

I'm going to tell you how we found Rocket Fuel, propellant, in the space near Earth, and how to use it to Occupy the Solar system. Personally, someday, I want, to send robotic prospectors to stake claims and have us own the gas stations.



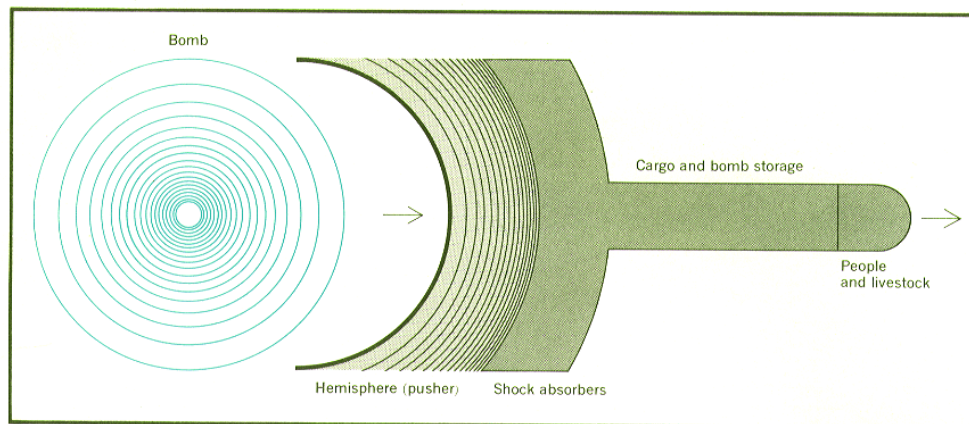
Nuclear explosions would power Dyson's "Orion Starship"

First, I'm going to tell you what started me on this journey.

When I was a graduate student I read the words in a physics trade journal:

*".... take a town the size Princeton New Jersey to the nearest star
..... cattle and livestock"*

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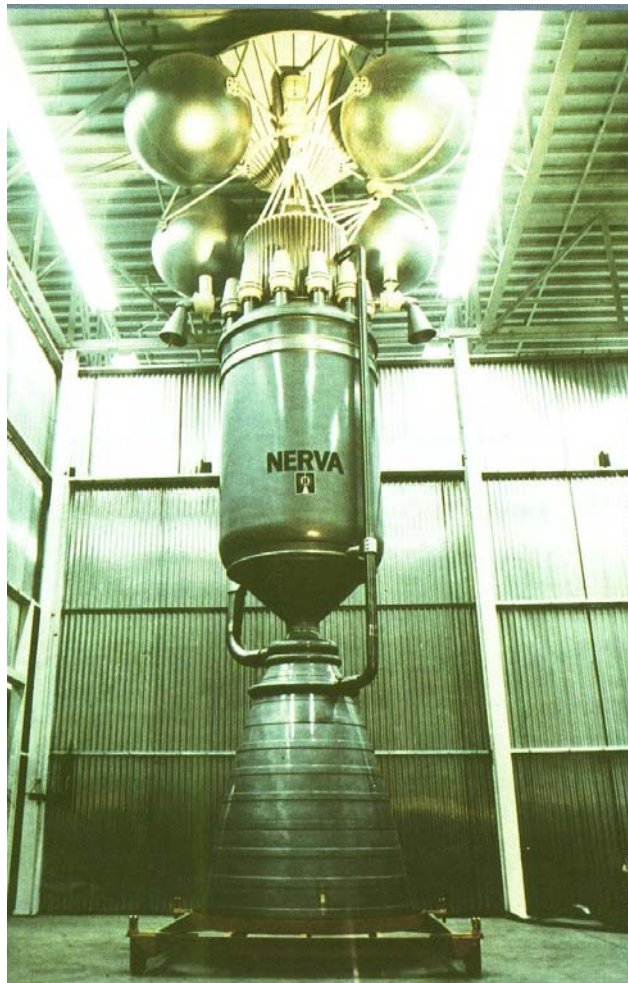
BOMB-PROPELLED SPACE SHIP. Debris from the exploding bombs transfers momentum to the shock absorbers and hence to the payload section of the ship. Mission velocities for this primitive design would be 500–10 000 km/sec; the upper limit is similar to supernova-debris velocities.

**He would propel our spaceship to the nearest star
using repeating atomic bombs. It was blast propulsion.**

This was the start for me, 40 years ago. Fanciful? Quite. I used to work for the Department of Energy. They called me a Rocket Scientist. My role was Principle Investigator for Nuclear Space Transport. I have a Ph.D. in solid state physics.

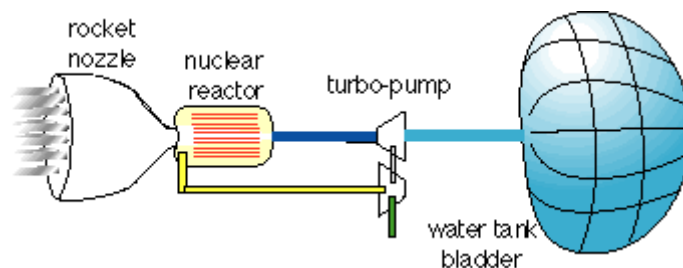
**Now, 40 years later, I get to tell you how we found
Rocket Fuel in the space near Earth,
and how to use it to Occupy the Solar system.**

The atomic bomb people introduced me to a rocket that would take people to Mars. They gave me and another bright eyed bushytailed phd felow a tour of Jackass Flats, where the key, nuclear rocket work was done. I tried to wrap my arms around this nuclear rocket. It used hydrogen propellant and an atomic energy, nuclear reactor to superboil the probellant into a rocket nozzle.



