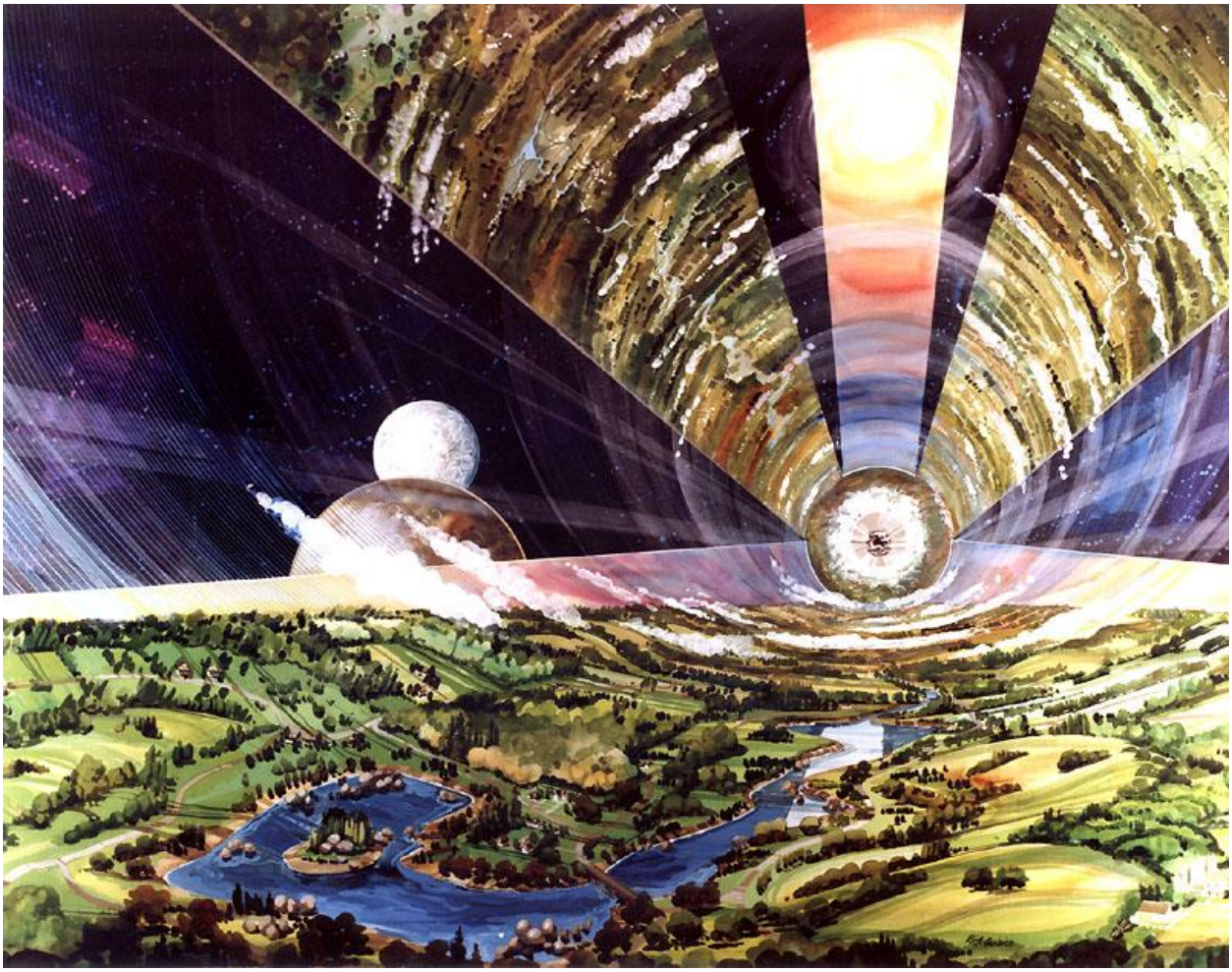


Garden the Solar System

Green the Galaxy

A Visual Manifesto

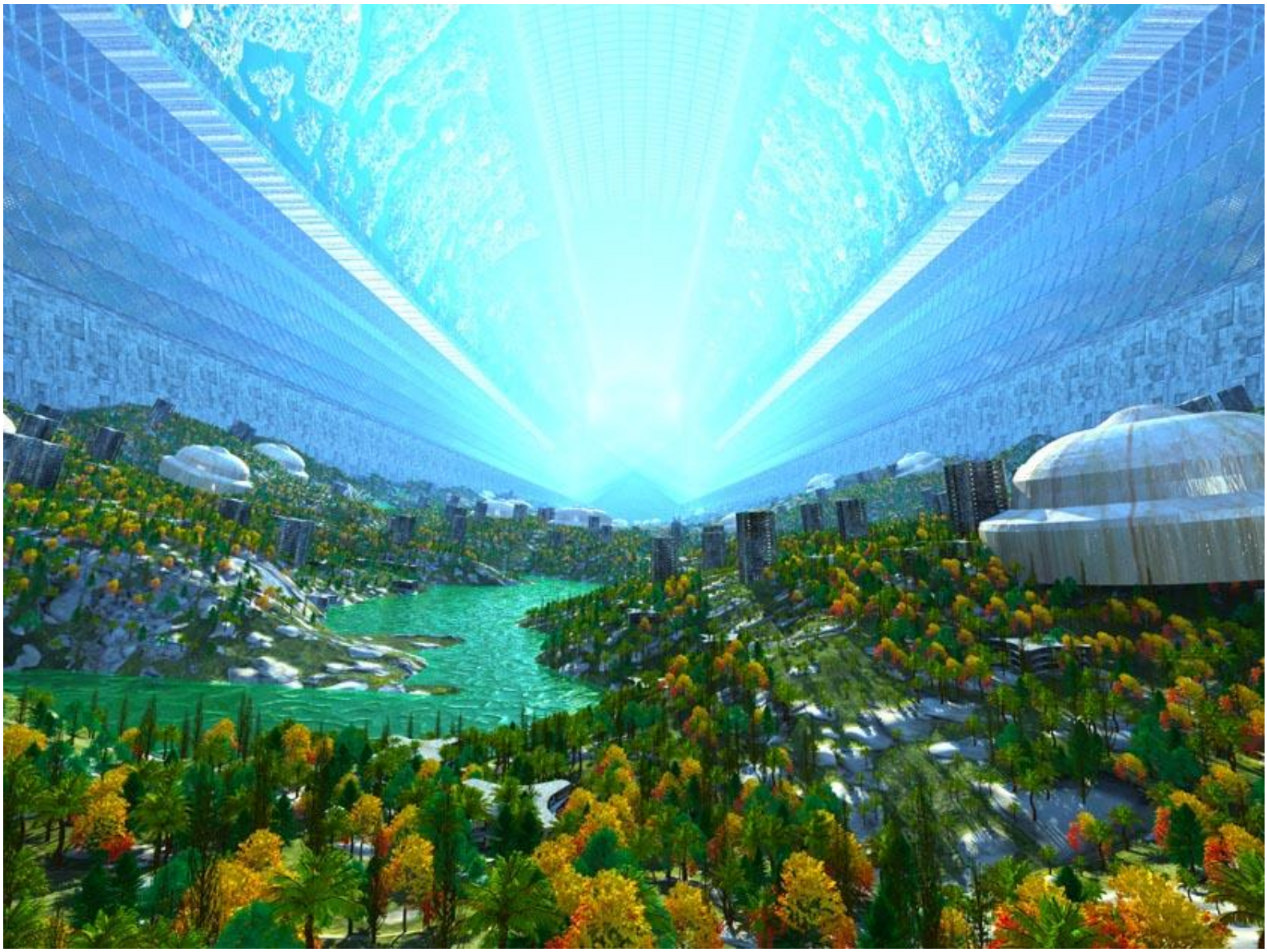
By
Howard Bloom
Chairman
The Space Development Steering Committee
Member of the Board of Governors
The National Space Society
Co-founder and Chair: The Asian Space Technology Summit

Bring space to life
By bringing life to space.

Nature has given us a challenge. How do we get from here

to here?

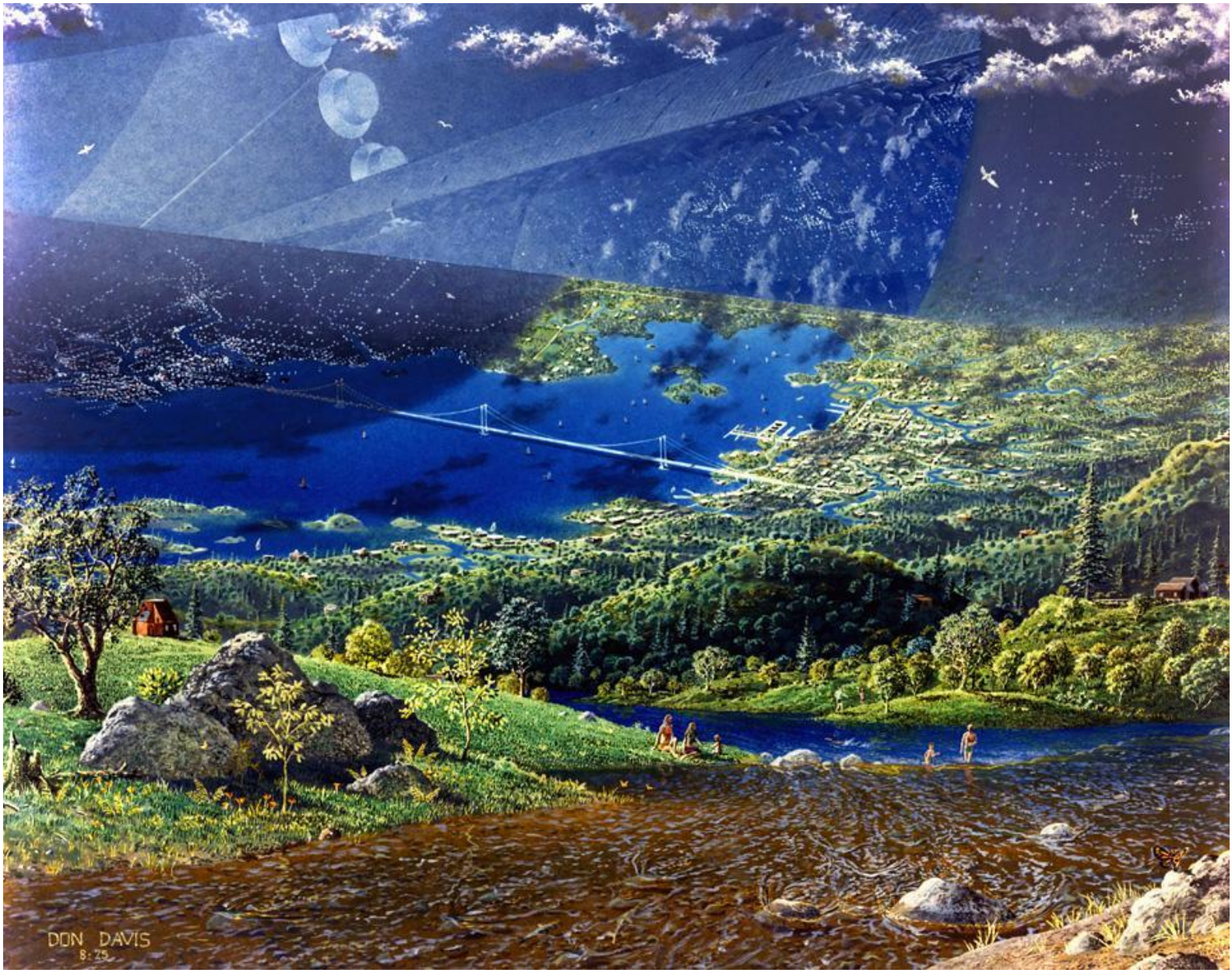
Not to mention here.



An O’Neill colony parked between the Earth and the Moon.

How do we bring space to life? Simple. We bring life to space.

(Below—more of an O'Neill colony.)

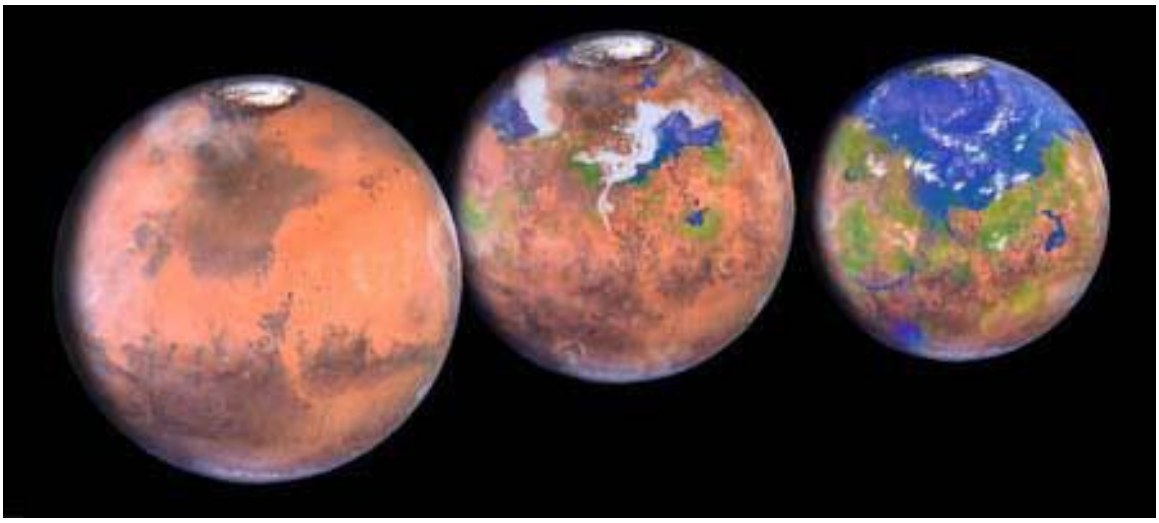


Four billion years ago there was less than half a teaspoon of life. Half a teaspoon threatened with extinction by a toxic planet. A planet of climate catastrophe and volcanic savagery. How did that half a teaspoon survive? How did it overcome the obstacle of 142 mass extinctions? By turning poisons into pleasures, disasters into delights, and wastelands into fields of waving grain.

Oxygen, sulfur, and phosphorus were deadly. So societies of ambitious cells invented ways to use these poisons as gears in the machinery of life. Four-hundred-degree sea vents and an ocean surface whipped by turbulence and bombarded by a form of radiation we call light—life turned those threats to its advantage, too. Life thrived by turning the toxic spaces of an alien planet green.

Then came the first space program. Nearly three billion years after life began, we took an immense gamble. We crawled from a cozy, comfortable place to a barren wasteland higher than any we had ever dared explore, a sterile and hostile rock face with seemingly nothing to offer. We went from the nurturing embrace of the sea to the raw, wind-scoured, sunlight-battered stone of land. A yawning empty space on high. And the move paid off.

Now how do we take life's next great leap? How do we garden the solar system? How do we green the galaxy? How do we bring the seeds of life to a cosmos of fire, darkness, stone, and ice?



Turning the red planet green—terraforming Mars.

And how do we use space to save the planet? How do we take the resource load off earth? How do we lift the poor and the oppressed of Earth's seven

continents? How do we triple the GHP, the Gross Human Product, the total contribution of humanity?

The answer? We are already on our way.

Telstar, the first commercial satellite, started harvesting solar energy in space and transmitting it to earth as communications signals over fifty years ago, in 1962. The medallion-like squares with black grids were photovoltaic panels turning sunlight into electricity.

Today solar energy harvested in space powers a quarter of a trillion dollar industry—the commercial satellite business. And someday that solar power harvested in space may free us from fossil fuels and power our lives.

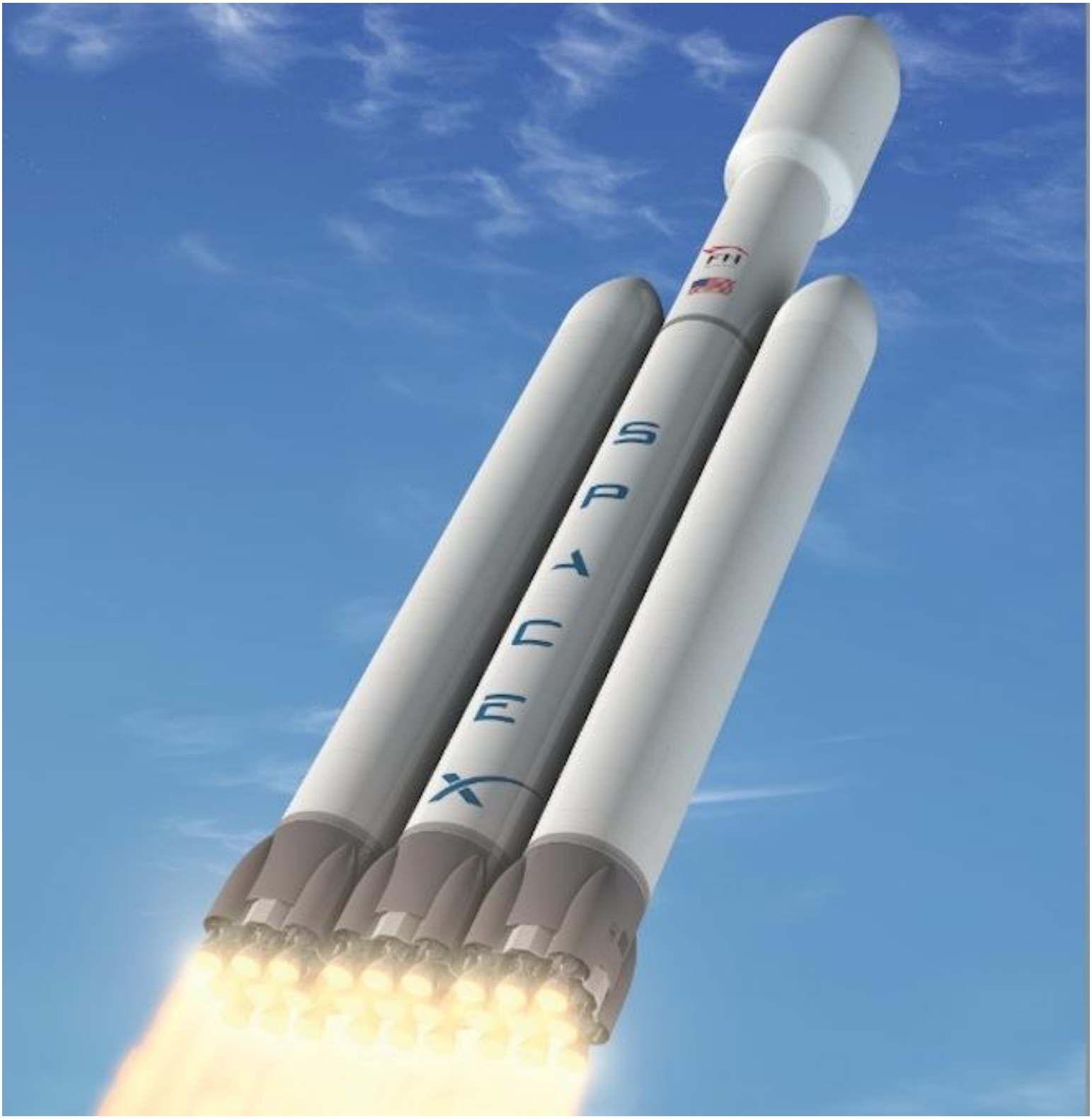
But that's getting resources from space to earth. How about getting the gardens of earth to space? That's life's ultimate leap. And it's life's ultimate challenge. Your ultimate challenge and mine.

Here's a quick how-to, a sketch of the steps to a cosmos alive with ecosystems.

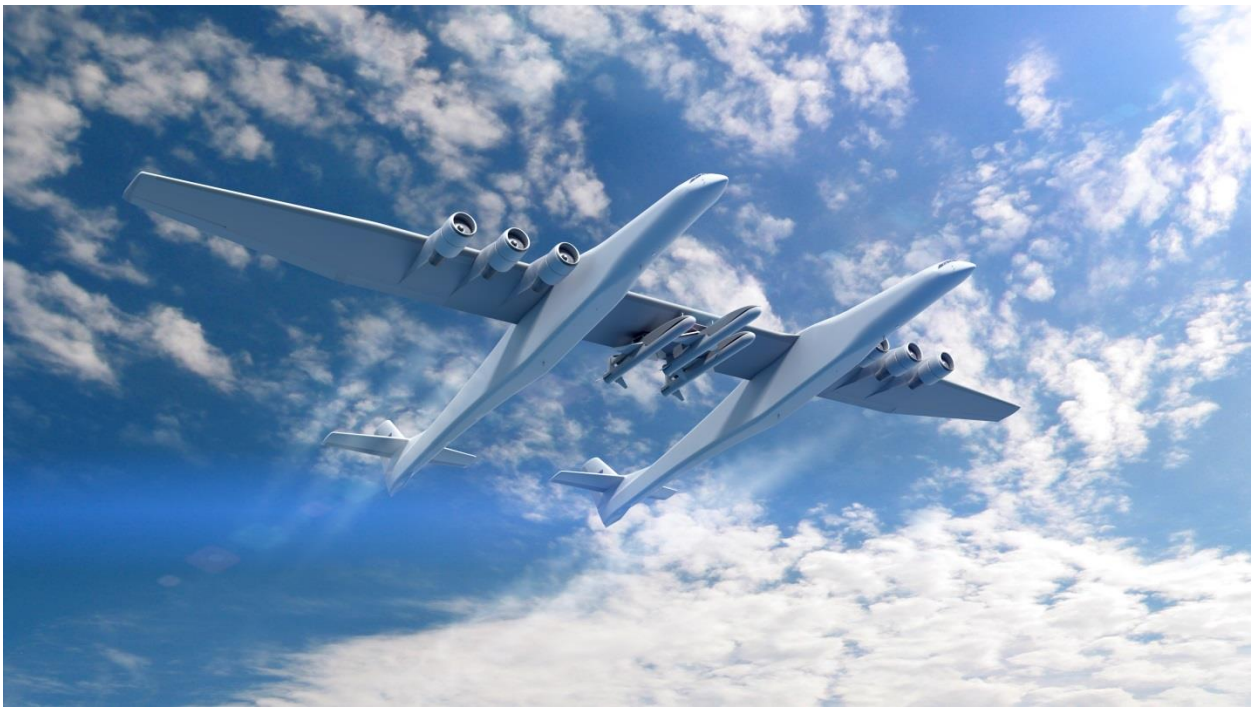
The first step? Rockets that can lift cargo and passengers to orbit, then can land on their tails, be serviced and refueled in ten hours, and can launch another load to space. Rockets as reusable as trains, buses, and planes. Reusable rockets from Elon Musk's SpaceX and from Jeff Bezos' Blue Origin.

Ever since we landed on the Moon in 1969, space has been expensive. Why? To take one trip to orbit, we've built a billion dollar rocket, then we've thrown it away and for our next trip, we've built another. This is like buying a Boeing 737, flying it from New York to LA, then throwing it away in the Pacific Ocean and buying another to take the return flight. Using this technique, a round trip from New York to LA would cost you three quarters of a billion dollars. But buy the Boeing 737, pack it with passengers, fly it for 30 years, and a trip to LA would cost you $300. That's the Reusability Revolution. And that's what Musk and Bezos are achieving in space.

An early version of Jeff Bezos' Blue Origin rocket has landed and taken off five times. That's reusability.

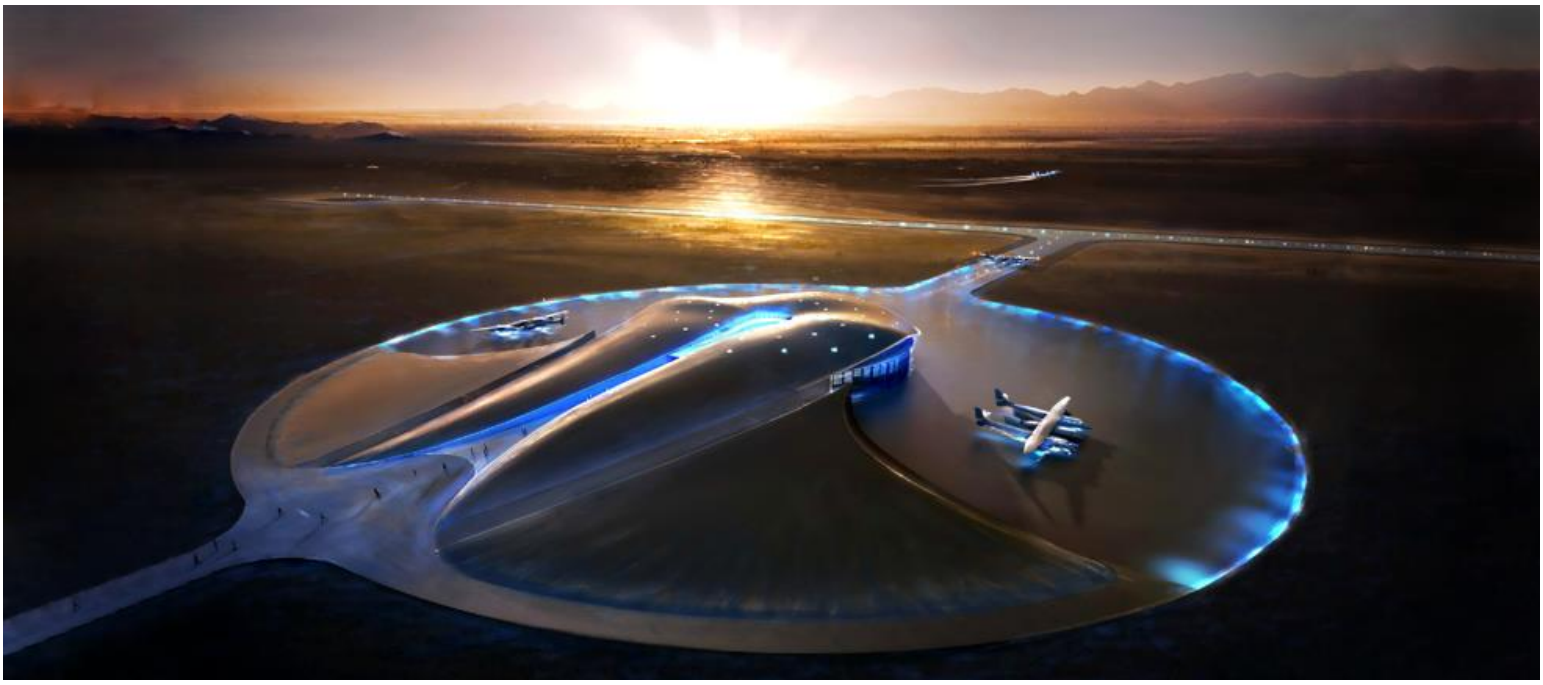


The next step: SpaceX’s reusable Falcon Heavy, in 2017, will lower cost to orbit from $10,000 per pound to $526 per pound…or less.



