

Shepherd Satellites
written by Steven Wintergerst on June 13, 2003

Shepherd satellites would be designed to combat a problem not commonly mentioned among terraforming circles.

The surface gravity of mars is so low that in it's current state, hydrogen molecules would reach escape velocity at the average Martian surface temperature.

This is a serious concern, as all atoms in the universe are constantly undergoing changes in molecular configurations. On the surface of mars, this takes on a critical twist.

When water becomes warm enough to melt, or sublimate, and thus is available for life, the temperature is above average, and thus, any hydrogen freed at this time is likely to reach, and possibly exceed escape velocity.

The ultraviolet rays emitted by the sun which do reach the surface of mars are especially good at breathing hydrogen-oxygen molecules, so that free hydrogen, much lighter than it's molecular counterpart, and recently charged from it's encounter with a photon are an almost certainty.

Thus, some method of replenishing, or reducing the loss of hydrogen will eventually become necessary. Otherwise, even the most valiant efforts at terraforming will quickly allow mars to slip back into a dry, and probably cold condition, no more hospitable to humans than it had been before.

Currently suggested methods of adding material to mars is generally limited to small packets from earth, or tie impacting of large comets, an activity which is certain to have negative impacts on any inhabitants there at the time.

Thus, I suggest a somewhat gentler device, modeled off of nature itself in the good rings of Saturn.

Astronomers asked will keenly tell you that the quantity of small particles in Saturn's rings, if left to their own devices, would soon dissipate throughout the solar system, leaving no rings at all.

The continued existence of these rings is due to one factor only, certain moons and smaller bodies orbiting among them. many rings have a tightly defined edge, which is bordered by just such a body.

The gravitational interactions are a bit arcane, but for example, as a large body orbits outside the ring of smaller debris, it's gravitational force pulls these small particles towards itself. Being slower, the result is that the moon slows over energetic particles, causing them to fall back in towards the center of the ring.

With Mars, the situation would have to be a bit different. We don't want rings around it, we want it to orbit through a ring of very small particles, molecules of hydrogen, and perhaps other atmospheric material.

Such a ring is just waiting to be formed, it comes in the shape of the solar wind, a material of over 70%hydrogen which streams put of the sun at a relatively constant rate as highly charged particles.

We need only arrange satellites (and here I mean by satellite any body which orbits another, natural or artificial) into an orbit, or orbits around the sun which can facilitate the formation of such a ring around the orbit of mars.

There is likewise, a nearby wealth of candidates in the asteroid belt, thousands of tons of rock and metal ore,

which will likely attract a rich mining interest in it's own right some day.

There is no doubt that large bodies will be moved around in this part of space some day, if not to mine then at least to reduce the number of "Earth crossing" bodies which might someday wipe us out as surely as the dinosaurs.

Thus, it seems logical that at some point, a portion of this material could be set up just outside of the orbit of mars, to facilitate the formation of such a ring of hydrogen, and other materials (for oxygen could escape the gravity of mars at earth temperatures) to supplement the planet's natural atmosphere.

Solar wind, being composed of charged particles on their way to escaping the solar system, contains a number of very energetic particles, which as they entered the atmosphere of mars might give a good deal of heat to the planet, possibly warming the planet to a good temperature on their own right.

The needs of shepherding particles so small as hydrogen molecules, and atoms may be a bit beyond current understanding. Shepherd satellites of a specific size, shape, or mass arraignment may be required. However, the albedo, color, and chemical composition of such a body will not come into play. There is no reason that special additions could not be placed on such bodies, such as solar cells, mirrors, gyroscopes, inhabited areas, or the like.

Mirrors on such bodies might add to the light sent to the planet, thus heating it, but it seems more likely to me that as the mass of the shepherd satellites are usually going to be far from Mars, that lights, or even lasers would be a more appropriate method of transferring solar energy at most times.

As this mass of bodies orbit mars, they might slowly affect it's orbit, pushing the planet into a more circular orbit, greatly reducing the drastic temperature swings caused by the world's elliptical orbit, and thus further adding to the earthlike nature of the final product.

A good deal of real research would be needed to complete this task, determining the appropriate orbits, sizes, numbers, and total masses of such shepherd satellites necessary to cancel out the outward push of the solar wind, but unfortunately, I am no orbital mathematician, and would not know where to begin such an endeavor.