A small nuclear reactor powered this NERVA rocket. NERVA used liquid hydrogen propellant, not water. A steam rocket is easier to make.

INSTEAD of atomic bombs, I found out how to use atomic energy, using a nuclear reactor. A dozen years later, I found out how to use water, steam rockets, instead of liquid hydrogen as propellant in the rocket.



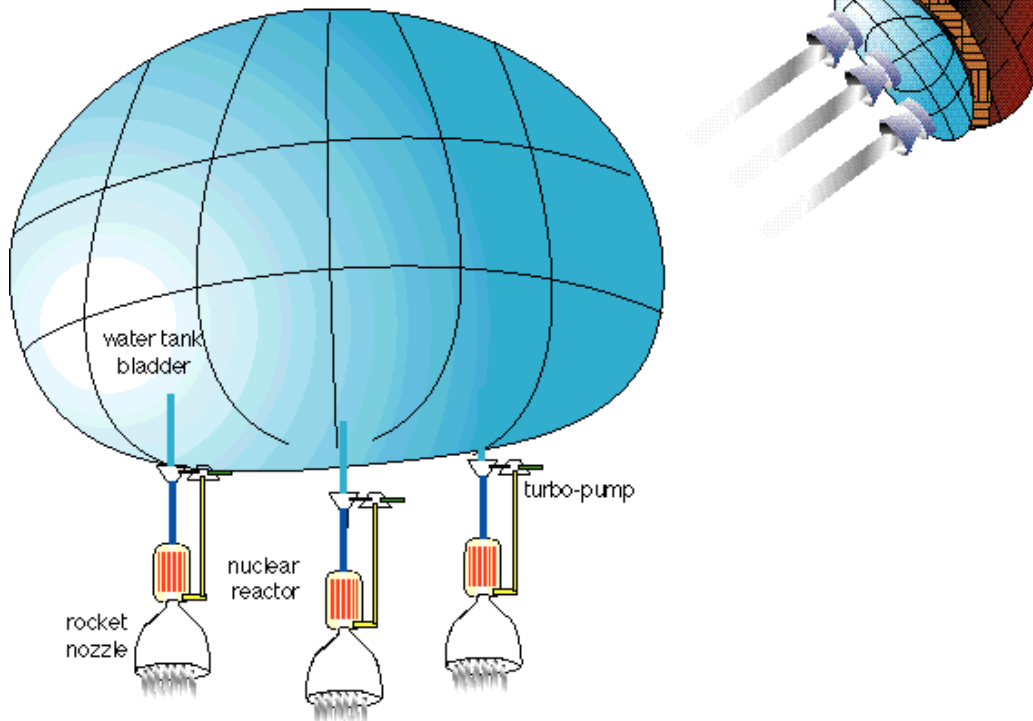
Steam Rocket:

heat water using a small nuclear reactor. Guide the steam into a rocket nozzle.

I calculated that steam rockets would barely work ok in space. Not wonderful, but just ok. And, the steam rocket space transport would lower the cost a 1000 times less expensive than what we do today. However,

I needed water in space to fuel a steam rocket.