SpaceX and Blue Origins' reusable rockets may compete with piggyback heavy lift vehicles that can take off like airplanes. Reusable rockets and piggybacks will slowly lower cost per pound to orbit to $10 per pound.

The Richard Branson-backed Virgin Galactic spaceports from which the first piggyback horizontal rockets may take off. One spaceport is being built in New Mexico. Another is planned for Abu Dhabi.



What will be the fruits
of lowering the cost per pound to orbit
from $10,000/lb. to $10?

Cutaway view of a Russian hotel in space.

Establishing a foothold on an asteroid.

Deep Space Industries' asteroid mining.

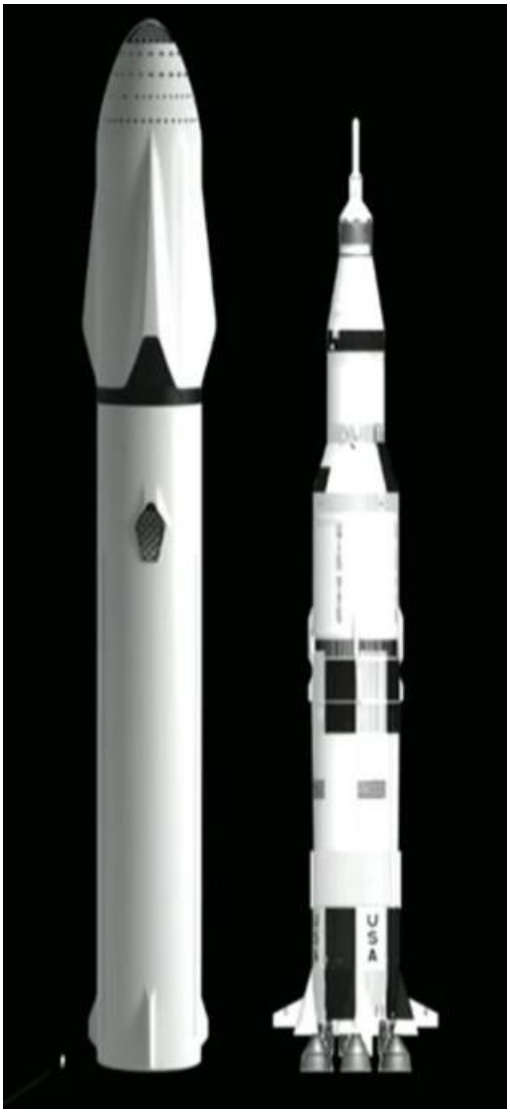
One asteroid of modest size can have $31 trillion worth of platinum—more than the gross domestic product of the United States, China, Japan, and France combined.

Planetary Resources, a company backed by Google founder Larry Page, Google executive chairman Eric Schmidt, and Titanic filmmaker James Cameron, is also pursuing the asteroid bonanza.

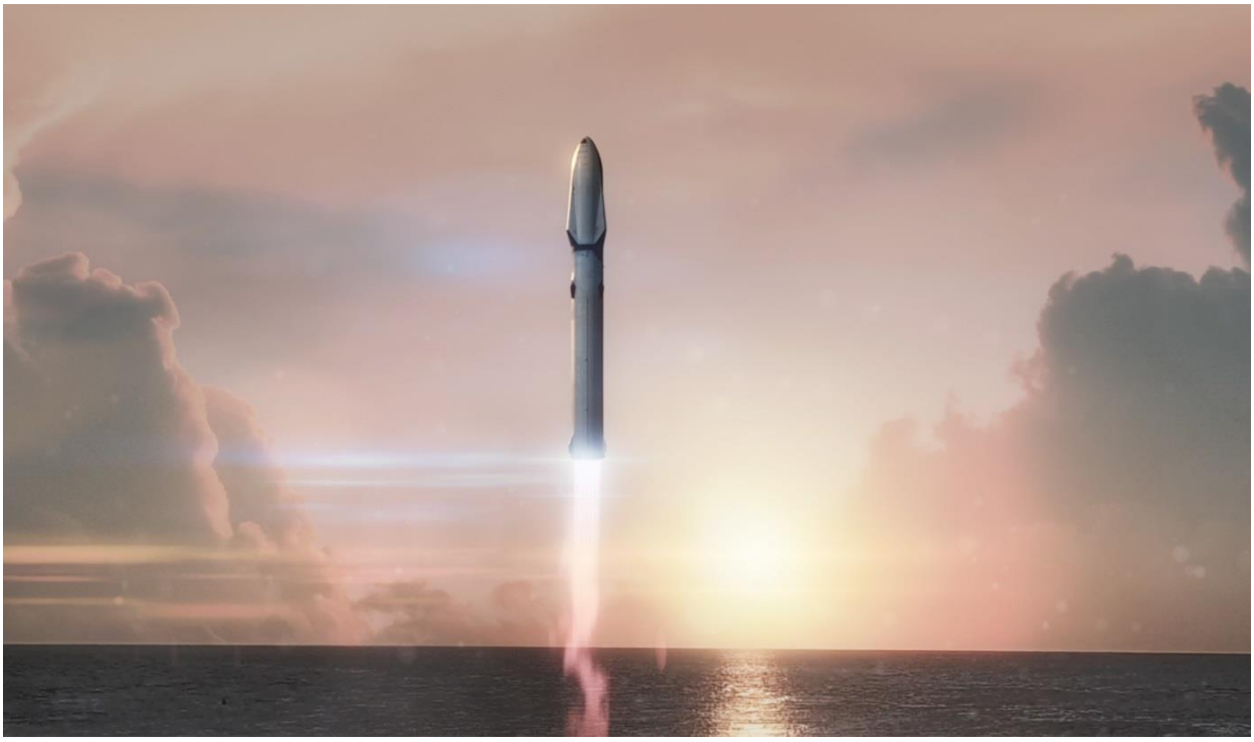
Elon Musk's SpaceX plans to take you to Mars by 2025. Step one, begin the regular launch of cargos to the surface of Mars by 2020, using Falcon Heavy rockets.

The SpaceX cargos will travel to Mars on Red Dragon capsules, rocket-equipped versions of the Dragon capsules that have successfully taken cargos back and forth from the International Space Station more than ten times. The advantage of rockets in the base of your capsule? You can land…and take off.

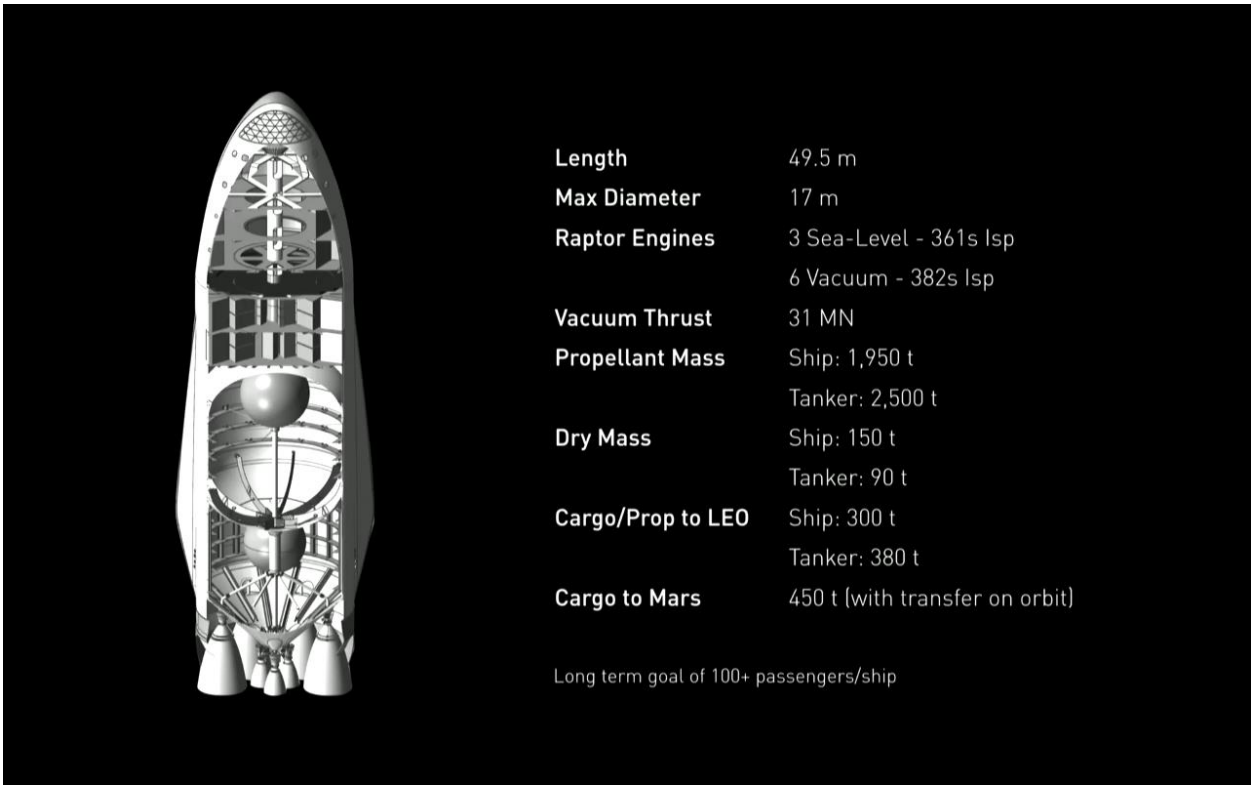
Step two of Elon Musk's Mars plan: build and launch a mega rocket and a mega transport luxury ship: the SpaceX Interplanetary Transport System.



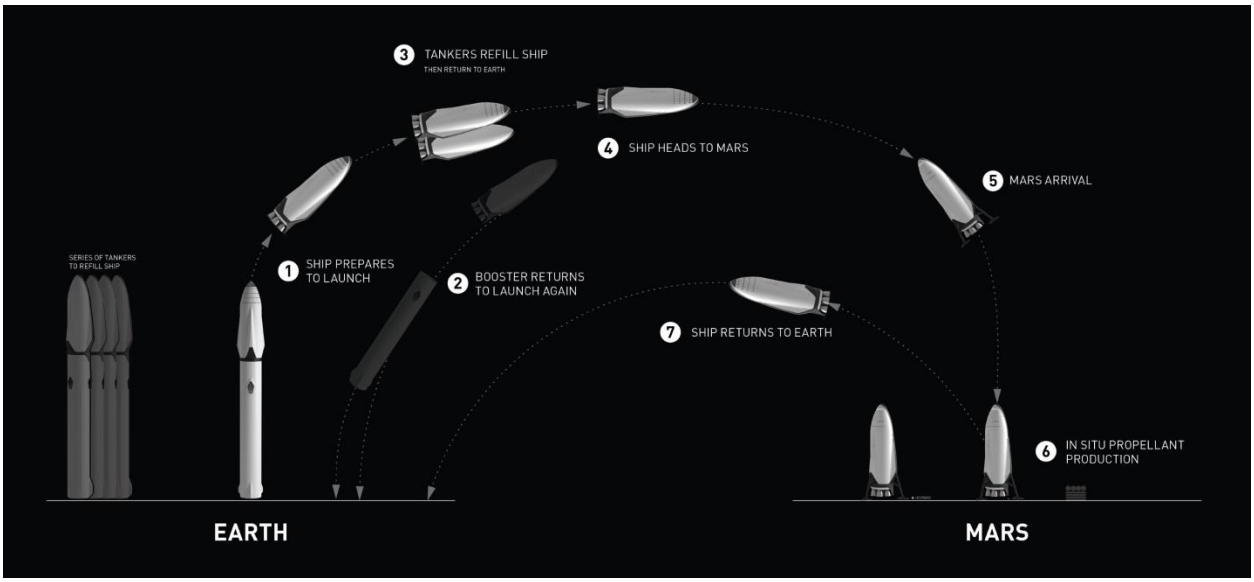
The Interplanetary Transport System rocket on the left will have 42 engines and will be able to lift nearly five times the payload of the biggest rocket ever, the Saturn V, the launch vehicle that took humans to the Moon. Yes, five times the payload of biggest rocket ever.

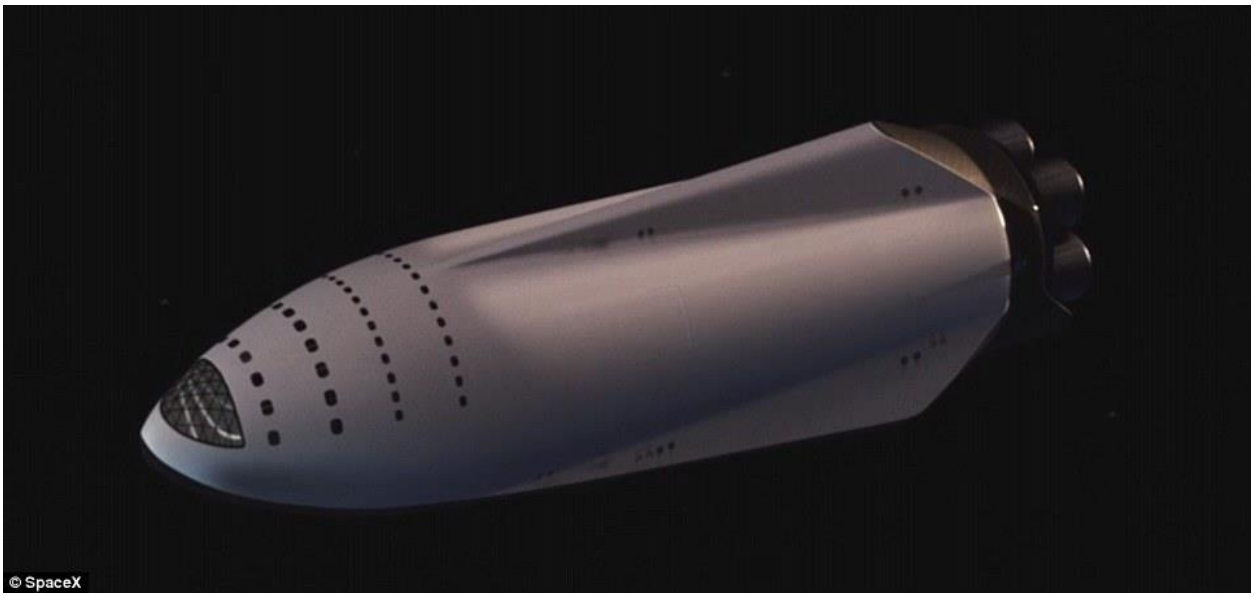


The Interplanetary Transport System rocket will launch two versions of a spacecraft of enormous size. Version number one will be hollowed out to perform as a massive fuel tanker. It will carry 840,000 pounds of fuel into orbit.

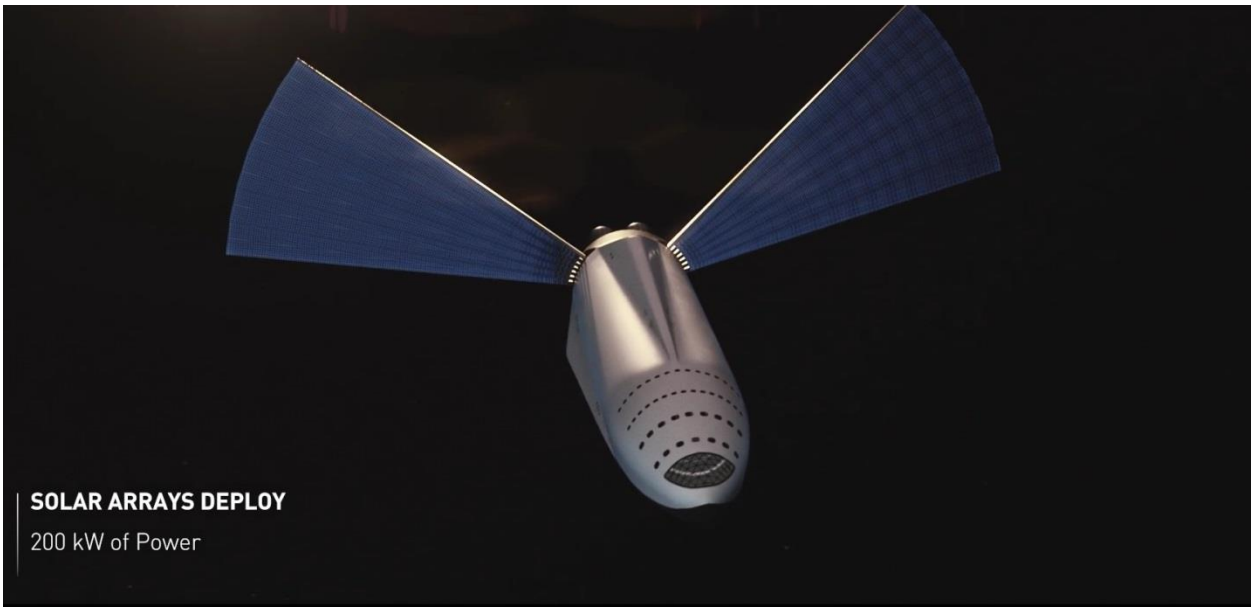


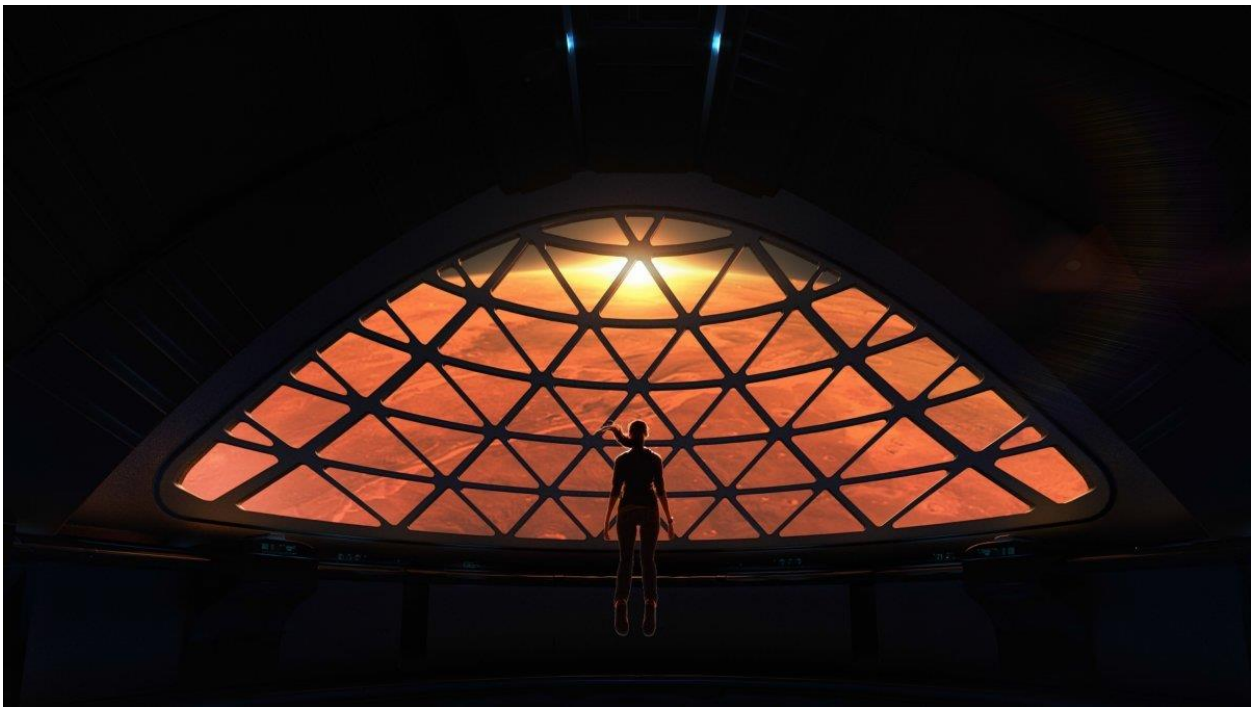
The tanker and its fuel will wait in orbit for the launch of the Interplanetary Transport System's passenger liner, a craft that will carry a hundred travelers in unparalleled luxury. In orbit, the passenger vessel will fill up with fuel from the tanker, fuel it will use to travel to Mars and land on the Martian surface.





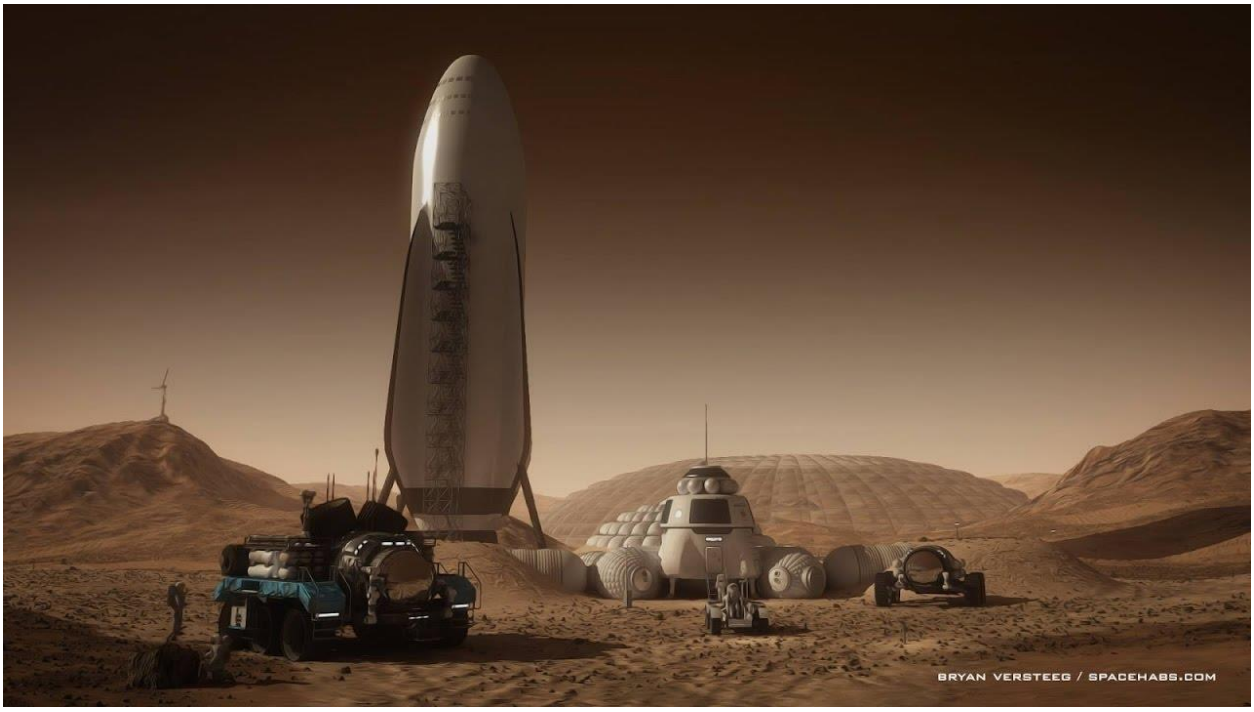
Then the passenger liner will fire its six engines, spread its solar panels, and head for Mars.



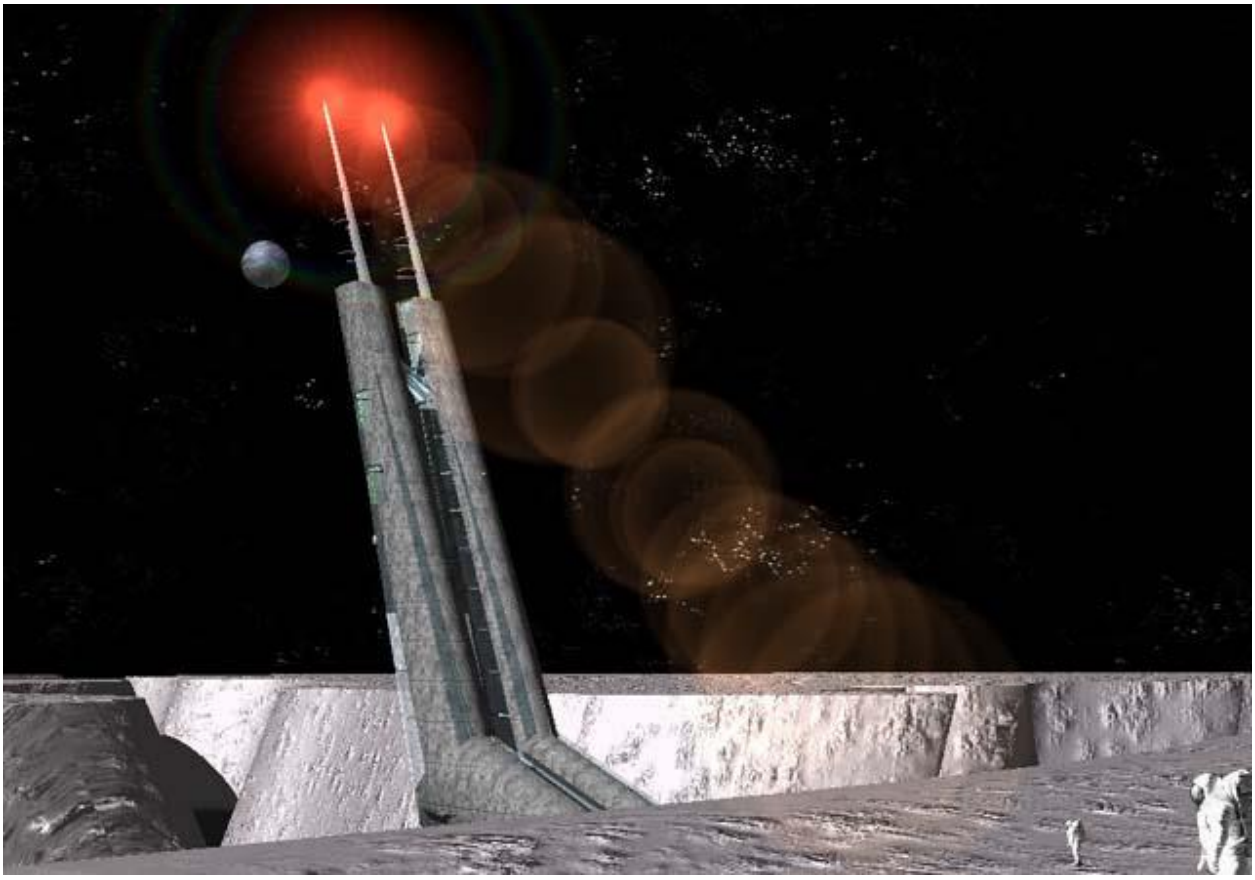


The view of Mars from the top deck of Elon Musk's Interplanetary Transport passenger ship.

