumulation of the harmful gasses could have been caused either by the physical blockage of the entrance or mouth of the tunnel or due to the air pressure difference between the inside of the tunnel and the outside air pressure particularly at the mouth of it. If the outside air pressure was higher than that of the inside, then the gases inside could not be released to the outside and would accumulate there. The elevation difference of the tunnel and its entrance is a crucial factor, as the air density and pressure in the higher altitudes is lower than that of lower altitude.

If the Persian tunnel, as shown at the first image, was built at a lower elevation and had an open entrance to enter the air, then a hole or any other open area could have unexpectedly connected the Roman and Persian tunnels together. The air and the harmful gases, either produced by those chemicals to produce light or intentionally to produce harmful gasses, would have suddenly rose up and gotten into the Roman tunnel due to the air pressure difference. Therefore almost all of the gasses that had lower densities than air would have rose up to the Roman tunnel. At the time if the Roman tunnel mouth was closed for any reason, even if the process of the gas transfer from Persian side to the Roman side was slowed, the gasses already existing in the Roman tunnel would have remained for awhile.

All the burning processes need enough oxygen, fuel, and temperature. The latter can be produced by the initial ignition that Sulphur Crystals might have cause; however,

the gases produced as the result of combustion are proportionate to the amount of fuel and air. By finding evidence of the existence of the quantity and quality of the fuel (a very difficult task), we can determine the amount of the gas released by creating a mass-energy balance for the chemical reaction of this combustion to see if enough hazardous gases were produced in order to kill 21 soldiers (20 Romans and one Persian). We also need to see if there as enough oxygen or air to realize the combustion is another issue.

So, these scientific take on the news imply that although the intentional use of “chemical weapons” was possible, the case could also have been a simple case of accumulation of poisonous gasses as the result of the burning of the chemicals used for creating light in the tunnels. In the former case, one should celebrate that the Persians were indeed as “advanced” as the Romans in their knowledge of warfare tactics and technologies. If the latter, one would also wonder the wisdom of trampling the history of Iran/Persia in all other occasions only to give it credence when violence is involved.



A Relief of the Sasanian King of Kings Shapur I meeting a Roman delegation, Darabgird, Iran