Power Rich Societies

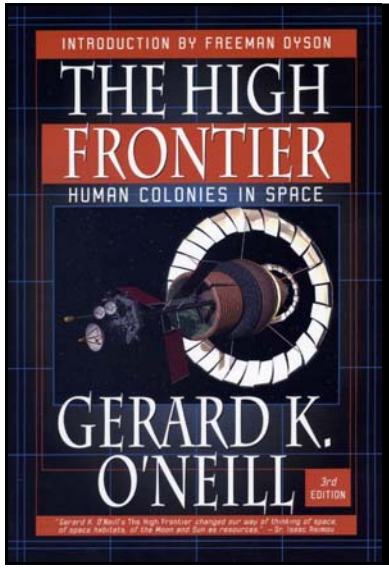
OLLI6

10/23/2009

Power Rich Societies

Power rich civilization must live in space

- They have to
- It is possible
- It may not be as expensive as we now perceive
- We don't need as much "stuff" as we imagine
- "Space" is the place for technology
  - ✓No "gravity"
  - ✓No corrosion
  - ✓No earthquakes, hurricanes, etc.



Two approaches to space colonization.

1.

Space colonies which offer a lifestyle rather similar to Earth.

What do we need to live permanently in space?

1. Gravity
2. Safety
3. Atmosphere
4. Water
5. Food
6. Stuff
7. Energy

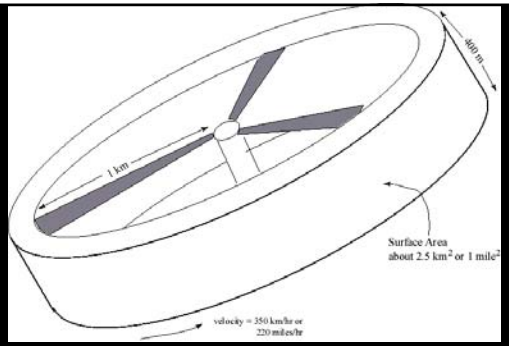
(1) Gravity

We have evolved 4 Gyr with gravity. We may now require it.

Problems with a zero-G environment:

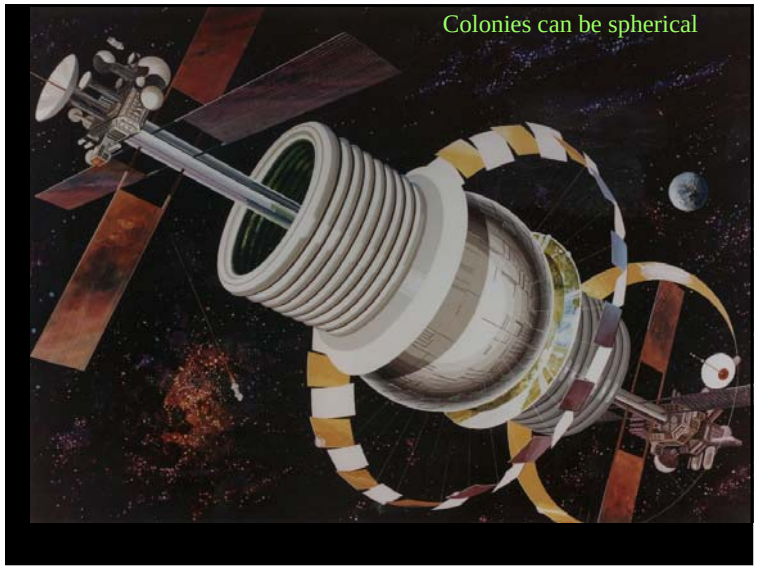
- Space sickness
  - ✓mixed messages about orientation
  - ✓For trained astronauts this is short term
- Fluid redistribution
  - ✓fluids to upper body
  - ✓plasma loss

- Muscle deterioration
  - ✓limbs heart
  - ✓Some changes at the cellular level
  - ✓Exercise only partially compensates
- Bone loss --- a major problem
  - ✓The body senses that the bones are no longer needed and dissolves them