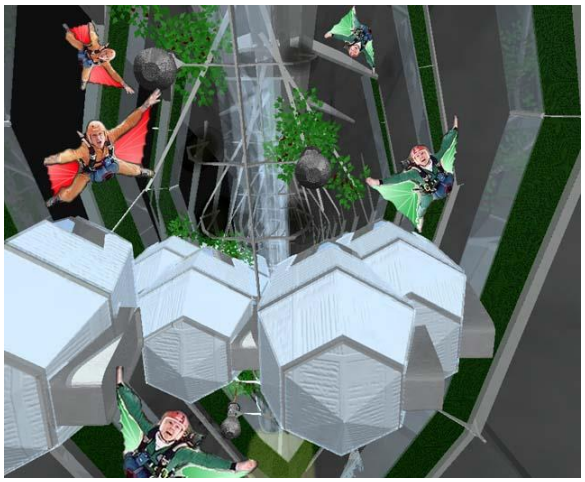
On the Martian surface, the passenger liner will offload its passengers, fill up on fuel made from the Martian atmosphere, pick up travelers going back to terra firma, and head back to Earth.

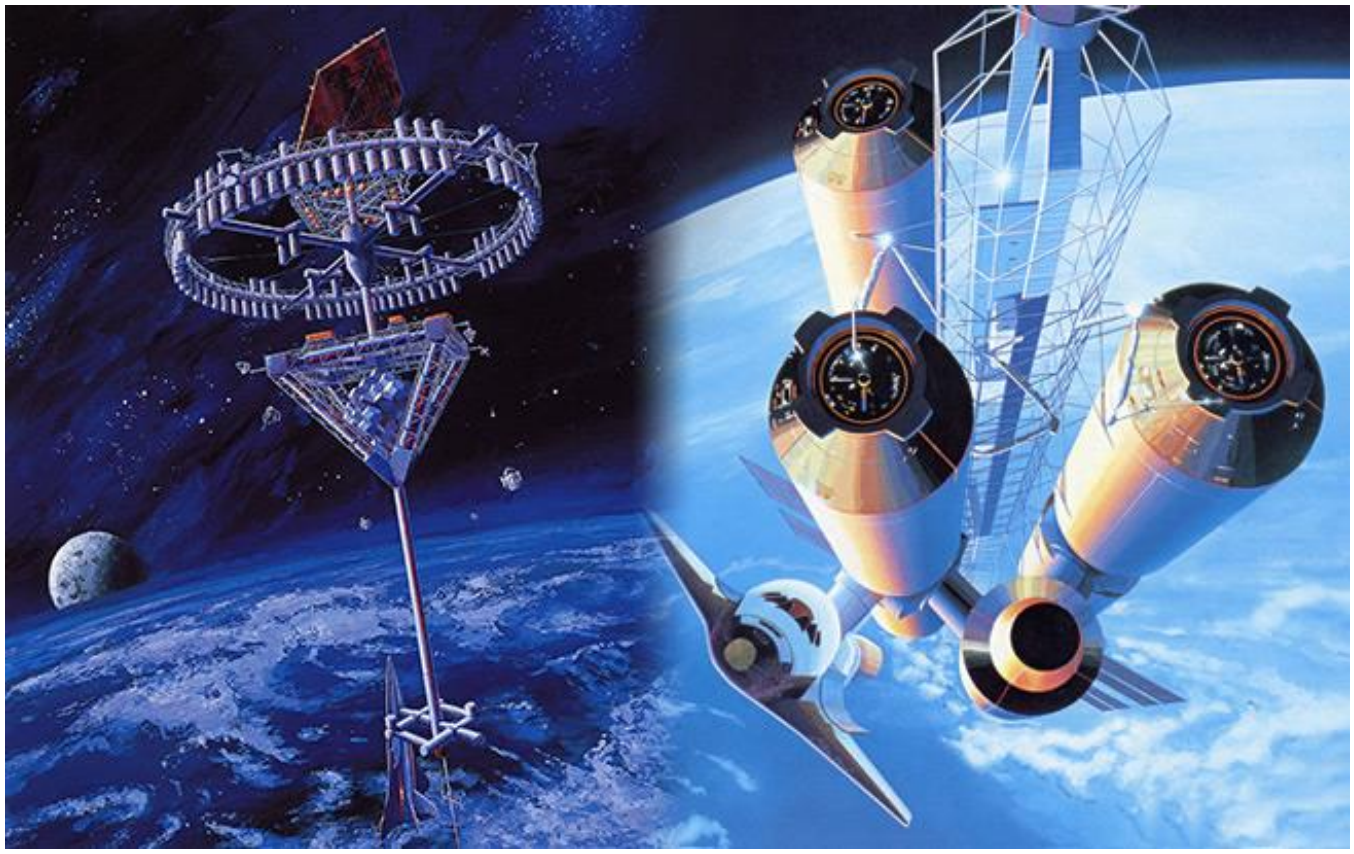


Musk’s goal: cities of millions on Mars. And a ticket to Mars you can afford. Meanwhile, there’s the Moon.



Dutch architect Hans-Jurgen Rombaut’s hotel on the moon.

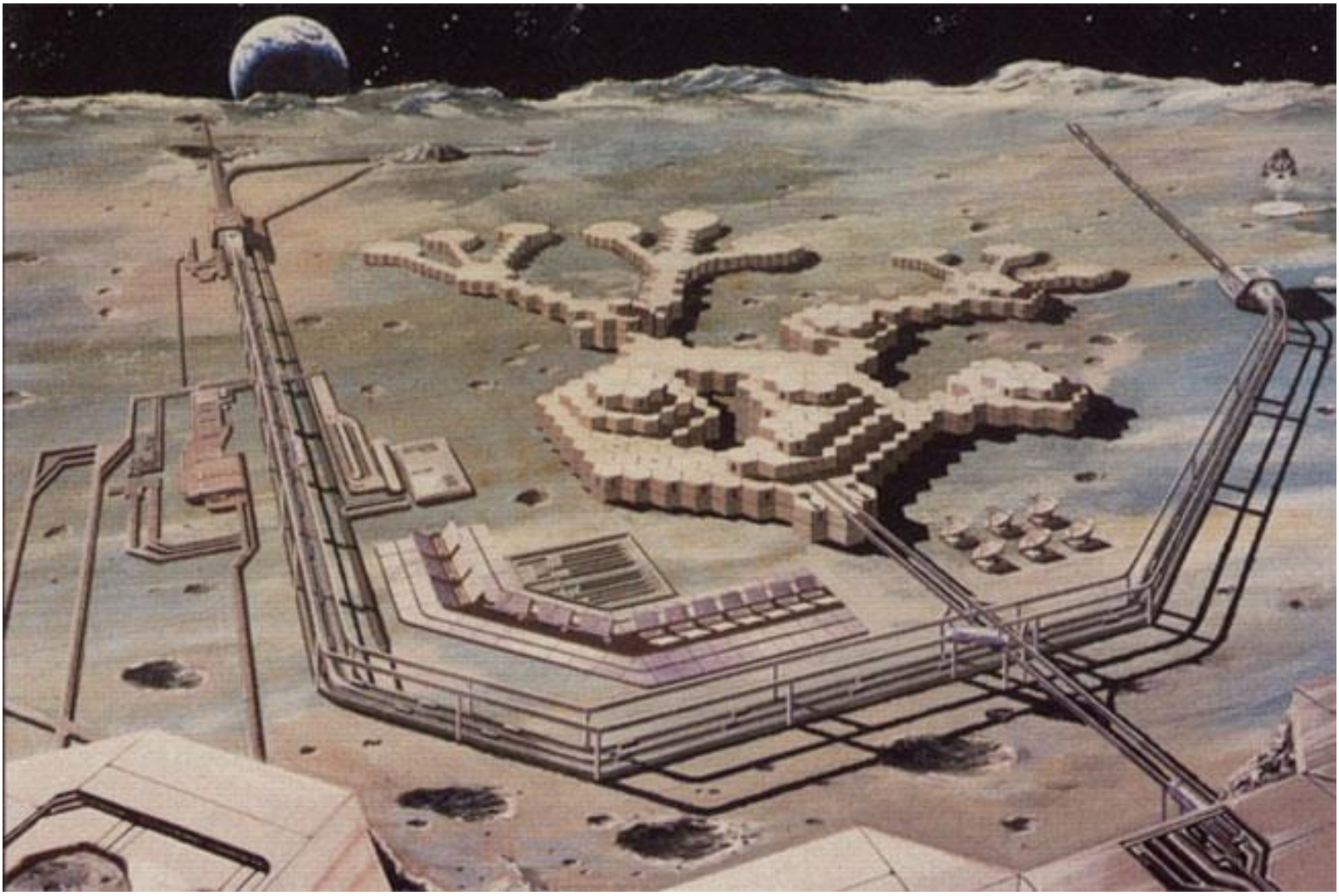


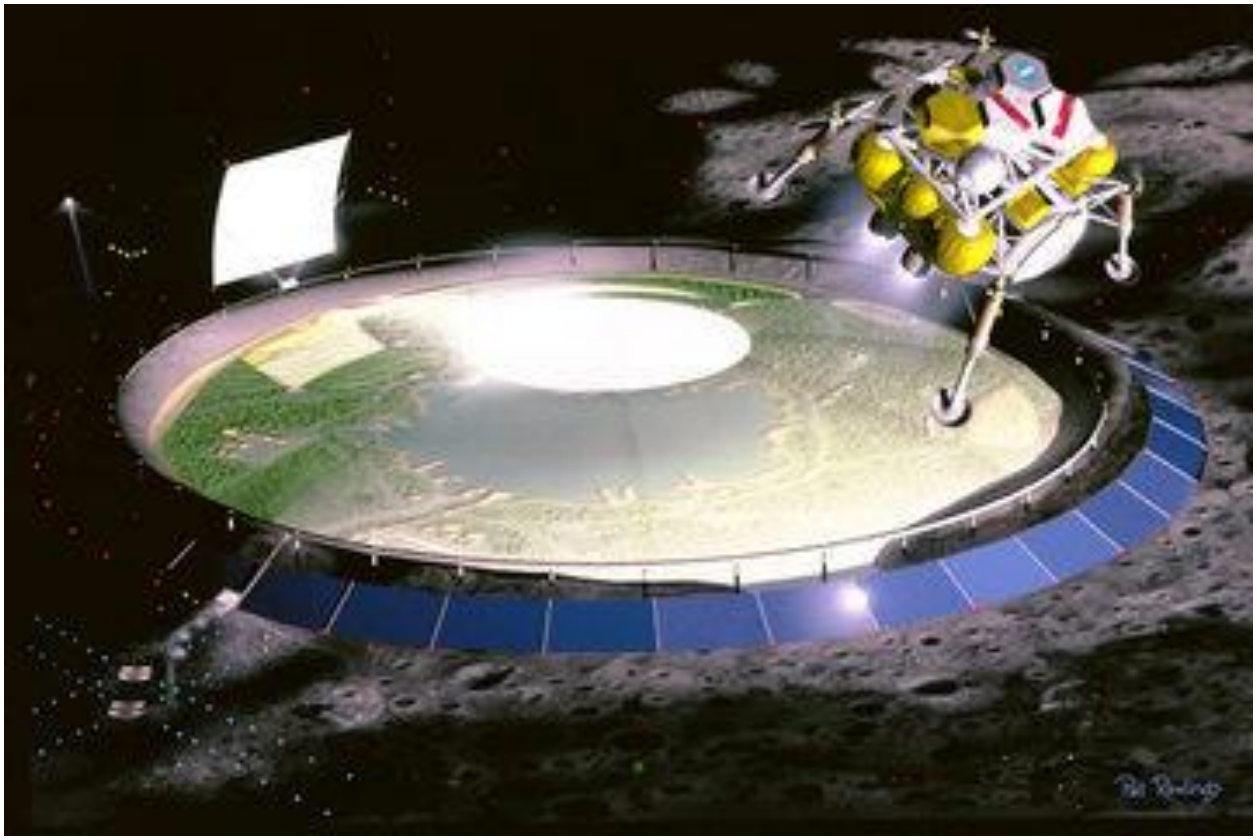


Shimizu Corporation’s space hotel.

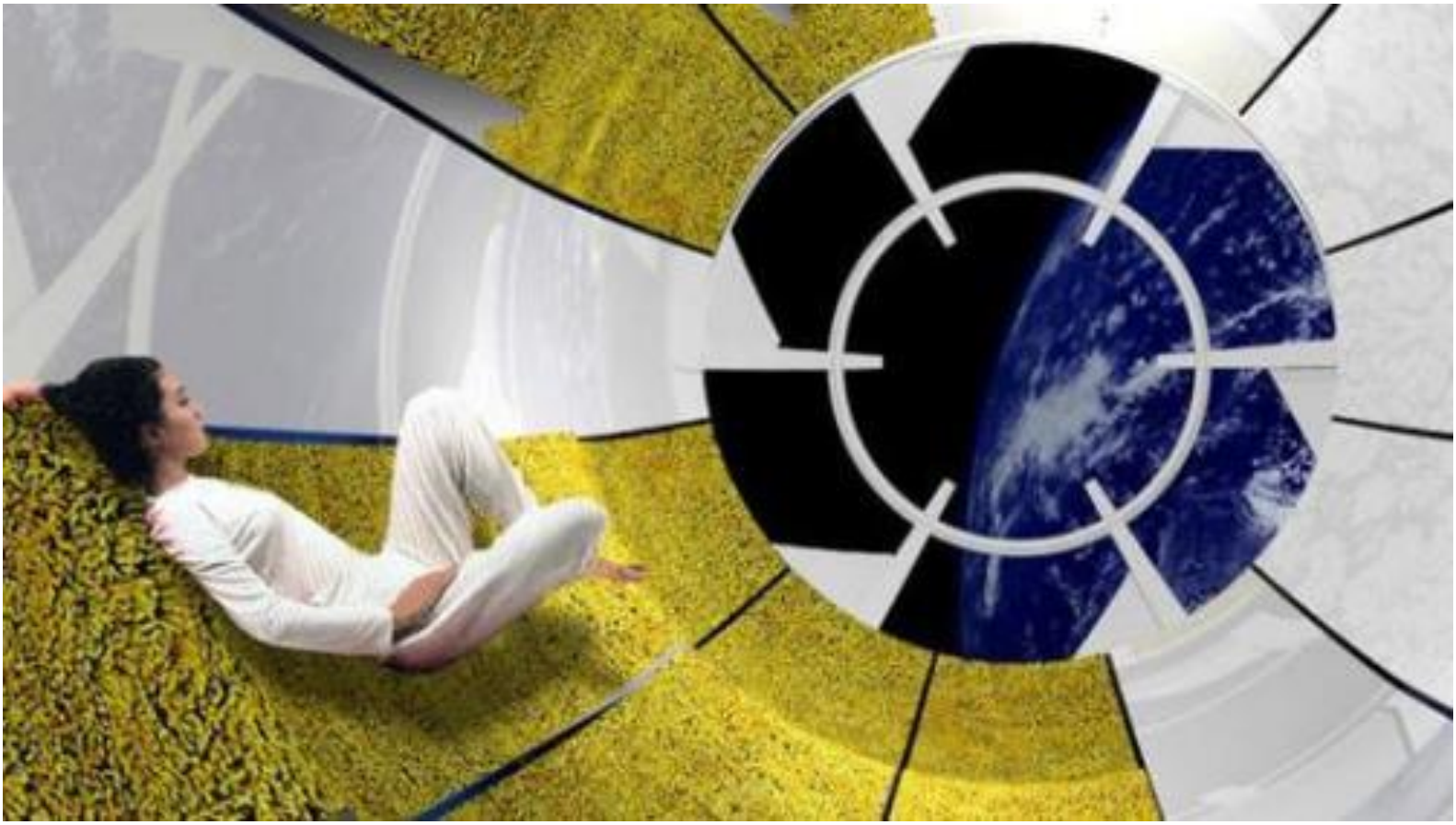
The public area in Shimizu’s space hotel.

Shimizu Corporation’s moon base. Made of moon-dust concrete.



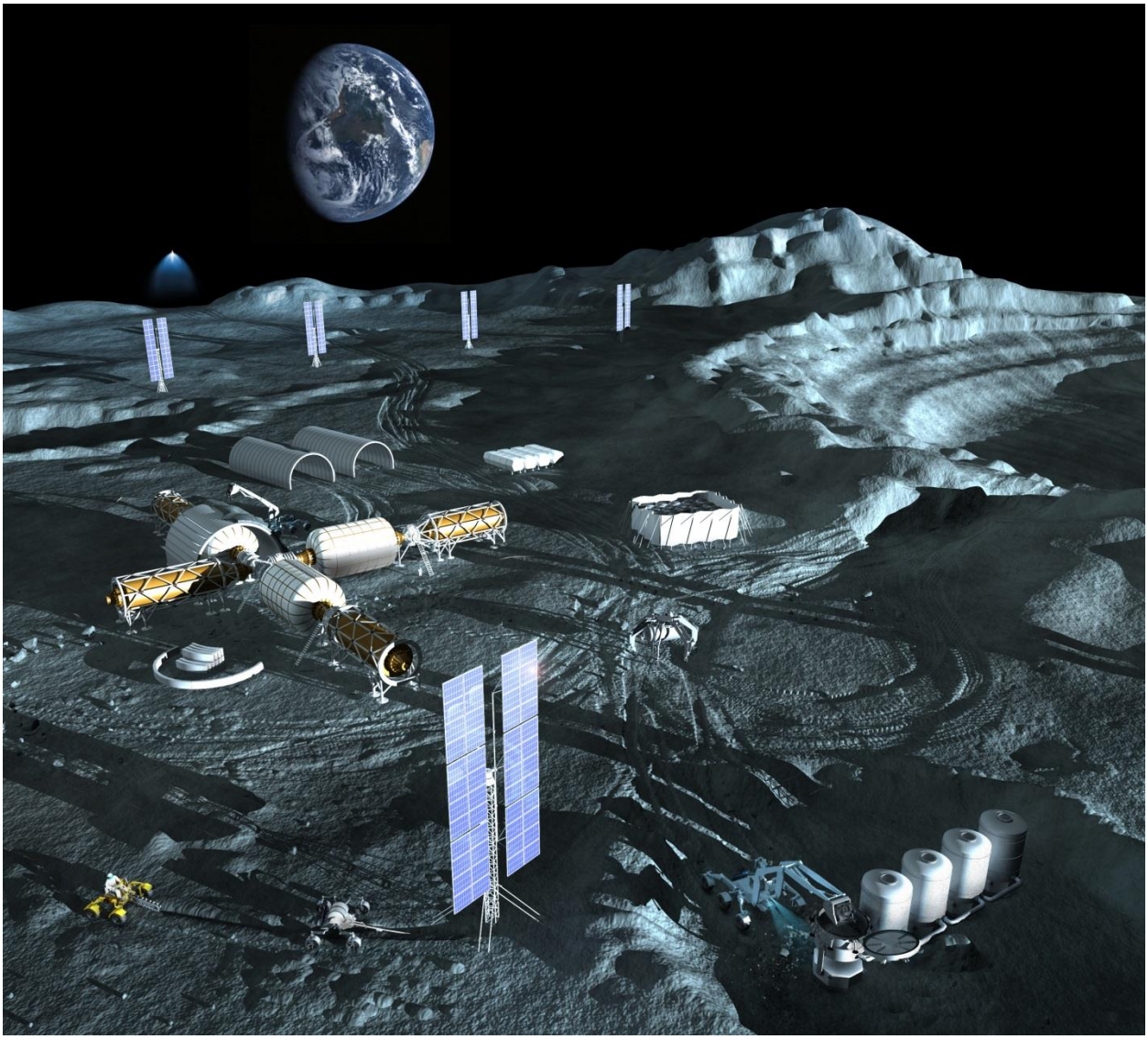


The first tiny twinge of green--gardening on the Moon. But that's just the start.



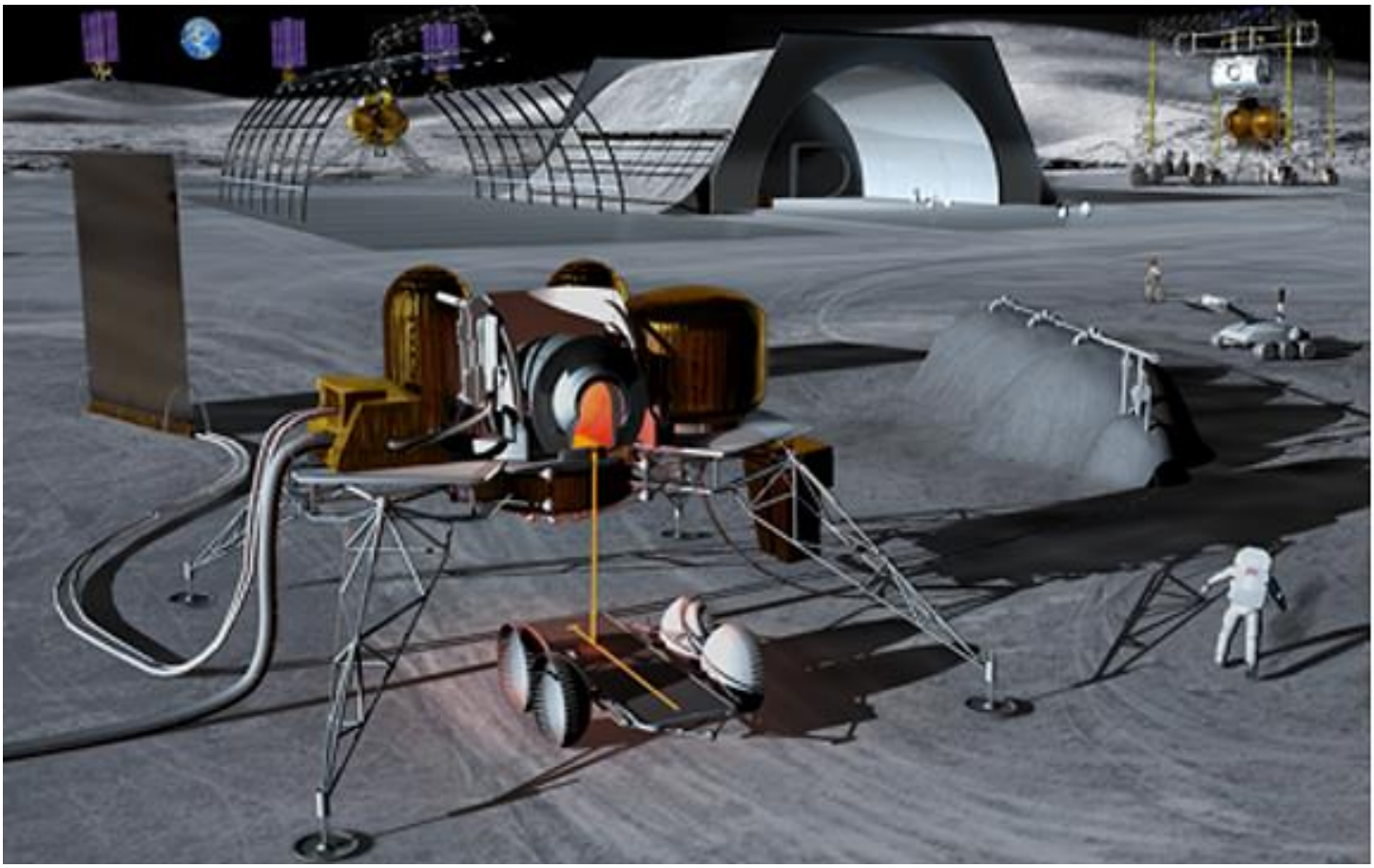
Relaxing in Spain’s Galactic Suite Space Resort

LunaCorp’s moon rover looks for the best spot on the Moon to mine ice—the raw material for rocket fuel and for the oxygen and water that keep humans alive.



