

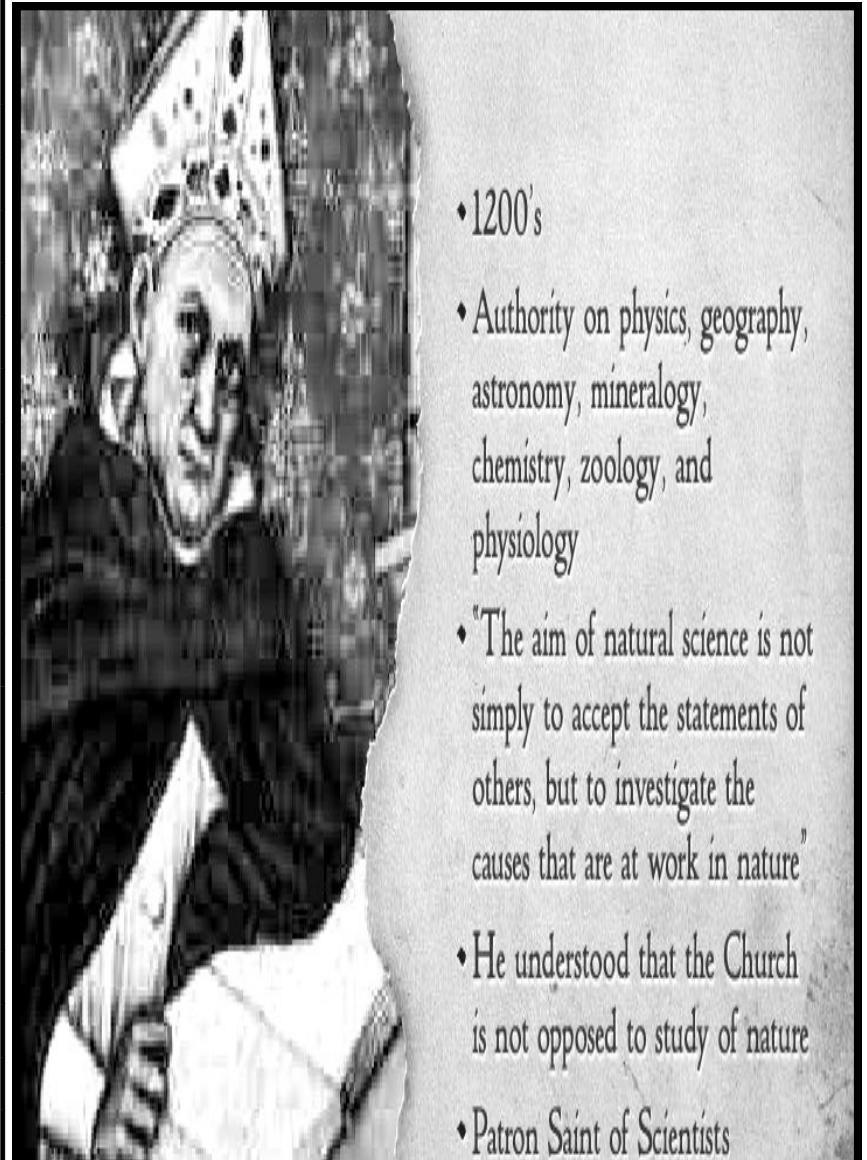
The philosophic/metaphysical context for these Anthropic conditions that Ellis sets forth will be given in the final post for this summary. It should be noted that one interpretation of the anthropic coincidences is the theory that infinitely many universes with potentially different physical laws and constants exist and so it is not unlikely that in all these one universe with appropriate conditions for life would be present. The analogy is like that of having a lottery ticket with the numbers 1 1 1 1 1 be the winner. That combination of numbers looks improbable, but since there are a whole host of numbers from 00000 to 99999, it is no less probable than any other number. This brings up the notion of a multiverse, which will be discussed in the next post. (See Part 33)

From a series of articles written by: Bob Kurland - a Catholic Scientist



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## ***Catholic Physics - Reflections of a Catholic Scientist - Part 32 Philosophic Issues in Cosmology 6: Are we special?--the Anthropic Coincidences***



