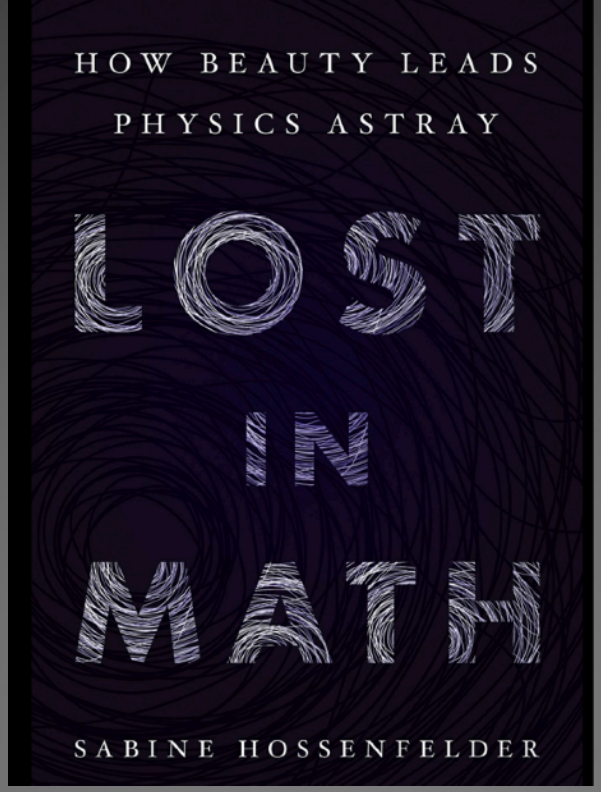

A Book on Biases of Physics

Alexey Burov, FSP, Mar 29, 2019

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Moira and Eileithyia for Genesis on the laws

First, the laws are endowed with a peculiar mathematical beauty, uniting in themselves formal simplicity, richness of solutions and one or another kind of symmetry, often as if suggesting itself as a hypothesis to a mind gifted with intuition. This special beauty is sometimes called elegance of the laws of nature. Thus, elegance has a decisive significance to a birth of a hypothesis, the most mysterious part of discovery.

Secondly, the same elegant mathematical law captures a tremendous range of parameters (distances, time intervals, energies, etc.), at that with a fantastic precision, up to twelve digits. This quality of the laws can be called universality.

Finally, the laws happen to be friendly to life's appearing and developing up to intellect; following the established terminology, this quality can be called anthropic.

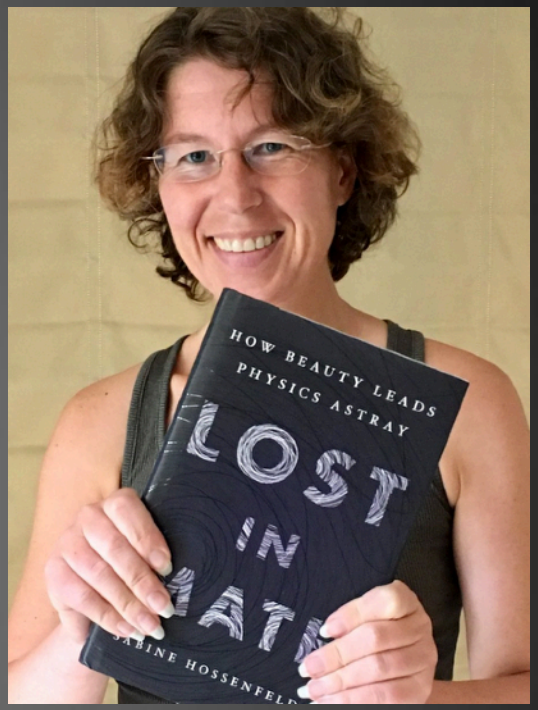
The combined presence of these three qualities allowed for their discovery by great minds, and for that reason, it seems that the most appropriate term, uniting all three, is discoverability. A universe whose laws satisfy the Discoverability Principle (DP) of being *elegant, universal and anthropic* we suggested to call Pythagorean.