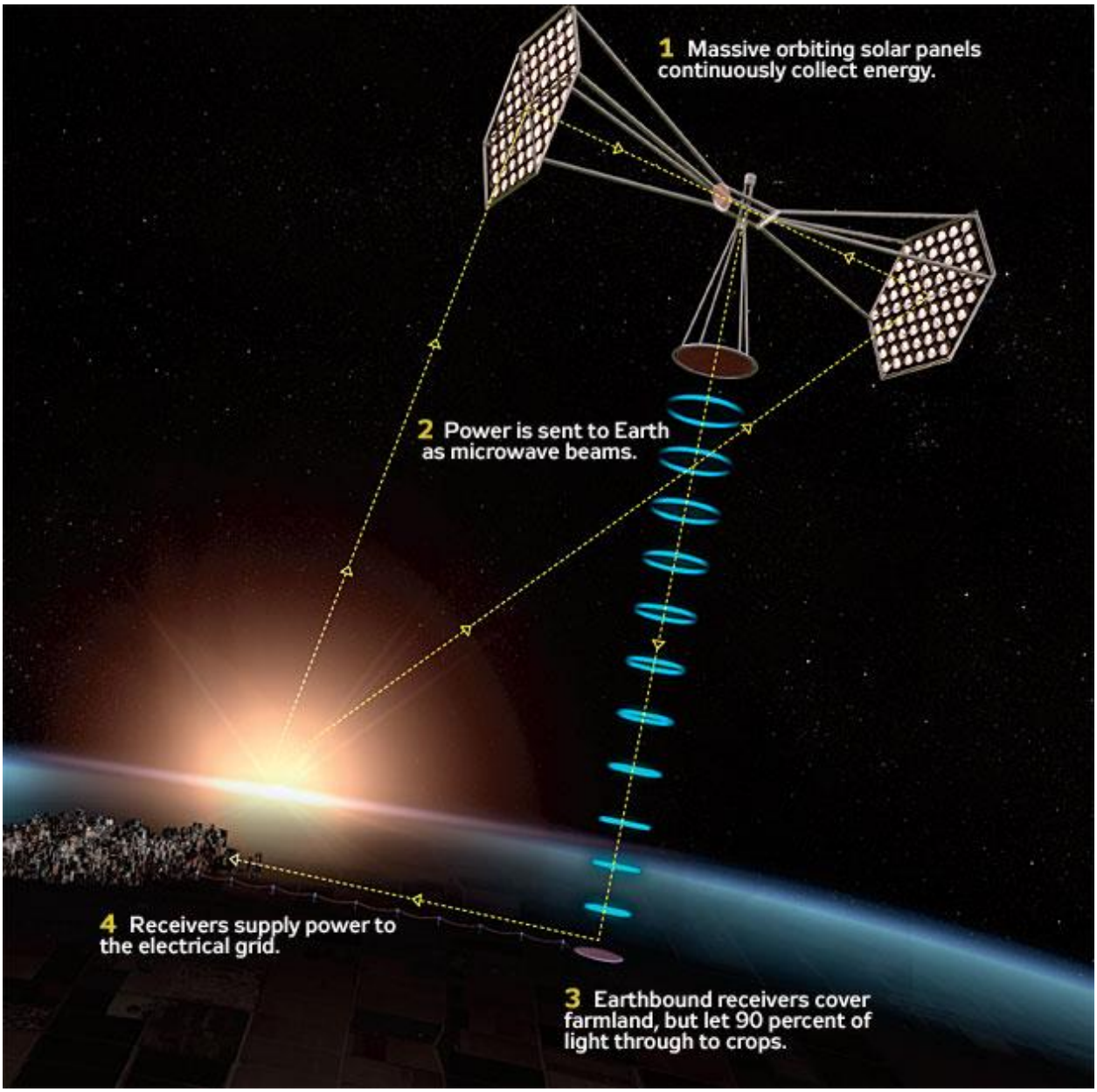
[picture: Anna Nesterova]

A base at the Moon's south pole turning lunar ice into drinkable water, breathable oxygen, and rocket fuel. Moon fans in the aerospace community want to sell fuel to customers like Elon Musk's Interplanetary Transport System. Fuel for Musk's regularly-scheduled Mars trips.



Then there's mining the Moon's minerals. Lunar mines can produce all the materials needed to build space stations, space ships, fuel depots, and entire space colonies. But in lunar extraction industries, humans will be rare. The

work will be handled by robots and autonomous vehicles.

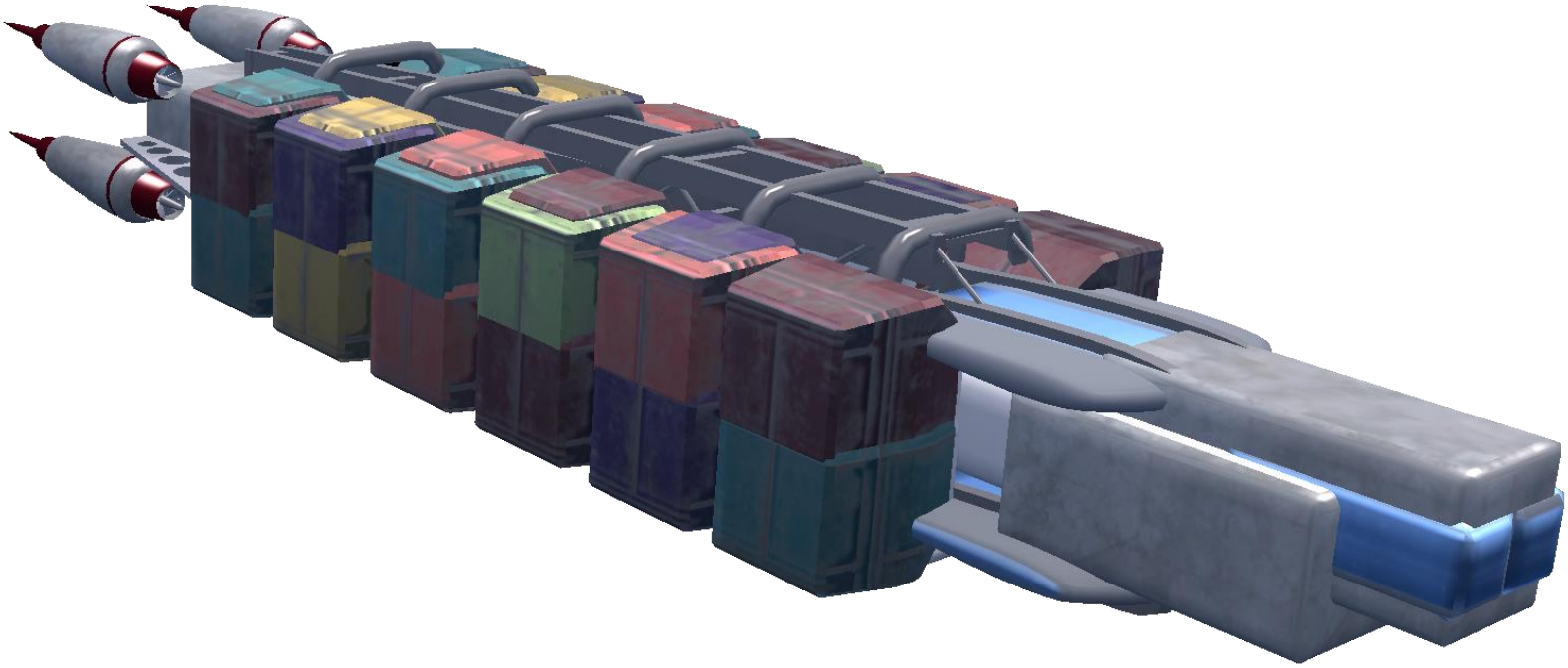


Harvesting solar power in space and transmitting it to earth using the same sort of signals received by your cellphone.

Solar panels on your roof have two small problems—clouds and night. Solar panels in the Sahara or the Mohave wipe out desert ecosystems. But solar panels in space are in the sun 24/7, produce no carbon emissions, do not set your tap water on fire, and harvest an energy supply that is endless, renewable, sustainable, and five times as intense as the sun's energy down on earth.

What's more, solar power from space is free to all nations without disputes over the possession of islands or seas.

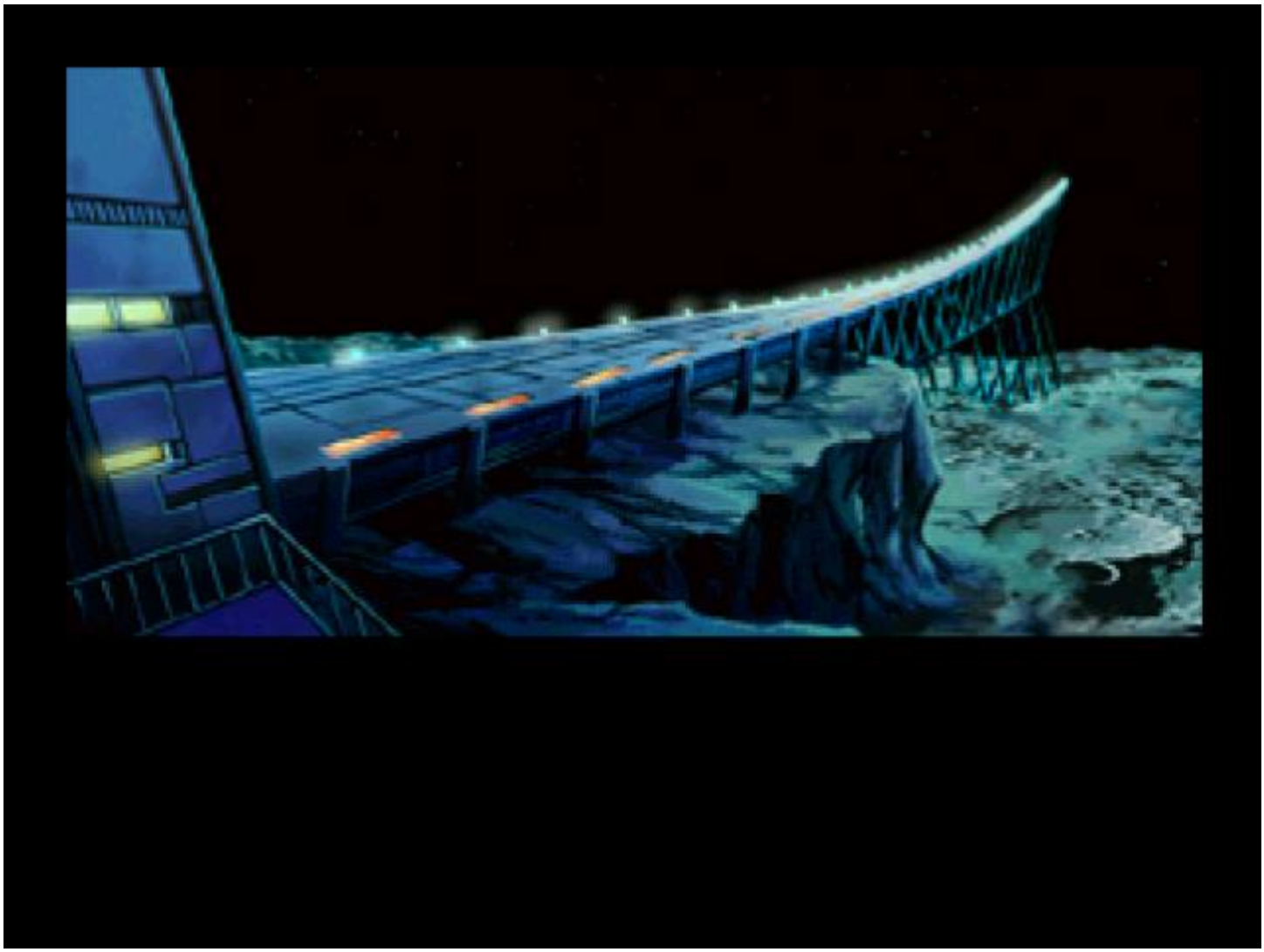
Low-cost access to space and the use of space resources like asteroid metals to build trusses and solar panels will slowly but surely make space solar power cheaper than power from coal or natural gas.



How will we transport space resources like the platinum from asteroids or moon dust? Why transport moon dust at all? It's the raw material for the glass, concrete, semiconductors, and steel of space colonies. To move these things from lunar mines and asteroids to construction sites, we'll use space tugs and space trucks Above is a space truck.

To move entire asteroids, we'll use space tugs.

Equip an asteroid to move itself using solar energy and ion propulsion, and you turn that asteroid into its own space ship.



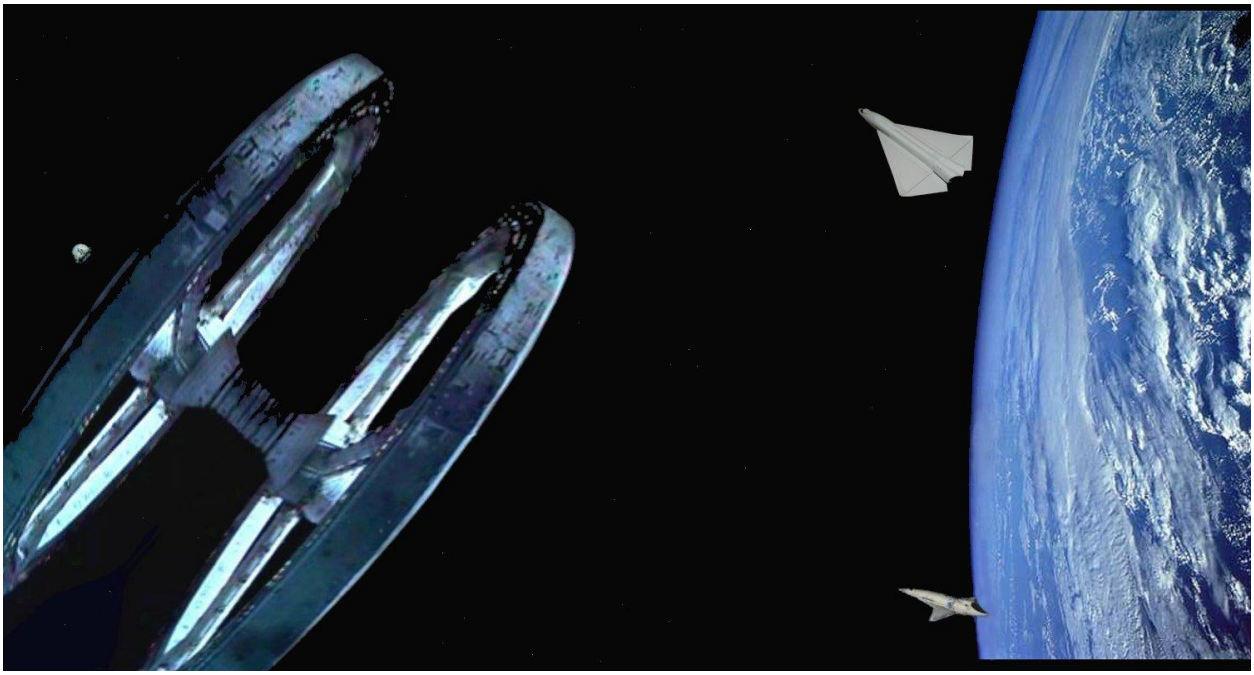
A mass driver on the moon—an electromagnetic rail gun that shoots lunar raw or processed materials into space.

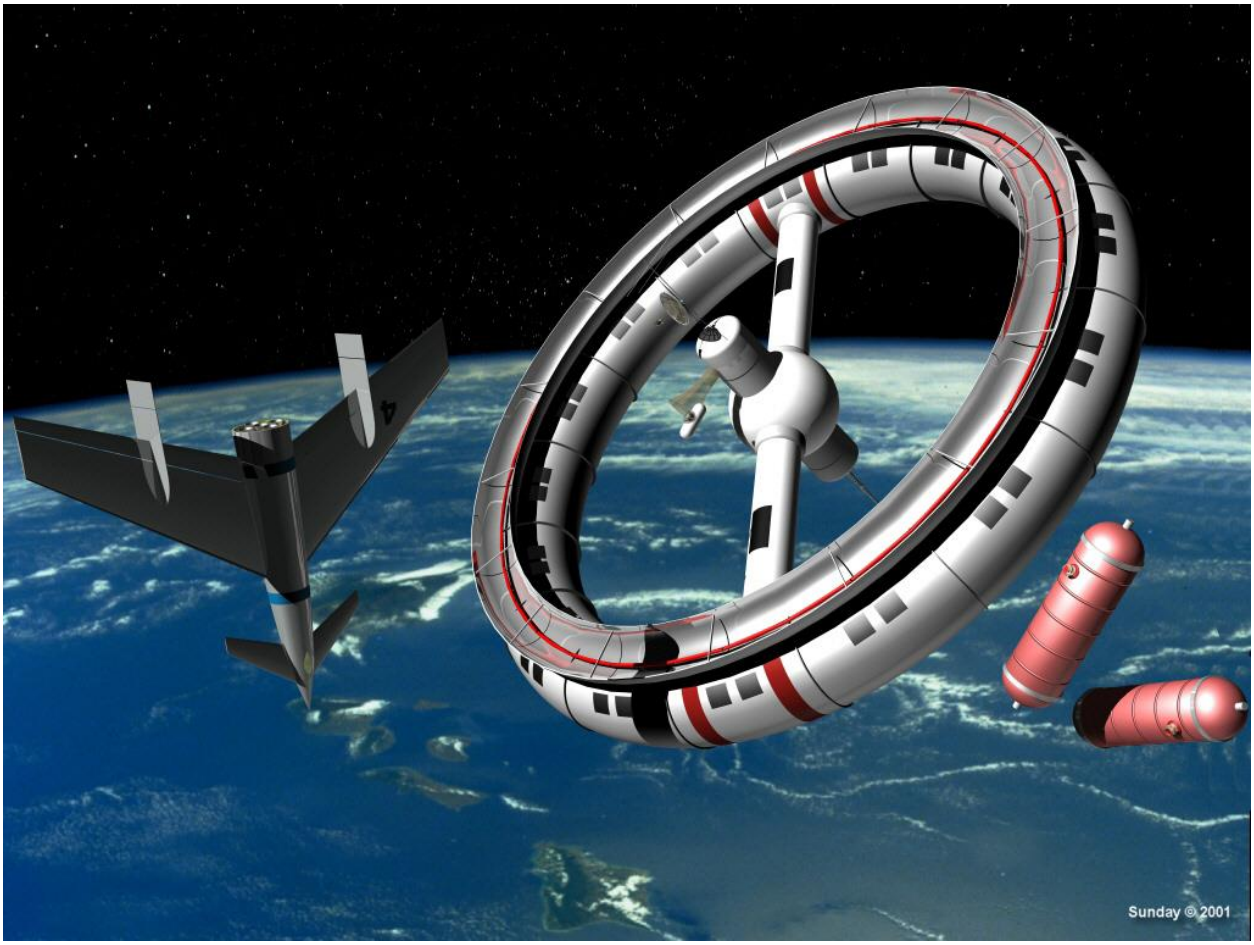
(image by Stanley von Medvey)

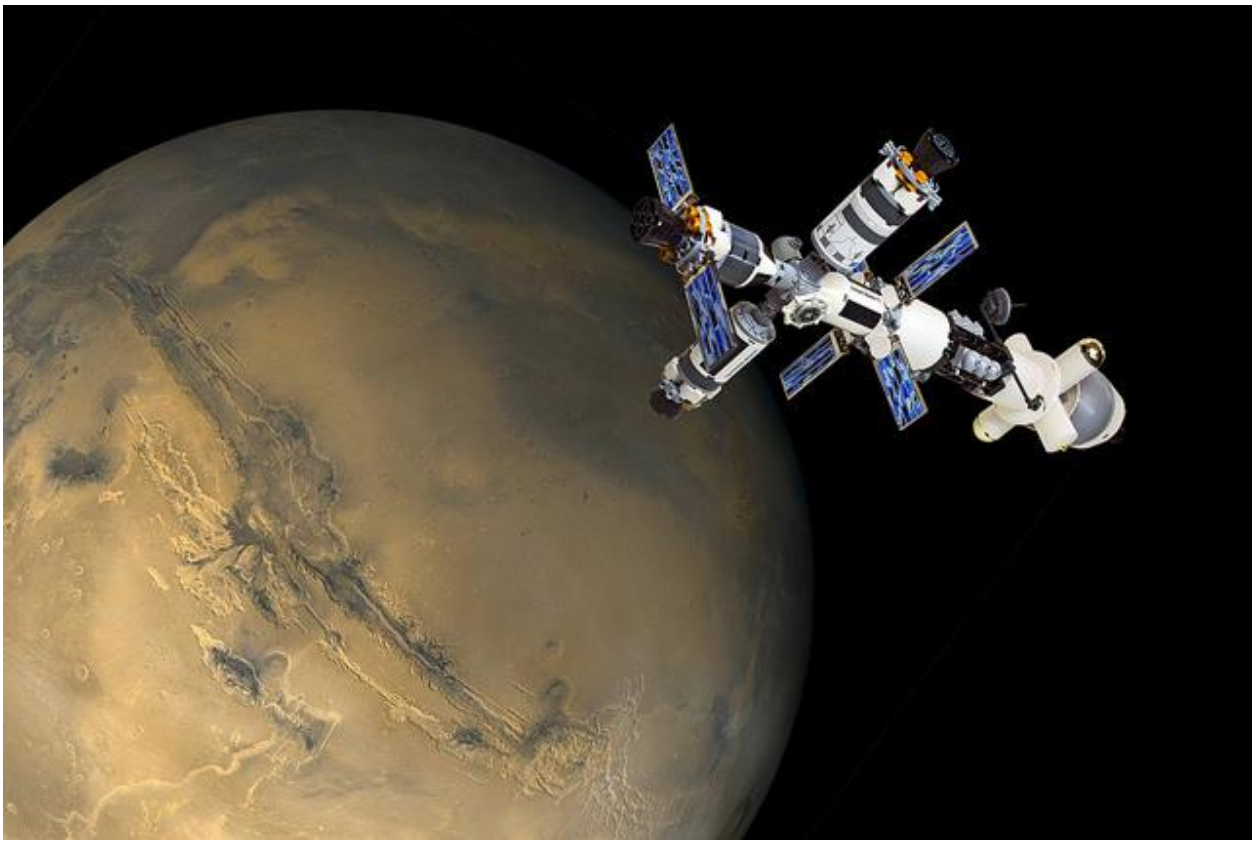
A construction site in space that builds space ships and colonies from moon dust and asteroid metals. This construction operation is 40 miles long. And it can handle thousands of tons of materials with ease. Why? No gravity.

Thanks to weightlessness, you can move a hundred tons with a push of your hand. If you can find a stable place to stand.

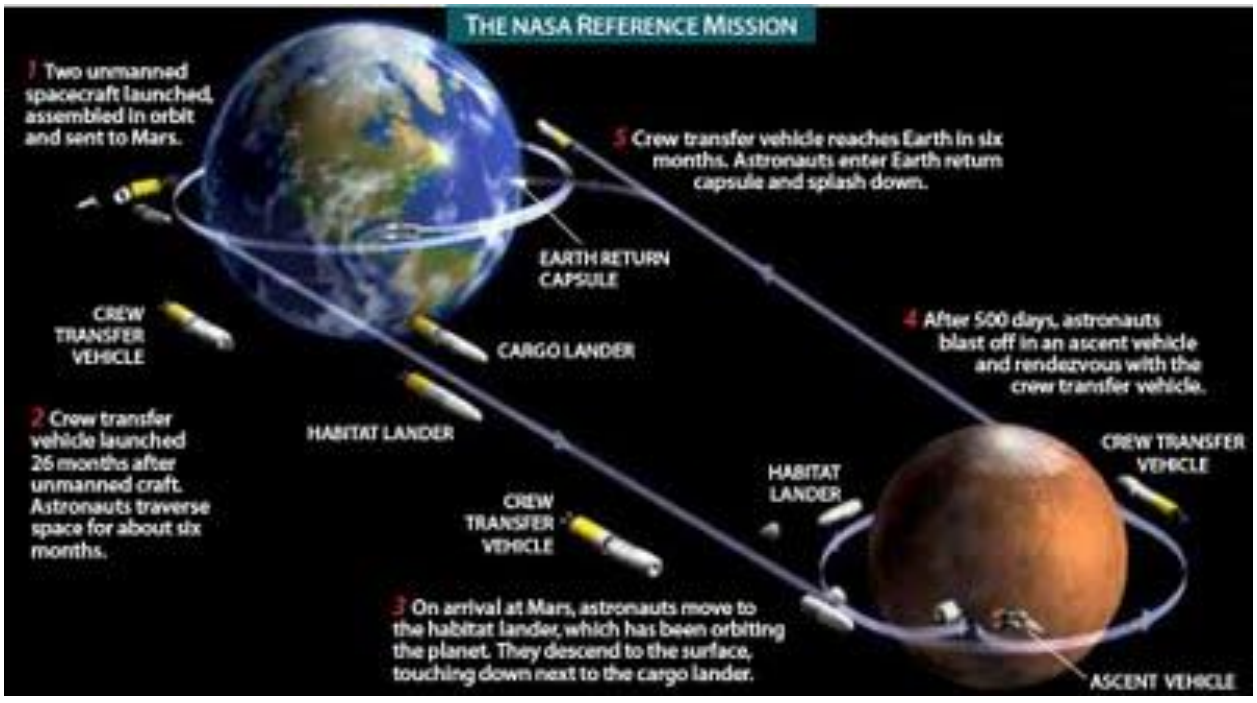
Two of the possible first space stations built from recycled space junk, metals smelted and separated from moon dust, plus titanium, nickel, and iron from asteroid mines.