- ♦ 1200's
- ♦ Authority on physics, geography, astronomy, mineralogy, chemistry, zoology, and physiology
- ♦ "The aim of natural science is not simply to accept the statements of others, but to investigate the causes that are at work in nature"
- ♦ He understood that the Church is not opposed to study of nature
- ♦ Patron Saint of Scientists

# Philosophic Issues in Cosmology 6: Are we special?--the Anthropic Coincidences

"Scientists are slowly waking up to an inconvenient truth - the universe looks suspiciously like a fix. The issue concerns the very laws of nature themselves. For 40 years, physicists and cosmologists have been quietly collecting examples of all too convenient "coincidences" and special features in the underlying laws of the universe that seem to be necessary in order for life, and hence conscious beings, to exist." Paul Davies.

" The argument (the Anthropic Principle) can be used to explain why the conditions happen to be just right for the existence of (intelligent) life on the earth at the present time. For if they were not just right, then we should not have found ourselves to be here now, but somewhere else, at some other appropriate time." Roger Penrose.

"One doesn't show that something doesn't require explanation by pointing out that it is a condition of one's existence. If I ask for an explanation of the fact that the air pressure in the transcontinental jet is close to that at sea level, it is no answer to point out that if it weren't, I'd be dead." Thomas Nagel, Mind and Cosmos.

"A common sense interpretation of the facts suggests that a super-intellect has monkeyed with physics, as well as with chemistry and biology, and that there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me so overwhelming as to put this conclusion almost beyond question." Fred Hoyle

This is the 6th in a series of posts summarizing an article by George F.R. Ellis on Philosophic Issues in Cosmology.

Robert Koons summarizes some general objections to invoking the Anthropic Principle for carbon-based life "well isn't that special" (as the Church Lady might say):

The problem of "old evidence";

Laws of nature don't need to be explained;

We had to be here in any event (see Penrose's quote above);

Exotic life might exist;

The Copernican Principle--rejection of anthropocentricity is fundamental to science;

We're only one among many universes (see below).

Objection 1 can be countered by the argument that such evidence is used frequently in science when direct experiments can't be done--witness the General Relativity explanation of the advance in the perihelion of Mercury.

Objection 2 would do away with all interpretations of theory, quantum mechanics, and the philosophy of science.

Objection 3 is countered as in Thomas Nagel's quote above; as information seeking life form we need explanations.

Objection 4 is invalid--we're talking about conditions for carbon-based life; science-fiction can explore and has explored conditions for exotic life.

Objection 5--the Anthropic Principle was introduced to rebut the Copernican Principle.

Objection 6--the multiverse proposition is not itself proven.

The existence of the arrow of time, and of laws like the second law of thermodynamics, are probably necessary for evolution and for consciousness. This depends on boundary conditions at the beginning and end of the Universe.

Presumably the emergence of a classical era out of a quantum state is required. The very early universe would be a domain where quantum physics would dominate leading to complete uncertainty and an inability to predict the consequence of any initial situation; we need this to evolve to a state where classical physics leads to the properties of regularity and predictability that allow order to emerge.

The fact that the night sky is dark...is a consequence of the expansion of the universe together with the photon (light particle) to baryon (mass particle) ratio. This feature is a necessary condition for the existence of life: the biosphere on Earth functions by disposing of waste energy to the heat sink of the dark night sky. Thus one way of explaining why the sky is observed to be dark at night is that if this were not so, we would not be here to observe it.

Physical conditions on planets must be in a quasi-equilibrium state for long enough to allow the delicate balances that enable our existence, through the very slow process of evolution, to be fulfilled." (see the Theology of Water.)

There are a number of other constraints, limited values for forces—gravity, electromagnetic, weak nuclear, strong nuclear—and fundamental constants, including that for particle masses and number of particles that are needed for life to evolve. In summary, Ellis puts the Anthropic Principle as the following:

“Life is possible because both the laws of physics and the boundary conditions for the universe have a very special nature. Only particular laws of physics, and particular initial conditions in the Universe, allow the existence of intelligent life of the kind we know. No evolutionary process whatever is possible for any kind of life if these laws and conditions do not have this restricted form.”