It could be even that the laws of our universe constitute the simplest possible set, compatible with the DP. The only so far available explanation of this amazing quality of the laws is that they come from the highest mind that created our universe able to not only be inhabited by intelligent beings but cosmically cognized by them.

A.&L. Burov, https://pythagoreanuniverse.com/

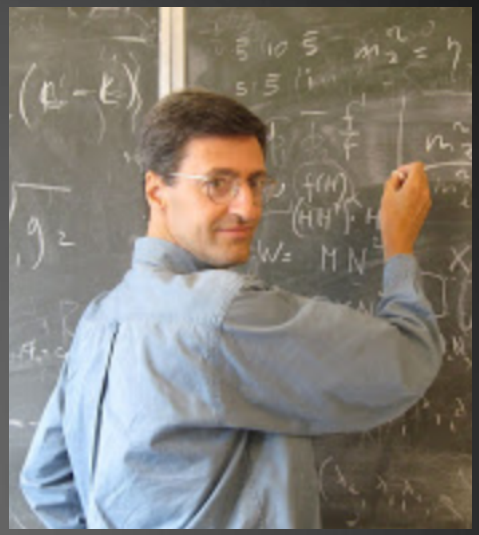
From the Preface to LiM

…The experiments didn't reveal anything new [anything fundamental predicted within last 40 years]. What failed physicists wasn't their math; it was their choice of math. They believed that Mother Nature was elegant, simple, and kind about providing clues. They thought they could hear her whisper when they were talking to themselves. Now Nature spoke, and she said nothing, loud and clear. Theoretical physics is the stereotypical math-heavy, hard-to-understand discipline. But for a book about math, this book contains very little math. Strip away equations and technical terms and physics becomes a quest for meaning—a quest that has taken an unexpected turn. Whatever laws of nature govern our universe, they're not what physicists thought they were. They're not what I thought they were. Lost in Math is the story of how aesthetic judgment drives contemporary research. It is my own story, a reflection on the use of what I was taught. But it is also the story of many other physicists who struggle with the same tension: we believe the laws of nature are beautiful, but *is* not believing something a scientist must not do? (*Preface*)



b. 1976

Why should the laws of nature care what I find beautiful? Such a connection between me and the universe seems very mystical, very romantic, very not me.



“The sense of beauty of a physical theory must be something hardwired in our brain and not a social construct. It is something that touches some internal chord,” he [Gian-Francesco Giudice, head of CERN theory dept] says. “When you stumble on a beautiful theory you have the same emotional reaction that you feel in front of a piece of art.”

It’s not that I don’t know what he is talking about; I don’t know why it matters. I doubt my sense of beauty is a reliable guide to uncovering fundamental laws of nature, laws that dictate the behavior of entities that I have no direct sensory awareness of, never had, and never will have. For it to be hardwired in my brain, it ought to have been beneficial during natural selection. *But what evolutionary advantage has there ever been to understanding quantum gravity?*

(LiM)

Beauty as a Delusion

In our search for new ideas, beauty plays many roles. It's a guide, a reward, a motivation. It is also a systematic bias…

1901–1976

Werner Heisenberg, one of the founders of quantum mechanics, boldly believed that beauty has a grasp on truth: "If nature leads us to mathematical forms of great simplicity and beauty we cannot help thinking that they are 'true,' that they reveal a genuine feature of nature." As his wife recalls:

One moonlit night, we walked over the Hainberg Mountain, and he was completely enthralled by the visions he had, trying to explain his newest discovery to me. He talked about the miracle of symmetry as the original archetype of creation, about harmony, about the beauty of simplicity, and its inner truth.

Beware the moonlight walks with theoretical physicists—sometimes enthusiasm gets the better of us. (LiM)

[AB: read e.g. E. Wigner, "Unreasonable Effectiveness of Mathematics"]

What makes a theory beautiful?

Weinberg continues: “I wouldn’t be in a hurry to set clear requirements for what a good theory has to be. But I can certainly tell you what a better theory has to be. A theory better than the standard model would be one that makes it inevitable that you have six rather than eight or four quarks and leptons. There are many things in the standard model that seem arbitrary, and a better theory would be one that makes these things less arbitrary, or not arbitrary at all.”

b. 1933

SH to FW: “And why should this sense of beauty be relevant for the laws of nature?”