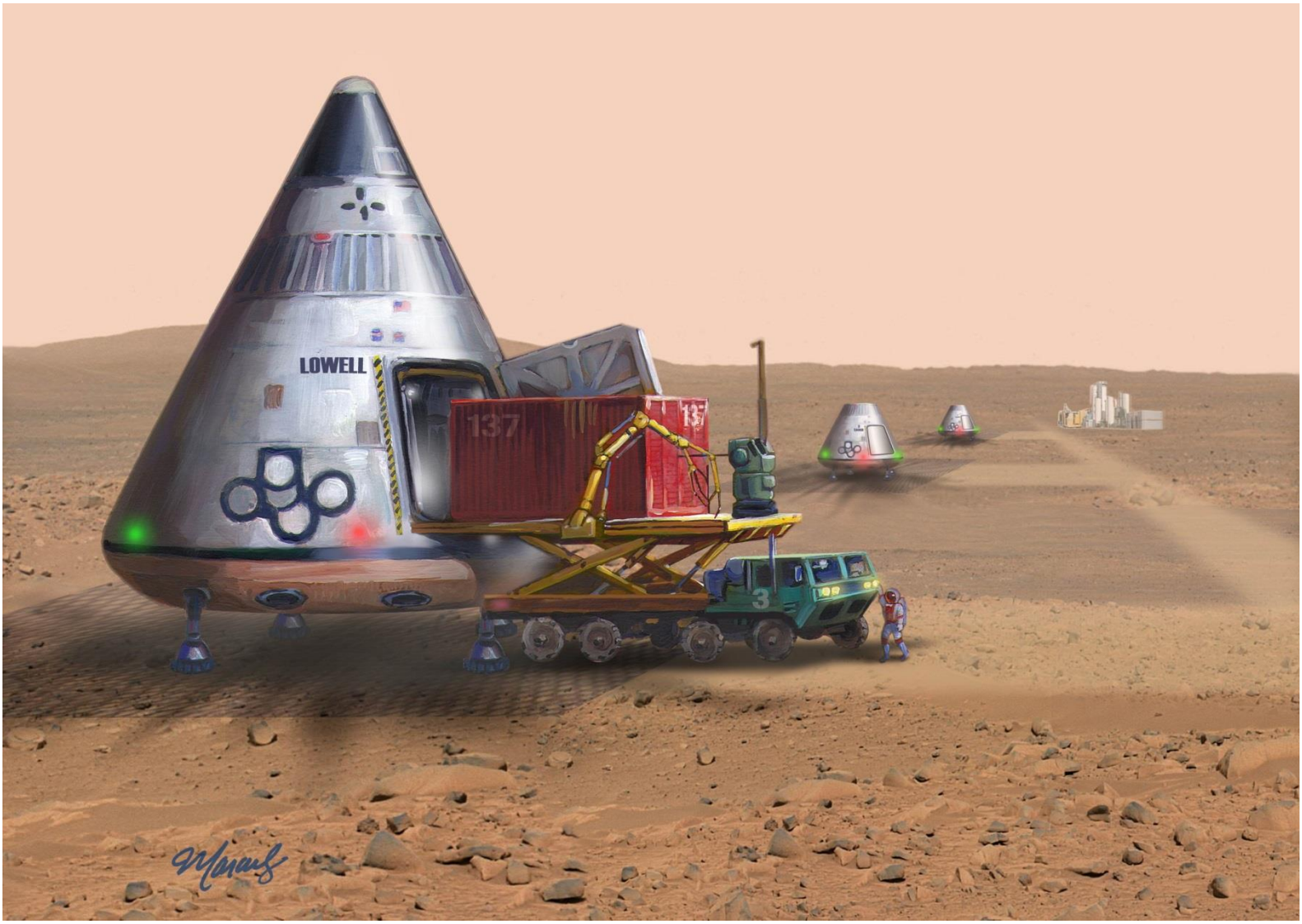






Aldrin Cyclers will act as shuttles, using gravitational forces to loop back and forth between the Earth and Mars. Carrying passengers and cargo.



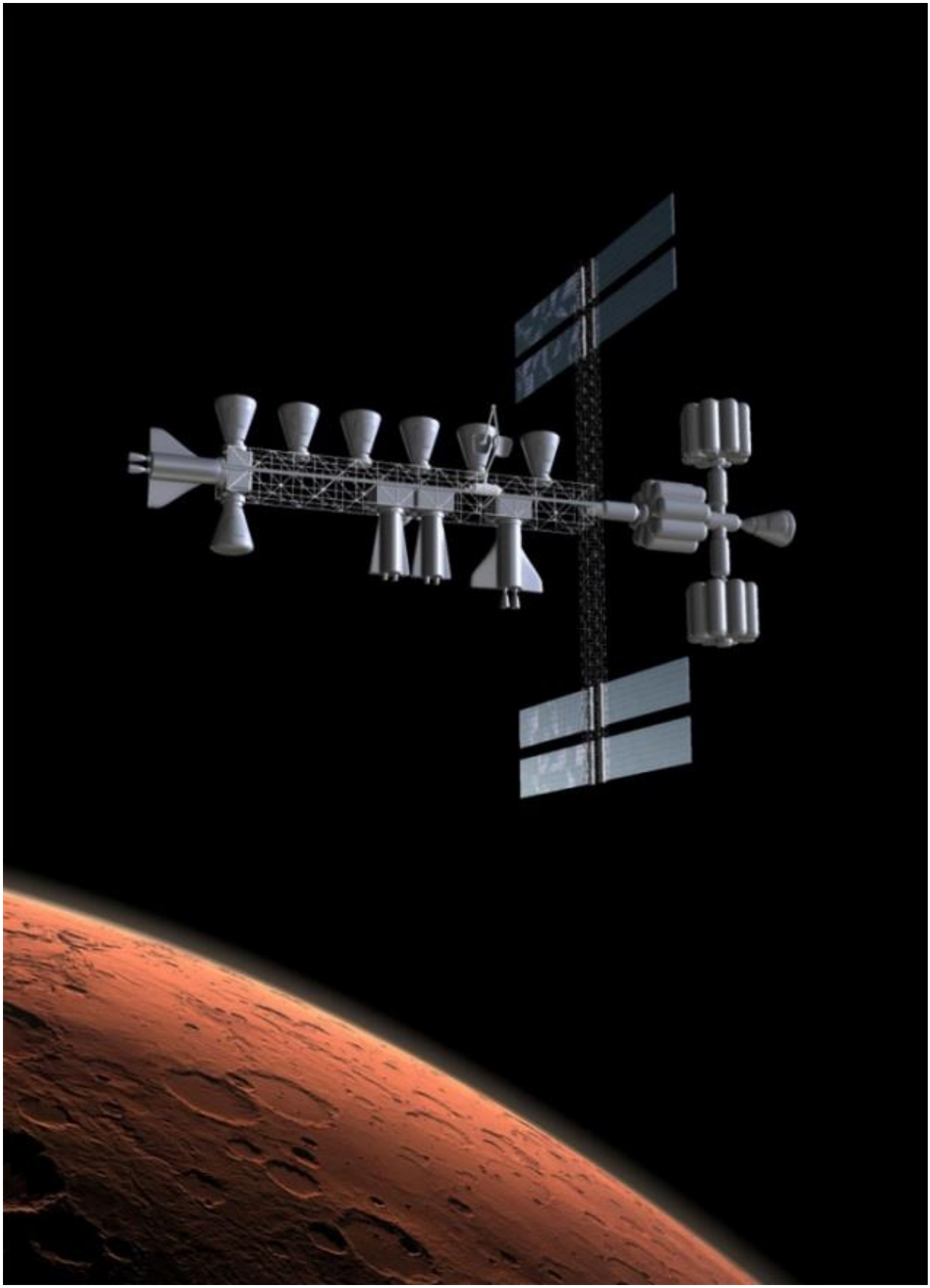


(illustration: Marcus Mashburn)

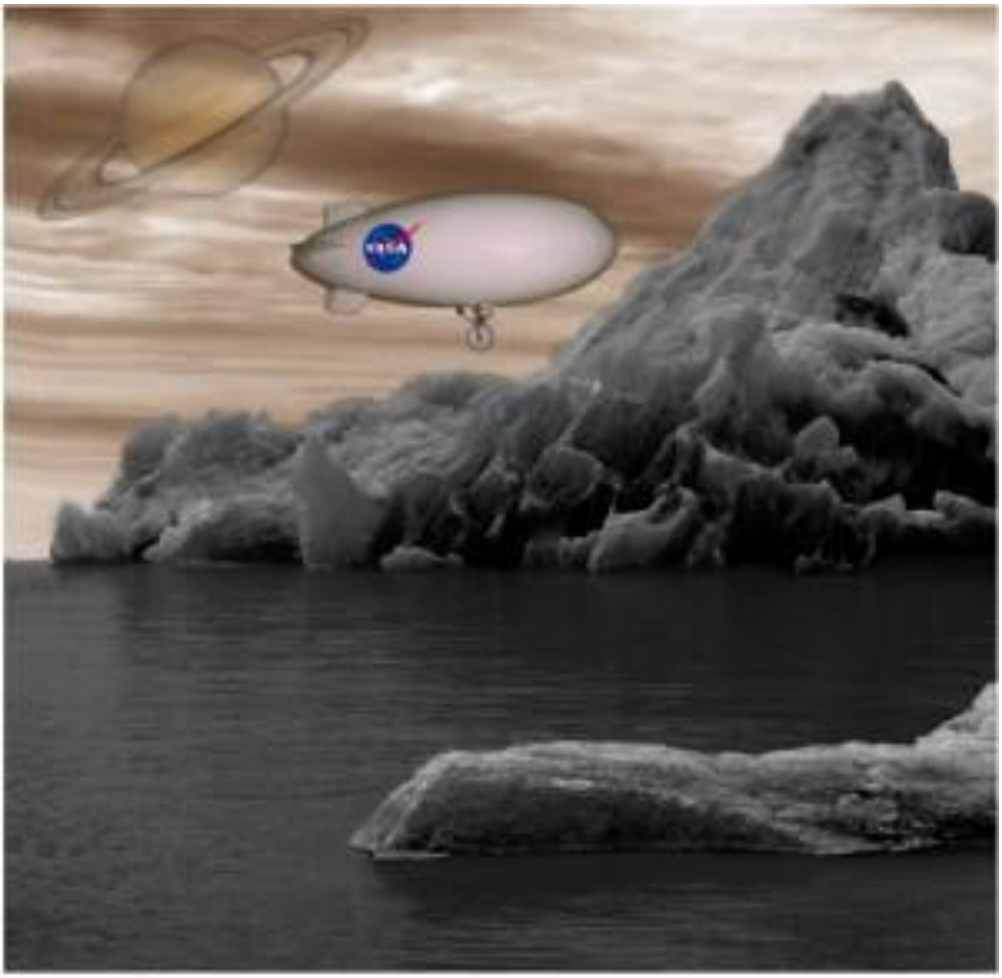
Then there’s the Mars ferry, a cargo carrier that travels between Mars’ surface and Mars orbit and goes back down to the surface again.

The Mars ferry meets up with a truck stop in space. A place where cargo can be offloaded from the ferry and shifted by a robotic arm to a vehicle headed for earth orbit.

(illustration: Anna Nesterova)

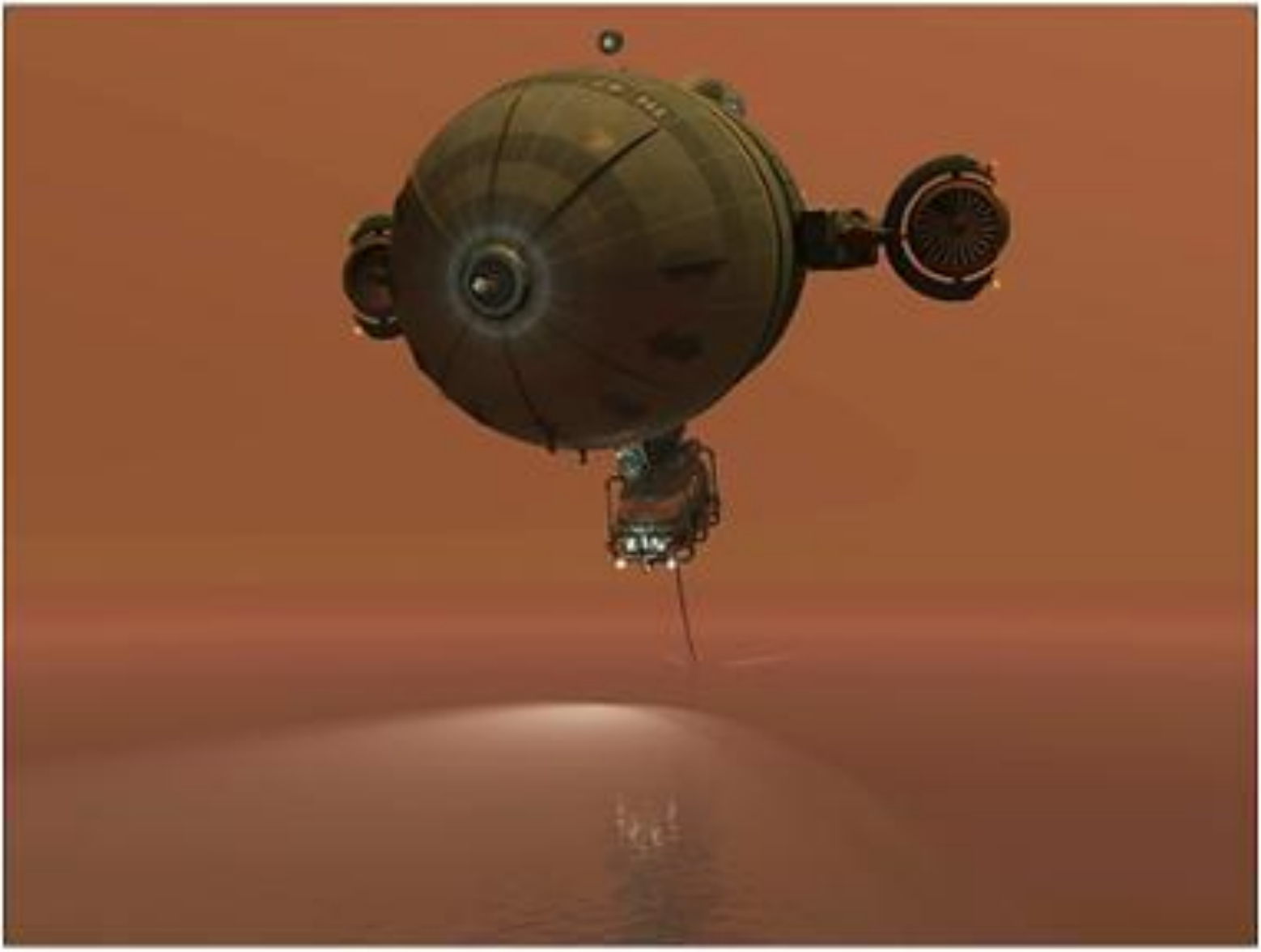


Mars bases.

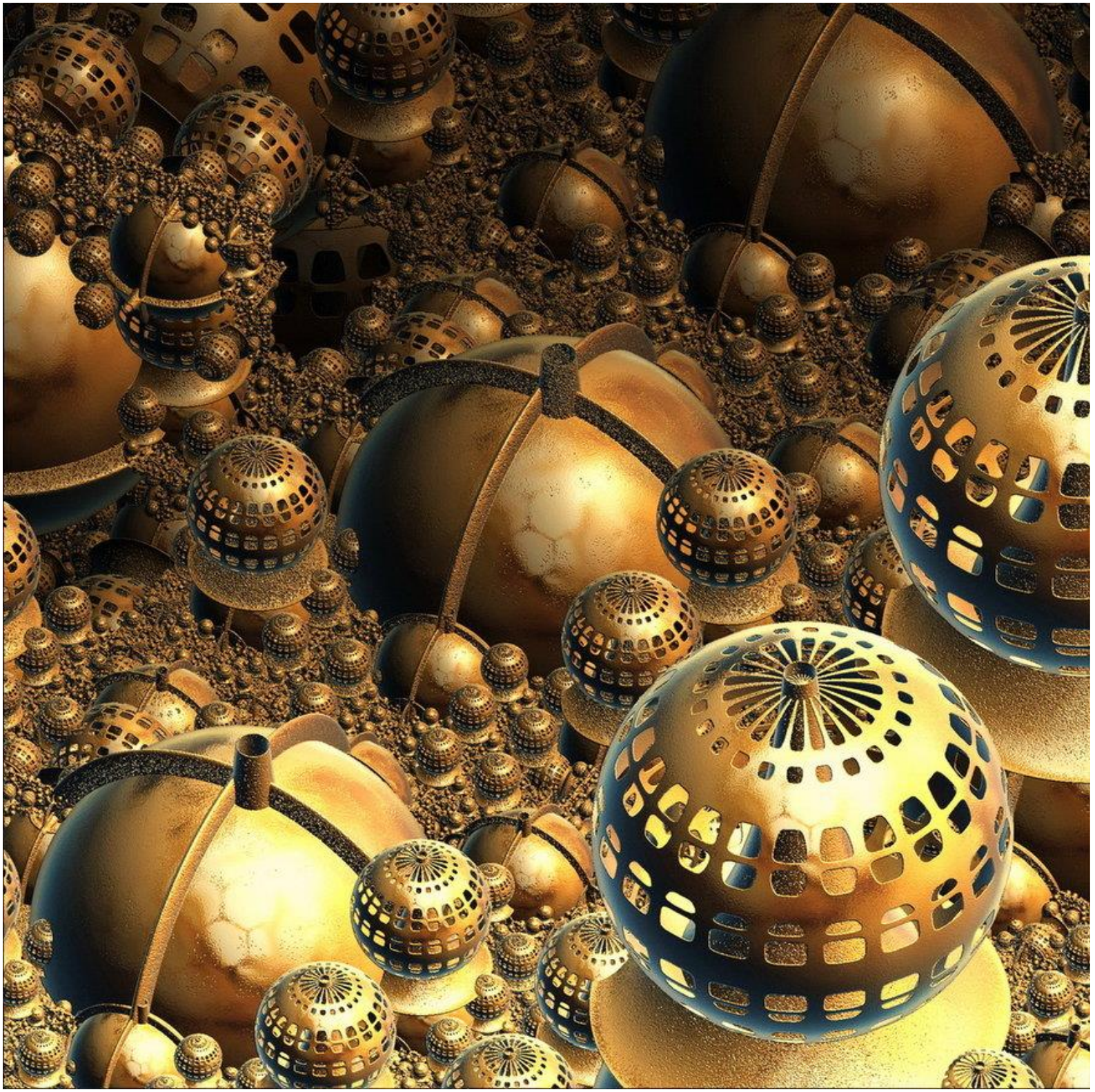


Exploring Titan, the biggest moon of Saturn, and floating in its methane atmosphere.

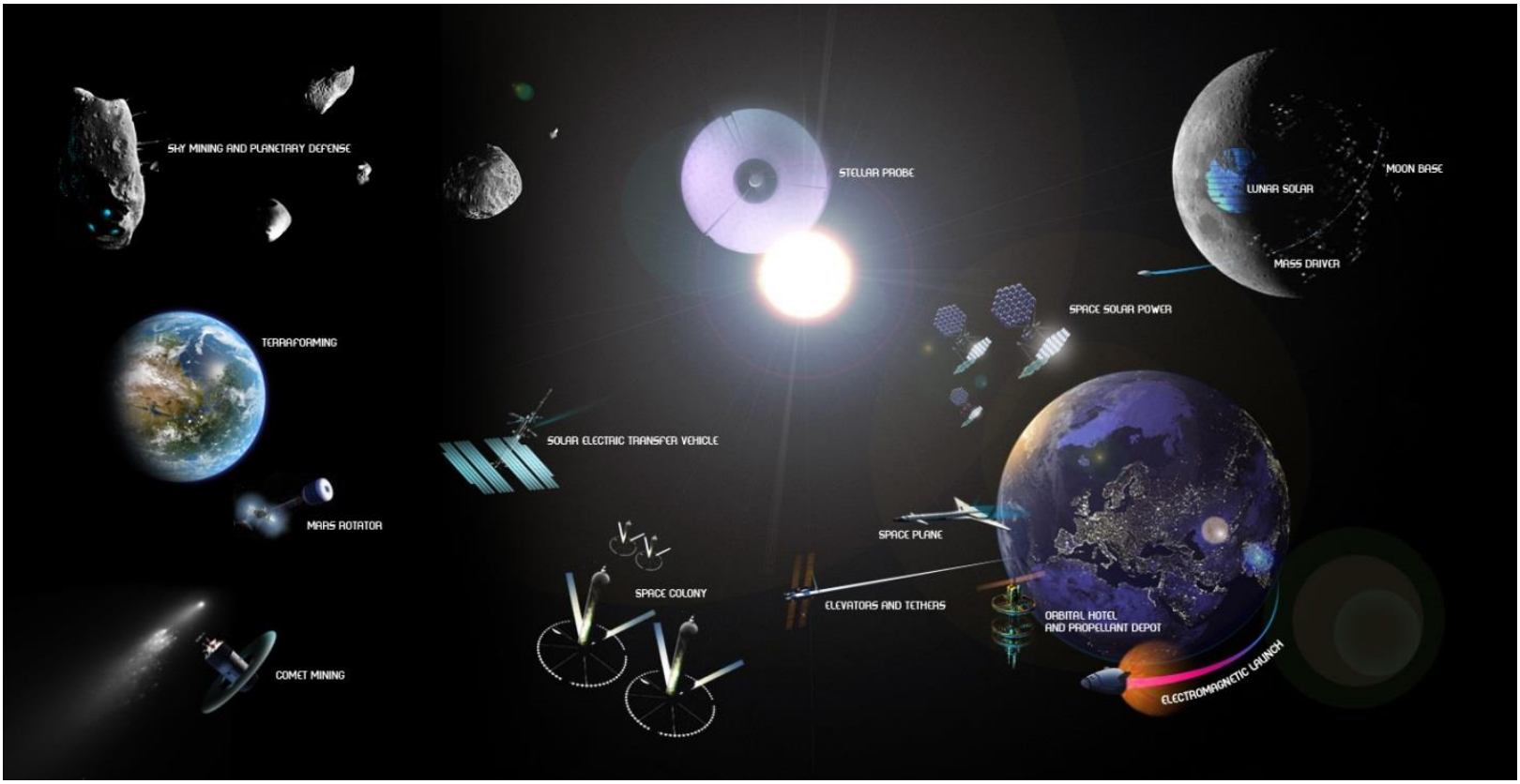
Yes, methane, a major fuel down here on Earth. On terra firma we call it "natural gas."



Colonizing Titan.



Note the heavenly body in the sky. Toto, I don’t think we’re on earth anymore.

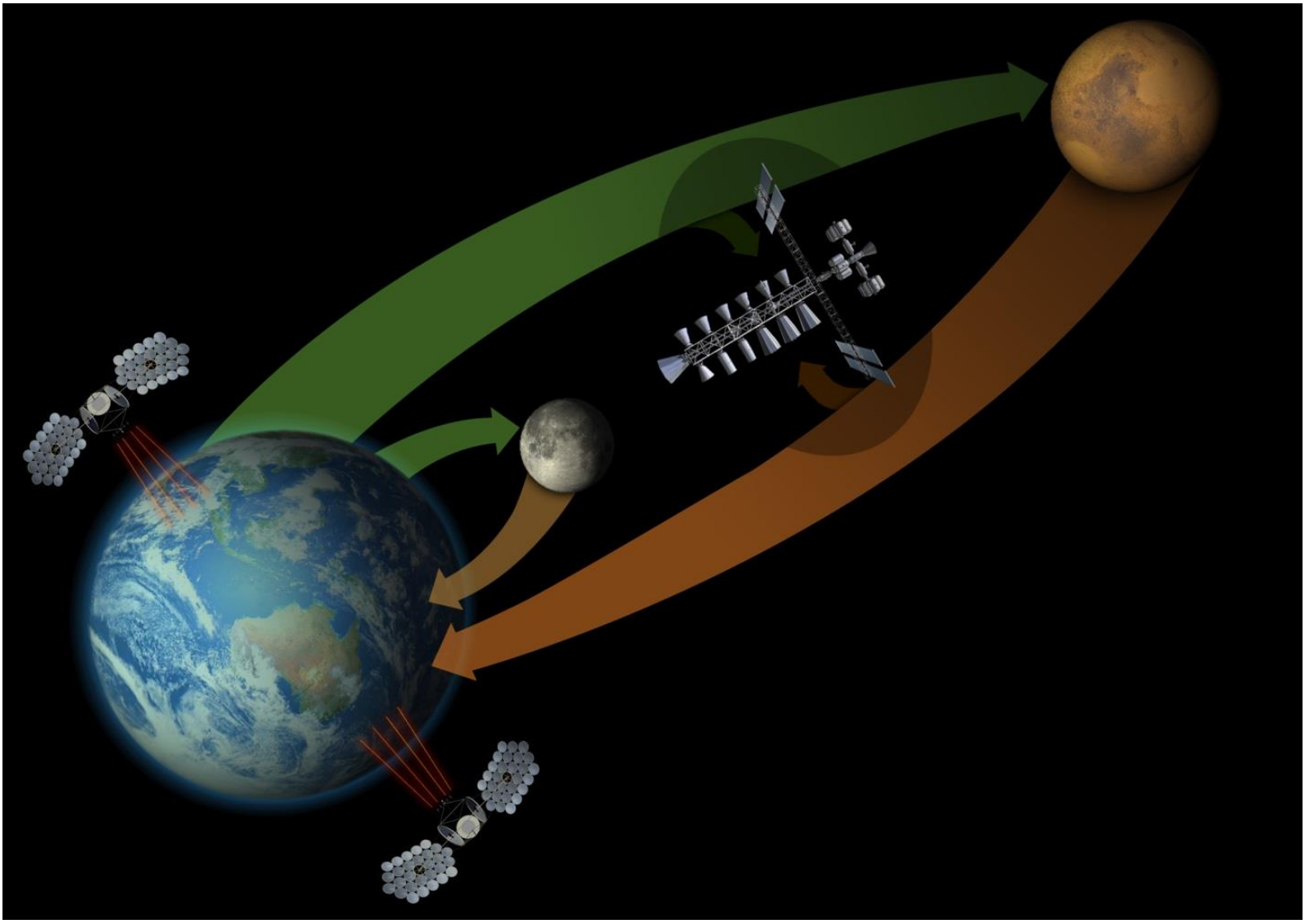


(illustration by Stanley Von Medvey)

The space infrastructure, the backbone of a space economy. An economy that will increase the gross human product, the GHP, by a factor of three. And an economy that will grow the evolutionary niches for life exponentially.