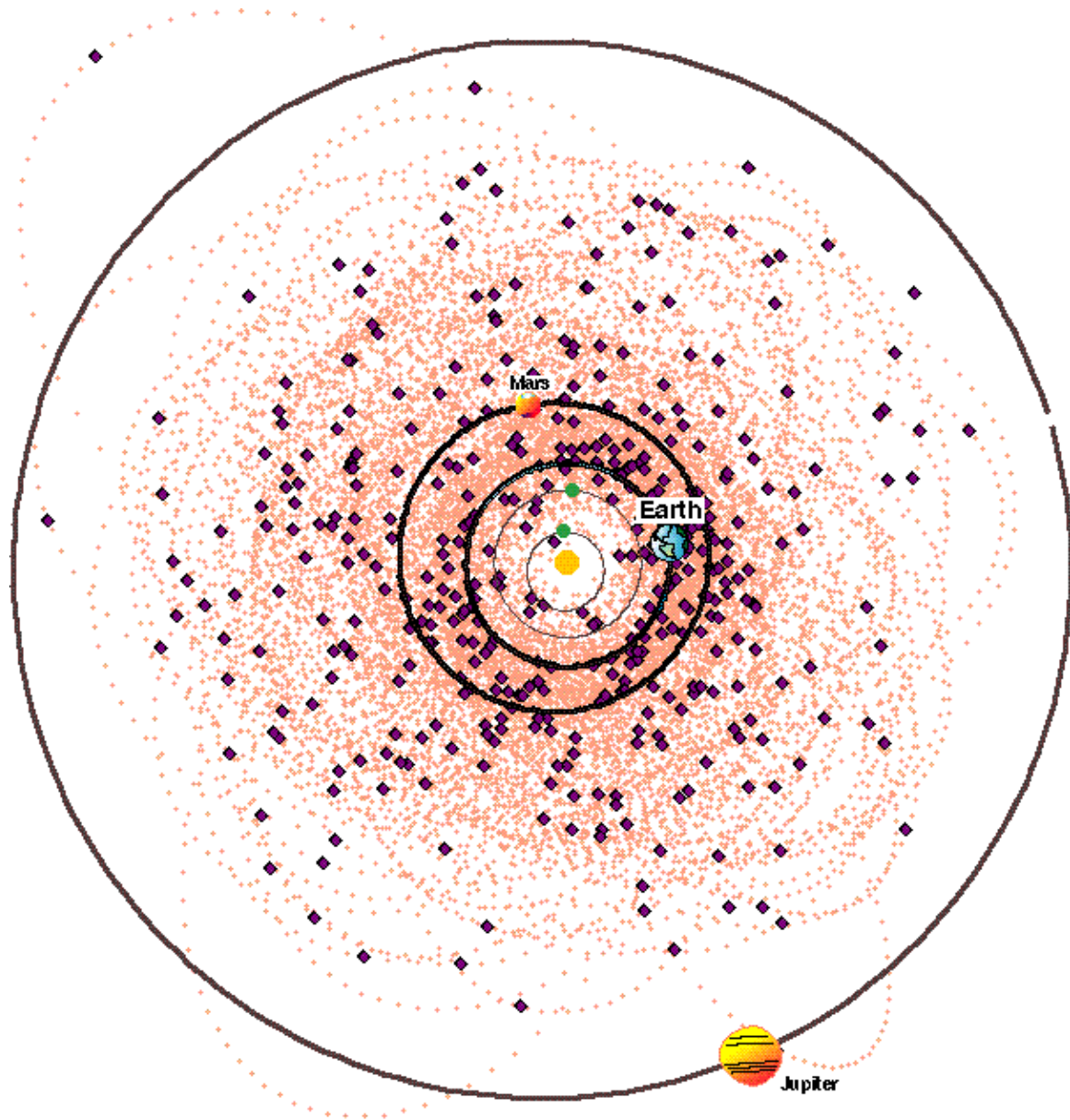
**Nuclear Heated Steam Rocket
= Simplest Space Transportation**



A steam rocket uses water that is stored in a very large bladder. Nuclear reactors heat the water, boiling it into super hot steam. Rocket nozzles use the super hot steam to propel huge payloads. It makes the simplest complete system in space.

I looked for anyone who would know where water would be in space. This was not a popular astronomy to do. Almost no one did it. There is no glamour in finding rocks and ice cubes in space.

**The problem was to find water or ice in space,
and near enough to get to
and accessible enough to be useful.**



Recently, my colleagues found a swarm of mountain sized objects in orbits that come scary close to Earth. The pink dots are the *orbits* of the dark diamonds, which are the "near earth objects", **NEO's**, where they were on 6 October 1996, the day we taped a Discovery Channel show.

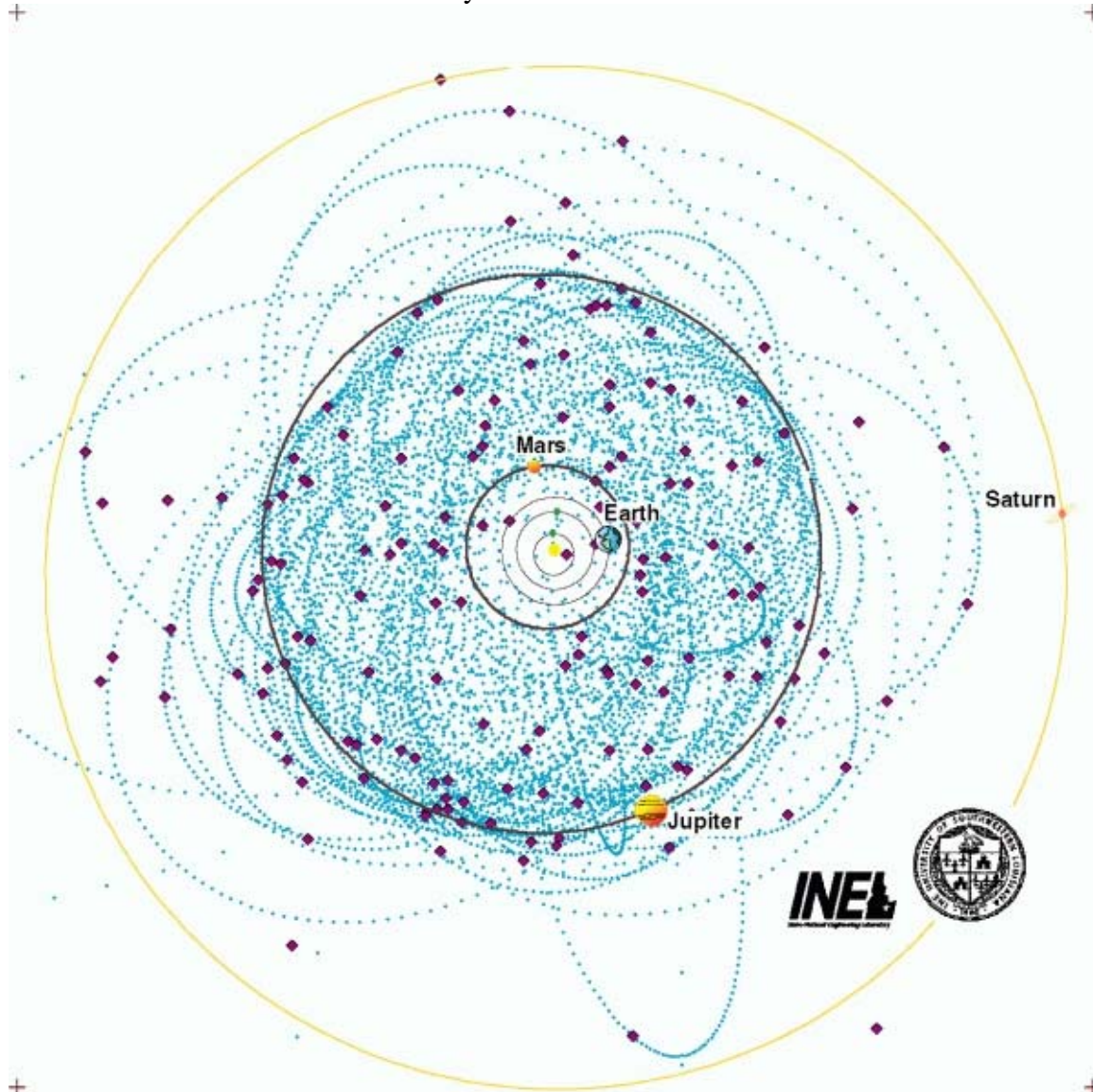
NASA spun the story into super scary stories. Asteroids smashing into earth. Almost The End Of The World. NASA wanted space survey telescopes to find all the killers. And then they wanted missions to push the killer asteroids out of a collision path with Earth.

