The Anthropic Phenomena

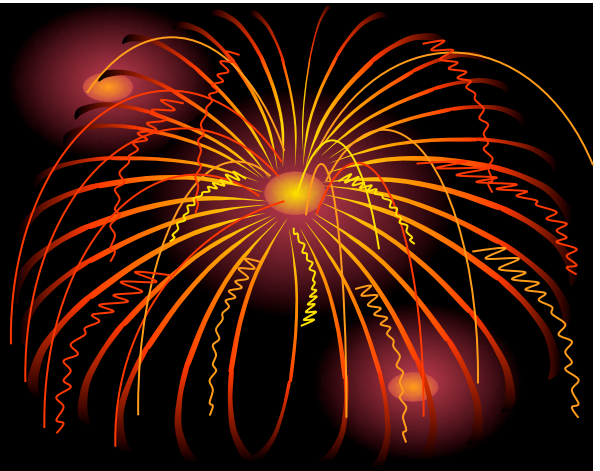
Design or Chance?

Robert C. Newman

What are these phenomena?

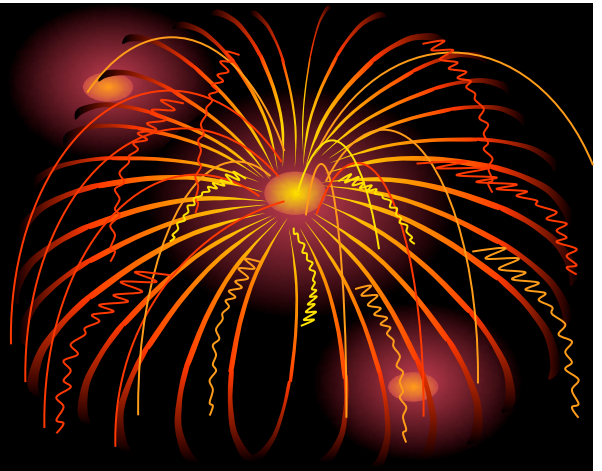
- Features in our physical universe that are:
  - Just right
  - Finely balanced
  - Finely tuned
  - Extremely good
- We will look at just a few examples here.

Water



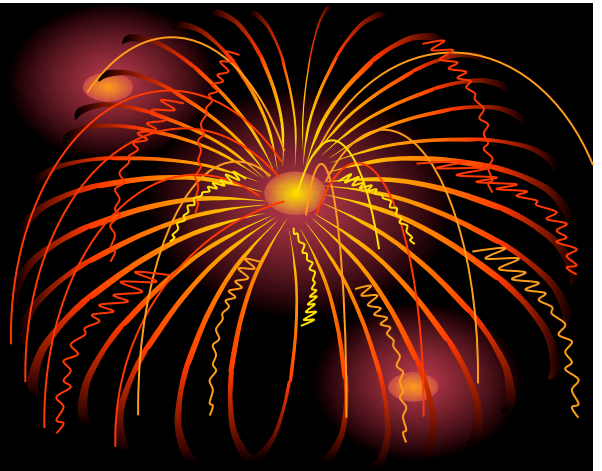
- See Barrow & Tipler, 524-541
- "one of the strangest substances known to science" (524)
- "most of its ... physical properties have values enormously higher or lower than those of any other known material" (524)
- Some of these features were already noted in *Bridgewater Treatises* (1830s) and in Henderson, *Fitness of the Environment* (1913)

Water



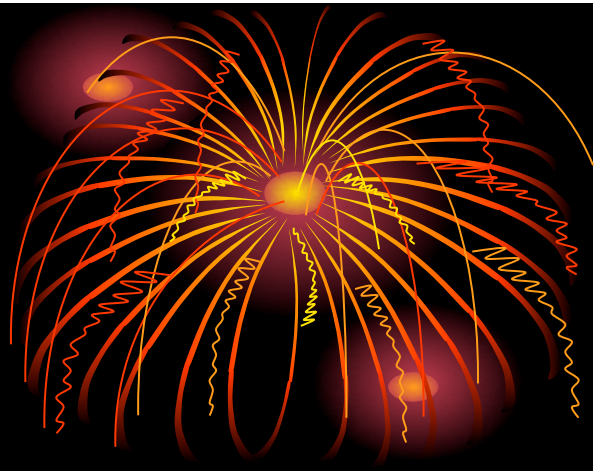
- Very high melting point, boiling point, heat of fusion (524-26)
- Heat of vaporization higher than any known substance (527)
- So best possible coolant by evaporation.