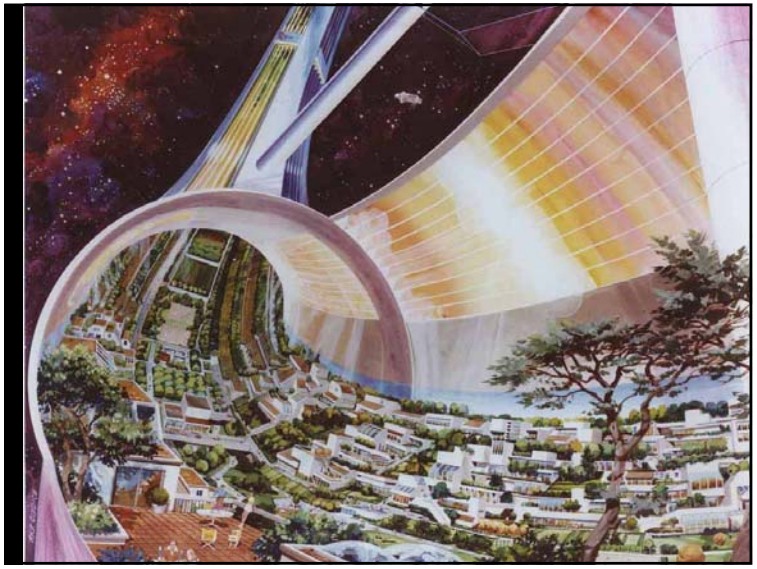
The requirement of normal gravity and slow rotation rate means that O'Neill colonies will be very big. With a reasonable height to radius ratio the interior area will be 2.5 km² ≈ 1 mile² ≈ 640 acres.

A population of 10,000 would not be at all excessive---indeed it would be comparable to the central grounds of UVa.


Colonies can be spherical


cylindrical

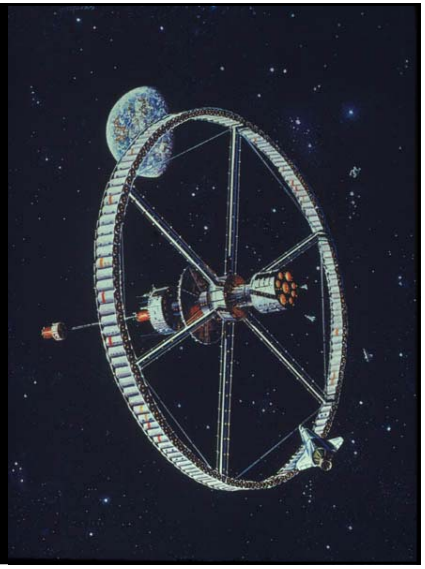

or toroidial

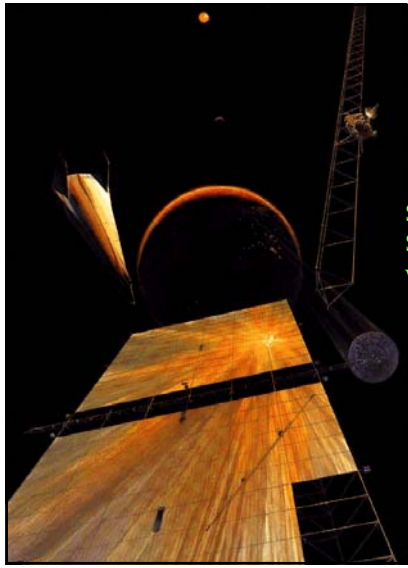


O'Neill Scenario

- Space Colonies with Earth-like environment
- Minimum radius 1 km; rotation at 1 rpm supplies 1 *g*
- Colonies manufactured in space using lunar raw material
- Raw material launched by electro-magnetic rail guns.
- Investment at a rate of $\$10^{10}$/year (1975). This was comparable to the annual capital investment the entire US electric power industry.
- Even including interest on borrowed money O'Neill argued that a profitable operation could emerge within a few decades.
- Main product is electric power.

