Question of Joseph Needham

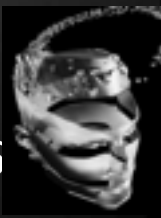
"Why did modern science, the mathematization of hypotheses about Nature, with all its implications for advanced technology, take its meteoric rise only in the West at the time of Galileo? Why modern science had not developed in Chinese civilization, which for centuries was much more efficient than occidental in applying human natural knowledge to practical human needs?"

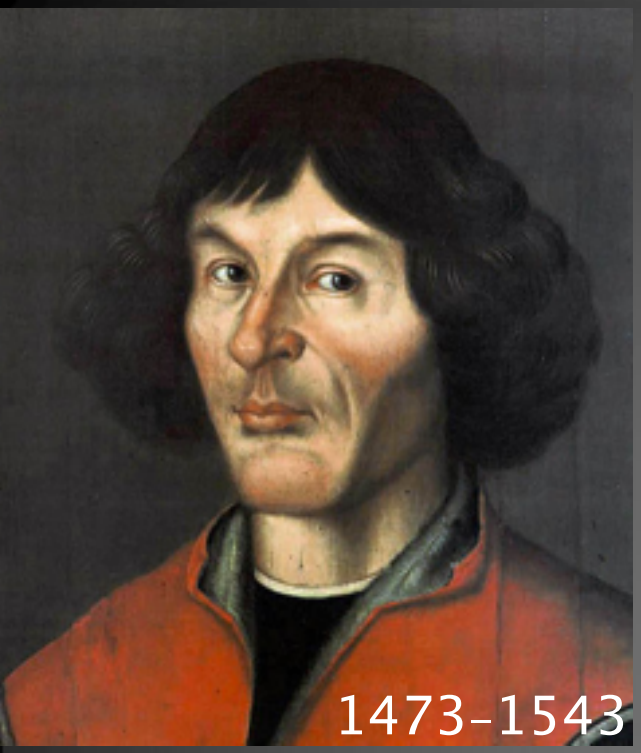
The same question can be asked about Antiquity, Eastern Roman Empire, Medieval Time, India, Muslim World, late start of Russia...

J. Needham (1900-1995)

J. Needham was a famous biochemist, embryologist and sinologist.

The Needham Research Institute, devoted to the study of China's scientific history, was opened in 1985 by Prince Philip, Duke of Edinburgh.





