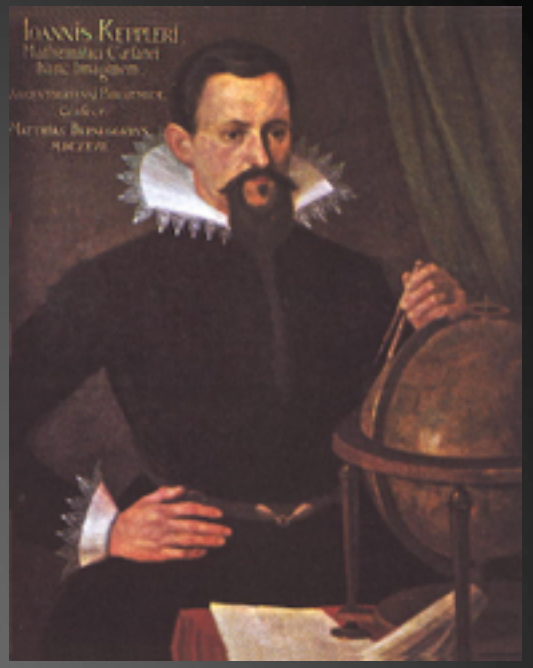
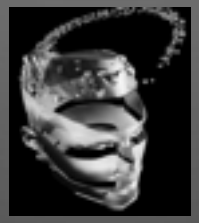
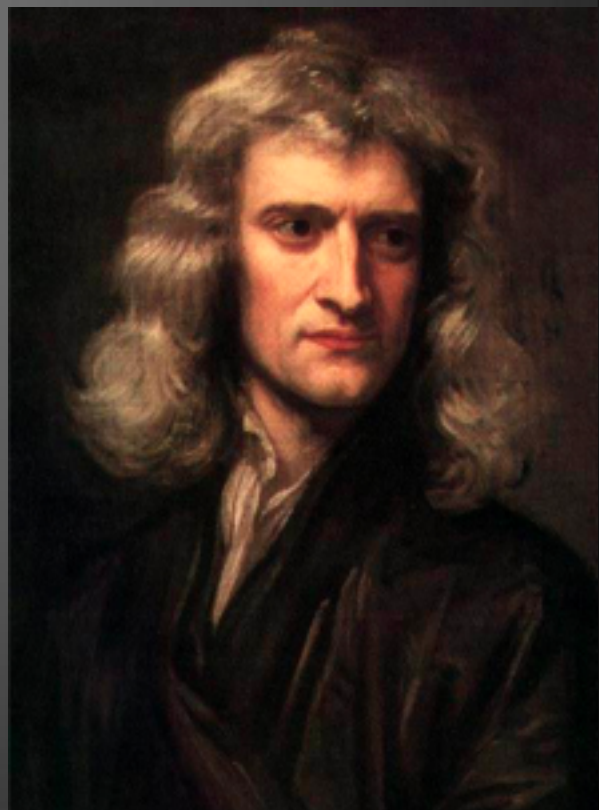
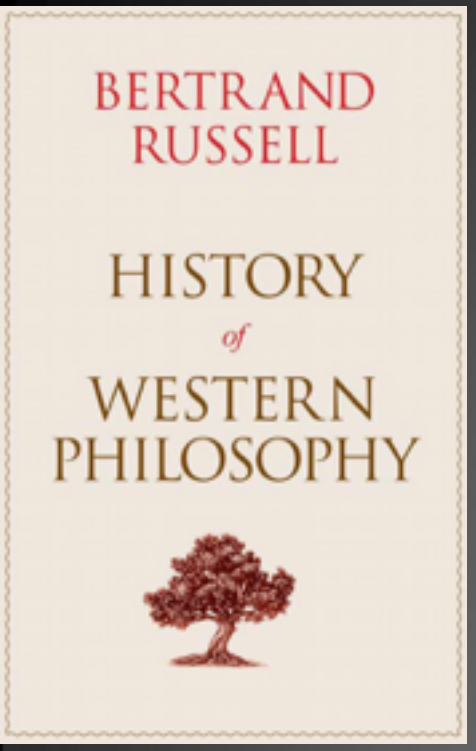


