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Physics and Philosophy – The Transition, The Stagnation and The Renaissance.

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Abstract: This is a peculiar, but unique research paper in Physics and Philosophy without including a single mathematical equation. Some of the material in the paper is from another paper titled, "An Arm-Chair Philosophy from a Physicist" published by the same author. The paper begins with the meaning of terms used in the title. The meaning of Philosophy and its history are given extensively so also the meaning of Physics and its history. The author has highlighted the meanings of Natural Philosophy and Renaissance Philosophy. Actual mini photographs of nearly 120 philosopher scientists with their scientific work in brief are given. Tables are made for each category of Natural Philosophers, Renaissance Philosophers and Philosopher Physicists and a combined graph is plotted the Period versus the number of scientists in each category. The author has included some Philosophy in the Conclusion. The reader should not miss the Epilogue which is interesting. The entire paper is almost an independent treatment by author from the past work of some researchers. As very few authors have attempted such a work in the past, the main reference for this paper is the Google Search and Wikipedia.

Key Words: History of Philosophy, History of Physics, Natural Philosophy, Physics, Pictures of over hundred Philosopher scientists, Renaissance, Renaissance Philosophy.

Philosophy: *The physicist analyses matter into particles, and finds that their forces and motions can be described in mathematical terms. The materialist pushes this scientific result into philosophy, and says that there is no reality* [21]

I INTRODUCTION

1.1 The Meaning of Terms: English is such a language that readers may not know the meaning of certain words appearing in the title of the Paper. I would like to give the meanings in the context and as applied to this Paper. The Period of Research is not uniform and may face a break at some stage and remain sluggish. Such a stage we call Stagnation. From the stage of stagnation, there is again a rise in research, of course the rise is gradual and remain at a lower level. This we call Transition which after some period may become stagnant. Sometimes after the stage of stagnation or transition, there is a fantastic increase of research over a long period with many researchers participating in it. That is, there is a revival of research. This we call a Renaissance. As on today we are in a stage of Renaissance in Physics and also science in general. The periods I mentioned here run into centuries and what I mean by increase or sluggishness in research is directly related to the number of researchers in the field.

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1.2 Our approach in brief: Looking upon the title of the Paper, the main topics to be discussed are Physics and Philosophy and the interplay of these two in the transition, stagnation and the renaissance of development of Physics. We shall define the terms in the title and deal with them extensively. List out the philosophers in each category with their photographs along with a brief description of their work. Plot a combined graph of the Period on the x-axis and each category of Scientists on the y-axis and study critically the approach of Renaissance from the Transition and Stagnation.

II PHILOSOPHY

2.1 What do you mean by Philosophy? Nair V.C.A [9] has given exhaustively the answer to this question and I reproduce the same in Italics:

The pocket Oxford Dictionary 7th edition 1984 page 552 gives the meaning of "Philosophy" as "Use of reason and argument in search for truth and knowledge of reality specially of the causes and nature of things and of the principles governing existence, perception, human behavior, and the material universe, particular system or set of beliefs reached by this system of conduct in life". The word, „Philosophy" is made up of two Greek words: σοφιγ – love and φιλεω – wisdom and so means, "Love of Wisdom". Philosophy embodies man"s striving to engage in a constant search in order to cognize the infinite, the "roots and causes" of all things existing and to call into the question everything he has achieved. Plato, the great philosopher of antiquity, said that "philosophy has its source in surprise and amazement". The great thinker Aristotle, the tutor of Alexander the Great, held that"all sciences pursue a special aim, except philosophy which alone of all sciences is free, for only this science exists for its own sake". separable from religion that, it helped towards a better understanding of religious dogma, while others were of the opinion that it was based on doubt and reason, and so was incompatible with religion, which proceeds from belief. Some of the thinkers maintain that philosophy is a doctrine about science and others like it to art while still others, for example, Albert Camus a French writer and philosopher assert that the only serious philosophical problem is that of suicide. In ancient Philosophy philosophers have to rake their brains over a great many problems which are now being studied by a whole army of scientists. To give an example, it was the Greek Thales of Miletus who divided the year into 365 days and the month into 30, but Plato, in order to make a harmony of numbers, made it exactly 3641 2 making the year 729 = 3 6 days and nights. Avicenna, who was called "Prince of Philosophy" by his contemporaries thought that motion is potentially contained in matter and amounts to its liability to be transformed. Thus, a convincing answer to the question, "What is Philosophy" can be that it is a "world outlook". It is a view of the world – of nature and society and a man's place in it – and an analysis of the possibilities of understanding and transforming it. But, it is also a conviction, a belief in the necessity for action on the basis of acquired knowledge. It is a blend of knowledge and assessment, knowledge and conviction, the emotional and rational. So philosophy is a special form of theoretical knowledge, involving not just an objective generalization of the entire human experience, but also the identification of moments in that experience which are of particular significance for man. According to the German philosopher Immanuel Kant, in philosophy we seek answers to three questions: "What can I know?", "What must I do?" and "What can I hope for?". According to Ludwig Wittgenstein, „philosophy" is not a theory but an activity. Charles Caleb Colton had quoted philosophy as one of the three modes of bearing the ills of life the other two being indifference and religion. According to Thomas Earnest Hulme, one of the main reasons for existence of philosophy is not that does provide you refuge for definitions. Ambrose Bierce said that philosophy is a "route of many roads leading

