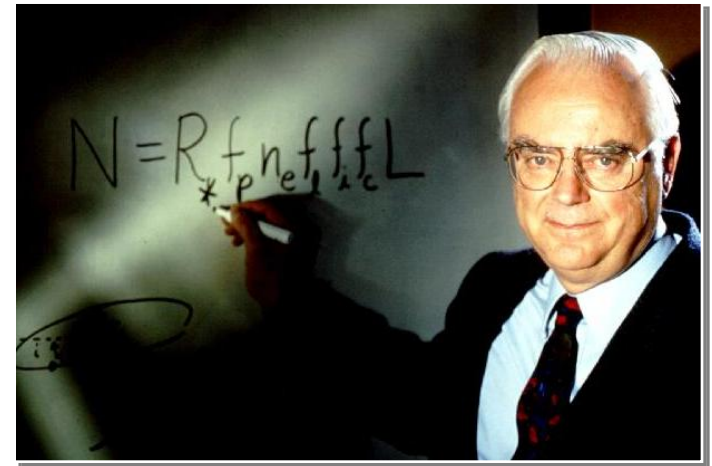


The Drake Equation



R_* average star formation rate (yr^{-1})

F_p fraction of stars with planets

N_e number of planets (per star) that could support life

F_l fraction of planets that could support life that develop life

F_i fraction of planets with life that develop intelligence

F_c fraction of intelligent species that develop IS communication

L lifetime of civilizations

$$N = R_* f_p n_e f_l f_i f_c L$$

Drake's estimates for the Drake Equation

- 5 R_* average star formation rate (yr^{-1})
- 0.5 F_p fraction of stars with planets
- 2 N_e number of planets (per star) that could support life
- 1 F_l fraction of planets that could support life that develop life
- 0.2 F_i fraction of planets with life that develop intelligence
- 1 F_c fraction of intelligent species that develop IS communication
- 10,000 L lifetime of civilizations

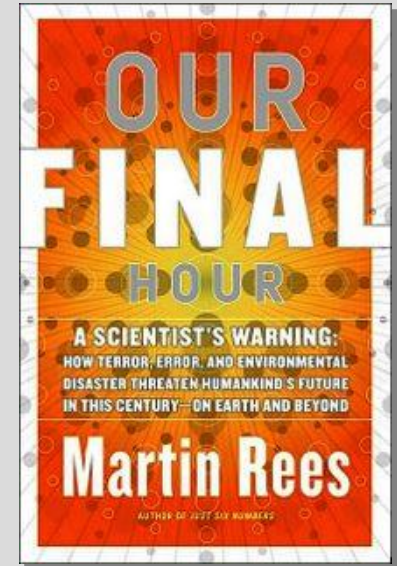
$$N = 10,000$$

$$10^4 / 3 \times 10^{11} = 30 \text{ ppb!}$$

Two extreme views of our future

A) ☹️ People (*or et equivalents*) are short-lived. As vermin of a planet, technologically savvy organisms do themselves in, in short order. Earth would be better off without us!

B) 😊 Technological species are the only hope for long term survival of advanced life on planets. People can divert asteroids- dolphins cannot. People can survive and terraform for billions of years until the Sun becomes a red giant!



Are we as bad as some of us think? Are we lem

The Voluntary Human Extinction Movement - VHEMT

What do humans do for the Earth's biosphere that isn't about humans?



QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

May we live long and die out
Voluntary Human Extinction Movement P.O. Box 86646 Portland OR 97286-0646

Thank you for not breeding
Voluntary Human Extinction Movement P.O. Box 86646 Portland OR 97286-0646

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Longevity of species

>99% of Earth's species are extinct

Most species last a few million years

Some last for $> 10^8$ years

How long can people last?

Will we be the last animal standing ?

Are we nearly extinction proof ?