Century of Geniuses





A. Burov, Fermilab, Jan 14, 2016


BERTRAND
RUSSELL
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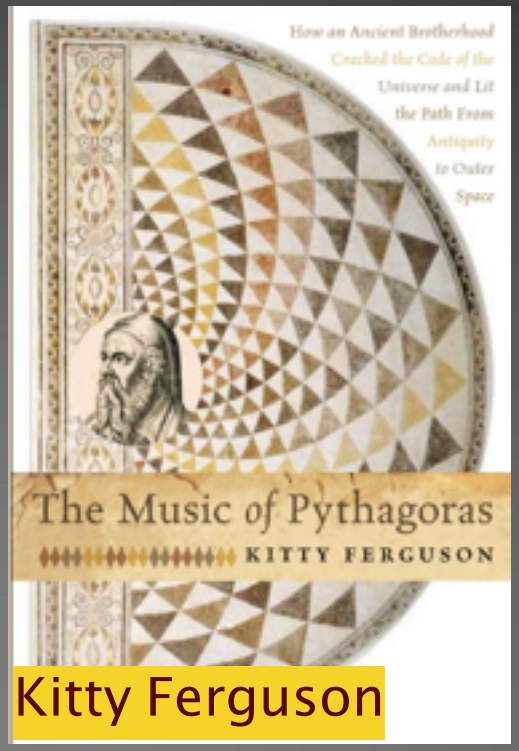
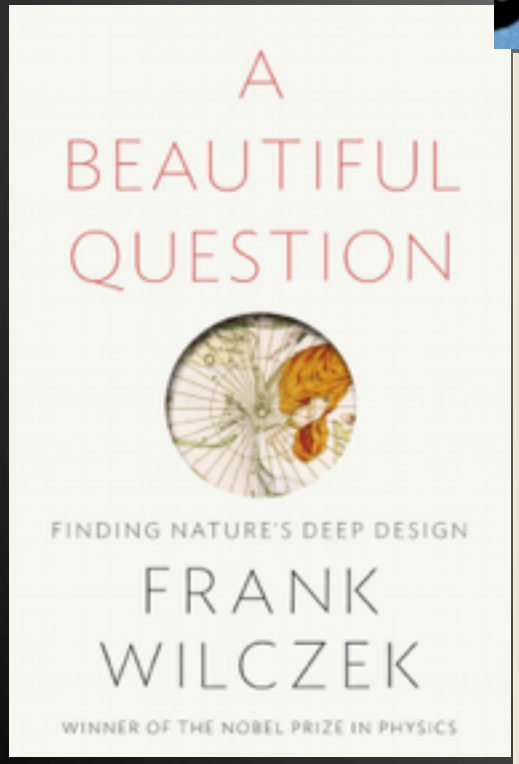
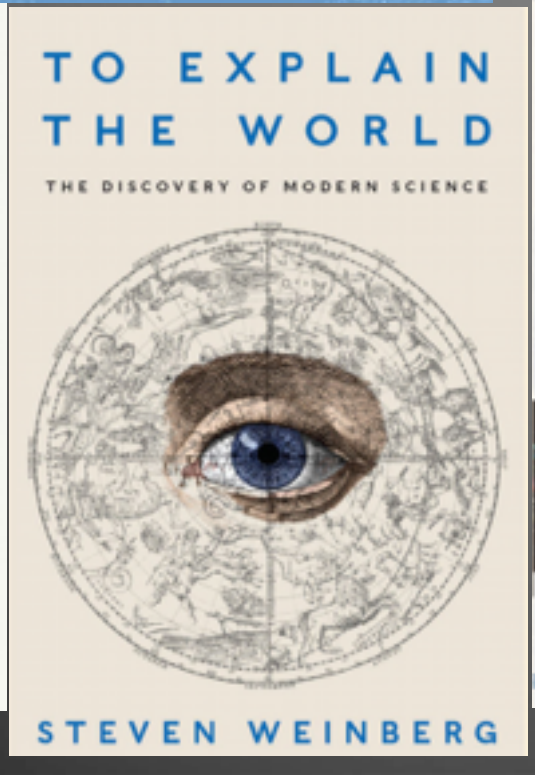
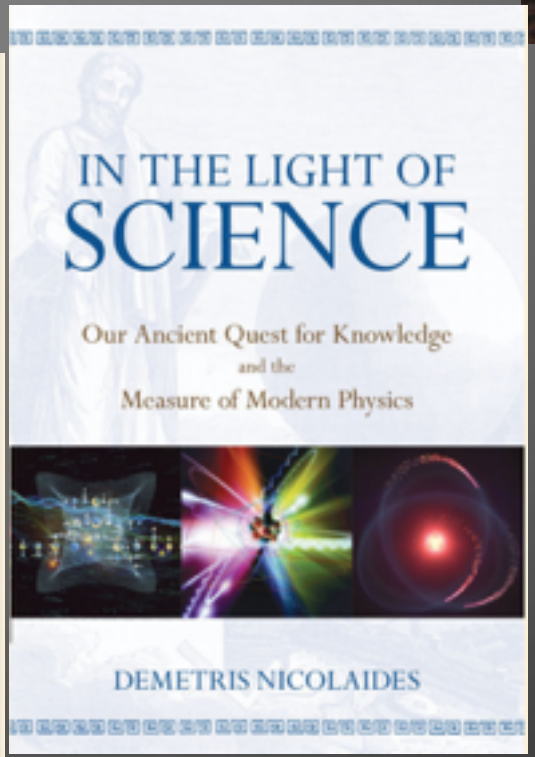
HarperCollins e-books
Religion and Science
Ian G. Barbour