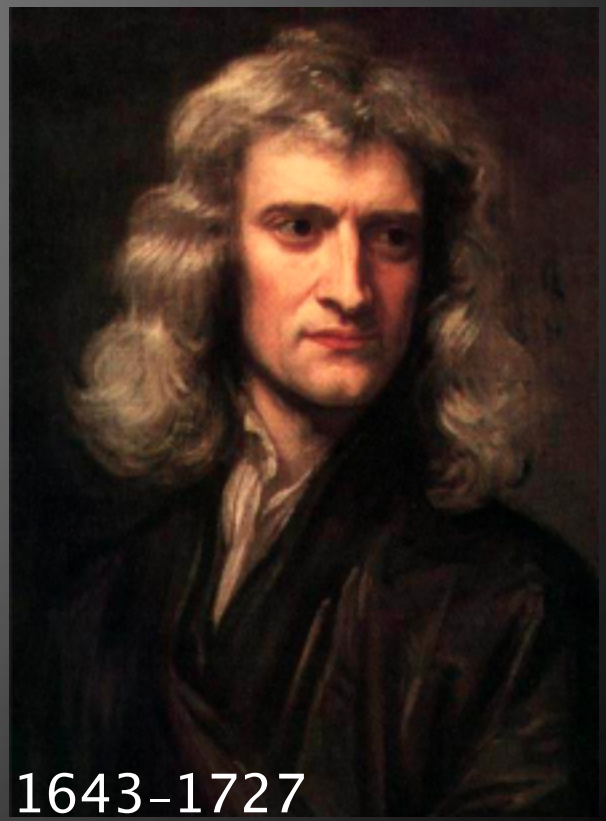
What did they

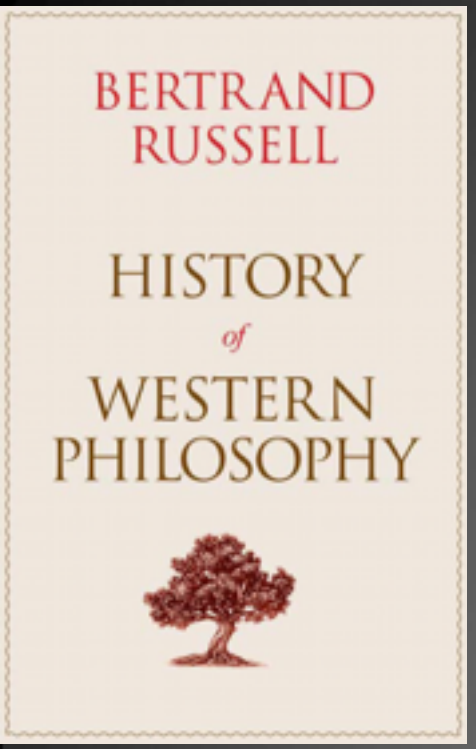
specifically invent,

which later

had been named

modern science ?




BERTRAND
RUSSELL
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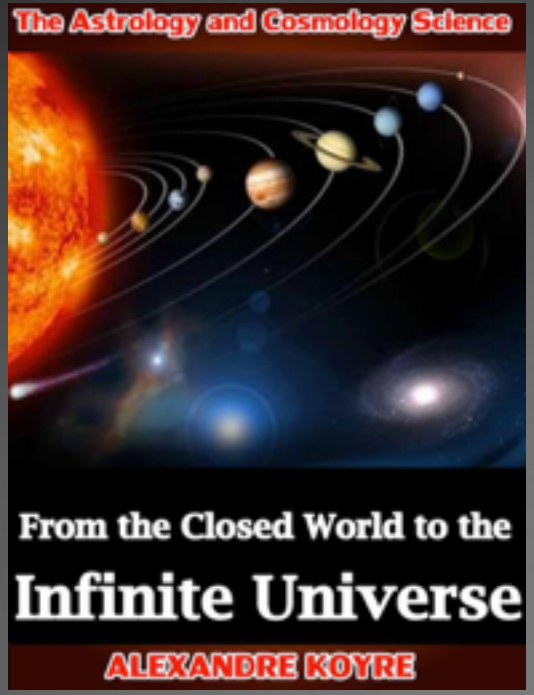
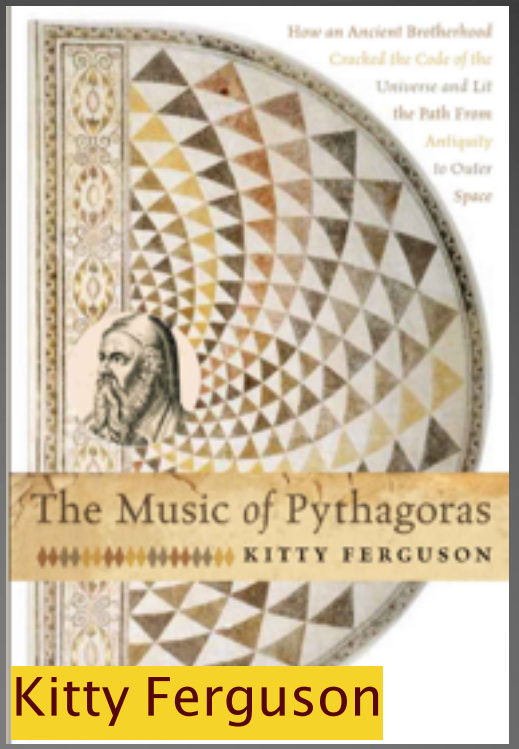
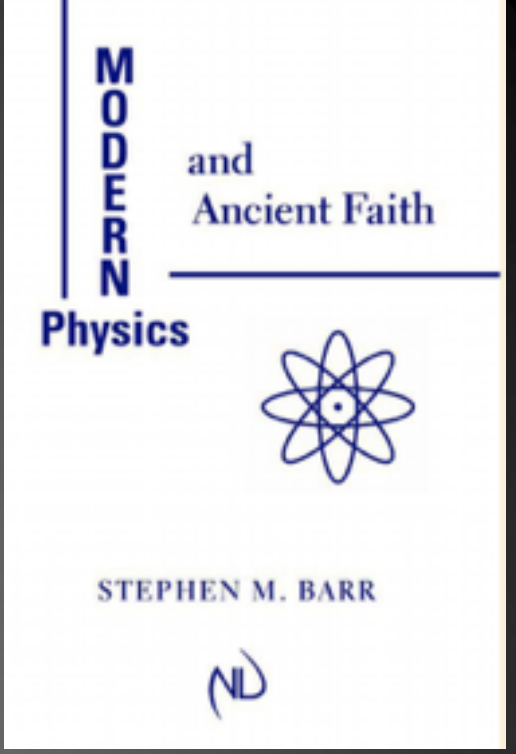
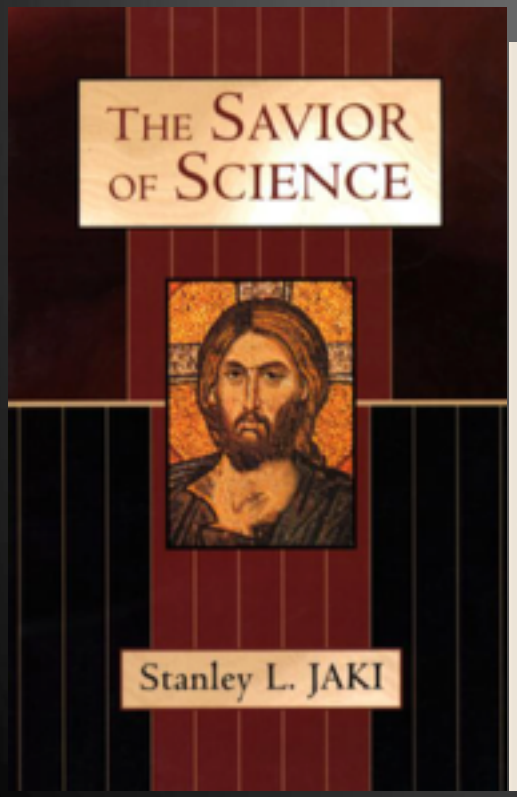
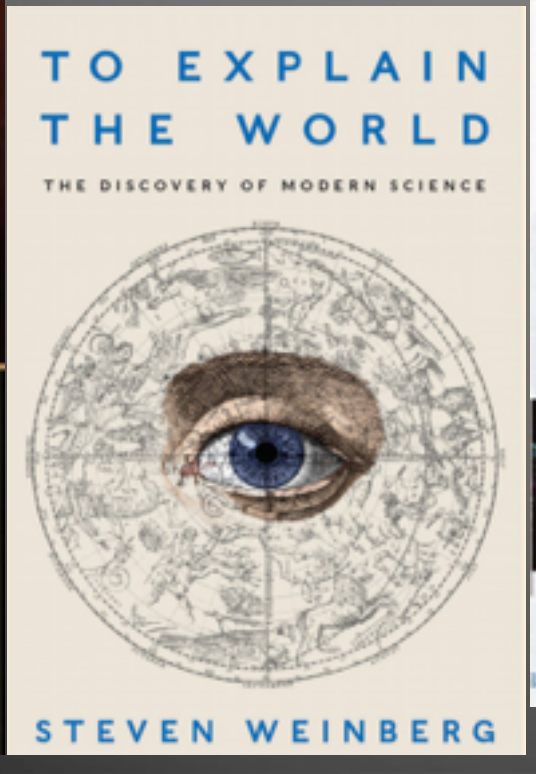
WESTERN
PHILOSOPHY