An O'Neill size colony made of subunits

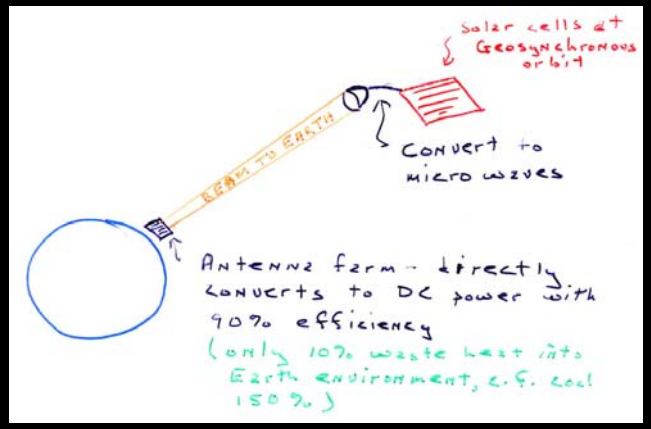




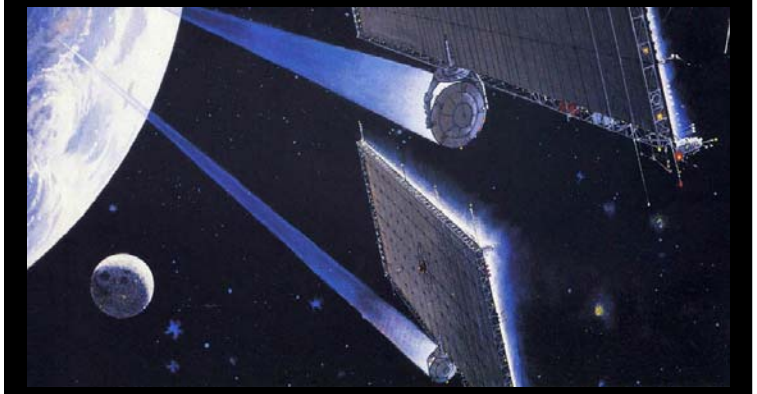
Solar Power Satellites

Solar Power Satellites or Satellite Solar Power Stations (SSPS) were an idea of Peter Glaser.