I would tell and retell the story to grade school children in Idaho, to Rotary clubs, to the Kiwanis clubs, to Senators, the Pentagon, The White House, the Discovery channel, to anyone who would listen.

I would describe vividly how it happened many times during geological history. A mountain sized, near earth object would hit the Earth. The whole sky ignited, on fire, over a continent. The blast created 1000 foot tidal waves. Each time the global catastrophe hit, the world collapsed. The End of the World as we knew it came. We had to change our bodies a little, improve them a little to survive, and then we would

prosper, as a Life Form. Eventually we became lizards and fish, and eventually, mammals, and then humans and everything alive on Earth.

We recently found out that almost half of the near earth objects (neo's) contain mineralized water. And nearly half contain a higher percentage of platinum and gold than the best platinum ore on earth. Almost none are hard rock meteorites, like those that make it to the Earth's surface and get into museums. Most neo's don't make it. Most are relatively soft.



My colleagues also found another swarm of almost invisible, dark, black comets mostly between Mars and Jupiter. The comets are the dark diamonds. Their orbits are the dotted lines. In Cosmic time, this picture changes like a swarm of bees. I took a snapshot like it was the day we taped the Discovery Channel show, 6 Oct 1996.

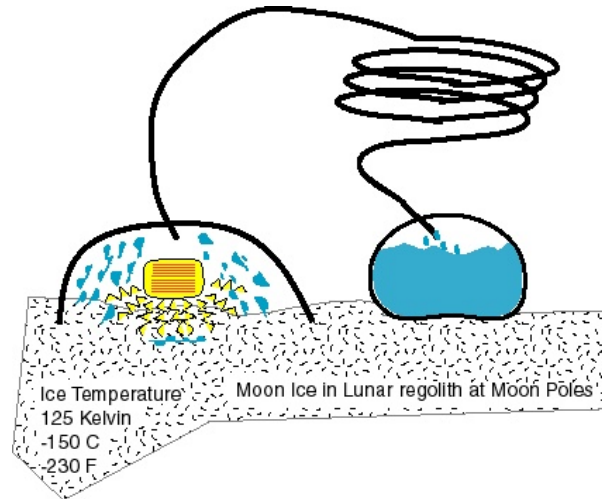
Those almost invisible comets are apparently made of hydrocarbons, strangely similar to very dirty coal, or oil shale. Curiously, they appear to be about 1/3 water ice, 1/3 hydrocarbons, 1/3 silicates, a percent amines. I would almost joke when I said: "*The closest thing on earth could be cat feces in a dry ice cooler. Not dog, cat, because it's black.*"

These were mysterious stories. How would you get coal in space? What kind of dinosaur could live in