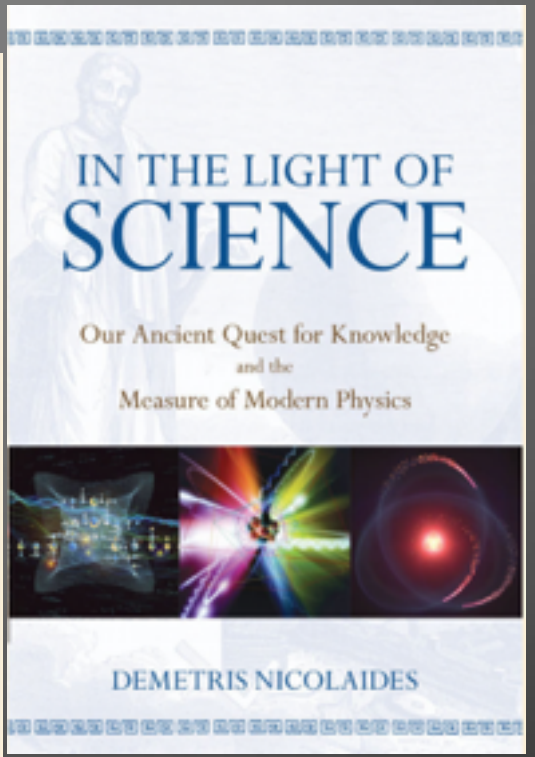

The Astrology and Cosmology Science
From the Closed World to the
Infinite Universe
ALEXANDRE KOYRE