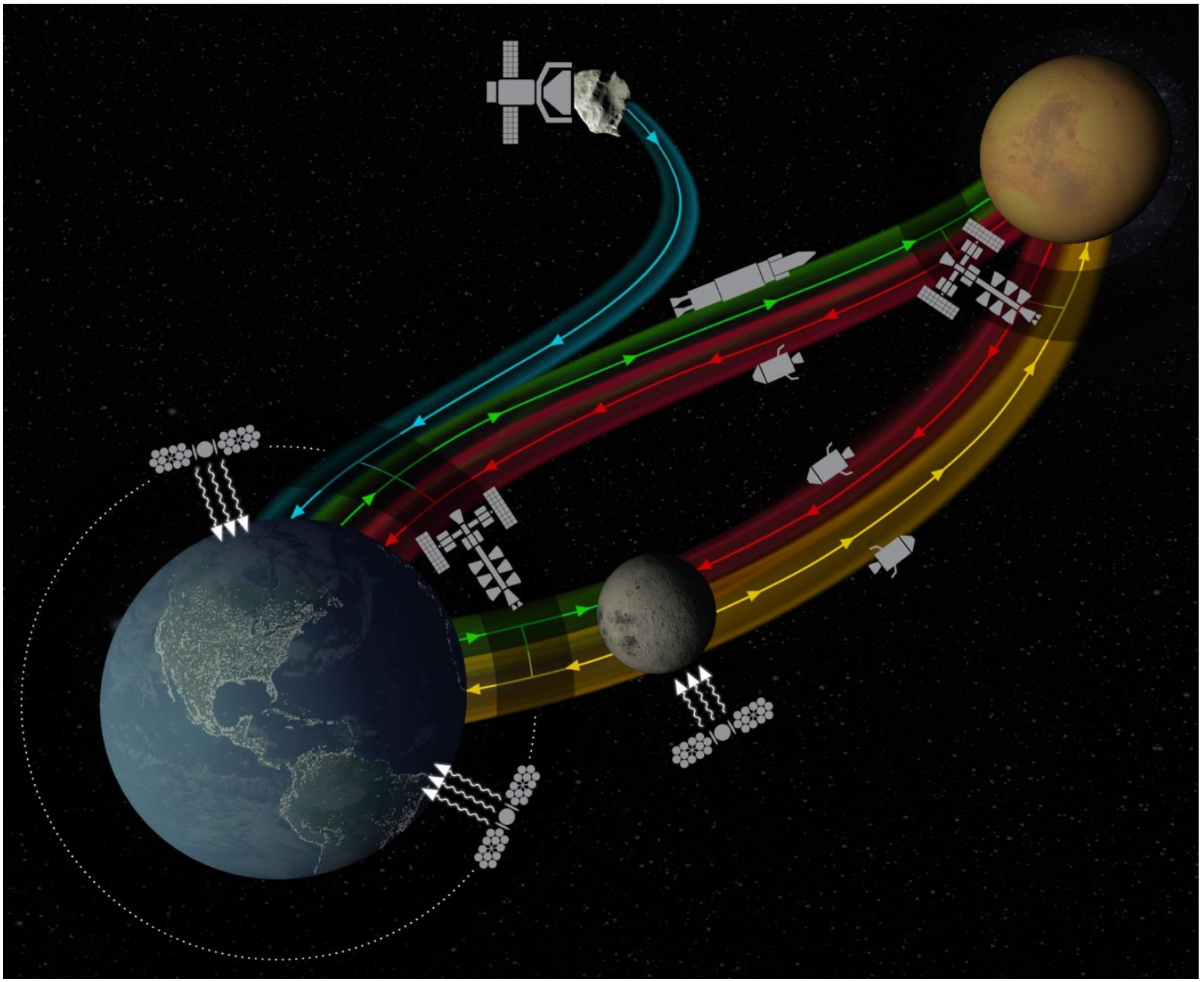
Robert Zubrin, founder of the Mars Society, a nuclear and aerospace engineer and one of the world's most extraordinary space visionaries, foresees a triangle trade between Earth, the Moon, Mars and the asteroid belt, a trade that could make even the poorest among us wealthy

The triangle trade starts small.

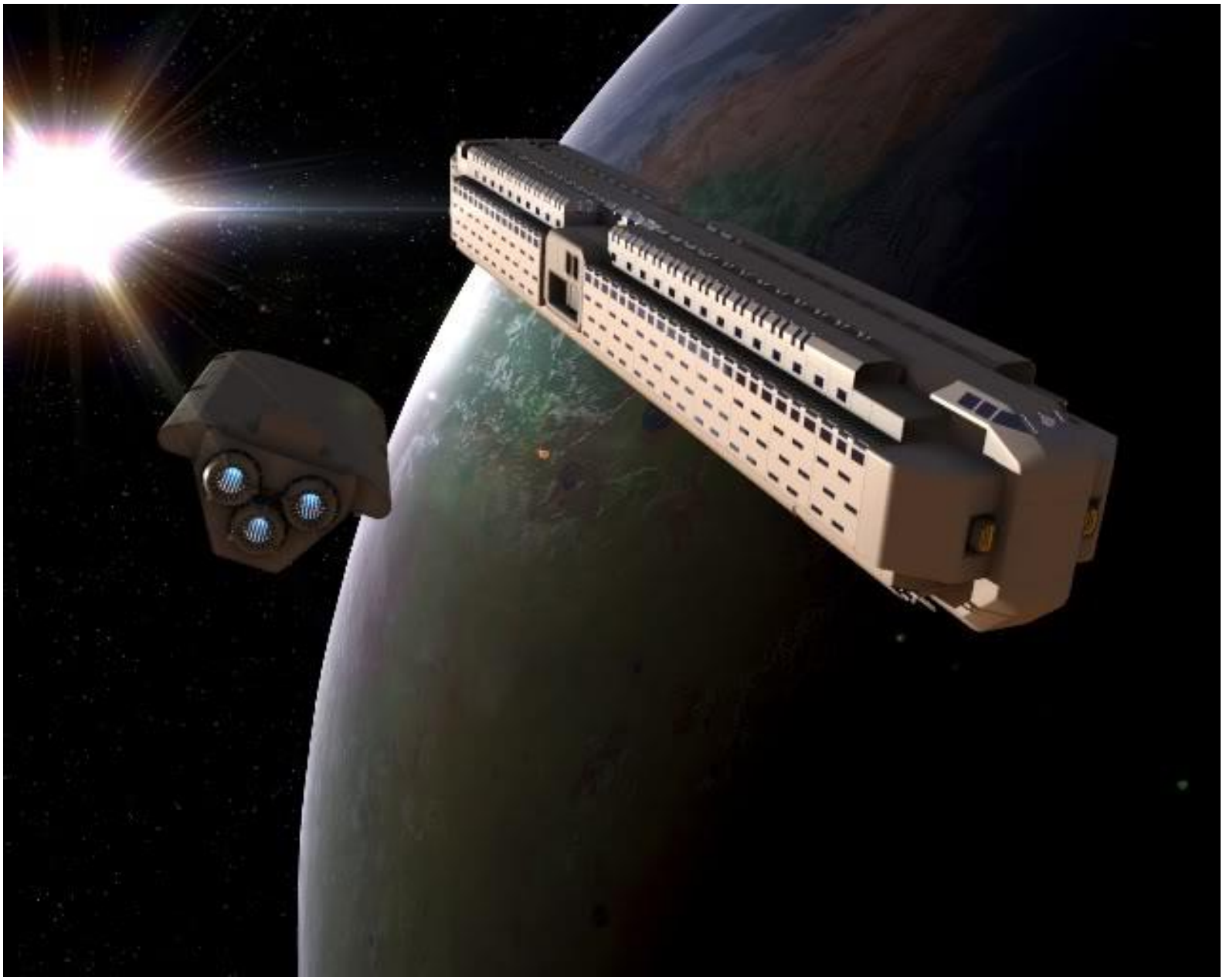


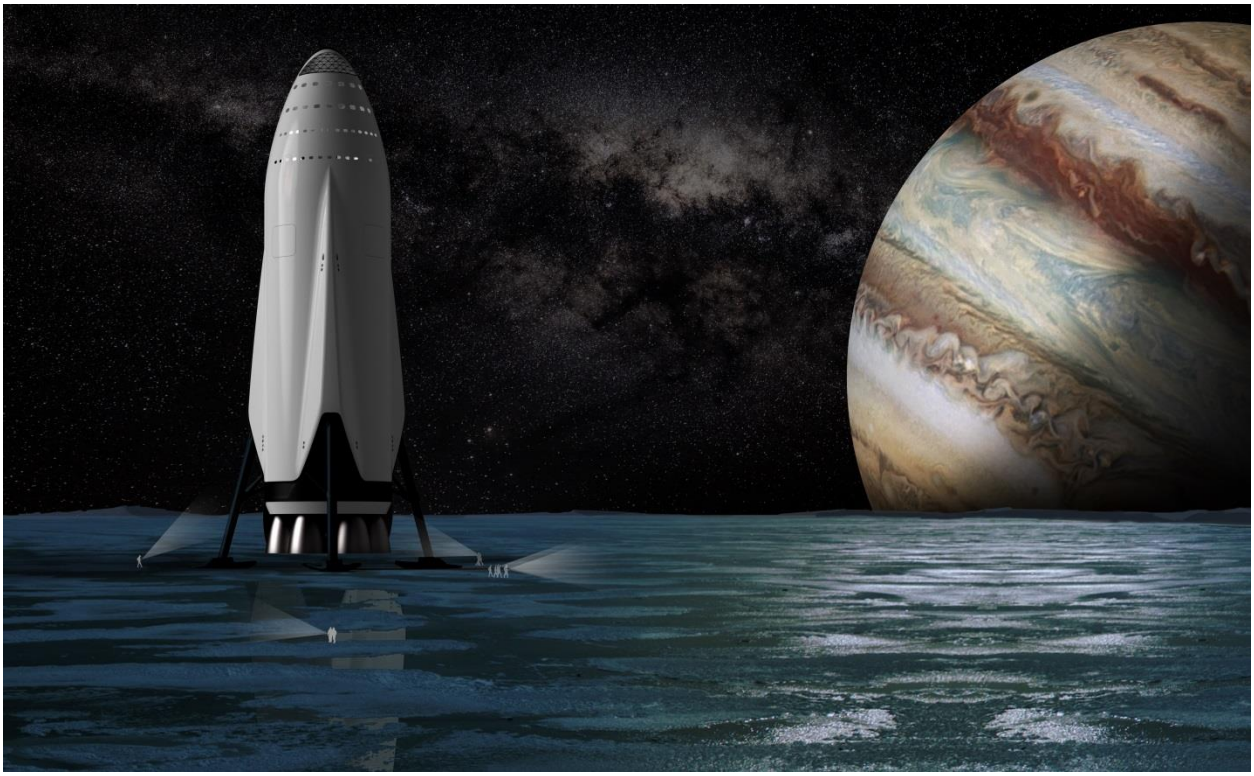
But it grows.

(Illustrations by Anna Nesterova)



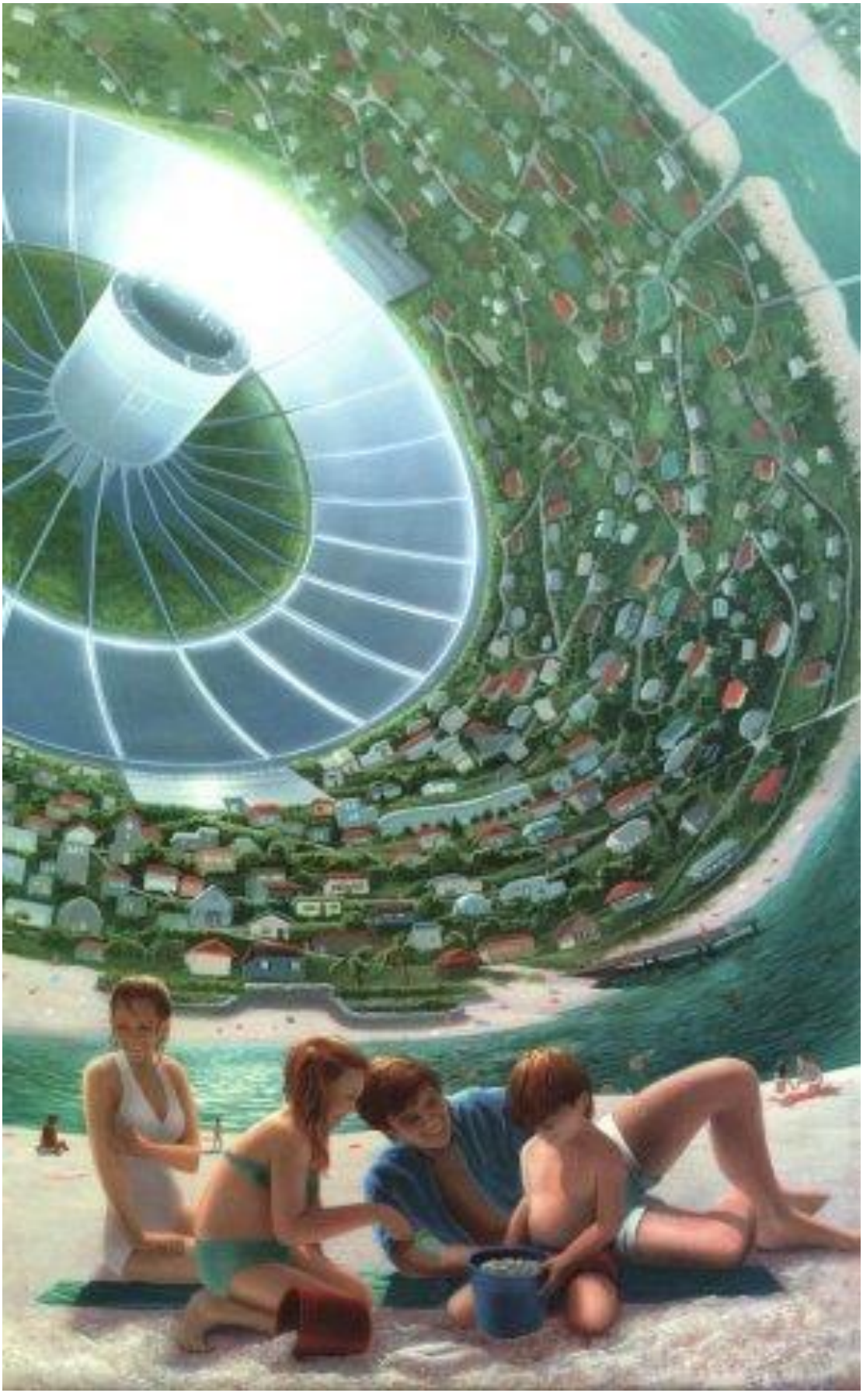
A human-carrying ferry for trips from one tourist destination in space to another.



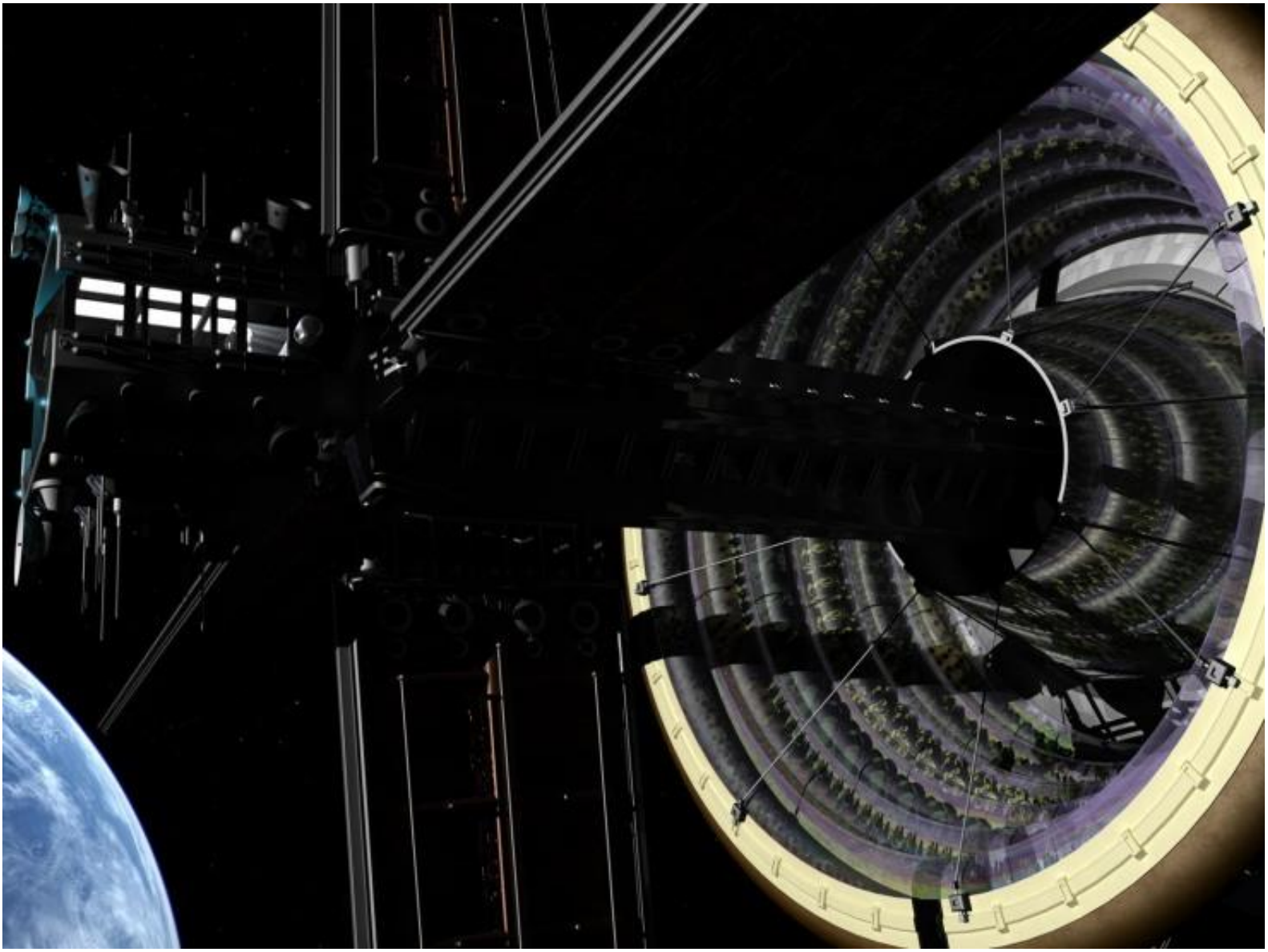


A SpaceX Interplanetary Transport System passenger ship landing on a Moon of Jupiter. Nice view.

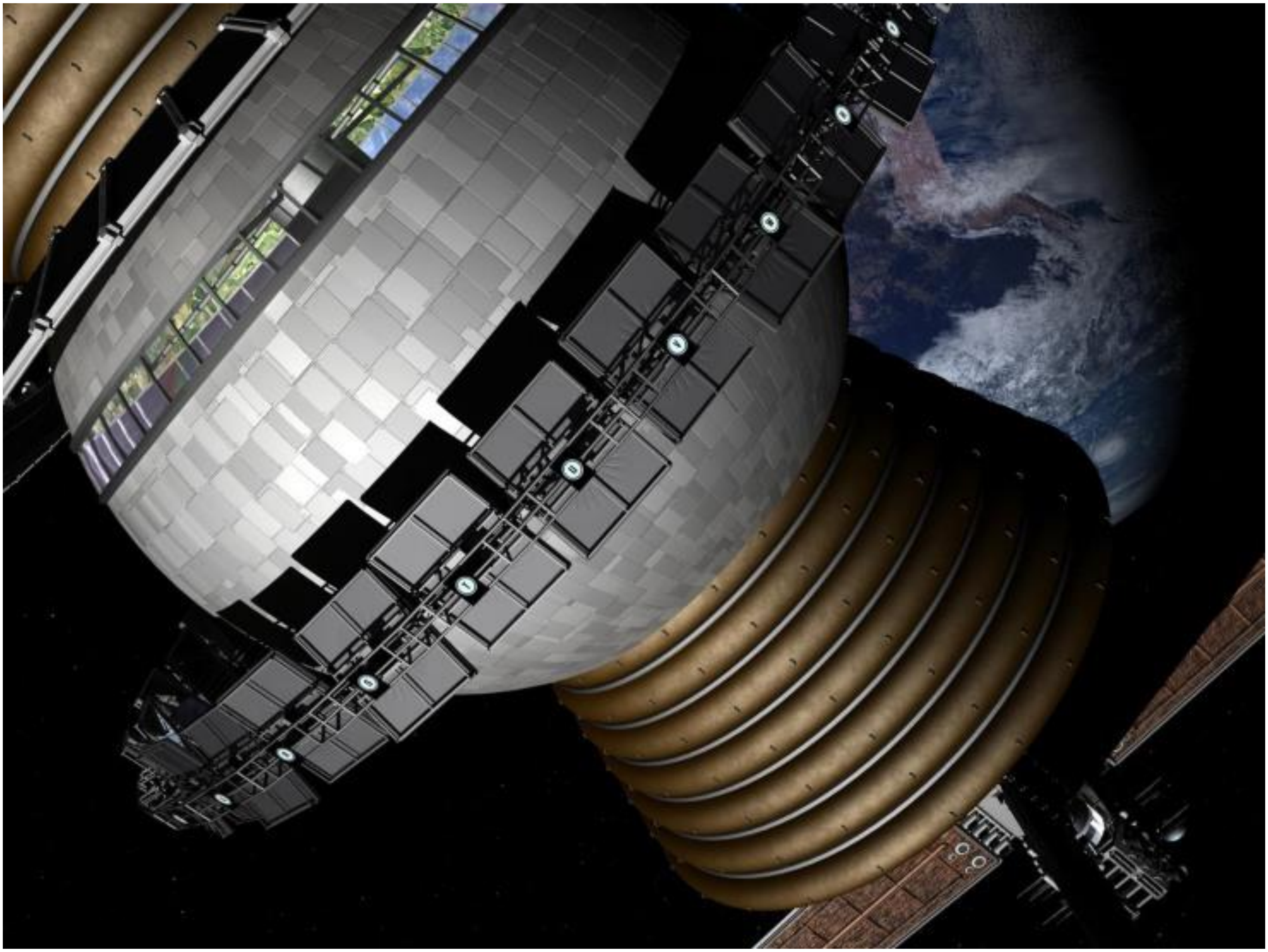
Then will come the colonies hanging in the heavens, micro moons teaming



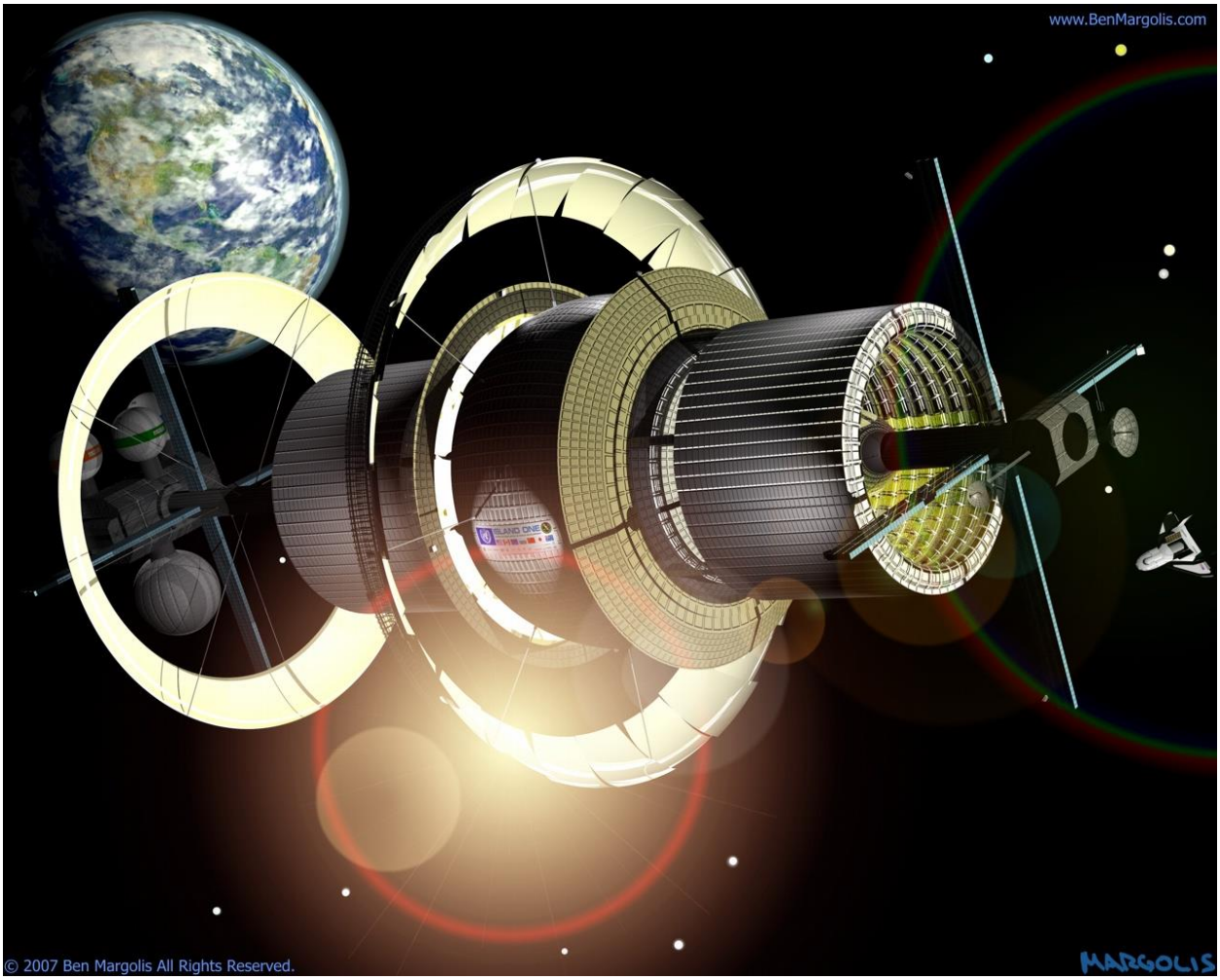
with life. First the little ones, Bernal Spheres with a mere 3,000 humans each.