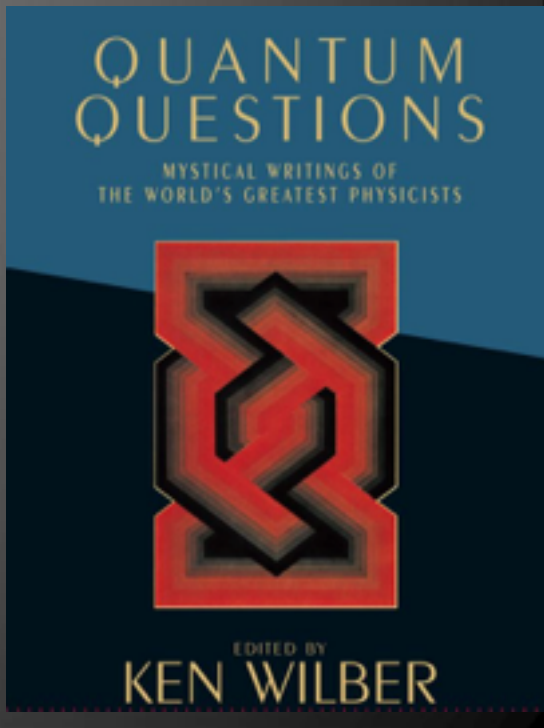

How an Ancient Brotherhood Cracked the Code of the Universe and Lit the Path From Antiquity to Outer Space
The Music of Pythagoras
KITTY FERGUSON
Kitty Ferguson


A STUDENT'S GUIDE TO
NATURAL
SCIENCE
Stephen Barr


A
BEAUTIFUL
QUESTION
FINDING NATURE'S DEEP DESIGN
FRANK
WILCZEK
WINNER OF THE NOBEL PRIZE IN PHYSICS


TO EXPLAIN
THE WORLD
THE DISCOVERY OF MODERN SCIENCE
STEVEN WEINBERG


IN THE LIGHT OF
SCIENCE
Our Ancient Quest for Knowledge
and the
Measure of Modern Physics
DEMETRIS NICOLAIDES


QUANTUM
QUESTIONS
MYSTICAL WRITINGS OF
THE WORLD'S GREATEST PHYSICISTS
EDITED BY
KEN WILBER

The Discovery of XVII century

Philosophy is written in this grand book, which stands continually open before our eyes (I say the 'Universe'), but can not be understood without first learning to comprehend the language and know the characters as it is written. It is written in mathematical language, and its characters are triangles, circles and other geometric figures, without which it is impossible to humanly understand a word; without these one is wandering in a dark labyrinth.(1623)

"...the same experiment which at first glance seemed to show one thing, when more carefully examined, assures us of the contrary." (1638)

"I do not feel obliged to believe that the same God who has endowed us with senses, reason, and intellect has intended us to forgo their use and by some other means to give us knowledge which we can attain by them." (1615)

Galileo Galilei

1564-1642

Bacon missed most of what was being done in science in his day. He rejected the Copernican theory, which was excusable so far as Copernicus himself was concerned, since he did not advance any very solid arguments. But Bacon ought to have been convinced by Kepler, whose New Astronomy appeared in 1609.