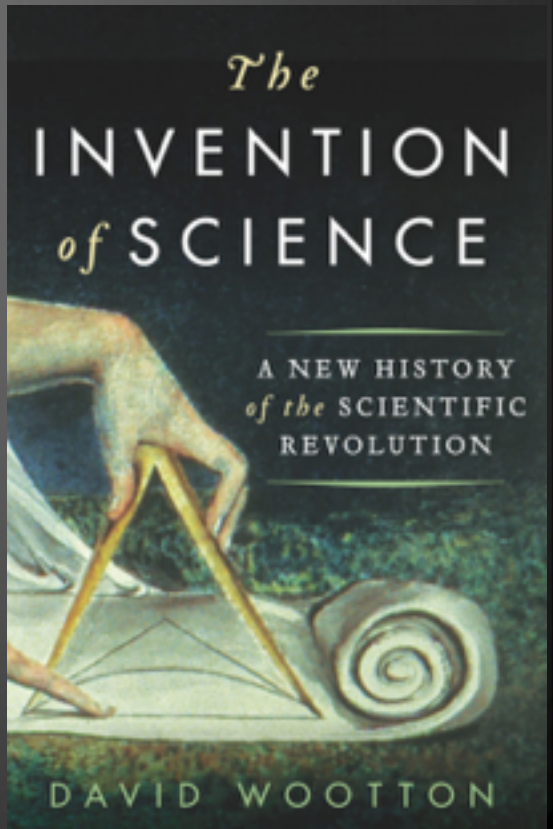

The Music of Pythagoras
KITTY FERGUSON
Kitty Ferguson

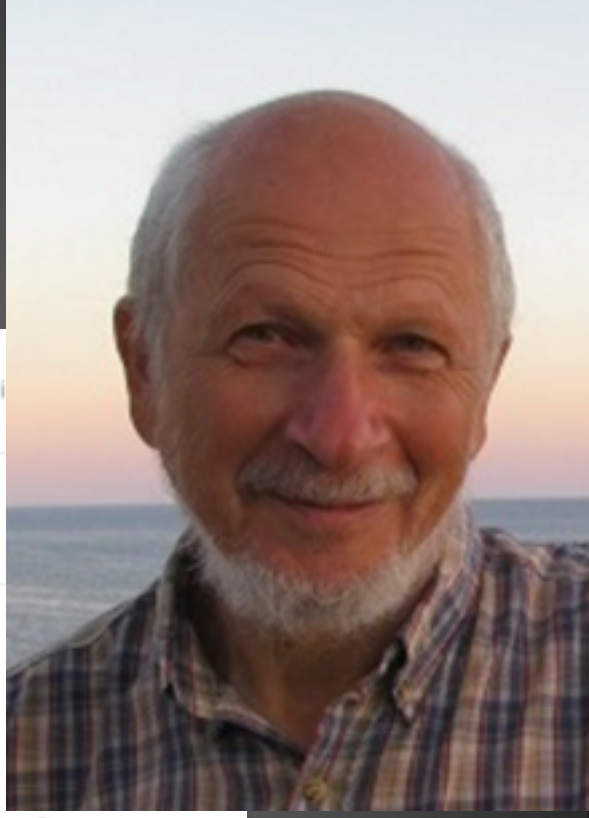

MODERN
Physics
and
Ancient Faith
STEPHEN M. BARR


THE SAVIOR
OF SCIENCE
Stanley L. JAKI


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


The
INVENTION
of SCIENCE
A NEW HISTORY
of the SCIENTIFIC
REVOLUTION
DAVID WOOTTON



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Guest Blog

How the Modern Physics was invented in the 17th century, part 1: The Needham Question