“I think it’s the other way round,” Frank [Wilczek] says. “Humans do better in life if they have an accurate model of nature, if their concepts fit the way things actually behave. So evolution rewards that kind of feeling that being correct gives you, and that’s the sense of beauty. It’s something we want to keep doing; it’s what we find attractive. So explanations that are successful become attractive. And over the centuries people have found patterns in what the ideas that work are. So we’ve learned to see them as beautiful.” (LiM)

b. 1951

Mother of all biases

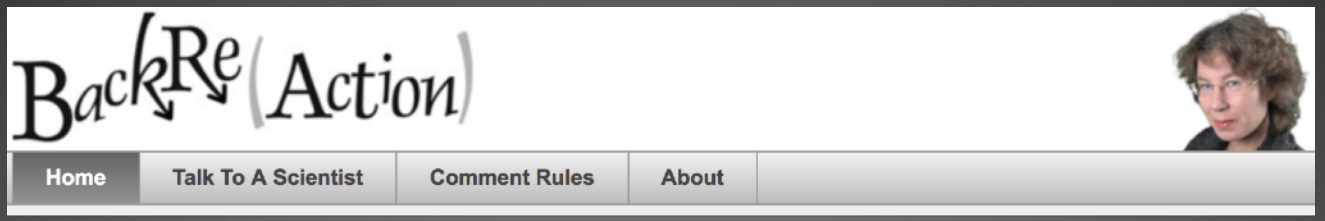
Biases: social and cognitive. See also at
http://backreaction.blogspot.com/2019/03/science-has-problem-here-is-how-you-can.html

"Then there is the mother of all biases, the bias blind spot—the insistence that we certainly are not biased. It's the reason my colleagues only laugh when I tell them biases are a problem, and why they dismiss my "social arguments," believing they are not relevant to scientific discourse. But the existence of these biases has been confirmed in countless studies. And there is no indication whatsoever that intelligence protects against them; research studies have found no links between cognitive ability and thinking biases.

Math keeps us honest, I told you. It prevents us from lying to ourselves and to each other. You can be wrong with math, but you can't lie. And it's true—you can't lie with math. But it greatly aids obfuscation.

I am biased."

From the Blog of SH



Physicists wrap appeals to beauty into statements like “this just can’t be the last word,” “intuition tells me,” or “this screams for an explanation”. … Of course I agree. I agree that supersymmetry is beautiful and it *should* be true, and it looks like there *should* be a better explanation for the parameters in the standard model, and it looks like there *should* be a unified force.

But who cares what I think nature *should* be like? Human intuition is not a good guide to the development of new laws of nature.

What physicists are naive about is not appeals to beauty; what they are naive about is their own rationality. They cannot fathom the possibility that their scientific judgement is influenced by cognitive biases and social trends in scientific communities…

The easiest way to see that the problem exists is that they deny it.

Her conclusions on the prospects of science

From these ideas and from numerous failures to guess and predict new laws of physics, she concludes that our feeling of math beauty is very unreliable source of possible truth, when there are no experimental data.

From here, she concludes about the proper priorities in scientific programs. Those of them, like FCC, which are expensive and might show nothing, should be abandoned, and the resources be directed to less expensive and less risky experiments, where you will see something valuable anyway.

All that relates to a question of value of fundamental physics, which she never asks.