Water



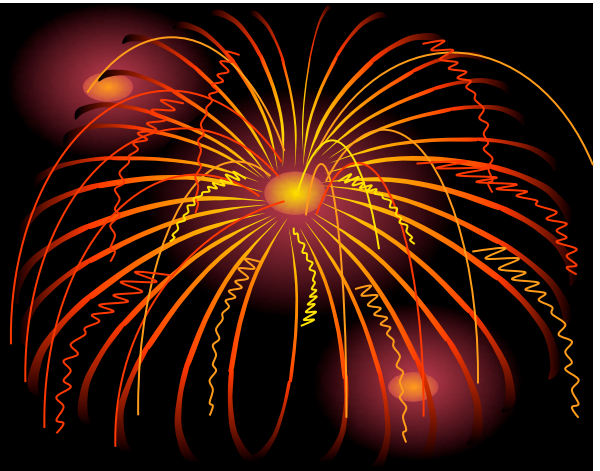
- Very high surface tension (537)
- High dielectric constant (537-38)
- So great solvent for polar molecules
- Water itself tends to ionize.

Water



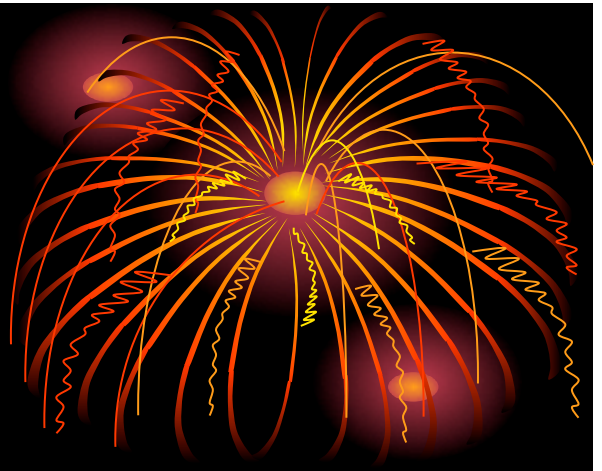
- Almost unique in having solid state lighter than liquid state (524, 533)
- So expands on freezing.
- Prevents freeze-up of lakes, rivers, oceans.
- Aids soil formation.

Water



- Higher specific heat than almost all organic compounds (ammonia is higher) (534)
- So functions very well as heat source or heat sink.
- Stabilizes temperature of environment.

Water



- These features perhaps boil down to three:
  - Hydrogen bonds (nature of H and O atoms)
  - Polar molecule
  - Angle between bonds

Other Life Elements

- Barrow & Tipler also discuss the anthropic significance of:
  - Hydrogen
  - Oxygen
  - Carbon
  - Nitrogen
  - Phosphorus
  - Sulfur

Electromagnetism & Gravity

- See Adair, *Great Design*, 321
- Both these forces are long-range, each decreasing as square of distance.
- E-m is enormously stronger than gravity, by some 37 powers of 10, yet gravity dominates on the astronomical size-scale.
- This allows hot suns & cool planets, and life as we know it.

Electromagnetism & Gravity

- Why does gravity dominate, when so much weaker?
- It has only attractive force, mediated by mass, which is only positive.
- E-m has both attractive & repulsive force, mediated by charges, which are positive or negative; like charges repel, unlike attract.

Electromagnetism & Gravity

- Thus e-m force tends to cancel out, so long as there are equal numbers of + and – charges.
- But for e-m not to dominate, its charges must cancel out to much better than 1 part in 10^{37}, perhaps 1 part in 10^{40} or so.

Electromagnetism & Gravity

- It is not obvious why this should be so.
- Electrons are the main carriers of – charge and protons of + charge.
- Protons are nearly 2000 times more massive than electrons and so these froze out at very different times in the expansion of the universe.

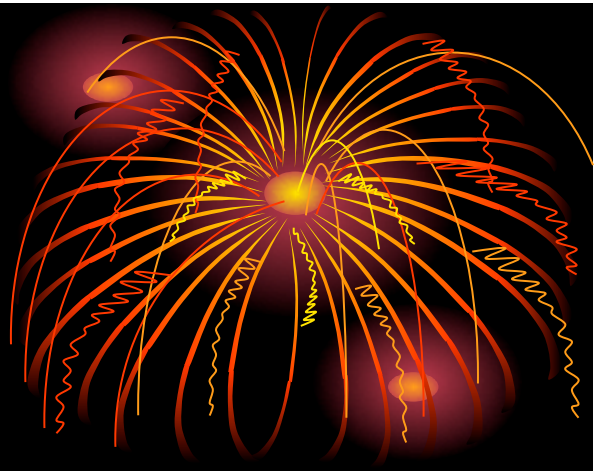
Anthropic Phenomena

- There are many more of these than we have sketched here.
- See:
  - Hugh Ross, *Creator and Cosmos*
  - PCW Davies, *Accidental Universe*
  - Barrow & Tipler, *Anthropic Cosmological Principle*