Francis Bacon
1561–1626

Bacon's inductive method is faulty through insufficient emphasis on hypothesis. He hoped that mere orderly arrangement of data would make the right hypothesis obvious, but this is seldom the case. As a rule, the framing of hypotheses is the most difficult part of scientific work, and the part where great ability is indispensable. So far, no method has been found which would make it possible to invent hypotheses by rule. Usually some hypothesis is a necessary preliminary to the collection of facts, since the selection of facts demands some way of determining relevance. Without something of this kind, the mere multiplicity of facts is baffling. The part played by deduction in science is greater than Bacon supposed. Often, when a hypothesis has to be tested, there is a long deductive journey from the hypothesis to some consequence that can be tested by observation. Usually the deduction is mathematical, and in this respect Bacon underestimated the importance of mathematics in scientific investigation.

B. Russell, History of Western Philosophy

The long chains of simple and easy reasonings by means of which geometers are accustomed to reach the conclusions of their most difficult demonstrations, had led me to imagine that all things, to the knowledge of which man is competent, are mutually connected in the same way, and that there is nothing so far removed from us as to be beyond our reach, or so hidden that we cannot discover it, provided only we abstain from accepting the false for the true, and always preserve in our thoughts the order necessary for the deduction of one truth from another (Discourse, 1640).

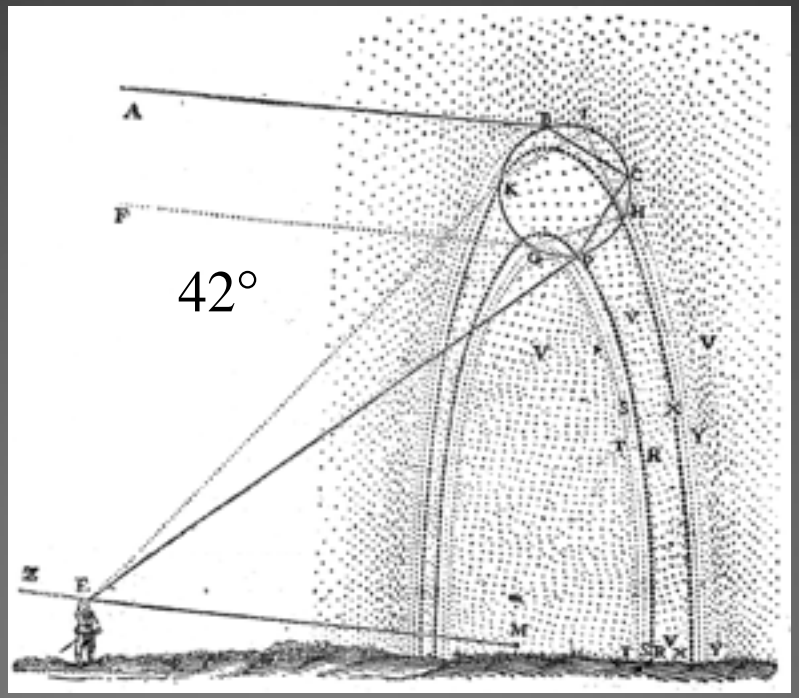
When I imagine a triangle, although there is not perhaps and never was in any place in the universe apart from my thought one such figure, it remains true nevertheless that this figure possesses a certain determinate nature, form, or essence, which is immutable and eternal, and not framed by me, nor in any degree dependent on my thought. (Meditations, 1641)

In my opinion, all things in nature occur mathematically. (1640)