Questions she never asks

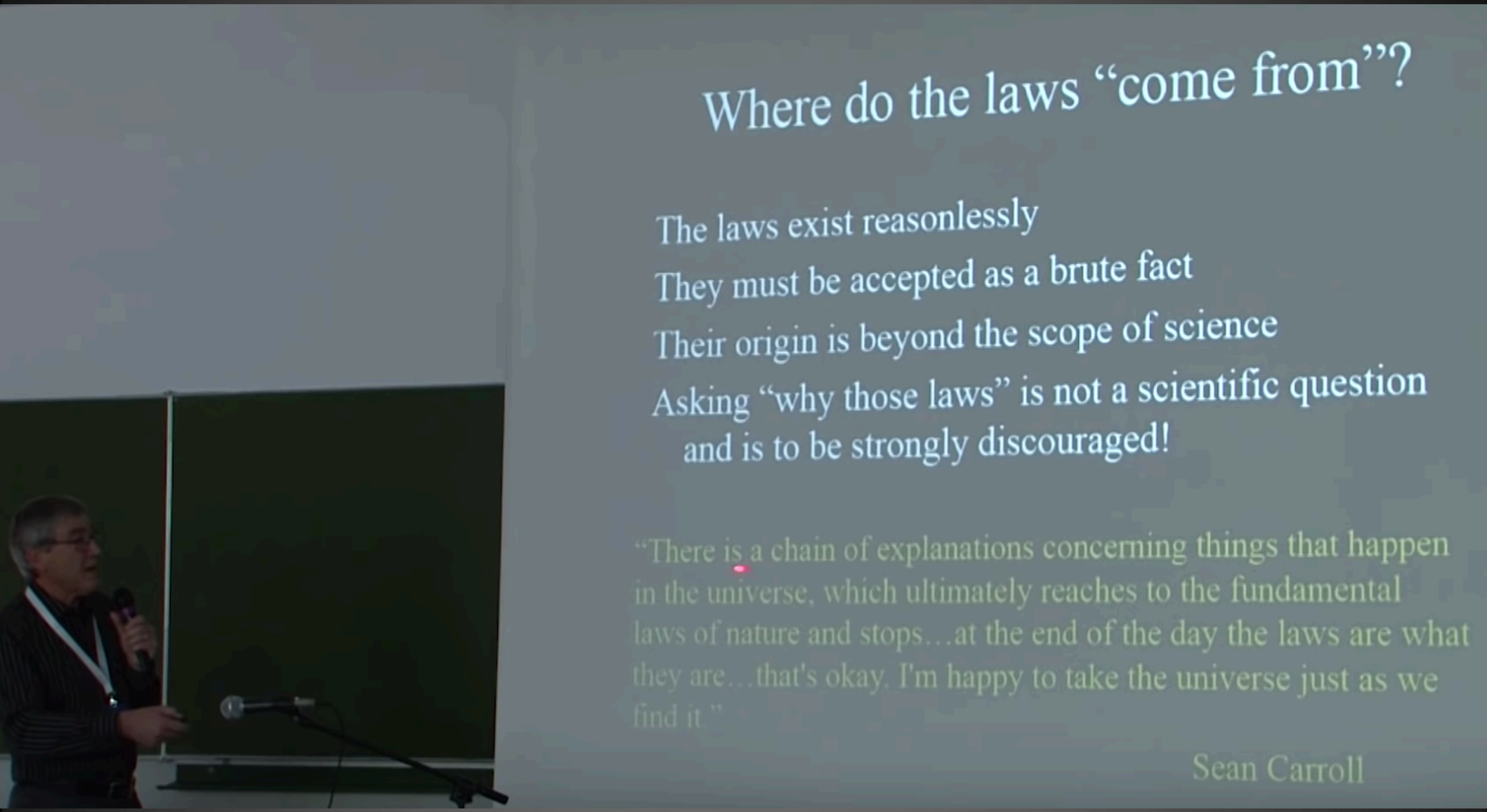
A bias is not an opinion, not even unreasonable opinion. A bias is an opinion you never try to examine seriously enough, as seriously as you could. Biases are associated with blind spots, with overlooked, inconvenient, avoided questions and taboos. Worldview biases which someone consistently resists to consider point to fanaticism, fear of reason.

SH points to her old belief in the beauty as the bias.

However, she never asks such key questions as:

- Why the belief in mathematical beauty was so effective in history of physics? Why the universe is comprehensible to such a significant degree?
- In our efforts to understand the universe better, is it possible at all to dispense with the belief in the mathematical beauty of not yet discovered laws?
- What is the value of the fundamental science—for the scientists and for humanity?
- There are old answers to these questions, shared by all fathers of physics; all the answers are pointing to God. There are no reasonable atheistic answers, at all. Does it mean that God exists?