Solar Power Satellites



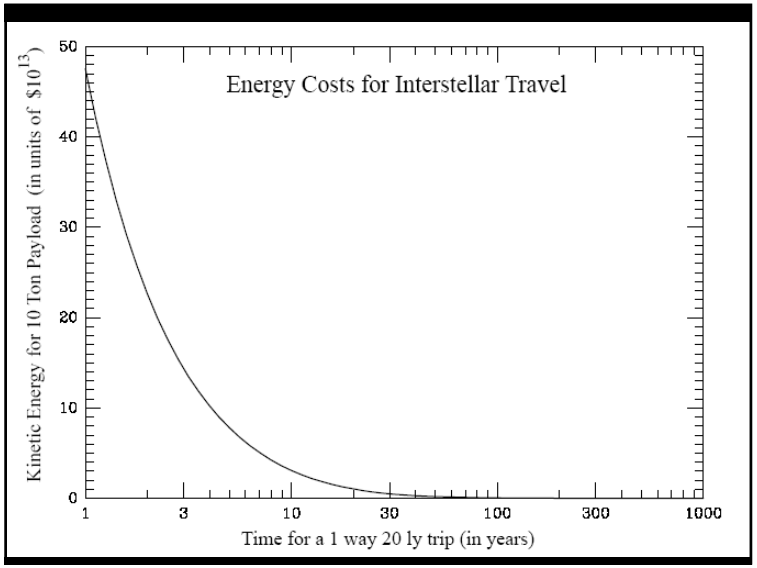
Solar Power Satellites

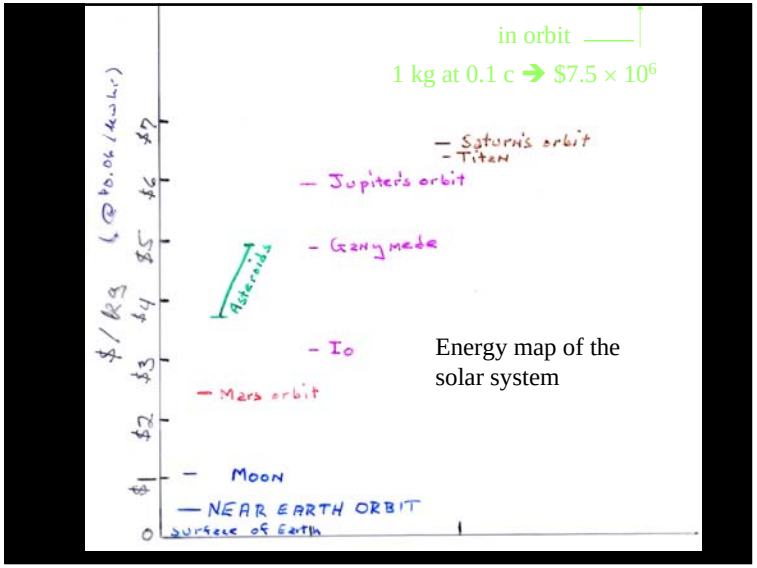


Problems with the O'Neill Scenario

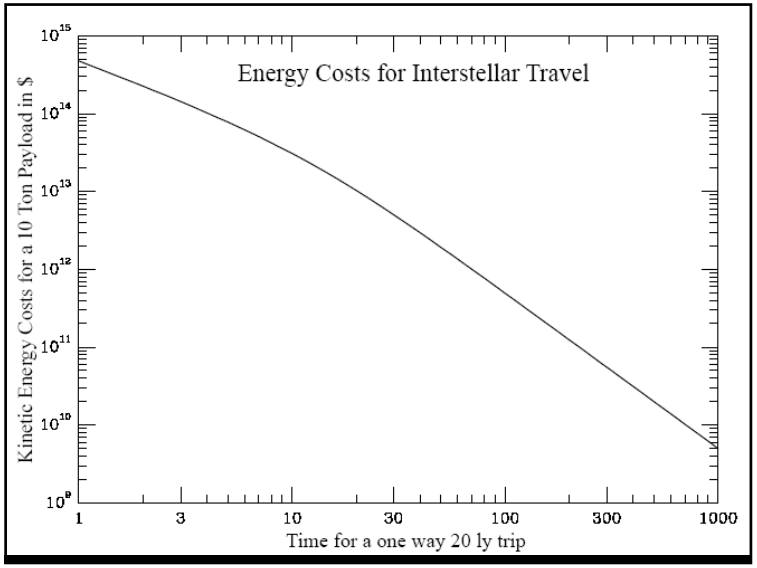
- Space development both more difficult and expensive than anticipated.
  - The Space Shuttle did not yield the great cost savings which were anticipated.
- In the 1980's and 90's there was a lack of urgency about power.
- In the 2000's the price of energy has soared but without the panic of the 70's
- No mechanism for funding
- O'Neill lost support because of his hypothetical tie-in with the population explosion.

Interstellar Travel





Energy map of the solar system



Why Interstellar Travel?

- It's very, very expensive
- One way multigenerational travel encapsulated in space seems very alien to us.

- The same multi twit civilizations that can afford to broadcast SETI beacons can afford IST.
  - The KE of a 0.1 c, 10^4 person space colony is
    KE = $3x10^5$ twit-sec = 0.01 twit-year

Since you've been listening to my OLLI lectures we've travelled ~ 40 million miles. Does that bother you?

- They spend all of their lives encapsulated in space anyway
- Why indulge in a pointless journey when you can go someplace?
- Would they passively let their civilization die along with their star?

Interstellar colonization at $v \approx 0.01\ c$

$\Rightarrow$ few centuries transit

$\Rightarrow$ If annual growth 6% (typical frontier society) 10^4 colonists become 10^{12} settlers in 300 years and conditions favor more colonization

$\Rightarrow$ wave of colonization

$$v_{wave} \sim \frac{\text{few pc}}{(\text{few 100 yrs} + \text{few 300 yrs})}$$

$$\sim 10^{-3} \text{ pc/yr}$$

- Time to colonize Galaxy ~ 3×10^7 yr
- The first technological civilization to embark on interstellar colonization gobbles entire Galaxy essentially instantaneously

So since they've colonized the entire Galaxy we should look for them at the closest suitable site for colonization.

Where is that?

They want a place with a stable long lived star and lots of asteroids.

They probably don't care one way or the other about earth-like planets.

Where is the closest such place?

It's here?

Where are they?

Fermi or Hart Paradox

- There should be ETI changing our asteroids into space colonies: *Where are they?*
- The significance of the absence of local ETI is most commonly referred to as the Fermi Paradox or the Hart paradox

1 January 00:00 Big Bang

1 January 23:00 Proto Milky Way has formed

2 January 00:00 Many generations of supernovae enrich the interstellar medium and some stars of solar abundance are forming

……

11 September Earth, Sun, and solar system form

1 January 00:00 the next year: Now

1 January 00:00 Big Bang

18 September Oceans exist and prebiotic organic molecules exist

14 October Stromatolites are forming (cyanobacteria have existed for sometime)

12 November Atmosphere becomes oxydizing

Late November First global scale glaciations

24 December First life moves to land

1 January 00:00 the next year: Now

1 January 00:00 Big Bang

26 December Atlantic ocean begins to open

29 December noon Large reptiles appear

30 December AM Warm blooded animals appear

30 December noon Dinosaurs get bashed

1 January 00:00 the next year: Now

1 January 00:00 Big Bang

31 December

14:00 First primates descend from trees

15:00 Alps form

22:00 Homo erectus appears

22:12 Periodic Milankovich glaciations start

23:57 Neanderthals in Europe

1 January 00:00 the next year: Now

1 January 00:00 Big Bang

31 December

23:59:20 Neanderthals extinct

23:59:38 Last glaciers retreat

23:59:50 Pyramids built

23:59:56 Christ born

23:59:57 Mohammed born

23:59:59 Newton born

1 January 00:00 the next year: Now

1 January 00:00 Big Bang

31 December

1 millisecond before midnight you enroll in ASTR342

1 January 00:00 the next year: Now

The cork pops

Before the cork hits the floor the first space colonies could easily be built

Before you take the first sip more people live in space than on the Earth

Before the party is over nearby stellar systems are colonized

Before the Rose Bowl game starts (18:00 EST) every suitable site site in the Milky Way has been colonized

1 January 00:00 Big Bang

8 September A million Earths start their paths toward civilization

9 September A million Earths start their paths toward civilization

10 September A million Earths start their paths toward civilization

11 September Earth, Sun, and solar system form along with a million other Earths (taking the optimistic view)

1 January 00:00 the next year: Now