Anthropic Phenomena

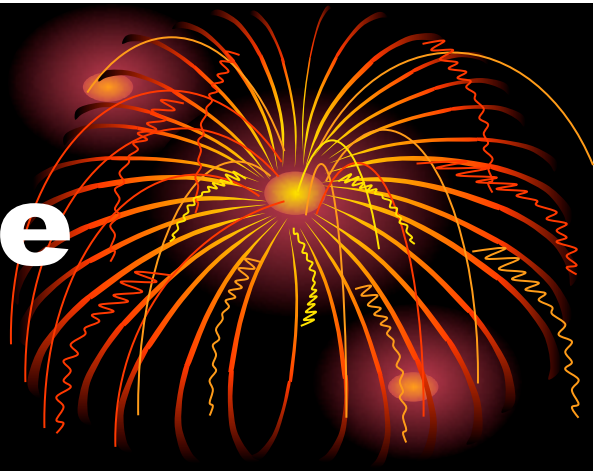
- These phenomena point strongly to a Designer for the universe.
- But this explanation is strongly resisted by those whose worldview does not include a Designer!

Attempts to Avoid a Designer



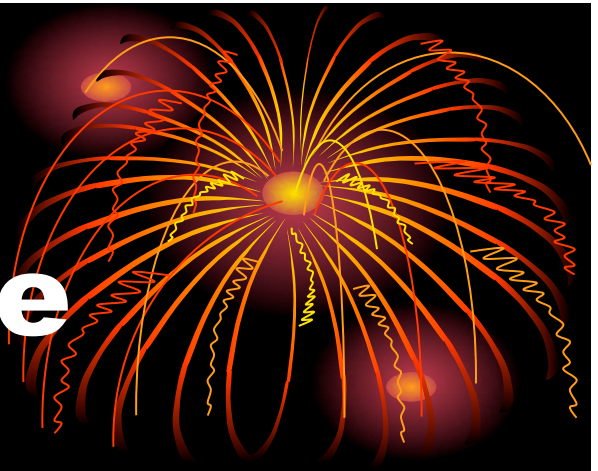
- See more detailed discussion in articles by Davis and Rhoda.
- These attempts are usually some form or other of the "Anthropic Principle."

Anthropic Principle



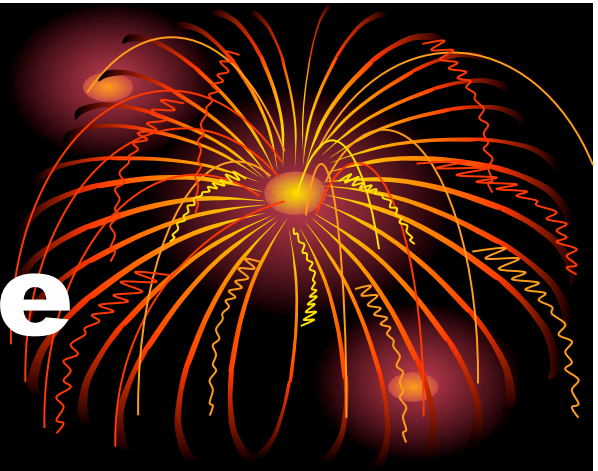
- The universe is the way it is because of humans.
- Strong Anthropic Principle
- Weak Anthropic Principle

Strong Anthropic Principle



- Mankind caused the universe to be the way it is so humans could arise! (Barrow, Wheeler)
- Either mankind is a manifestation of God (monism)…
- Or causes operate backward in time.
- Little reason to believe either of these without strong evidence.

Weak Anthropic Principle



- If the universe weren't the way it is, there would be no observers.
- Since there are observers, the universe must be sufficiently fine-tuned for them to exist!
- Duh! Is this an explanation?

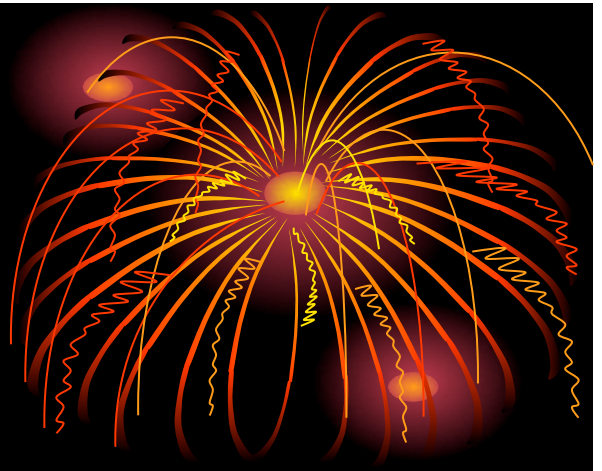
Selection Effect

- Apparent design is the result of selection; observers only exist in universes which are fine-tuned.
- But variables are so fine-tuned, it is an enormous surprise that there are any observers!
- Leslie's illustration of firing squad with 1000 marksmen…