Rene Descartes

1596-1650

Discourse of the Method
(Meteorology addendum)
1637



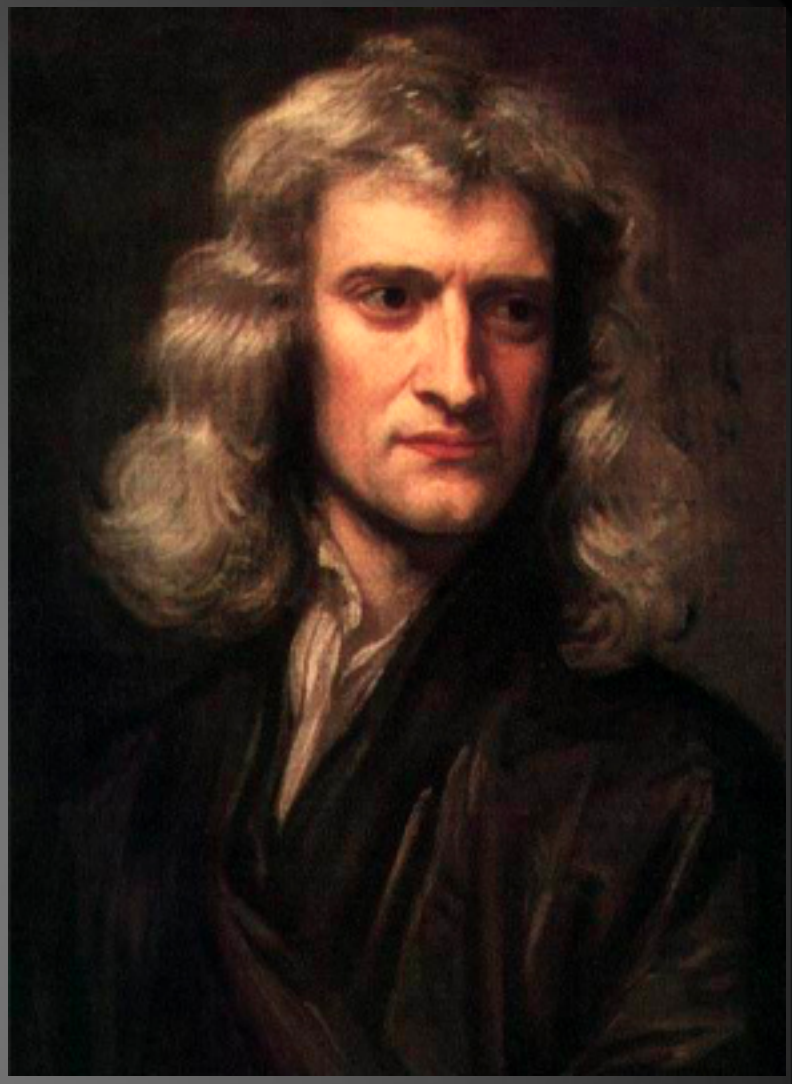
Knowing that the size of raindrops did not appear to affect the observed rainbow, Descartes experimented with passing rays of light through a large glass sphere filled with water. By measuring the angles that the rays emerged, he concluded that the primary bow was caused by a single internal reflection inside the raindrop and that a secondary bow could be caused by two internal reflections. He supported this conclusion with a derivation of the law of refraction (subsequently to, but independently of, Snell) and correctly calculated the angles for both bows. His explanation of the colors, however, was based on a mechanical version of the traditional theory that colors were produced by a modification of white light.

(https://en.wikipedia.org/wiki/Rainbow)

The main point of XVII century was not a dispute between rationalists and empiricists. There was nothing new in the empiricism, it is as old as the world; even rats behave by trials-errors-corrections, induction-deduction.

The main point was the discovery of rationalism (empowered rediscovery in fact), i.e. the discovery of theoretical cognition, *modo geometrico*. Prophets of the new thinking were Galilei and Descartes. Philosophically it was expressed and absolutized in Spinoza. Scientifically it came in full glory in Newton's *Principia*.

Compared to these giants, thinkers like F. Bacon and J. Locke, or scientist like R. Boyle were at best of tertiary significance for the birth of science.



Isaac Newton
1642-1727

Morson and Tolstoy

Two great spirits presided over the birth of modern science in the seventeenth century. Francis Bacon, the Englishman, said:

> All depends on keeping the eye steadily fixed on the facts of nature, and so receiving their images as they are. For God forbid that we should give out a dream of our own imagination for a pattern of the world.

René Descartes, the Frenchman, said:

> I showed what the laws of nature were, and without basing my arguments on any principle other than the infinite perfections of God, I tried to demonstrate all those laws about which we could have any doubt, and to show that they are such that, even if God created many worlds, there could not be any in which they failed to be observed.

In the history of science, from its beginnings to the present day, the Baconian and the Cartesian traditions have remained alive, Baconian science emphasizing empirical facts and details, Cartesian science emphasizing general ideas and principles. The healthy growth of science requires that both traditions be honored. Bacon without Descartes would reduce science to butterfly collecting; Descartes without Bacon would reduce science to pure mathematics.

"From Eros to Gaia", 1992

Freeman Dyson

b. 1923