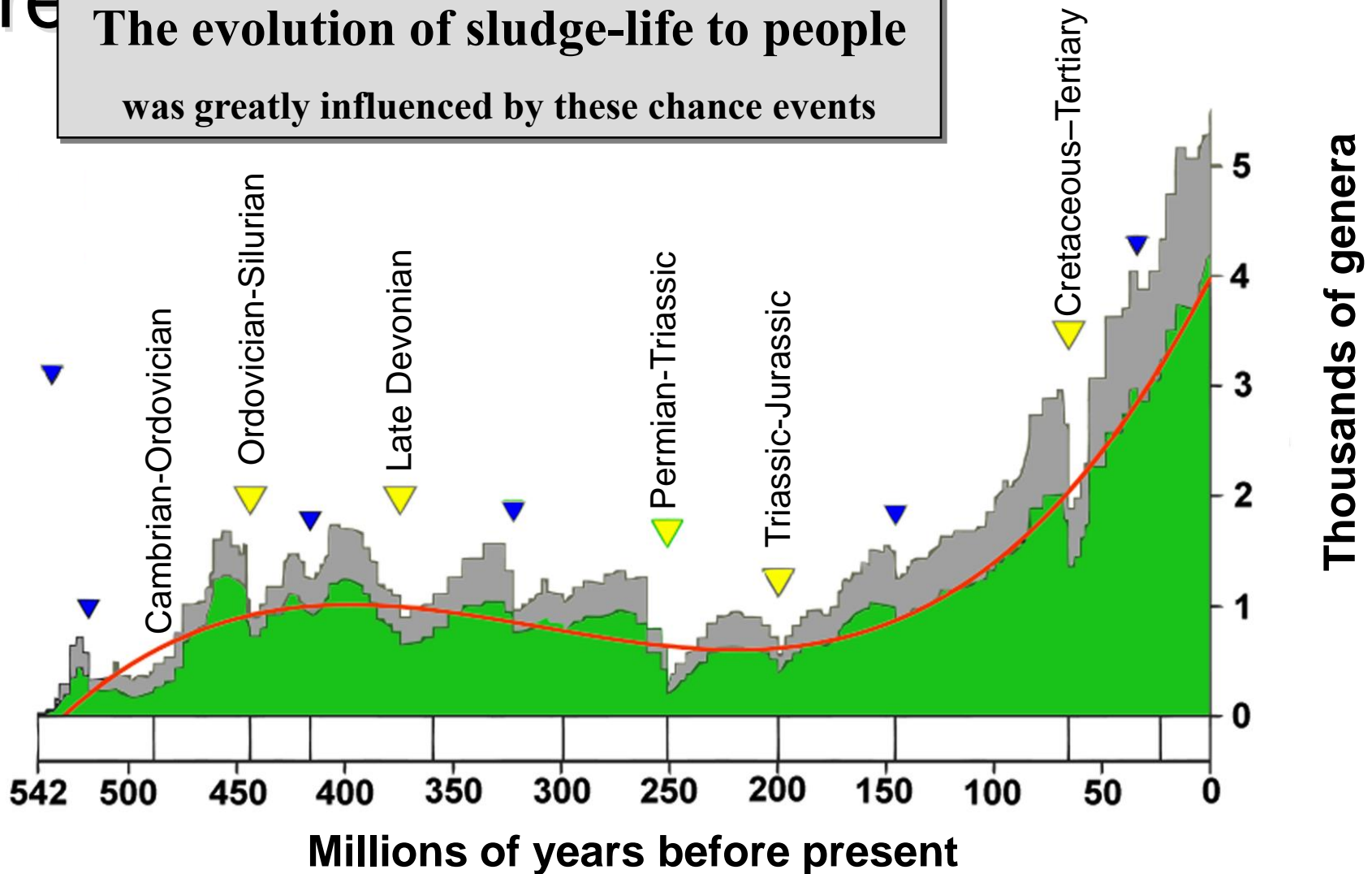
QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

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TIFF (LZW) decompressor
are needed to see this picture.

