ELEMENTAL DANGER:

Earth, air, fire and water: These were Aristotle's four fundamental elements. Each is associated with specific threat to the safety of underground coal miners: cave-ins, suffocation, incineration and floods.

The 12 miners from West Virginia who recently lost their lives were more than just a few guys trying to support their families in a place where employment options were limited. They were no less heroic than the police, firefighters and soldiers who risk their lives to keep us safe and secure. The main difference is that coal miners risk their lives to supply us with electricity. Ultimately, coal-mining deaths are a statistical consequence of coal-fired power generation in an age averse to strip mining.

What seems to have been forgotten in the emotional crossfire among the press, the mining corporation, grief-stricken families, federal regulators and an outraged public is that mining safety precautions -- even if perfectly followed -- can only diminish, rather than eliminate, deaths in the line of duty. When the miners said goodbye to their loved ones to go two miles underground, they were as aware of the danger as is a city police officer leaving home for the night shift.

In her recent book "Coal: A Human History," Barbara Freese writes of the 17th century: "Coal mining ... was probably the most dangerous profession of a dangerous time, vivid and literal proof of the depths to which society would sink for fuel." Mining remains dangerous, even though its safety record has improved relative to even riskier professions such as long-haul trucking.

In the case of the recent Sago mine disaster, it was death by two of the four elements of antiquity, fire and air. One of the 12 died from a fiery explosion of uncertain origin. The remaining 11 huddled together before carbon monoxide apparently snuffed out their lives.

There are other gaseous threats to underground coal miners. Carbon dioxide -- the same stuff that fizzes out of a carbonated beverage and causes global warming -- is a routine product of combustion, but it's produced more slowly when coal is exposed to air. At high concentration, CO\textsubscript{2} is denser than air: It can puddle or it can flow like an invisible river. You can stumble into a pool of it and drown or be overtaken by a gas flood.

Another coal-related gas is methane. It seeps steadily out of coal seams and the rock stratum between them, and it explodes when ignited.

The final gas of concern is oxygen. In the West Virginia case, it was the absence of oxygen that killed, not the presence of other gasses. Oxygen deprivation happens in enclosed spaces when it's breathed up faster than it returns.

As for the two other elements of antiquity, earth and water: The collapse of mine shafts, tunnels, rooms and passageways, whether from above or below, is the most direct cause of mine deaths, crushing men or blocking air and escape.

Finally, water: Virtually all deep mines extend well beneath the water table, meaning that constant pumping is required to evacuate the seepage from rock fractures and pores. The danger comes when miners become trapped by rising water when the pumps fail or pumping cannot keep pace with an unexpected influx of water. This often takes place when a mine shaft that is being extended taps into a stream, pond, pocket of groundwater or abandoned, water-filled shaft.
All other things being equal, the greater the demand for coal-fired electricity by consumers -- particularly when the coal comes from underground mines -- the greater the risk posed to miners and their families.

The next time you flip a switch for some appliance or tool in your home, pause to thank the miner who risked his life for your benefit.