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from nowhere to nothing". Frederick the Great, however, had a different view. He said that "If I wish to punish a province, I would have it governed by philosophers". Alfred North Whitehead says that "Philosophy begins in wonder, and at the end, when philosophic thought has done its best, the wonder remains". Swami Chinmayananda one of the many Indian religious preachers said that "Philosophy is a view of life whereas religion is a way of life".

2.2 History of Philosophy: Ancient philosophy as historically the first form of the European thought, its birth on the basis of civilization and culture. Periodization of ancient philosophy and sources of its study. Medieval philosophy. The socio-historical context of the formation of medieval philosophy. Patriotic philosophy. Scholastic philosophy. Early Middle Ages. Scholasticism of the twentieth century. Mature scholasticism. Augustinism and its role in the development of scholasticism. Late scholasticism. Specific features of philosophy of the Renaissance, its integral unity with the culture, art and science of that epoch. Michelangelo, Rafael, Leonardo da Vinci. Philosophy of nature and science of modern times. Mathematics, physics and metaphysics in Cartesianism. Mechanism and its philosophical justification. The study of man in the philosophy of modern times.The natural phenomena in man and the human "nature" (essence). Investigation of the problems of cognition and methodology.Rationalism and its struggle against empiricism. German classical philosophy in the context of the social and cultural situation in Europe and Germany in the second half of the 18th century and the first half of the 19th century. Philosophy and other sciences. The role of German classical philosophy in rethinking and enriching the new European humanism. The modern philosophy. Philosophy of life. Positivism. Pragmatism. Phenomenology. Psychoanalysis. Existentialism.

III PHYSICS

3.1 What is Physics? This question cannot be answered in a simple sentence or even in a big paragraph. But, however I shall try and give appropriate answer from my past experience of teaching Applied Physics to Engineering students for nearly half a century (46 years). Well!!! I am 81 today. *"Physics is that branch of Science which deals with the effects of various forms of Energy regarding the position, Motion and States of Matter. Summing it up and put the same thing in another way, "Physics is the study of Matter and Energy and Energy possessed by Matter in its various forms."* Readers are not satisfied nor am I and hence I shall elaborate.

Physics is *the branch of science concerned with the nature and properties of matter and energy. The subject matter of physics includes mechanics, heat, light and other radiation, sound, electricity, magnetism, and the structure of atoms.*

Trying to sum up the question, *What is Physics?* is not entirely straightforward. The dictionary definition above only tells part of the story. Whilst it is accurate, it doesn't convey that physics has developed over time, as physicists have made discoveries and found new ways of understanding the universe.

Essentially, physics is all about trying to describe a complex universe by seeking answers to some really big questions by observing, experimenting and modelling. To understand the jugglery of topics covered in a subject like Physics will be made clear when one looks at Fig.1. Various concepts in Physics are expressed and explained in Mathematical terms which from the lower level of a simple algebraic equation to vector, Tensor equations involving linear and non-linear differential equations. In short, Mathematics has thus become the language of Physics which the present day engineers

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know that it is the language of engineering. One may glance at Fig. 2 to understand the extent of Mathematics used in the study of Physics.