By Gennady Gorelik on April 6, 2012

by Gennady Gorelik

http://www.scientificamerican.com/author/gennady-gorelik/

https://arxiv.org/pdf/1106.6345.pdf

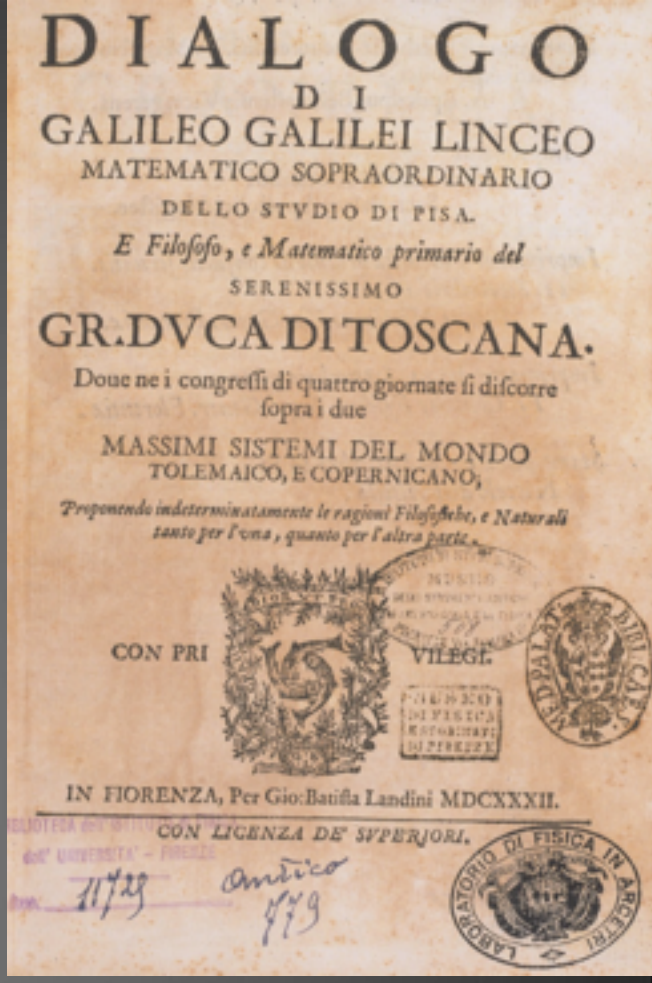
Philosophy is written in this grand book, which stands continually open before our eyes (I say the 'Universe'), but can not be understood without first learning to comprehend the language and know the characters as it is written. It is written in mathematical language, and its characters are triangles, 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


DIALOGO
DI
GALILEO GALILEI LINCEO
MATEMATICO SOPRAORDINARIO
DELLO STVDIO DI PISA.
E Filosofo, e Matematico primario del
SERENISSIMO
GR. DVCA DI TOSCANA.
Doue ne i congressi di quattro giornate si discorre sopra i due
MASSIMI SISTEMI DEL MONDO
TOLEMAICO, E COPERNICANO,
Proponendo indeterminatamente le ragioni Filosofiche, e Naturali tanto per l'vna, quanto per l'altra parte.
CON PRI VILEGI.
IN FIORENZA, Per Gio: Batista Landini MDCXXXII.
CON LICENZA DE' SVPERIORI.

"I know perfectly well that the Pythagoreans had the highest esteem for the science of number and that Plato himself admired the human intellect and believed that it participates in divinity solely because it is able to understand the nature of numbers. And I myself am well inclined to make the same judgment."[65]

[65] *Dialogo*, 35.

(1632)

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

"Finally, if there be still persons who are not sufficiently persuaded of the existence of God and of the soul, by the reasons I have adduced, I am desirous that they should know that all the other propositions, of the truth of which they deem themselves perhaps more assured, as that we have a body, and that there exist stars and an earth, and such like, are less certain..."

"God cannot be a deceiver, since fraud and deception necessarily proceed from some defect."

1596-1650

Let's focus on one of the most famous of those statements and ask about its explicit and implicit meanings:

The grand book of the Universe
is written in the language of mathematics.
It stands continually open before our eyes.
Without knowledge of this language,
one is wandering in a dark labyrinth.

(Il Saggiatore, 1623)

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.

Powerful poetry => a powerful meaning.

The material world is beautiful and good.

Its deep understanding is of extreme importance and value.

This understanding is possible for humans.

Mathematics is the language of the “grand book”.

Inasmuch as humans learn that language, they see the related part of the “grand book” as clear as its Author. Thus, it is a specific communion.

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.

Didn't we miss anything that important?

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.

Well, what was meant by mathematics?

What was meant by Mathematics


1596-1650

"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)

So, What Is Mathematics, precisely?

1. Mathematics is much more than just a knowledge about figures and numbers. It is a very special way of thinking:

2. With absolute certainty and universality, potentially unlimited number of clear and distinctive statements, theorems, can be proved or refuted.

3. This thinking is detached from all specific cultural or even biological features of humans. Thus, it belongs to the universal absolute reason, to the Mind of God.

