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Intimations from Order of a Mind Behind the Universe

Introduction

How does one recognize an artifact?
    e.g., distinguish between natural chipped stones & humanly prepared flints?
How does one recognize an intelligent message?
    e.g., SETI – pulsars or little green men?
    Stone markings – inscriptions or plow marks?
Certainly there are difficult boundary cases, but basically the question is one of the level of order encountered.

Is Life an Artifact or an Accident? The Organization in Living Systems

Carl Sagan on the simplest living cell:

> "The information content of a simple cell has been estimated as around 10 to the 12th power bits, comparable to about a hundred million pages of the *Encyclopaedia Britannica*." (*EB* [1970], s.v., "Life")

The production of order by random processes:

> "Give enough monkeys enough time, and they will eventually type our the entire *Encyclopaedia Britannica*." (source unknown)

How much time? How many monkeys? A *Gedanken* experiment:

(1) Type the title only, all caps.
(2) Use monkey-proof typewriters, with 33 keys: alphabet, all caps; space; punctuation.
(3) Have trained monkeys to type, at 3 characters per second.
(4) Our "word" is 24 chacters long, with 33 possibilities at each location.
(5) How long to type all combinations, assuming no repeats?
(6) The job will take 3 x 10^{28} monkey-years. In the 15 billion years since the big bang, would need 2 x 10^{18} monkeys!

A sample calculation for protein construction: Molecules move faster than monkeys, but an analogous calculation can be done for constructing a simple protein from amino acids:

(1) Contruct the protein of 100 amino acids, about the smalles that is functional.
(2) We have about 20 different amino acids in living systems, so this is equivalent to typing a 100-letter word/phrase with a 20-letter alphabet.

http://www.newmanlib.ibri.org/Documents/Abstracts.htm

(3) Some simplifying assumptions:
   (a) The system only forms 100-link chains, never repeating the same pattern.
   (b) The chains change randomly at the rate an amino acid moves (say) 10 Angstroms at standard temperature, i.e, 3×10^{11} combinations per second.

(4) How long will it take to produce all combinations, assuming no repeats?
   Job = 10^{111} chain-years.

(5) Case #1: time (T_{ss}) to form all possibilities in our solar system:
   (a) Assume one amino acid for every nitrogen atom in the solar system.
   (b) Relative abundance of N = 1.2×10^{-4}.
   (c) $T_{ss} = 10^{61}$ years.

(6) Case #2: time (T_{gal}) to form all possibilities in our galaxy:
   (a) Number of stars in our galaxy = 10^{11}.
   (b) $T_{gal} = 10^{50}$ years.

(7) Case #3: time (T_{hr}) to form within Hubble radius:
   (a) Density of galaxies = 1 per 500 Kiloparsec.
   (b) H = 75 Km/sec/Mpc.
   (c) $T_{hr} = 10^{37}$ years.
   (d) Fraction formed since big bang = 3×10^{-28}.

Is the Universe an Artifact or Accident? The Organization in the Universe

Nuclei: C^{12} is crucial to life in forming long chain molecules.

Formation in stars: a rare thee-He collision, but thermal energy in stars is right at the C^{12} resonance!

Destruction in stars: C + He => O, but the thermal energy in stars is above the O^{16} resonance, so C^{12} is preserved (according to Hoyle; see Davies, *Accidental Universe*, 117-18).

This produces a bottleneck, giving a large abundance of C in the universe.

Molecules: water (see Hayward, *God Is*, 59-61)

Very small molecule (weight 18 vs N_2 at 28, O_2 at 32), yet it is luquid at temperatures suitable for life due to polymerization (2x or 3x), so able to work as liquid in chemical reactions for life processes; but gaseous state is not polymeric, so behaves as lighter than air gas, not hugging surface and stifling life. No other substance has this property.

Universal solvent: carries solid chemicals in blood stream, plant sap, and in fluid within the cell; other comparable solvents are desctuctive to living tissue.

High heat capacity: moderates earth's climate, stabilizes body temperatures.

Expands on freezing: a very rare property; prevents ocean freeze-up, aids soil formation.