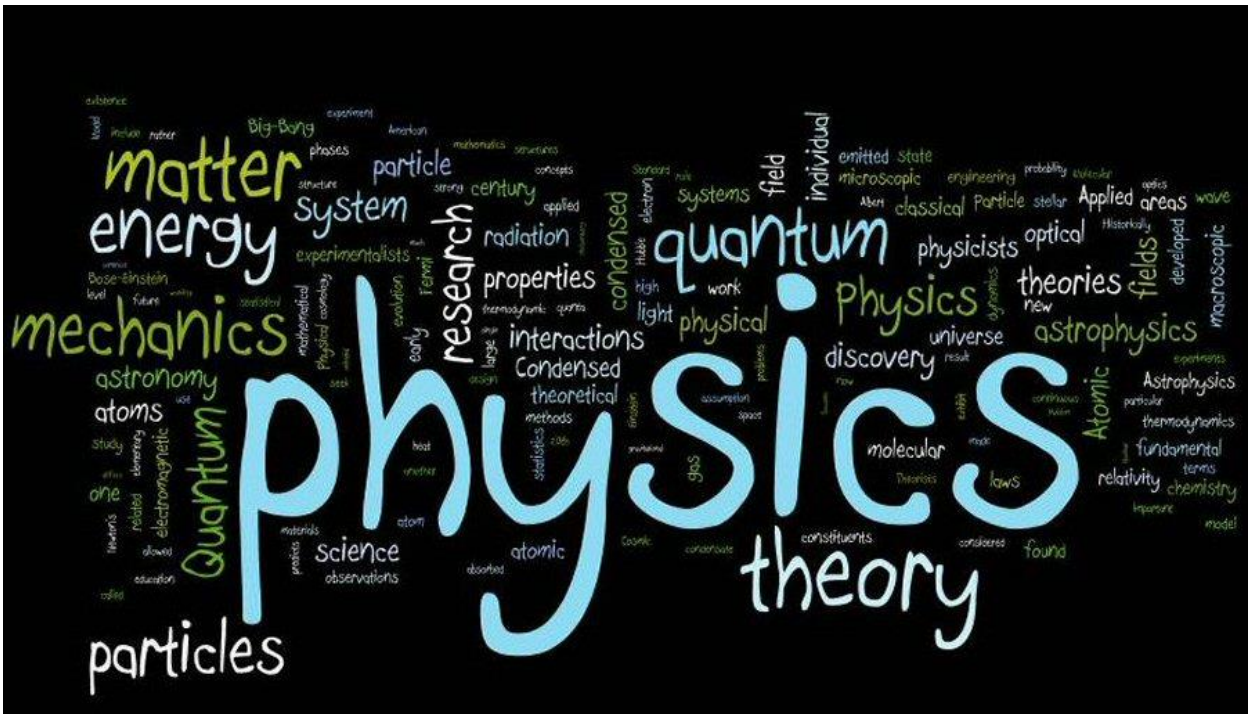

Fig.1 Picture illustration of the jugglery of Physics

3.2 History of Physics: The physical knowledge in Antiquity. From natural philosophy to Archimedes' statics and Ptolemy's geocentric system. Physics of the Middle Ages (11^{th} and 14^{th} centuries). Academic stagnation of European science. The emergence of universities. Physics in the Renaissance and the Copernican revolution in astronomy (15^{th} – 16^{th} centuries). Newton's creation of the basics of classical mechanics. The beginning of the formation of classical physics on the basis of an exact experiment, the phenomenological approach and the mathematical analysis. Physics of thermal phenomena. An experimental breakthrough into the microcosm; the crisis of classical physics: electromagnetic field in the world. Max Planck's quantum theory of radiation. Albert Einstein's light quanta. A particular theory of relativity. General theory of relativity. I. Bohr's quantum theory of the hydrogen atom and its generalization. Quantum mechanics. Quantum electrodynamics. Relativistic quantum theory of an electron and quantum field theory. Baselines of development of modern physics. Nuclear weapons and nuclear reactors. Problems of the controlled thermonuclear process. General characteristics of the quantum-relativistic picture of the world (paradigm). Unresolved problems of physics in the early 21st century. The problem of a unified theory of four fundamental interactions. Quantum theory of gravity and superstrings. The problem of future scientific revolutions in physics.

3.3 Philosophy of physics: Wikipedia [17]

The Philosophy of Physics deals with conceptual and interpretational issues in modern physics, many of which overlap with research done by certain kinds of theoretical physicists. Philosophy of physics can be broadly lumped into three areas:

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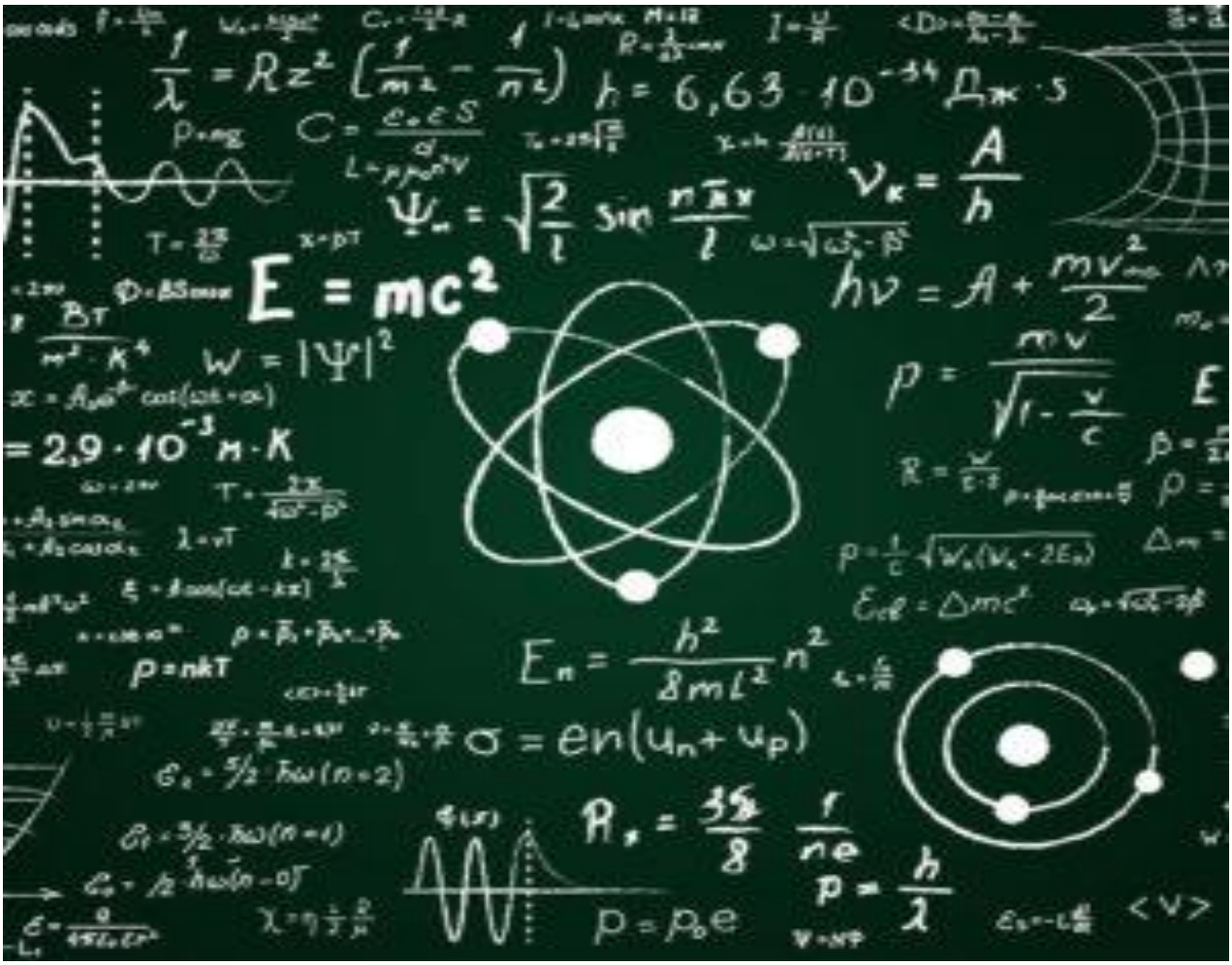

Fig.2 Picture illustrating that Mathematics is the language of Physics

- Interpretations of quantum mechanics: mainly concerning issues with how to formulate an adequate response to the measurement problem and understand what the theory says about reality
- The nature of space and time: Are space and time substances, or purely relational? Is simultaneity conventional or only relative? Is temporal asymmetry purely reducible to thermodynamic asymmetry?
- Inter-theoretic relations: the relationship between various physical theories, such as thermodynamics and statistical mechanics. This overlaps with the issue of scientific reduction with the study of matter and energy and how they interact.

Today, the **philosophy of physics** is very close to and the most active subtopic within **philosophy** of science.

3.3.1 Physics Needs Philosophy. Philosophy Needs Physics By Carlo Rovelli [6] is an Italian theoretical physicist, a philosopher physicist specialized in *Quantum Gravity*. (See Fig.58, Philosopher Physicists). I have extensively gone through his Research Paper. I would like readers to follow the same because when one reads between the lines of his article, the author has revealed that a majority of physicists hold supremacy of the subject ignoring the philosophical aspects of the same. He mentions that contrary to claims about the irrelevance of philosophy for science, he argues that philosophy has had, and still has, far more influence on physics than is commonly assumed. He

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maintains that the current anti-philosophical ideology has had damaging effects on the fertility of science. He also suggests that recent important empirical results, such as the detection of the Higgs particle and gravitational waves, and the failure to detect supersymmetry where many expected to find it, question the validity of certain philosophical assumptions common among theoretical physicists, inviting us to engage in a clearer philosophical reflection on scientific method.