Leslie's Illustration

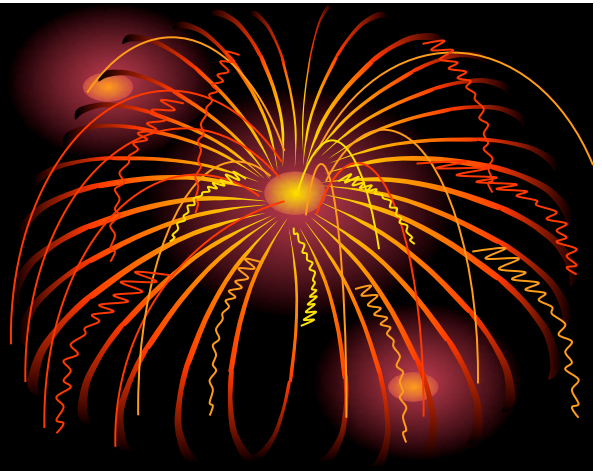
- You have been condemned to death. You are put before a squad of 1000 marksmen. They all fire.
- When the smoke clears, you are still alive!
- Well, if they hadn't missed you, you wouldn't still be here. What's the big deal?

Large Ensemble



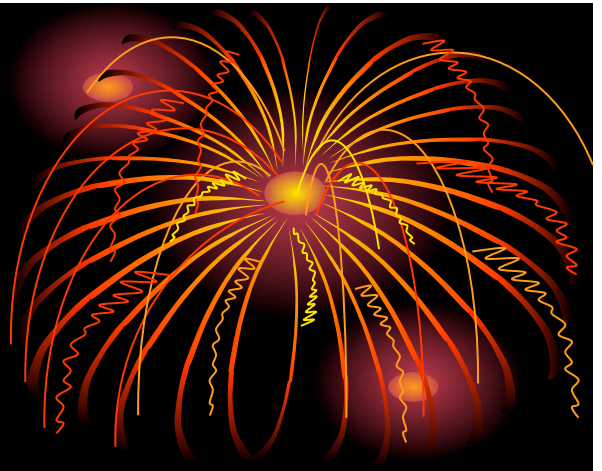
- Postulate a large number of universes to make observers reasonably probable:
  - Successive oscillations (Wheeler)
  - Quantum many-worlds (Everett)
  - Inflationary many-worlds (Leslie)
- But these all have problems.

Large Ensemble



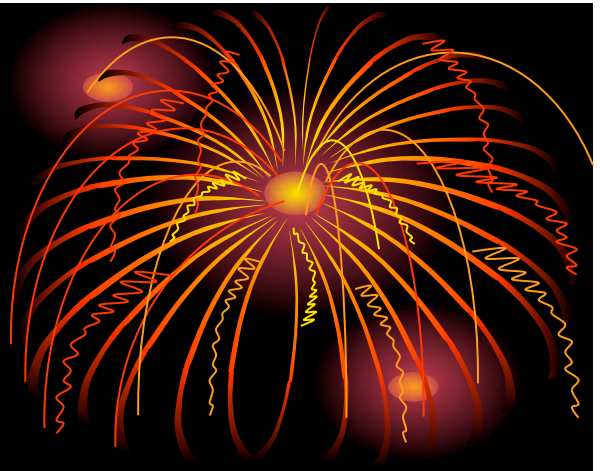
- Successive oscillations of universe won't work (Hawking).
- No evidence for quantum many-worlds.
- Inflationary many-worlds is possible, but the evidence for so many universes is not comparable to the evidence for God.

God?



- If God exists, the anthropic coincidences are not surprising.
- If he doesn't, even the need for so much fine-tuning is rather amazing, not to mention that we actually have it.

God



- Thus the "God model" naturally explains fine-tuning.
- The "no God model" must make huge assumptions to account for the anthropic phenomena.
- Doesn't this have some practical implications?

The End

Nature is telling us something very theological

Further Reading

- Adair, R.K. *The Great Design* (1987).
- Barrow & Tipler. *The Anthropic Cosmological Principle* (1986).
- Davies, P.C.W. *Accidental Universe* (1982).
- Davis, J.J. "Design Argument" (1988).
- Henderson, L.J. *The Fitness of the Environment* (1913).
- Rhoda, A.R. "Chance vs Design" (1993).
- Ross, H. *The Creator & the Cosmos* (1993).