4. Thus, Mathematics is a "participation in the divinity", a specific Pythagorean communion.

5. Since the Creator is a perfect master and artist, only beautiful mathematical forms have to be expected as the World axioms, or the laws of nature.

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.

Are we still missing anything?

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.

Yes, one more important point still remains to be said…

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.

On which ground did he conclude all that?

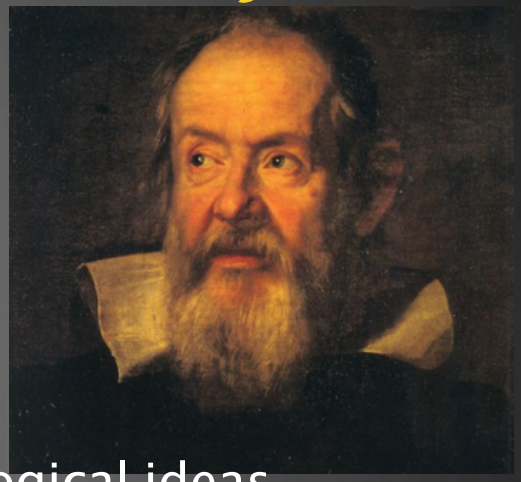
Where did he take all the audacity required by these ultimate statements, power of this prophecy about World, Man and God?

Why was his prophecy supported by inspired followers?

The grand book of the Universe is written in the language of mathematics.

It stands continually open before our eyes.

Without knowledge of this language, one is wandering in a dark labyrinth.



Fathers of Science were people of Renaissance
and Reformation epochs.

They learned from ancient Greeks the power of reason,
the fascinating perfection of mathematics, boldness of cosmological ideas.

They learned from the Bible that they are sons of God, Who is the Author of everything. They new that everything He created was “very good”. They learned to trust and love Him.

On that basis, they saw as their duty to establish a synthesis of all the wisdom they inherited. They were audacious enough to believe they can do that, and gingerly enough to know how easy to make a mistake.

The supreme Father, God the Architect, had already built this cosmic home we behold, the most sacred temple of divinity, according to the laws of the mysterious wisdom... But when the work was finished, the Craftsman still longed that there were someone to ponder the meaning of so great a work, to love its beauty, and to wonder at its vastness...

He therefore took man, this creature of indeterminate image, set him in the middle of the world and thus spoke to him: «We have given you, Adam, no fixed seat nor features proper to yourself nor endowment peculiar to you alone, in order that whatever seat, whatever features, whatever endowment you may responsibly desire, these same you may have and possess according to your desire and judgement... It will be in your power to degenerate into the lower forms of life, which are brutish; you shall have the power, according to your soul's judgement, to be reborn into the higher orders, which are divine...

Giovanni Pico della Mirandola
1463-1494

If man cultivates his vegetable seeds, he will become a plant. If he cultivates his sensitive seeds, he will become brutish. If he cultivates his rational seeds, he will become a heavenly animal. If he cultivates his intellectual seeds, he will be an angel and a son of God.

Oration on the Dignity of Man, 1486

Audacious Spirit of That Time

1. Medieval Western pluralism, with its significant freedom.

2. Universities with their universal thought and special freedoms.

3. Religion of perfection: Man is an image and similarity of God. “Therefore you are to be perfect, as your heavenly Father is perfect.” The parable of talents. God became man for man to ascend to God. Original sin as what has to be and can be overcome.

4. Return of the ancient texts and a necessity of the new synthesis.

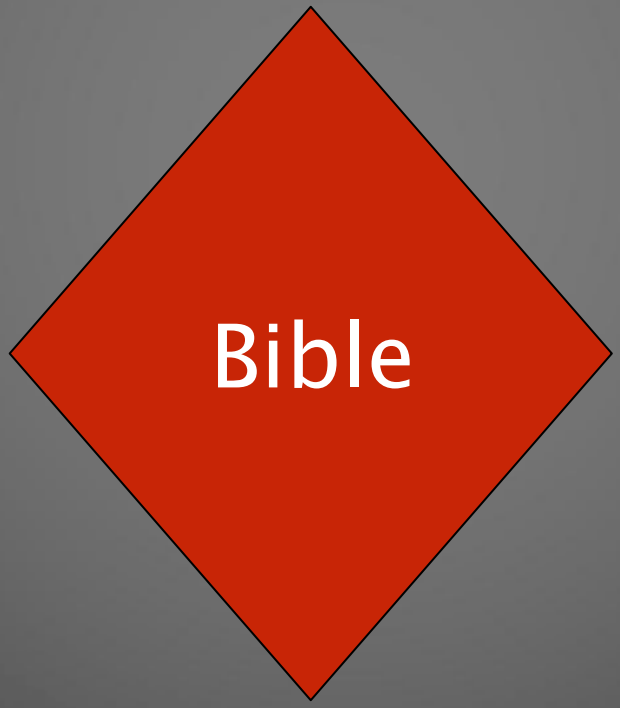
5. Gutenberg press (c. 1450) made books available for the middle class.