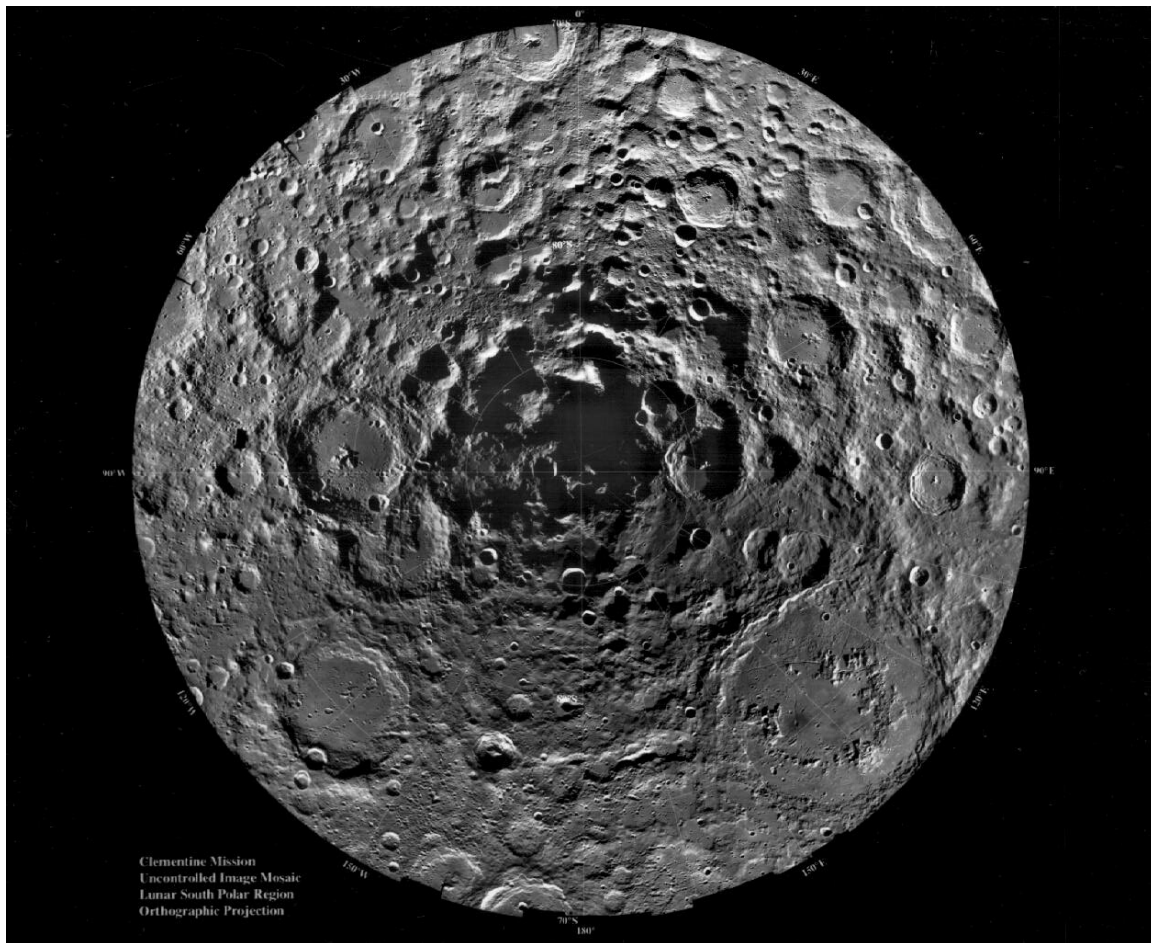
space? Aliens?

All I wanted from space was water in space, not hydrocarbons or oil shale.

Two little satellite probes surveyed the moon and claimed there should be water in some form at the moon's poles.



Heating moon ice makes water. Does moon ice exist?

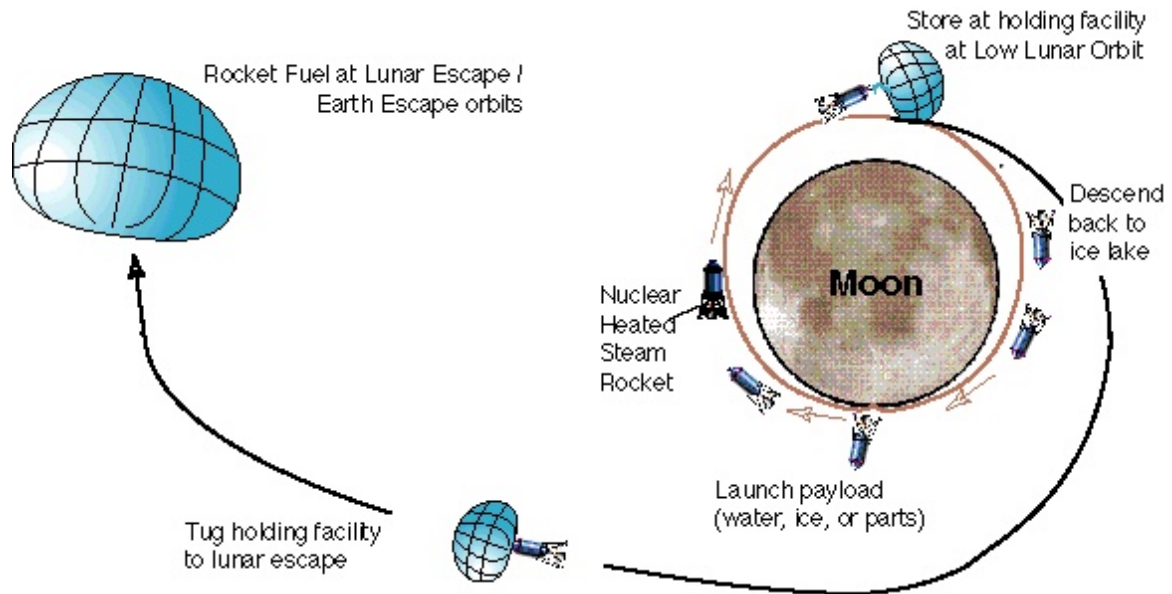


Earth's moon, viewed from its bottom, its forever-dark south pole, taken by the US Defense Department (DOD) Clementine mission, for \$99 M. Measurements suggest water ice inside the