Earth-Sun System

Sun:

Lifetime over 4 billion years:

Only true if $M_* < 1.2\ M_{sun}$

Enough UV for life (say 10% of sun's):

Only ture if $M_* > 0.8\ M_{sun}$

Probably need a single-star system to form planets.

Star cannot have too much luminosity variation

Even sun's L has risen 25% over past 4 billion years.

Earth:

Need enough atmosphere for life:

Only true if $M_{planet} > .25\ M_{earth}$.

Must not have so much for massive greenhouse effect:

Only true if $M_{planet} < 2.0\ M_{earth}$.

While L_{sun} was increasing 25%, CO_2 replaced by O_2 in just such a way that T_{earth} stayed in life-support range.

Meanwhile, the right kinds of changes were taking place in life in order to be able to cope with the rising O_2 in the atmosphere.

Putting these features together, we get a very narrow window for survival of life on earth over 4 billion years:

(1) If earth 5% nearer sun, then runaway greenhouse effect near the beginning of the period.

(2) If earth 1% farther from sun, then runaway glaciation at about 2 billion years

(see Michael Hart, *Icarus* 37 [1979]: 351-57)

Suggest about 1 star in 10^5 to 10^7 would fit these constraints; so only about 20 thousand to 2 million in our galaxy.

Universe

There is a delicate balance of forces for element formation:

(1) $m_{neutron} - m_{proton} = 10^{-3} \times m_{proton} = m_{electron}$; together with relative sizes of G (gravity) and g_{weak}, this means neutrons and protons "freeze out" in the early universe with comparable numbers of each, instead of nearly all n or all p (actually, about 1/10 are n, 9/10 are p).

(a) If abundance of n about equal abundance of p, little H formed.

(b) If abund n << abund p, little He formed.

(2) If g_{weak} much smaller, no supernovas, as neutrinos would not interact with and explode the outer shell of the star, to scatter heavy elements; if g_{weak} much stronger, no supernovas, as neutrionos could not escape core of star to scatter heavy elements; thus if g_{weak} much different, no heavy elements (including C, N, O) outside cores of stars, so no life, no people.

(3) If g_{strong} much weaker, fewer stable elements:
If g_{strong} 50% less, Fe, C, etc. unstable
If g_{strong} 5% less, Deuterium would not exist, and stars would not burn.
If g_{strong} a few % larger, diproton would be stable, p + p => D would go by the strong force, and stars would burn catastrophically.

There is a delicate balance of cosmic expansion and gravity:
The current matter density of the universe is between 1/10 and 10 times the critical density.
This means that at the Planck time (10^{-43} sec after the big bang), the matter density differed from the critical density by less than one part in 10^{60}.
(1) If the density were much larger than this, the universe would have quickly collapsed, and there would be no life.
(2) If the density were much smaller than this, the universe would have expanded too quickly to form galaxies; again, no life.

Conclusions

We have only given a few examples here. More are given in P. C. W. Davies, *The Accidental Universe* (Cambridge, 1982) and Alan Hayward, *God Is* (Nelson, 1978).
How do we explain these things?
(1) Chance? => Weak Anthropic Principle
No matter how unlikely the chances, if the universe couldn't support life, we wouldn't be here to observe it. Improbability is therefore selected by the presence of intelligent obervers. Therefore, it is necessary that the universe we observe be able to support intelligent life.
It is hard to argue with this position, but it is not much of an explanation. Like an old-time interviewed on his 100th birthday: "To what do you attribute your longevity?" "Well, if I weren't still here, I wouldn't have it!"
It this explanation falsifiable? What would count against such a view, other than divine revelation?
Is there any evidence for other universes (whether sequential or contemporary) to raise the probability?
The rarity of events calculated above goes far beyond the experimental basis of reandomness; compare this to the idea of ice forming in a pan on a hot stove, or all the air moving to one end of a room.
(2) Intelligent Universe? => Strong Anthropic Principle
Somehow the universe itself guides the values of the relevant parameters in order to produce (intelligent) life.
Is there any evidence for this?

(3) God?

A mind is behind the universe, not itself a part of that universe.