Paul Davies on the “Party Line”



https://www.youtube.com/watch?v=pj7POKgkJTs 19:30

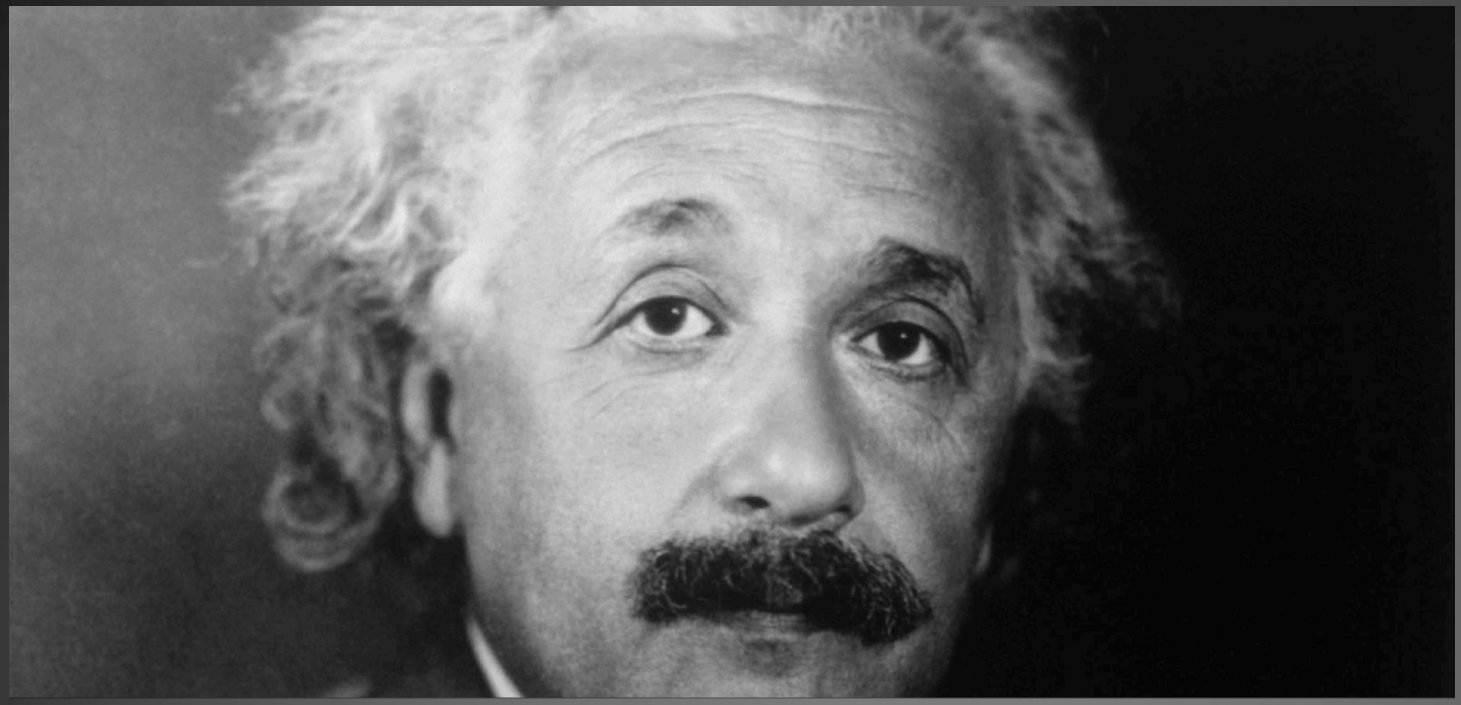
Lecture as part of the conference VARCOSMOFUN’16

… strongly discouraged!

AB: Could you please express your opinion why the universe is comprehensible to such a significant degree?