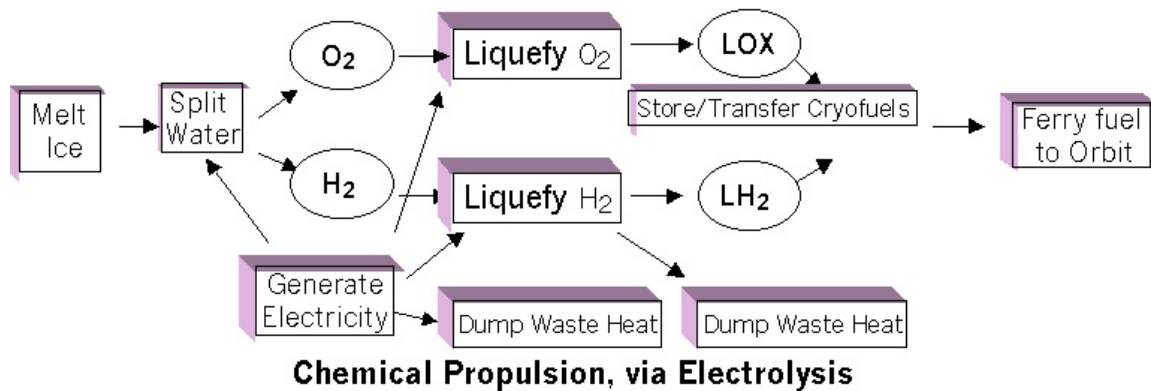
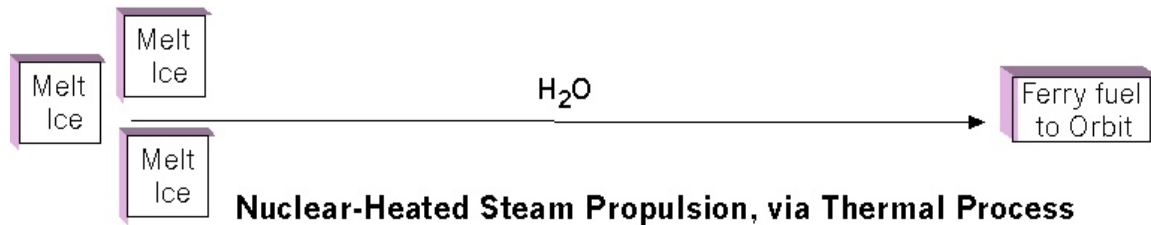
extremely cold, forever-dark crater bottoms at the top and bottom of our moon. More recent observations can't find as much water they first suspected.



I showed how to use steam rockets to transport the moon's water into space.



If the moon really has enough water, we could provide rocket propellant (fuel) stations in space.



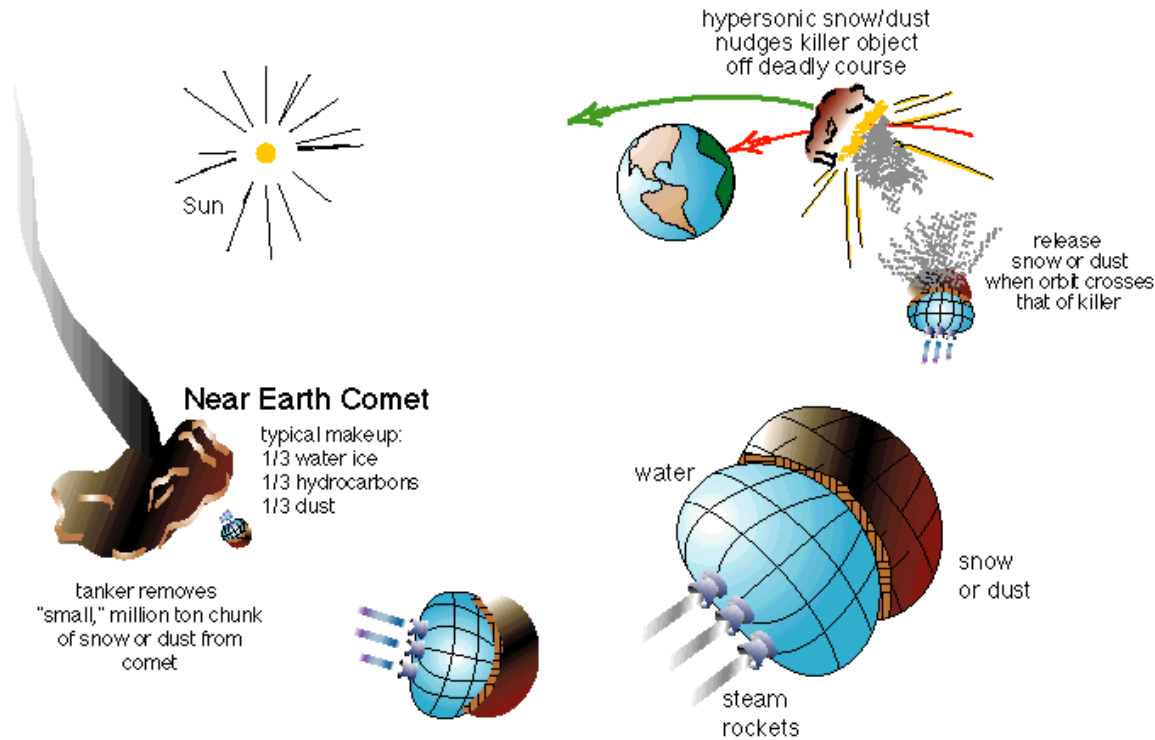
See how simple the top part is compared to the bottom part? Nature surprised me. Nature gave us a gift. We do not need to go to the trouble of making rocket fuel. We can use the water directly, straight off, in a simple steam rocket. Getting rid of all that hardware in space lowers the cost, by a factor of at least 1000.