6. Reformation connected salvation with personal efforts in the Bible studies, “sola Scrittura” was made associated with “sola fide”.

7. Thus, the meaning of life got a strong personal, spiritual and historically unfolding accent.


Pythagoras


Freedom


Bible

Rationalism
Mathematical
Thought

Bible:
Trust to Creator
Value of World
Trust in Man
Religion of Perfection

Freedom of Thought
Audacious Spirit of the Time
Medieval Pluralism
Universities
Renaissance
Gutenberg Press
Reformation

After all the elements of the modern science are explicated,

We are, hopefully, ready to consider the Needham's question.

Why did Archimedes (287-212 BC) was the first and the last math physicist of Greek-Roman Antiquity?

1. Material World did not have ontological value, it was not "very good" in the eyes of those who were interested in math.

2. Math was a mystical way of thinking, valuable as a way of soul purification and salvation, not as a language of nature. Archimedes was the single exception.

The Fields Medal

Hagia Sophia, the patriarchal basilica in Constantinople designed 537 AD by Isidore of Miletus, the first compiler of Archimedes' various works. The influence of Archimedes' principles of solid geometry is evident.

Why Modern Science was not born in the Eastern Roman Empire Inherited both the Bible and Greek wisdom in its own language?

It lost freedom, the audacious thinking. It turned into a totalitarian state, where the spiritual head either blessed the emperor or died. That empire never had the feudal pluralism with its freedoms.

Why the Modern Science was neither born nor even picked up by the Islamic World, for centuries open to Greeks, Indian and Chinese?

"Perhaps one of the most significant advances made by Arabic mathematics began at this time with the work of al-Khwarizmi, namely the beginnings of algebra. It is important to understand just how significant this new idea was. It was a revolutionary move away from the Greek concept of mathematics which was essentially geometry. Algebra was a unifying theory which allowed rational numbers, irrational numbers, geometrical magnitudes, etc., to all be treated as "algebraic objects". It gave mathematics a whole new development path so much broader in concept to that which had existed before, and provided a vehicle for future development of the subject. Another important aspect of the introduction of algebraic ideas was that it allowed mathematics to be applied to itself in a way which had not happened before."

— MacTutor History of Mathematics archive

Why the Modern Science was neither born nor even picked up by the Islamic World, for centuries open to Greeks, Indian and Chinese?

Islam is primarily a religion of obedience and mystical contemplation. Its support to audacious creative spirit, personal establishing of new rational truths about the world is rather weak. Its Golden Age was the age of its openness. In Islam, Man is further away from God than for Christians; Allah is less anthropomorphic than the Trinity.

Golden Age of Islam ended together with its openness and freedom of thought.

Why the Modern Science was neither born nor even picked up by India with its great ancient wisdom, its huge spiritual freedom, its numbers and zero?

Value	0	1	2	3	4	5	6	7	8	9
Western Arabic	٠	١	٢	٣	٤	٥	٦	٧	٨	٩
Eastern Arabic	٠	١	٢	٣	۴	۵	۶	۷	۸	۹
Devanagari	०	१	२	३	४	५	६	७	८	९
Gujarati	૦	૧	૨	૩	૪	૫	૬	૭	૮	૯
Gurmukhi	੦	੧	੨	੩	੪	੫	੬	੭	੮	੯
Limbu	□	□	□	□	□	□	□	□	□	□
Bengali	০	১	২	৩	৪	৫	৬	৭	৮	৯
Oriya	୦	୧	୨	୩	୪	୫	୬	୭	୮	୯
Telugu	౦	౧	౨	౩	౪	౫	౬	౭	౮	౯
Kannada	೦	೧	೨	೩	೪	೫	೬	೭	೮	೯
Malayalam	൦	൧	൨	൩	൪	൫	൬	൭	൮	൯
Tamil (Grantha)	൦	க	உ	ங	ச	ஞ	ண	ன	அ	க
Tibetan	๐	๑	๒	๓	๔	๕	๖	๗	๘	๙
Burmese	၀	၁	၂	၃	၄	၅	၆	၇	၈	၉
Thai	๐	๑	๒	๓	๔	๕	๖	๗	๘	๙
Khmer	០	១	២	៣	៤	៥	៦	៧	៨	៩
Lao	๐	๑	๒	๓	๔	๕	๖	๗	๘	๙

India was never interested in the material world. The main idea was liberation from it; the material world had a rather negative value.