The 10,000 dials and 10,000 monkeys analogy

The presence of organic life in the universe (namely us) requires a series of unlikely happenings and restricted values for physical laws and constants. This “fine-tuning” (as it's been called) has been likened to a room full of 10,000 dials, each of which has to be set to a precise setting in order to achieve action; 10,000 monkeys are let into the room and each adjusts a dial and, lo, action occurs. The set of coincidences was termed “The Anthropic Principle” by Brandon Carter in 1973, when he introduced it in a conference to oppose the “Copernican Principle”, that man has no special place in the universe.

References

The Anthropic Principle has been discussed extensively in books and articles. There is a concise summary by Robert Koons in his philosophy lectures, giving various interpretations, with arguments for and against each. (I'll summarize some of these below.) A good collection of articles with different (and opposing views) of the Anthropic Principle is given in *God and Design* (ed. Neil Manson). There are many versions of the Anthropic Principle ranging from the Weak Anthropic Principle, WAP, which tautologically observes that if the universe weren't fit for us to be here we wouldn't be here discussing the principle (see the Penrose quote above), through the Strong Anthropic Principle, SAP, that the universe has been fine-tuned for intelligent life (us), on up to the Completely Ridiculous Anthropic Principle (by Martin Gardner—you complete the acronym).

Can unlikely be quantified?

In assessing the improbable nature of the anthropic coincidences, some authors assign a specific probability to the value of some particular physical constant. Such assignment is not always justified, because probability considerations are ill defined, in the usual sense of evidential probability. For example, theoretical calculations have shown that if the strong nuclear force were 2 % higher or 2 % lower, then the elements as we know them would not have been formed. This does not mean that the probability of having the strong nuclear force at an anthropic value is 4%. In order to give a probability for this range, the population distribution of the parameters for the strong nuclear force would have to be known. Moreover, there is a difficulty in using probability in an after-the-fact, rather than a predictive sense. The way to use probabilities in assessing the anthropic coincidences is via Bayesian probability techniques, with well-defined prior assumptions, and to use the resulting Bayesian probability as a measure of belief.

Ellis's interpretation

Ellis, in his presentation of the anthropic coincidences, focuses on the special nature of physical laws that allow for the presence of life, rather than on their improbability:

“One of the most profound issues in cosmology is the Anthropic question...why does the Universe has the very special nature required in order that life can exist? The point is that a great deal of “fine tuning” is required in order that life be possible. There are many relationships embedded in physical laws that are not explained by physics, but are required for life to be possible; in particular various fundamental constants are highly constrained in their values if life as we know it is to exist...What requires explanation is why the laws of physics are such as to allow this complex functionality (life) to work. ...We can conceive of universes where the laws of physics (and so of chemistry) were different than in ours. Almost any change in these laws will prevent life as we know it from functioning.”

Ellis posits as a first requirement for the laws of physics “the kind of regularities that can underlie the existence of life”: laws that are not based on symmetry and variational principles are unlikely to produce the kind of complexity that would be required for life. He also sets up general conditions that allow for organic life and cosmological boundary/initial conditions. In this respect he cites the following as necessary:

“Quantization that stabilizes matter and allows chemistry to exist through the Pauli exclusion principle;

The number D of large spatial dimensions must be just 3 for complexity to exist.

The seeds in the early universe for fluctuations (quantum fluctuations) that will later grow into galaxies must be of the right size that structures form without collapsing into black holes...

The size of the universe and its age must be large enough...we need a sufficiently old universe for second generation stars to come into existence and then for planets to have a stable life for long enough that evolution could lead to the emergence of intelligent life. Thus the universe must be at about 15 billion years old for life to exist.

There must be non-interference with local systems. The concept of locality is fundamental, allowing local systems to function effectively independently of the detailed structure of the rest of the Universe. We need the universe and the galaxies in it to be largely empty, and gravitational waves and tidal forces to be weak enough, so that local systems can function in a largely isolated way.