A small group of almost unknown astronomers assured me that the comets were about 1/3 water ice. All I would need to do to get the water out would be to heat them.

They also told me that they thought almost 40% of the near earth asteroids were hydrated minerals. All I would need to do is cook them at hot oven temperatures and they give off steam, water steam. It would be like overcooking cookies in a hottest kitchen oven, to fry off the water.

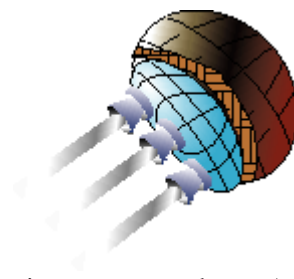
It means we can Occupy the Solar System.

Deflect Celestial Objects by Leveraging NEO Resources



We could also use a steam rocket to push killer asteroids or killer comets away from colliding with Earth. Choose a comet whose orbit is convenient. You have 150 to choose from. You push some comet pieces into an orbit that hits the killer object. It moves out of the way.

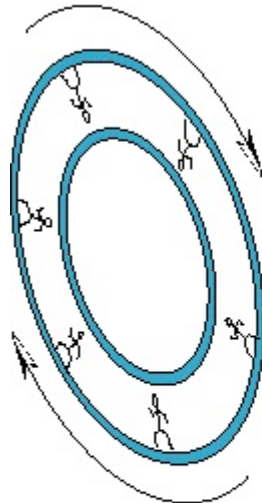
That's nice, but no cigar. There is no money in pushing killer asteroids in space, because there aren't any killers. We haven't found one yet that will kill the whole world. Anything less dangerous than that is not worth the effort. Pushing asteroids gets to be extremely expensive, compared to all the money in the world (about \$ 50 Trillion).



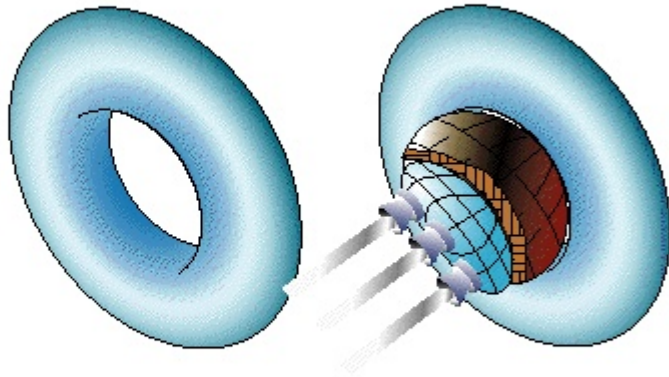
We can push megaton payloads in space using steam rockets. A megaton is about 10,000 times as heavy as a single Space Shuttle.

Steam rockets only work when going to the Moon, Mars and Jupiter. Everywhere else takes too much water. We get the water from the Jupiter family comets and near Earth asteroids.

"Ice Tire" Torus Space Ship



slowly spins
to give "gravity"

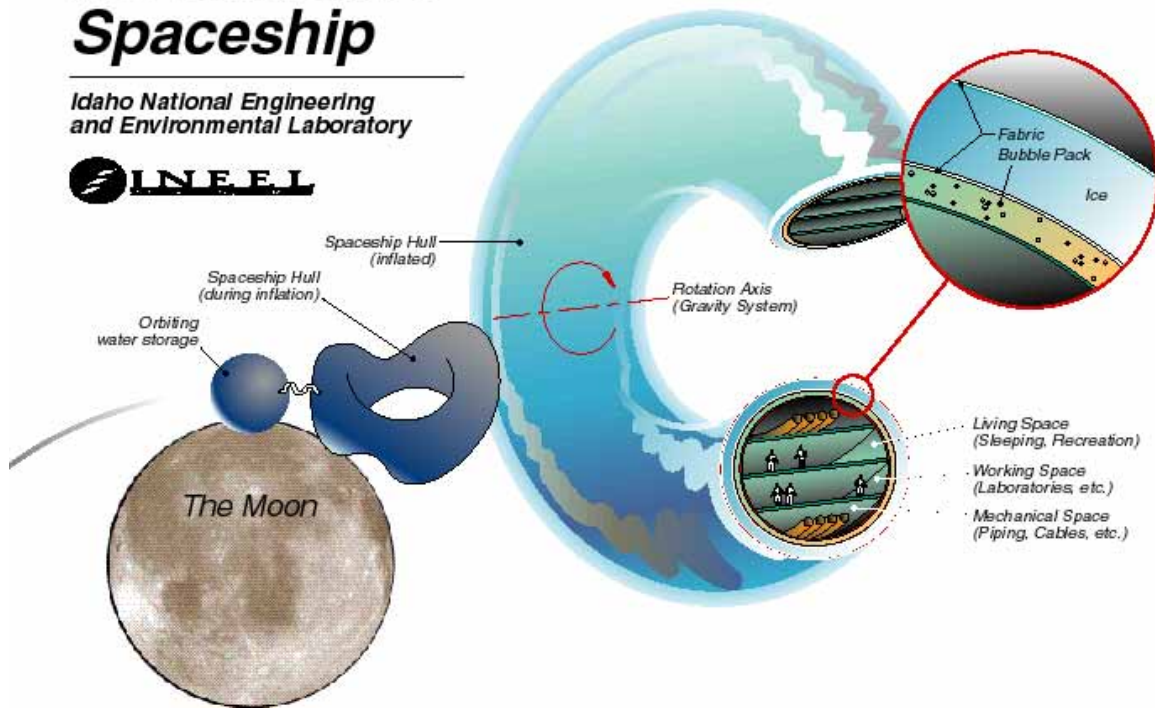


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The real surprise was founding out how to use water ice to make a spaceship, a big spaceship, an ice spaceship.