India invented zero and decimal system, but not the mathematics. Perhaps, math thought was alien and not that interesting for India.

"Why modern science had not developed in Chinese civilization, which for centuries was much more efficient than occidental in applying human natural knowledge to practical human needs?" (JN)

China knew all practically important facts about figures and numbers, but not mathematics as a way to think. They never proved theorems, they just knew results, which appear enough for practically oriented minds.

Metaphysical thought in China was either strictly mystical, poetical and indefinite (Taoism), world-rejecting (Buddhism), or moral and social-oriented (Confucianism).

> Confucian cosmology neither restrained nor promoted the interrogation of nature or the search for technological solutions to problems of production. What it did not provide for, even during the continued economic advance of the Qing empire, was that powerful promotional confidence that entered into the cultures of Western elites of a natural world that was the rational and explicable work of their God. As Needham observed, 'there was no confidence that the codes of nature could be read because there was no assurance that a divine being had formulated a code capable of being read'. His point is intact and remains open for research and discussion.

P. O'Brien, "The Needham Question Updated: A Historiographical Survey and Elaboration", in History & Technology, Vol 29 (2009) available at http://www.lse.ac.uk/economicHistory/Research/URKEW/NeedhamQuestion.pdf .

Why did it take so long for modern science to be born in the Western civilization?

After the crash of the ancient Greek-Roman civilization under the Barbarian Invasions, it took a millennium for:

1. A new pluralistic, rather free society to appear and stay;
2. A new educational system, schools and universities being established and successfully working long enough;
3. Value of personal learning of the most important texts was supported by availability of these texts.

“Why modern science started so late in Russia and why it developed so fast?

Until XVIII c. the Tsardom of Russia were a second-rate copy of the Byzantine Empire: a totalitarian asiatic state, but without historical treasures.

Peter I (1672-1725) made Western education fashionable. In a couple of generations, the upper class became westernized.

Reforms of Catherine the Great (1729-1796) granted civil rights to the upper class.
This upper class created new Russia of XIX century.

Thing which was long missed was freedom, civil rights. With progress in civil rights, the country’s art, science, technology, philosophy… skyrocketed.

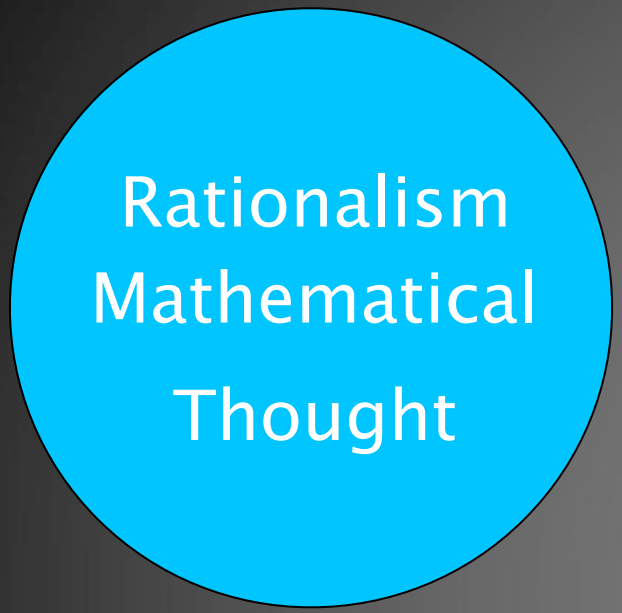
Alexander I (1777–1825)

Alexander II (1818–1881)

They moved Russia to much more freedom and education

It would not be correct to point to a single magic element as the answer to the NQ.

The answer rather consists in a creative synthesis of several key elements


Rationalism
Mathematical
Thought


Freedom
Audacious Spirit of the Time
Universities
Renaissance
Gutenberg Press
Reformation


Bible:
Trust to God
Value of World
Trust in Man
Religion of Perfection

Many Thanks!