BB: It is not. We don't even know why we are here, right? The same energy is needed to accelerate particles as antiparticles. Why do we have only particles and no antiparticles in the world we are living in? What happened? We have ideas, but we certainly don't understand it, what happened at the time of Big Bang, it's a complete mystery. We don't even know why we are here. So I would say that your statement is a big overstatement. (*Fermi Colloquium, 02/13/2019*)

Biases and Taboos versus Metaphysical Awareness



1879-1955

The interpretation of religion, as here advanced, implies a dependence of science on the religious attitude, a relation which, in our predominantly materialistic age, is only too easily overlooked. While it is true that scientific results are entirely independent from religious or moral considerations, those individuals to whom we owe the great creative achievements of science were all of them imbued with the truly religious conviction that this universe of ours is something perfect and susceptible to the rational striving for knowledge. If this conviction had not been a strongly emotional one and if those searching for knowledge had not been inspired by Spinoza's *Amor Dei Intellectualis,* they would hardly have been capable of that untiring devotion which alone enables man to attain his greatest achievements.

… This firm belief, a belief bound up with deep feeling, in a superior mind that reveals itself in the world of experience, represents my conception of God. (*Ideas and Opinions)*

Machine for the making of gods

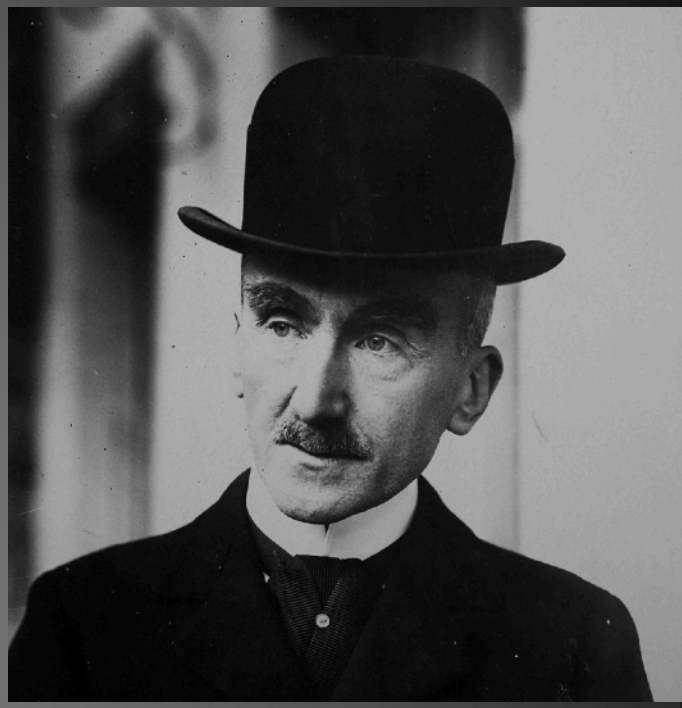
…the ultimate end of *mysticism* is the establishment of a contact, consequently, of a partial coincidence, with the creative effort of which life is the manifestation. This effort is of God, if not God himself. The great mystic is to be conceived as an individual being, capable of transcending the limitations imposed on the species by its material nature, thus continuing and extending the divine action.

As a matter of fact, the mystics unanimously bear witness that God needs us, just as we need God. Why should He need us unless it be to love us? And it is to this very conclusion that the philosopher who holds to the mystical experience must come. Creation will appear to him as God undertaking to create creators, that he may have, besides himself, beings worthy of his love.

Beings have been called into existence who were destined to love and be loved, since creative energy is to be defined as love. Distinct from God, Who is this energy itself, they could only spring into being *in a universe*, and therefore the universe sprang into being…

Theirs the responsibility, then, for deciding if they want merely to live, or intend to make just the extra effort required for fulfilling, even on their refractory planet, the essential function of the universe, which is a machine for the making of gods."

The Two Sources Of Morality And Religion, 1932



Henri Bergson

1859–1941

There is only one reasonable ground for the laws
to be discoverable and highly valued:

They were chosen by the Creator to enrich our communion with Him
by the important modus of creativity and cosmic contemplation
of very special intellectual beauty.

Would God be happy then to see the scientific Mount Olympus
being occupied by those to whom this idea is totally foreign?

Would He want keeping the laws discoverable by such a community?

Many Thanks!