Sharks have lasted
100's of millions of years

Major mass extinctions in the fossil record

The evolution of sludge-life to people was greatly influenced by these chance events

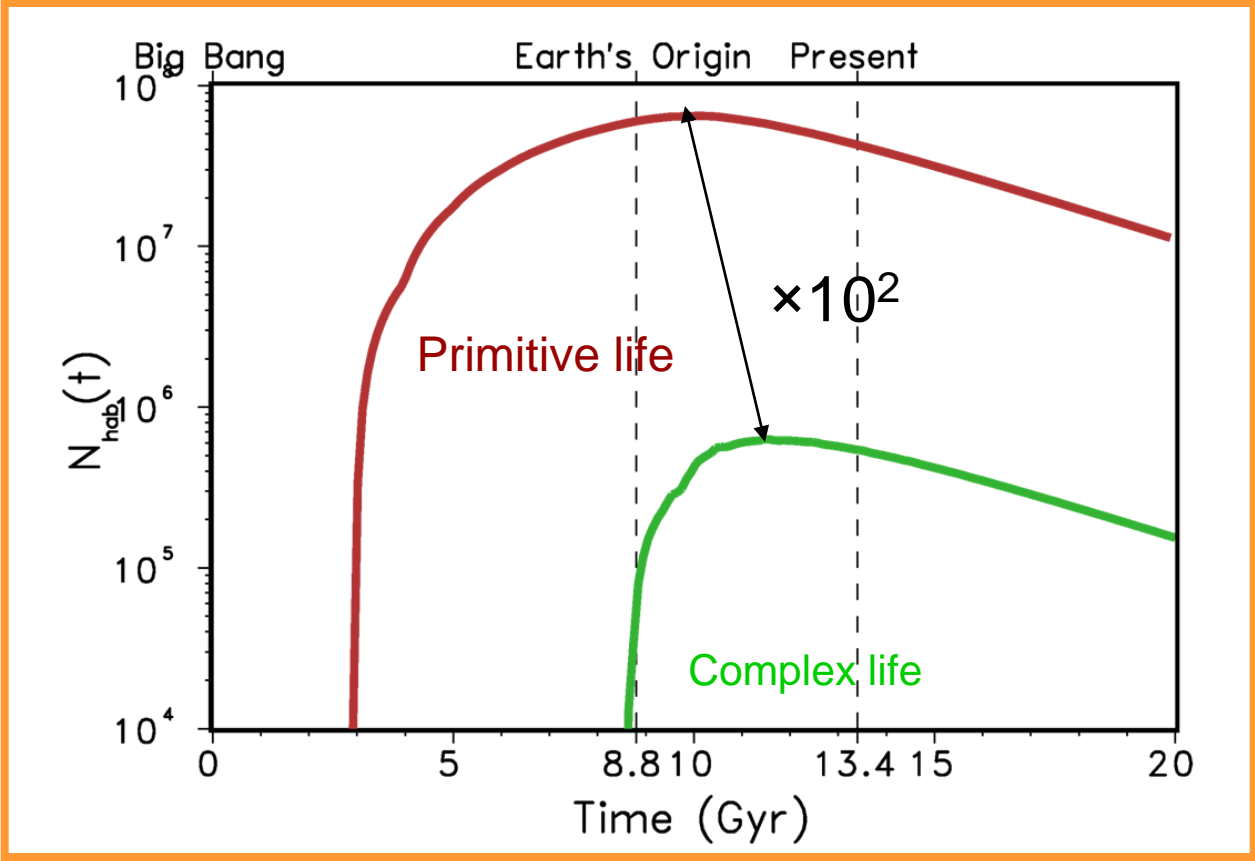


Long term threats to advanced life

- **Impacts**
- **Misc mass extinction events**
- **Loss of CO₂**
- **Loss of Oceans**
- **Red Giant Sun**

**Effects due to the increasing
brightness of the Sun
~10% per billion years
until the red giant phase**

Number of habitable planets



Without interdiction -
all intelligent life on planets will be done in by impacts



All planets are exposed to impacts!

**Earth has many intelligent species
Only humans have science and tec**



Events in Earth's Future

Next glacial cycle?

