Space Gophers: Robotic Mining Systems in Inner Solar System Exploration.
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Tunnels have been proposed to be the main ecumene of humans outside of the envelope of habitation around planet Earth. During various manned exploration scenarios habitable structures on non-terrestrial bodies is an important factor in defining the mission capabilities of those specific missions. The following paper describes the operational capabilities of robotic pre-landing tunneling vehicles that the author has aptly named 'Space Gophers'.

Humans would be preceded before any manned mission landing by a mining mission which would hollow out a series of compartments that would serve as the primary habitation of the on site mission. These tunnels would be constructed over a period of time by a mining robot so that when humans landed on a nonterrestrial body they would only have to apply a sealant to the interior of the tunnel system or inflate a large balloon inside and an air lock leading to the outside. The orbital transfer vehicle or landing vehicle could serve as the air lock if it was positioned directly over the entrance of the tunnel system.

The three primary excavation systems that will be examined are the:

1) The manual burrowing system.
2) The explosive excavation systems.
3) The torch system of 'melting' excavation.

If advance teams of robots were dedicated to the task of developing a closed ecological system that could support human life, then human teams, once they arrived, would not be required to construct rudimentary shelters, and their time and energy could be directed towards other important tasks. An unmanned mining mission to Phobos or Demos scheduled five years ahead of the manned mission could make Swiss cheese of the Martian moons before the arrival of humans. If 1 foot of a 6 by 6 foot tunnel were excavated every day for five years, then 1825 linear feet of tunnels would be excavated by the time humans made their appearance. After sealing and pressurizing the tunnel interior, habitation would be possible.

One well-designed 250 kilogram mining machine with partial intelligence and partial Earth-centered control could easily handle the task with off the shelf systems. If the machines are used at the above stated rate, their life expectancy would be substantially longer than on Earth in conventional mining operations.

This concept is a logical precursor to a long-duration mission to the Earth's moon. In the case of our Moon, the mining system could land within a crater, move slowly toward the wall of the crater, and then proceed to burrow. Along with its main task of preparing the environment for human habitation, the advance team of robots could also pre-position equipment for later use.

The concept is very simple and yet it would expand our manned mission capabilities and give a real head start to the development of long-term habitation and exploration facilities on non-terrestrial bodies. Phobos and Demos, for example, have already been suggested for use as Martian 'space stations', and this proposal would allow a system for exploration and habitation to exist the moment a manned mission arrived in Martian orbit.