Ice Structure Spaceship

Idaho National Engineering
and Environmental Laboratory



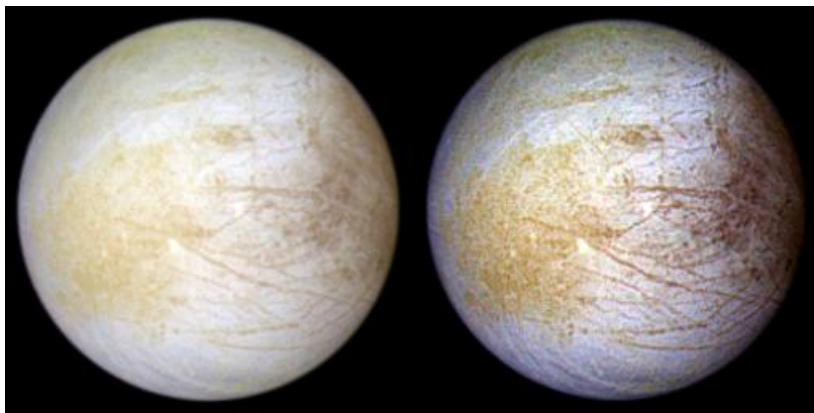
Just making a big ice cube into a space ship is not so amazing. The amazing part was that the ice was strong enough to let me spin the ship without it flying apart. Then I put the people on the inside. I could turn their gravity on and off. We die when we don't have gravity. I kept them from dying. Using ice was

simple.

The most useful discovery was finding out how to use the water and steam rockets and ice ships to travel on and off the ice moons of Jupiter. The moons of Jupiter are made of ice and rock.



Ganymede of Jupiter, ice moon



Europa of Jupiter, ice moon

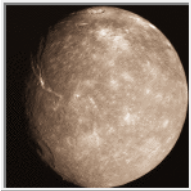


Callisto of Jupiter



The Moons of Jupiter, Ice moons

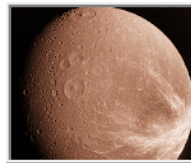
I could not believe it when the orbital mechanics worked out. I really could use steam as the propulsion. I did not have to split the water and make liquid hydrogen and liquid oxygen rocket fuel, for conventional propulsion. Steam rockets really are primitive. They make horrible rockets, terribly awful rockets, compared to the good nuclear rockets we tested 40 years ago. However, a simple steam rocket would propel a huge iceship between nearly all the water moons of any big gas giant planet.



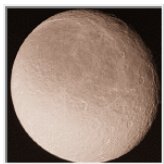
Titania of Saturn,



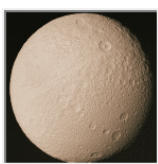
Miranda, Uranus



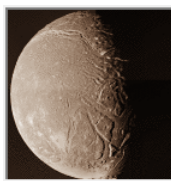
Dione



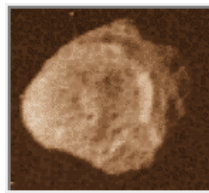
Rhea



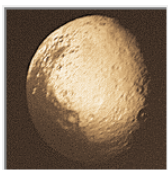
Tethys



Ariel Uranus,



Hyperion Saturn,



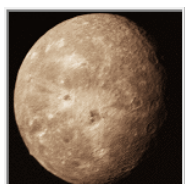
Iapetus Saturn, ,



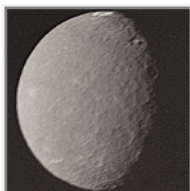
Enceladus Saturn,



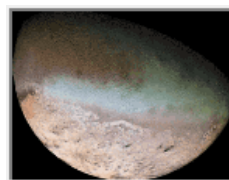
Janus Saturn,



Oberon Uranus,



Umbriel Uranus,



Triton of Neptune,

The moons of Jupiter, Saturn, Uranus and Neptune have nearly two dozen water ice moons among them.

I need to repeat this. I was overjoyed when I found that the orbital mechanics worked out to send an ice ship *between* the gas giant planets themselves, using steam rockets. We could travel from Jupiter to Saturn, from Saturn to Uranus, from Uranus to Neptune. We could travel between the gas giant planets.

I could take on as much water for the steam rocket as I wanted off the ice moons. The dozens of ice moons were accessible.

It meant we could occupy. We could own. We could stop at and make permanent space stations on at least dozens of the water moons of the Solar System.

All I want is to send prospector space ships to find and stake a claim on the water objects in space. We would cover them with our names and claims.

If we get the water in space, we can occupy New worlds, worlds of ice in space.

**We would Occupy,
not as visitors,
but as Victors.**