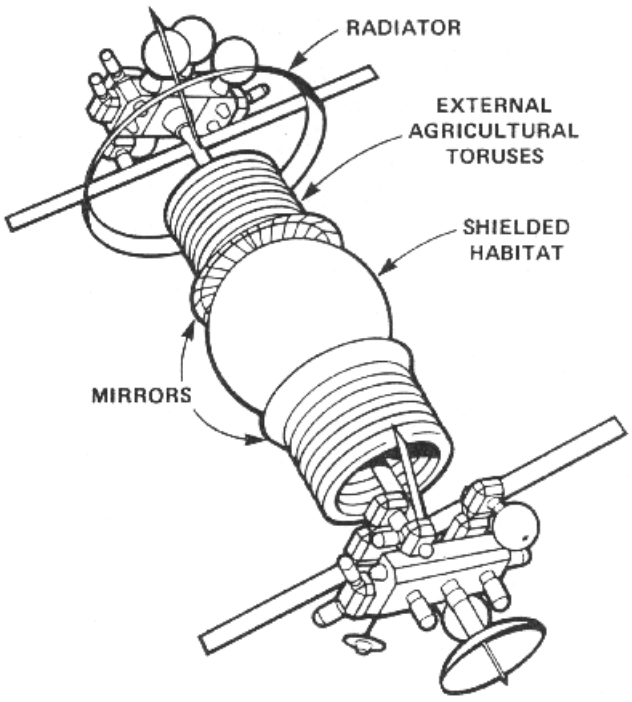


A Bernal Sphere from the outside. If you look hard at the nested circles on the right, you can make out the green tiers of the farming rings, the agricultural terraces.

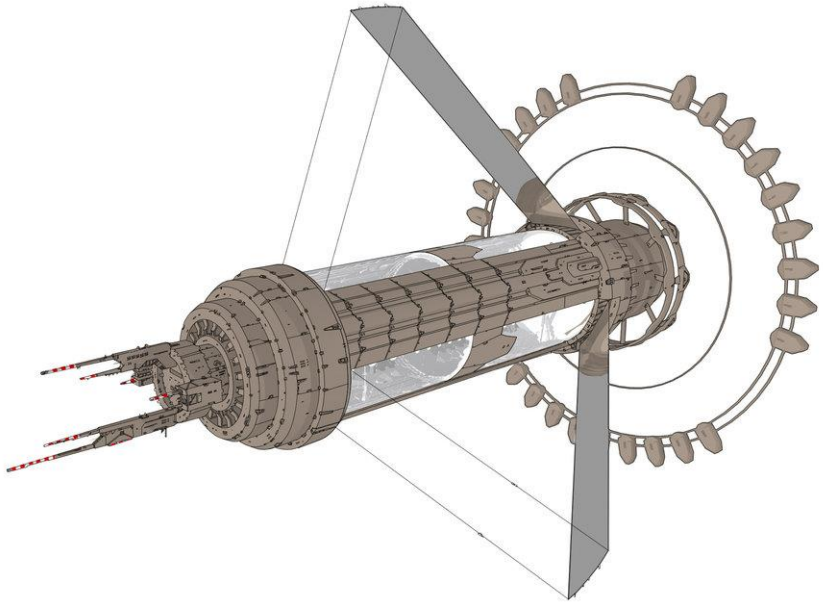


A view of the Bernal sphere from a slightly greater distance. The bulging round bulb is where we humans will live. Windows and mirrors will give us sunshine galore.



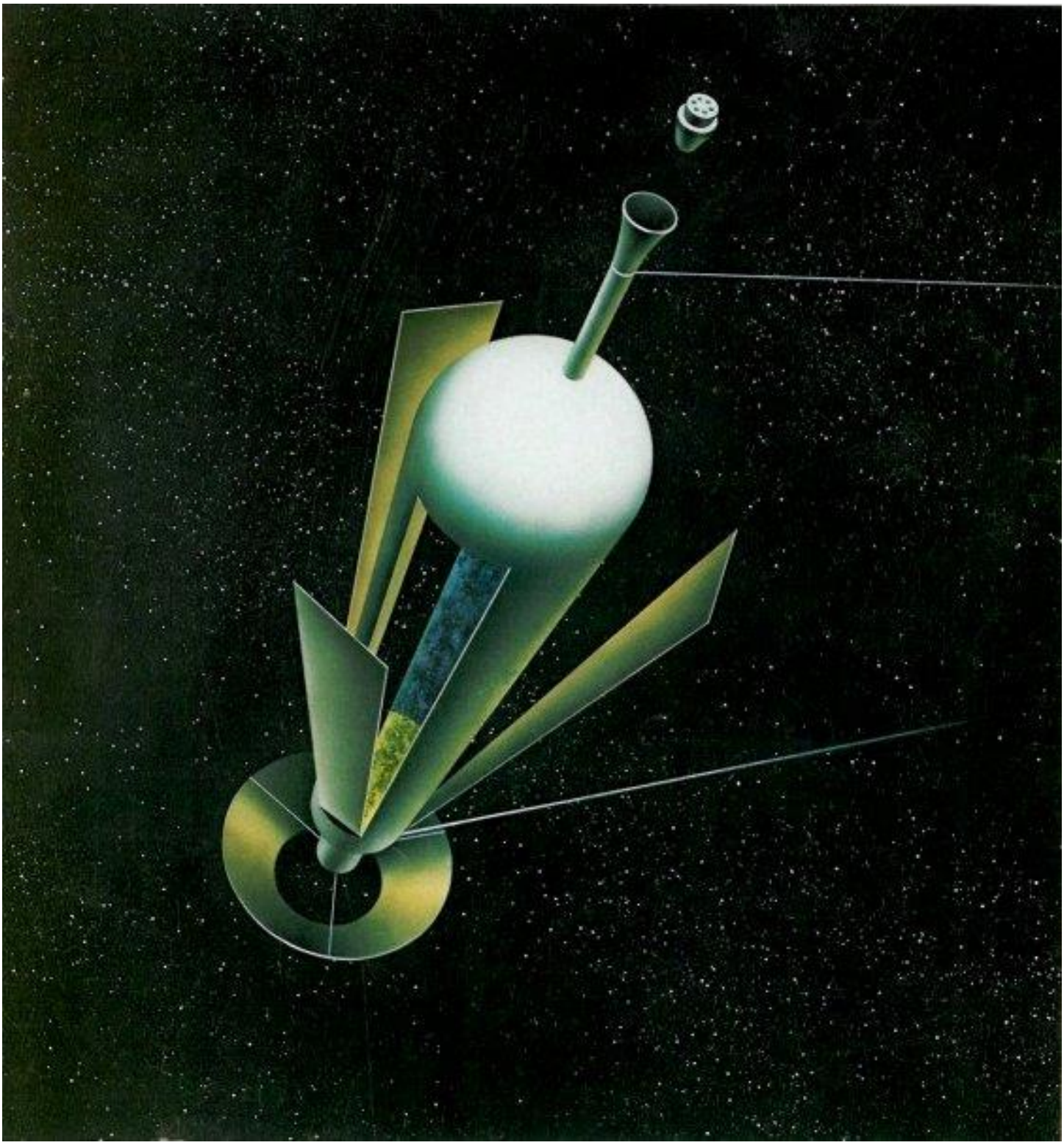


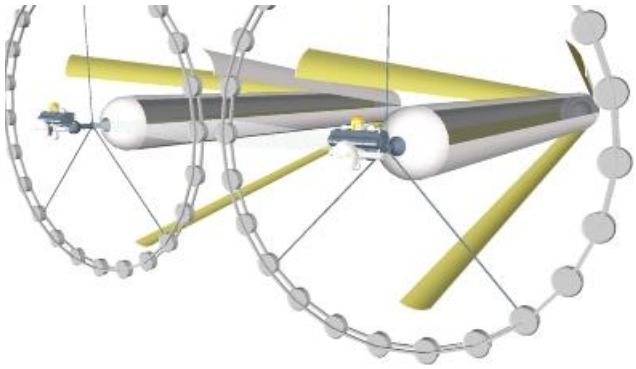
Bernal Sphere details.



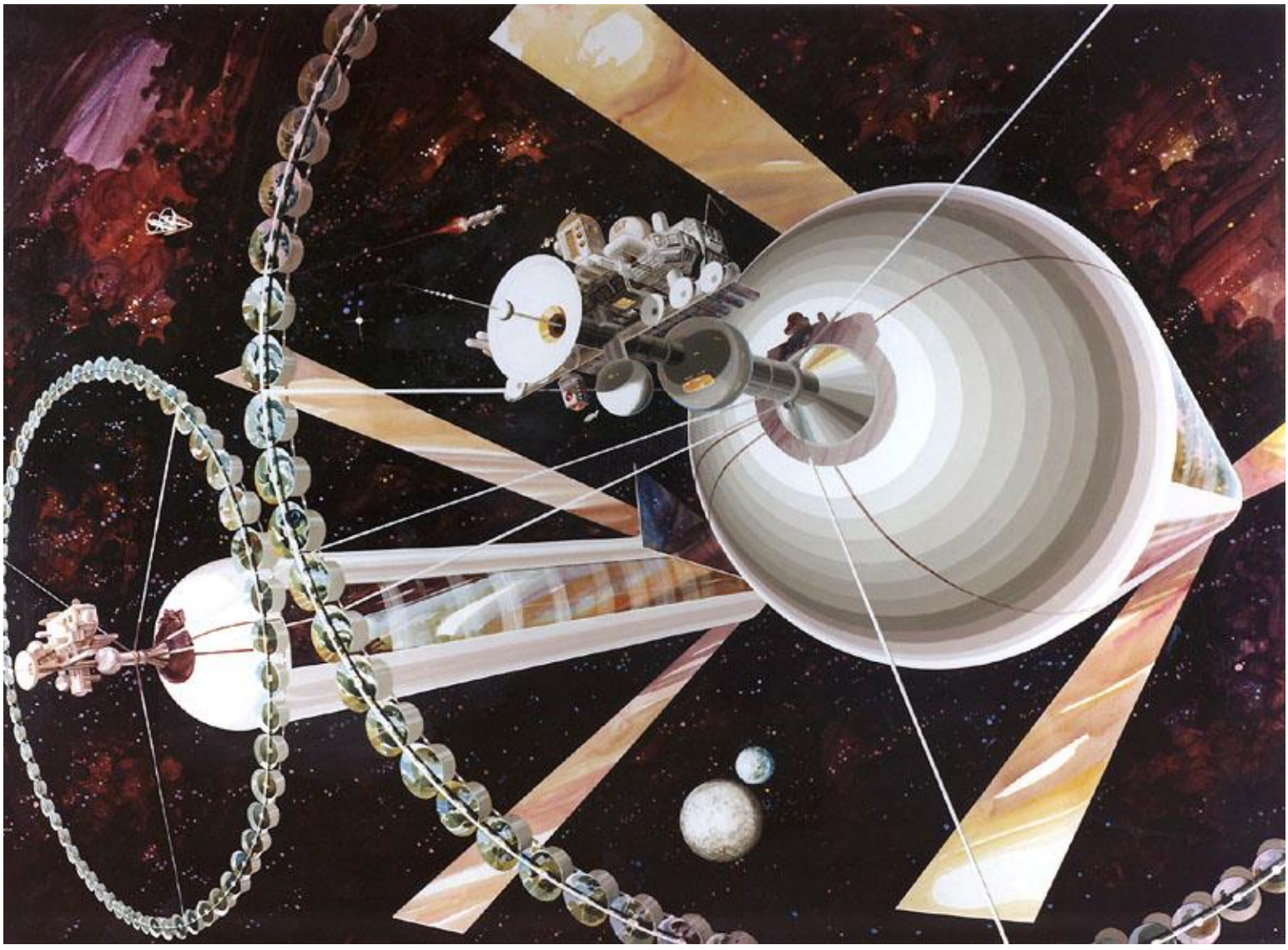
Next will come the really big mothers--the O’Neill Colonies, The Stanford

Toruses, and the huge O'Neill Cylinders. Five hundred square miles or more of farms, forests, parks, puppies, pussycats, sunlight, wildlife, and cities per colony. Imagine the emptiness of space alive with the innovation, industry, and trade of thousands of these mega-cylinders--the black of space hung with communities like a Christmas tree hung with ornaments.

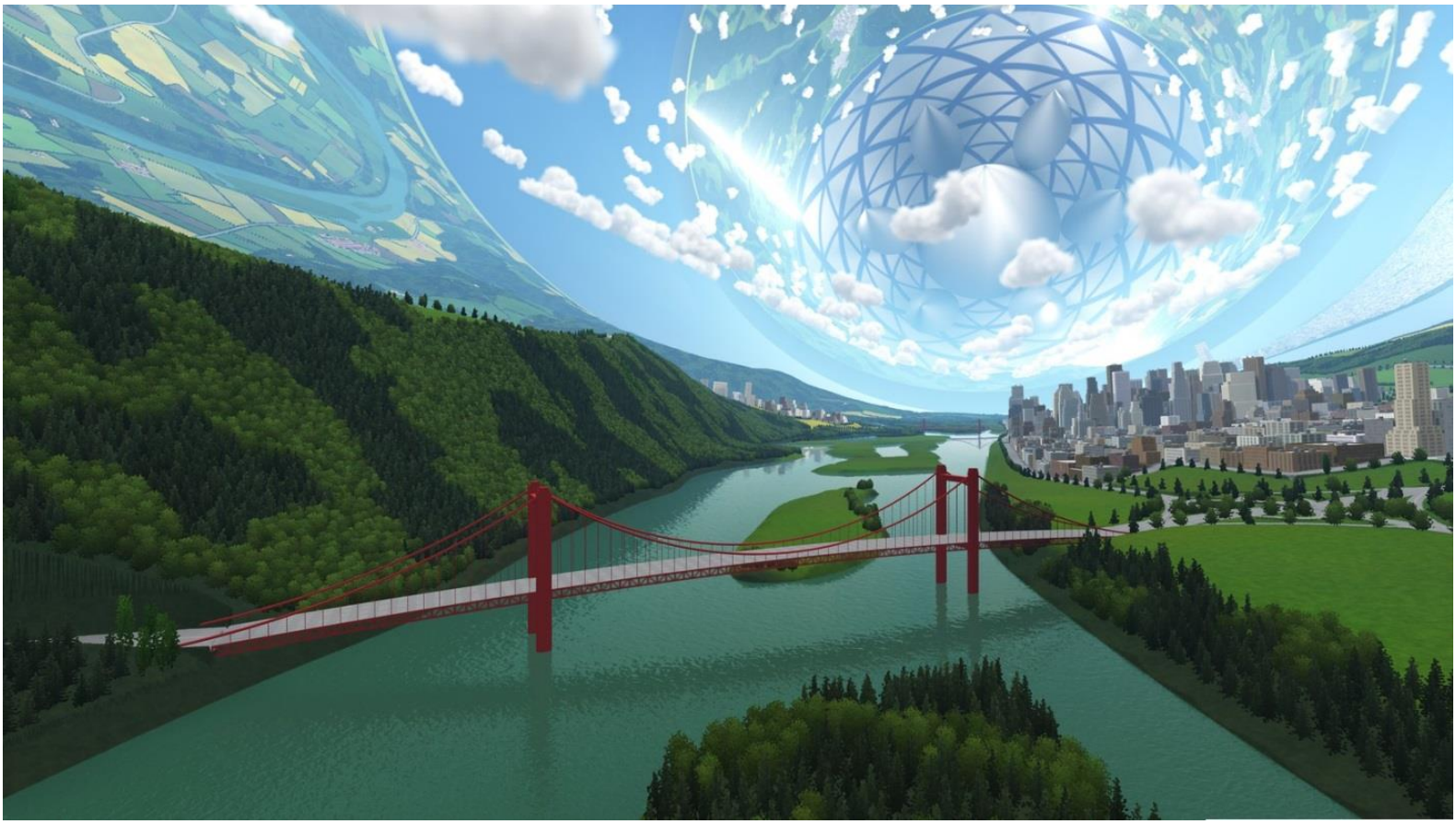


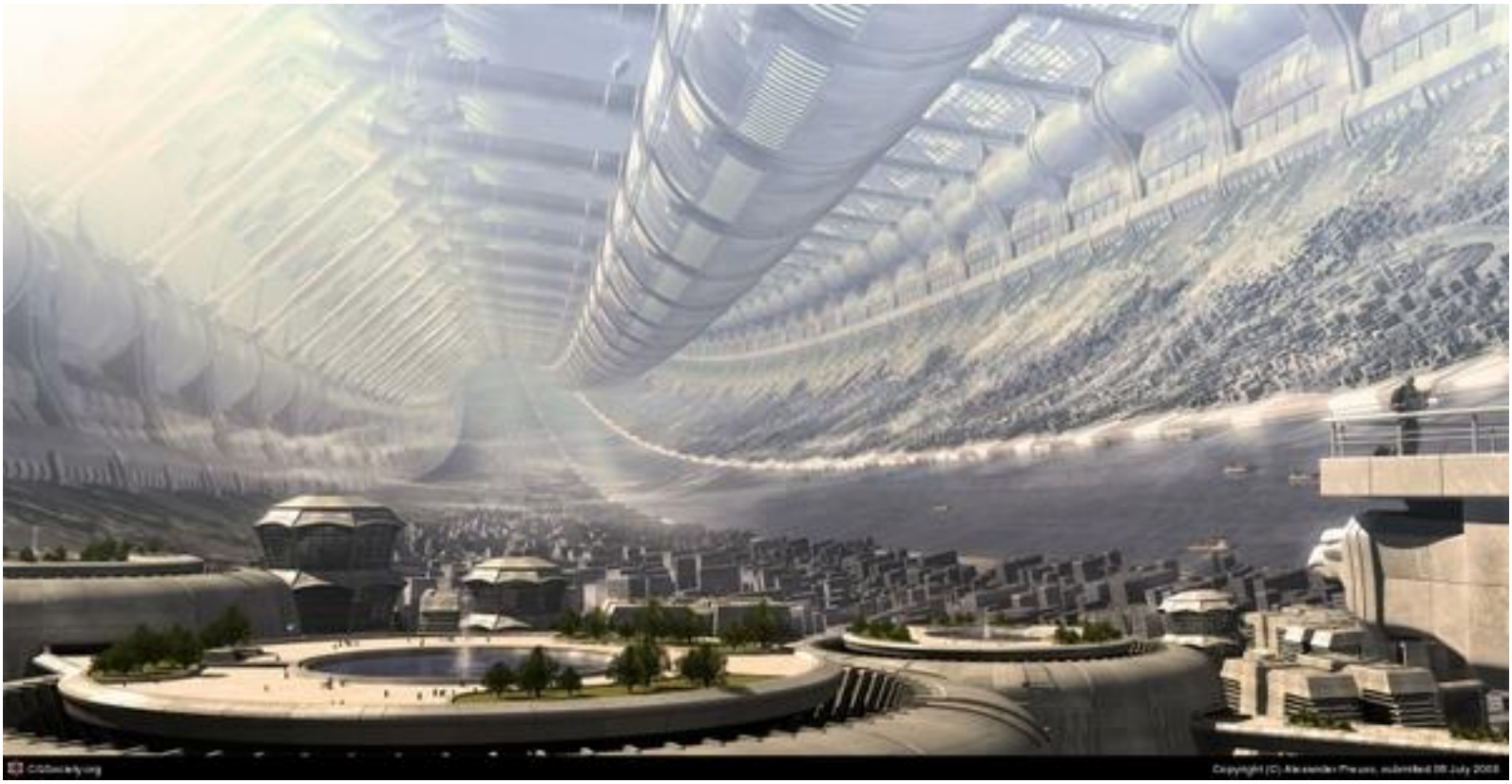


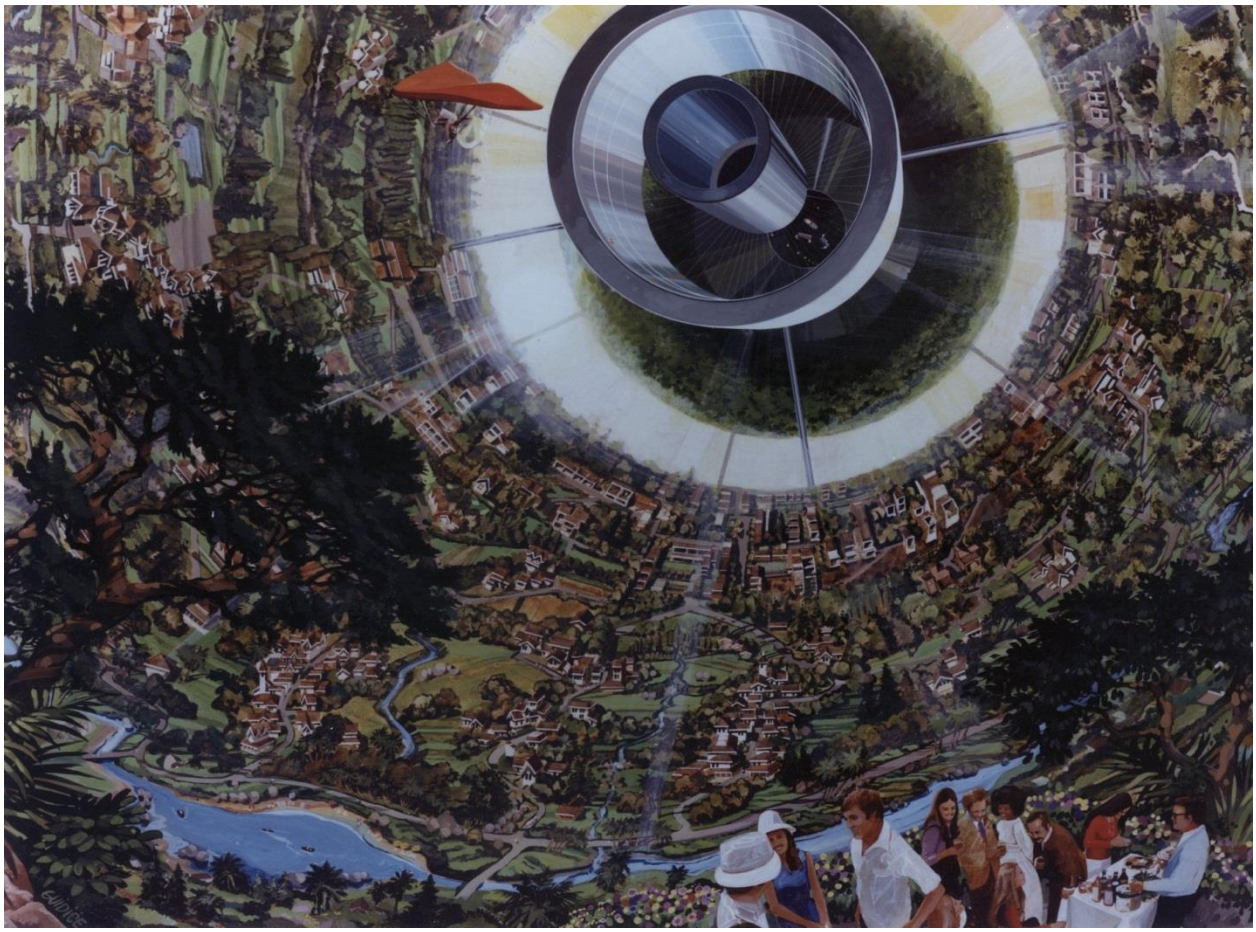
To generate stability, O’Neill Colonies will often be constructed in pairs.