Return of Super-continent

Decline in CO₂

Devolution

Mass extinctions

End of plants & animals

Loss of oceans

Merge with M31

Red Giant Sun

Lunar impact

Even if we can't prevent the loss of

CO₂ and the loss of the oceans

We can live in artificial environments

We already live in highly modified environments

A large, multi-faceted glass and steel structure, known as Biosphere II, is shown against a dramatic sky with orange and blue hues. The building has several large, pyramid-shaped sections and a central dome. It is surrounded by greenery and a small body of water in the foreground.

Biosphere II- Arizona

Humans have the potential to survive to see the re

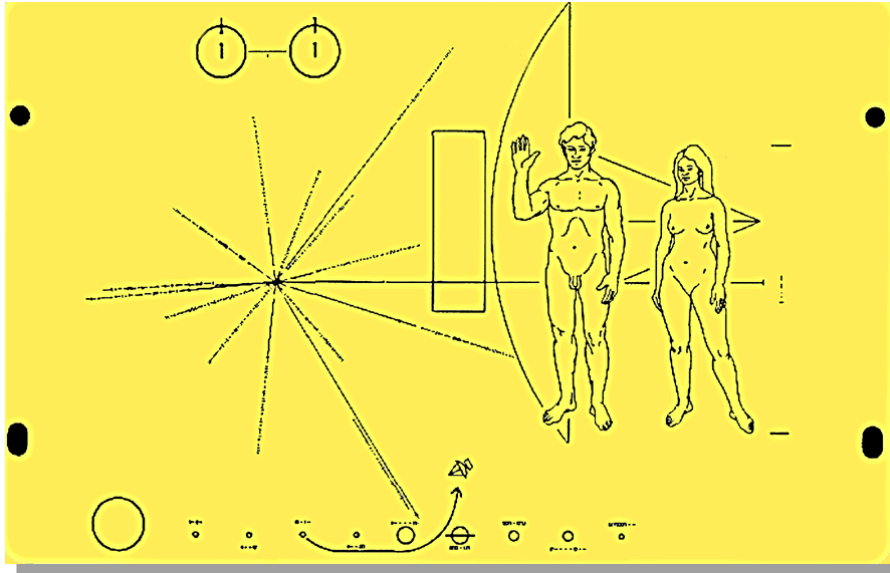
For good & bad

Humans control the fates of kilogram and larger land organisms

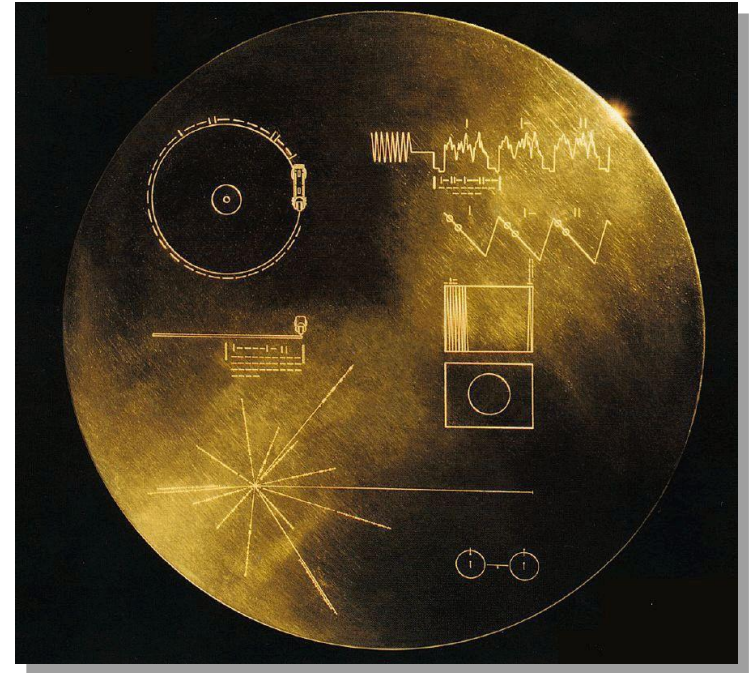


We are likely to control much of future life Alexis Rockman

Pioneer 10



Voyager



Stardust

QuickTime™ and a
GIF decompressor
are needed to see this picture.

Contact