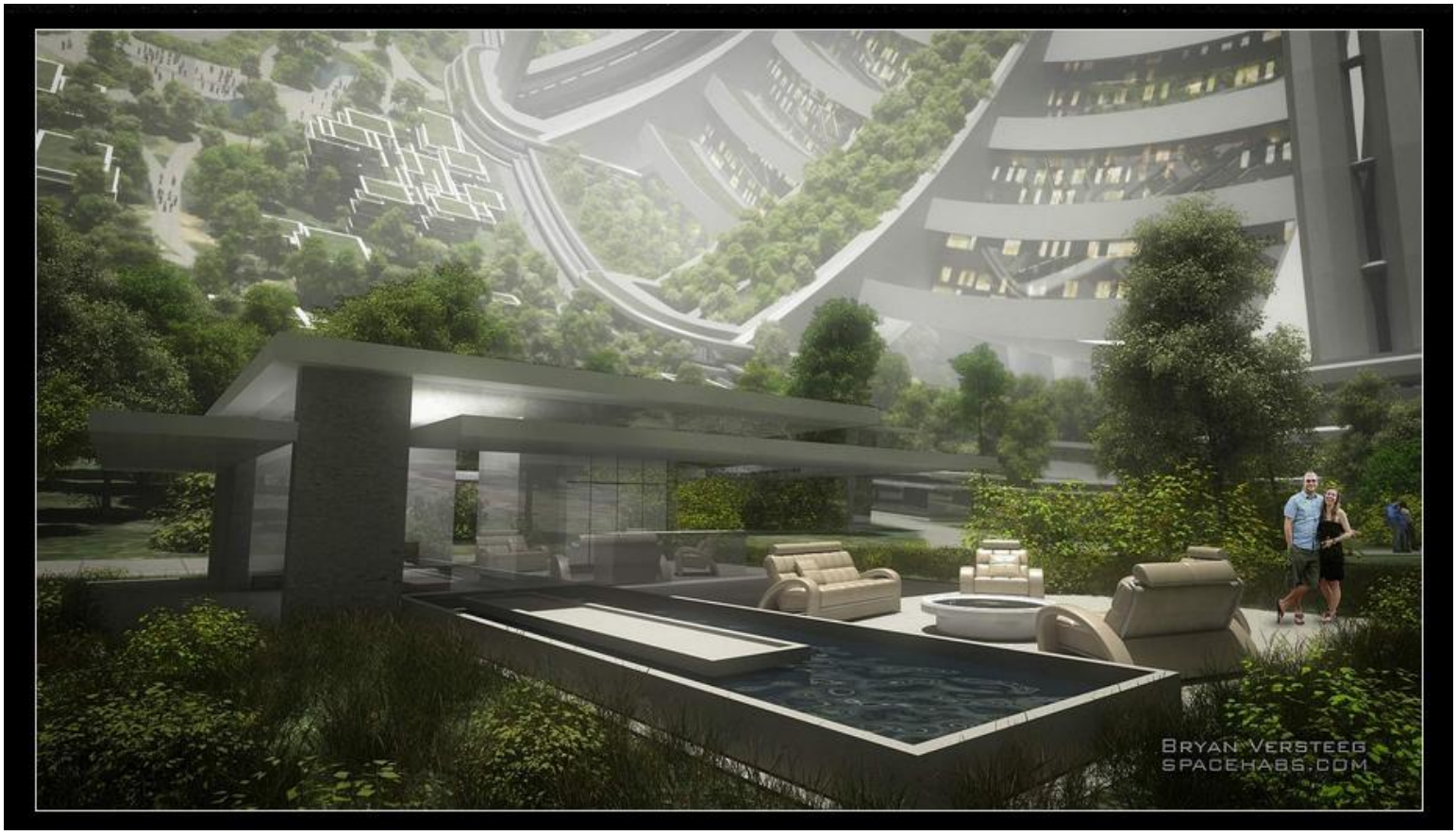
Which colony would you pick for your next home?



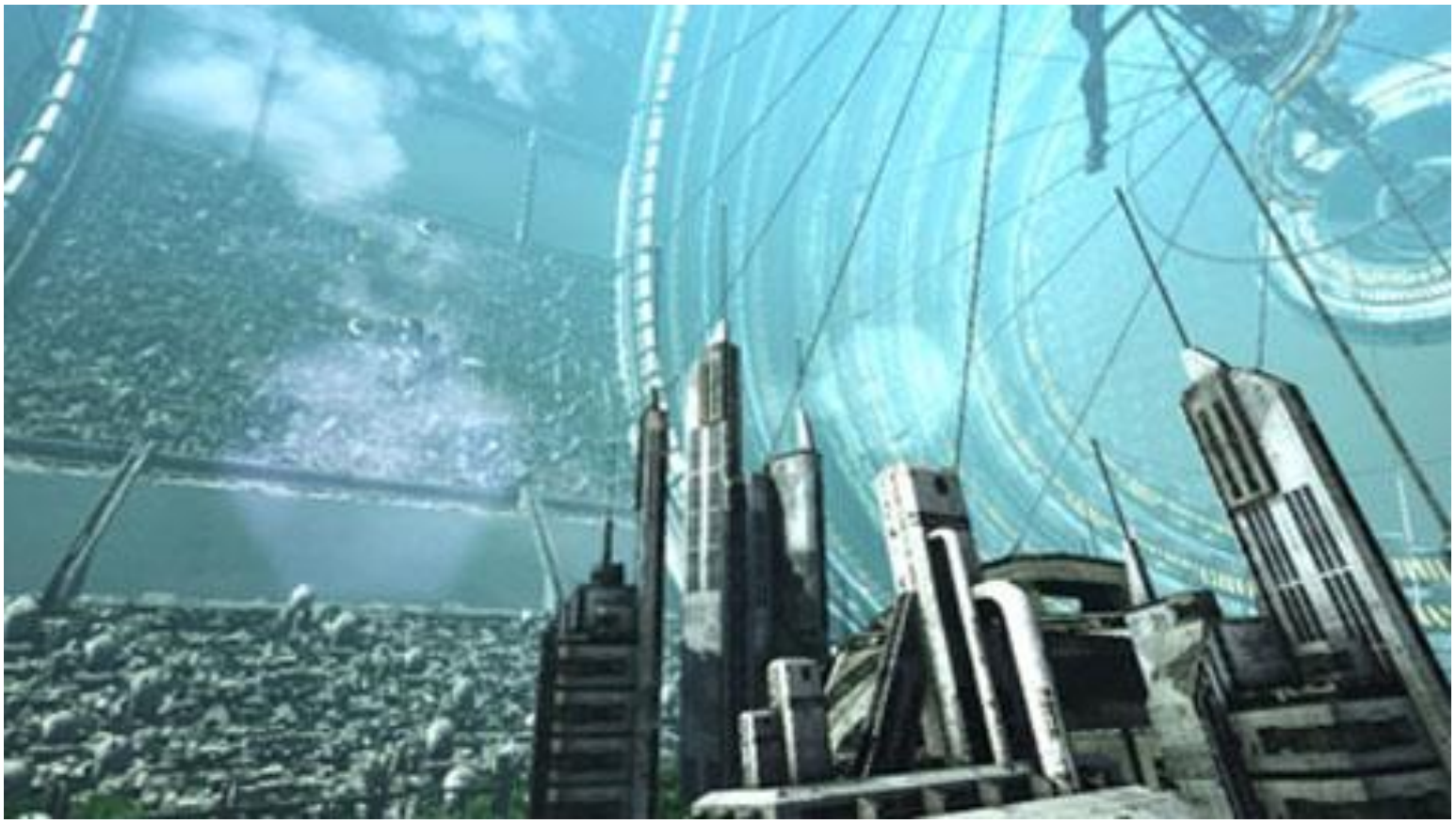

CGSociety.org
Copyright (C) Alexander Preuss, submitted 08 July 2003




BRYAN VERSTEEG
SPACEHABS.COM



Showing off the backyard in your starter home. Like your pool.



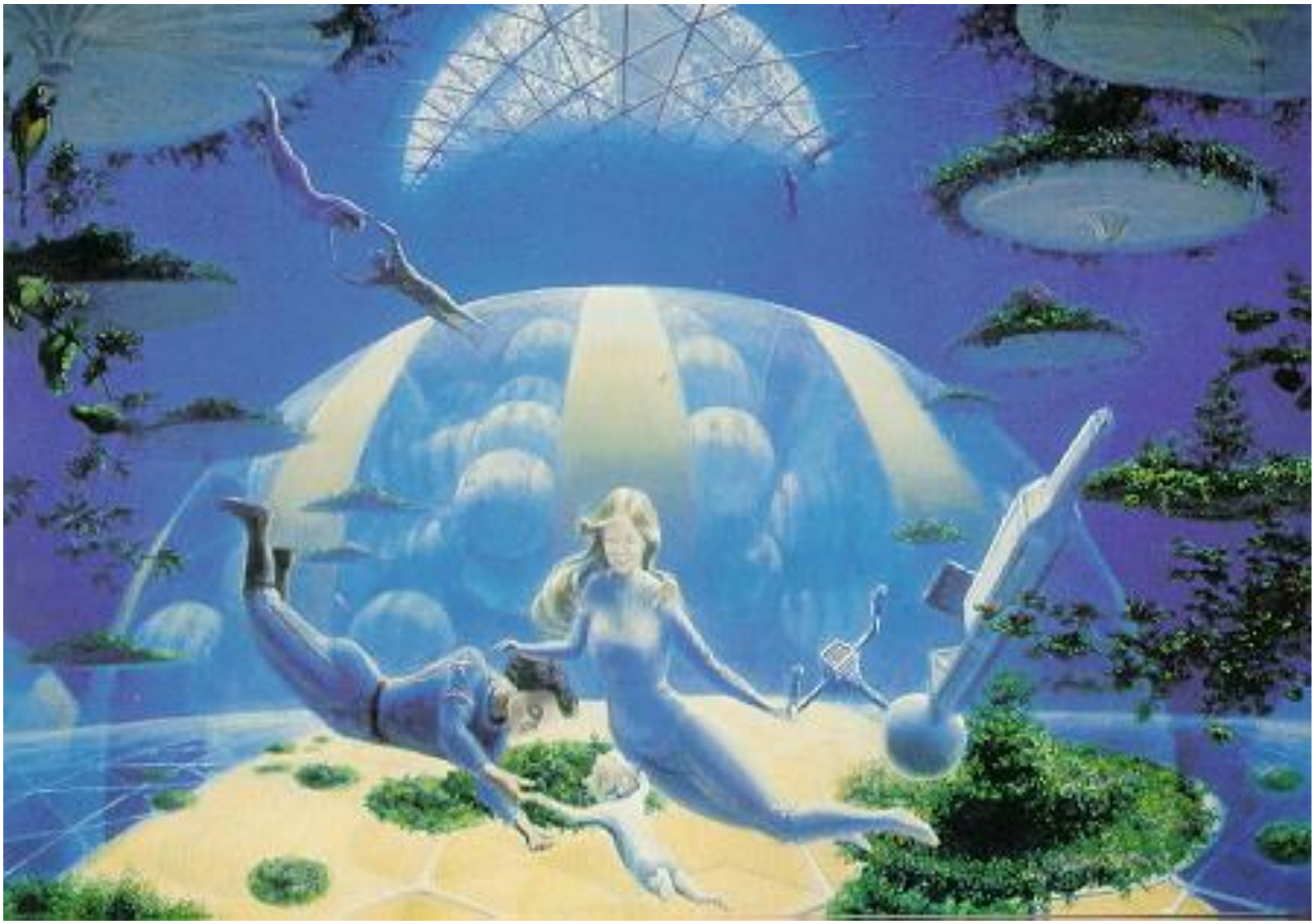

DON DAVIS

Tired of leaves and grass? How about moving to an O'Neill colony modeled

on Venice?


25

Previous page—a theme park in an O'Neill colony. Below: A family picnic in

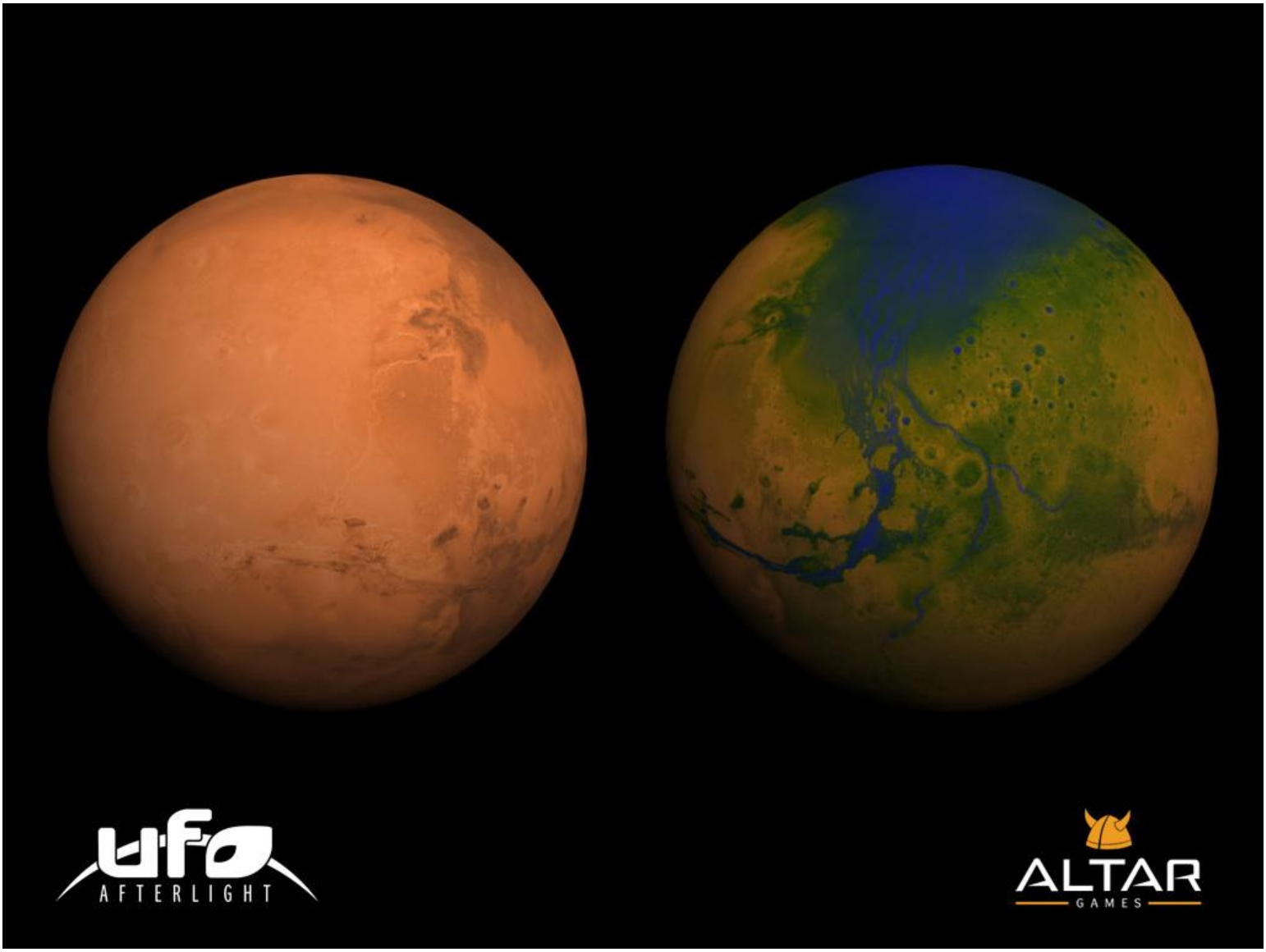


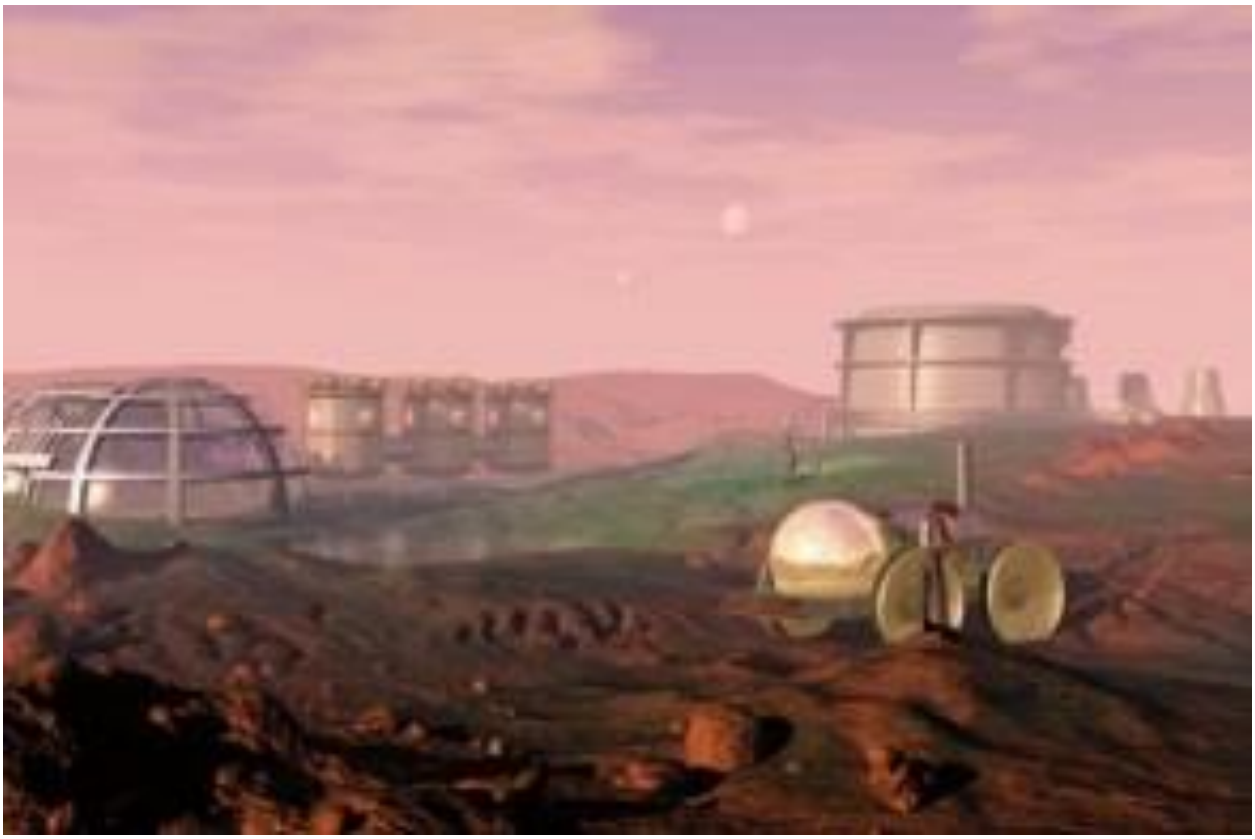
the weightlessness at an O'Neill colony's center.

Or, if you're up for the heroic, how about settling down to homestead…on the fourth planet from the sun, Mars. Your goal? To bring an entire planet to life.

A base on Mars' moon Phobos. A base designed as a way station to the Martian surface.

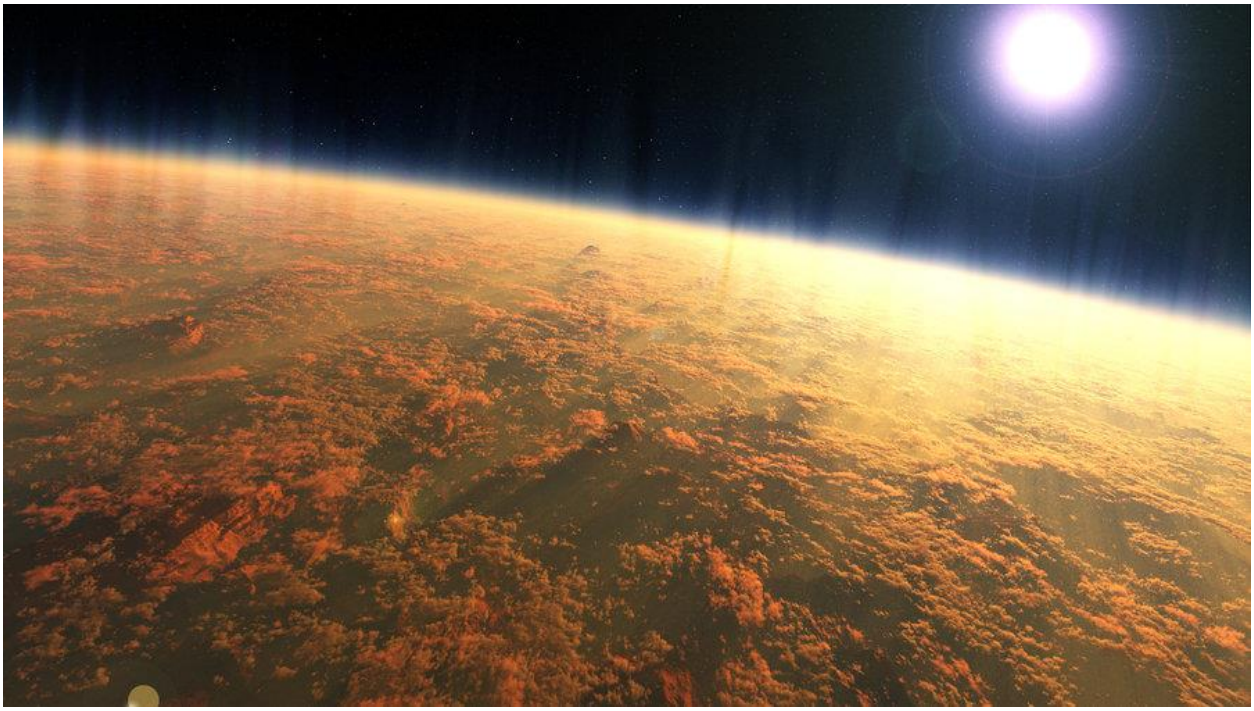
Turning the red planet green.

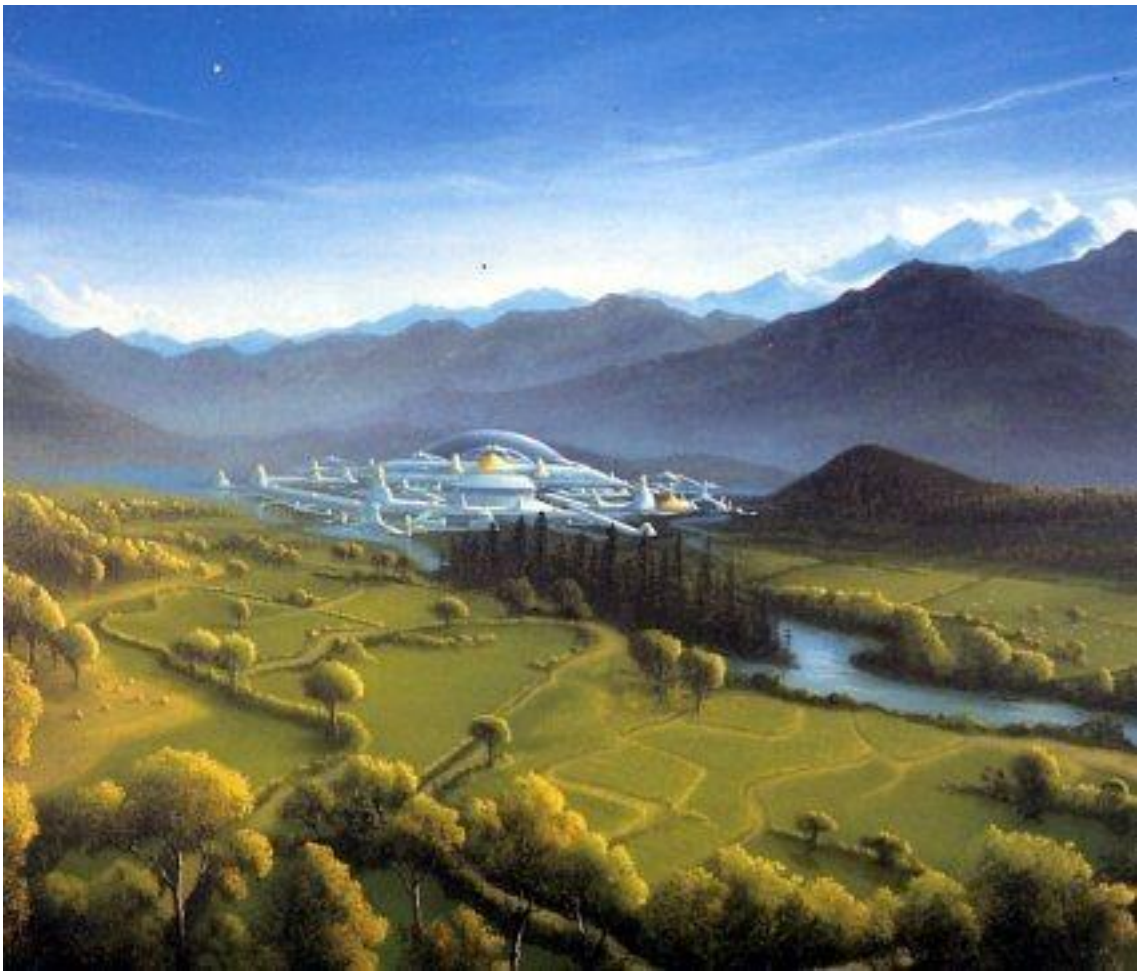




Terraforming Mars. Giving it an atmosphere like ours. Then gardening the red gravel like crazy. And letting the carpet of plants make the ruddy planet's temperature friendly.


Miguel Rita






© Marc Pélissier

once upon a time
125 million years ago
a bunch of loony dinosaurs
came up with a weird idea:
flying.

if dinosaurs could speak,
the conservatives among them would have pooh-poohed the entire notion
don't you get it, the conservatives would have said,
there is nothing up there but empty space

the earth is your mother.
every good thing in your life is here on her breast--
food, shelter, and company. not to mention greenery.
up there there is absolutely, now listen very carefully and look up above your head.
what do you see?
Absolutely NOTHING.

but a strange thing happened.
the dinosaur conservatives with a love of nature and a deep commitment to the earth died out 65 million years ago
and the nutty loons who wanted to loop and play in the empty space above their heads

are called birds
what's more
there are twice as many species of birds
as of us nice, conservative ground-walking mammals.
meaning that the fliers have found twice as many ways of making a living in the emptiness of the sky.

and fliers
be they birds or flying mammals
live roughly 60% longer than groundlings.

is nature trying to tell us something?

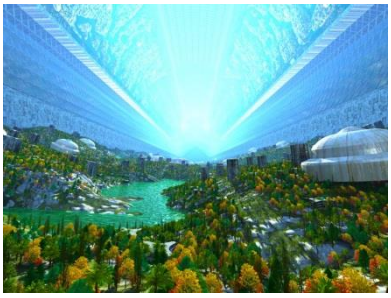
Is there another empty space above our heads waiting for us to ply?

We have gardened one toxic ball of stone—earth. Now it's time to garden more.

The key to going from here

To here?

Not to mention here?



Persistence. Passion. Organization. Imagination. And investment.

Only one species can answer the call of destiny for the four billion year old enterprise of cells and DNA. Only one species can take life on the eight-minute leap beyond the gravity well, the leap to orbit and beyond. Homo sapiens. You and me.

Life gave you and me a home. Now you and I owe life new lands in which to plant its seed. New spaces in which to roam.

Are you up for the challenge?

If you are, volunteer to work with The Space Development Steering Committee. Email howlbloom@aol.com.