Whether it is Archimedes Principle or Newton's Laws, Philosophy is inherent in their statements making Physics and Philosophy as two sides of the same coin. I would like to further highlight some important and highly meaningful statements made by the author.

Carlo Rovelli comes much against Steven Weinberg the Nobel Laureate and the architect of the Standard Model of the Elementary Particle Physics who argued eloquently that Philosophy is more damaging than helpful in Physics in support of which late Stephen Hawking said that 'Philosophy is dead'.

In item 2 p.484, the author says in his paper that philosophy can provide methods for producing new ideas, novel perspectives and critical thinking. Philosophers have tools and skills that Physics needs but do not belong to the physicists training: conceptual analysis, attention to ambiguity, accuracy of expression, the ability to detect gaps in standard arguments, to devise radically new perspectives, to spot conceptual weak points and to seek out alternative conceptual explanations. Nobody puts this better than Einstein himself, he says. The author quotes Aristotle, "Those who deny the utility of philosophy, are doing philosophy". The author further says that the views of scientists, whether they like it or not, are impregnated with philosophy. Far from being immune from philosophy, current Physics is deeply affected by philosophy. But the lack of philosophical awareness needed to recognize this influence and the refusal to listen to philosophers who try to make amends for it, is a source of weakness for Physics. In the conclusory part, the author ends by adding that *"what is clear to him is that 'the best science listens keenly to philosophy, so the best philosophy will listen keenly to science*."

I feel that no author other than Carlo Rovelli has ever tried to write such an article in support of philosophy.

3.3.2:The Role Of Philosophy In Physics By Chad Orzel [3]

Philosophers strive for conceptual clarity. Their training instills certain habits of thought—sensitivity to ambiguity, precision of expression, attention to theoretical detail—that are essential for understanding what a mathematical formalism might suggest about the actual world. Philosophers also learn to spot the gaps and elisions in everyday arguments. These gaps provide entry points for conceptual wedges: nooks where overlooked alternatives can take root and grow. The "shut up and calculate" ethos does not promote this critical attitude toward arguments; philosophy does.

3.3.3 Victor J. Stenger**,** et.al [16], Scientific American argues for the validity of philosophy in the context of modern theoretical physics and gives a controversial article as against the one given by Carlo Rovelli in section3.3.1. The authors are not in favor of belief that the progress in Physics or in general in Science is exclusively done only by Philosophers. They say that even Physicists are Philosophers in conformation with the title of their paper. So, it is really hard to understand what justifies it and so I would say that this tension occurs. So, it is really hard to understand what justifies it. And so, I would say that this tension occurs because people in Philosophy feel threatened – and they have every right to feel threatened, because Science progresses and Philosophy doesn't". Philosophical speculations about Physics and nature of Science are not particularly useful and have

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had little or no impact upon progress in my field. Even in several areas associated with what one can rightfully call the Philosophy of Science I have found the reflections of Physicists to be more useful. as against the statement of physicists that the building blocks of nature are discrete particles such as electron or quark, these authors argue that they Fields continuous fluid like objects spread throughout space. More precisely the Quantum Field Theory in curved space-time.

IV NATURAL PHILOSOPHY

4.1 Natural Philosophy or Philosophy of Nature: Wikipedia [18] Natural philosophy or philosophy of nature (from Latin *philosophia naturalis*) was the philosophical study of nature and the physical universe that was dominant before the development of modern science. It is considered to be the precursor of natural science.

From the ancient world, starting with Aristotle, to the 19th century, *natural philosophy* was the common term for the practice of studying nature. It was in the 19th century that the concept of "science" received its modern shape with new titles emerging such as "biology" and "biologist", "physics" and "physicist" among other technical fields and titles; institutions and communities were founded, and unprecedented applications to and interactions with other aspects of society and culture occurred. Isaac Newton's book *Philosophiae Naturalis Principia Mathematica* (1687), whose title translates to "Mathematical Principles of Natural Philosophy", reflects the then-current use of the words "natural philosophy", akin to "systematic study of nature". Even in the 19th century, a treatise by Lord Kelvin and Peter Guthrie Tait, which helped define much of modern physics, was titled *Treatise on Natural Philosophy* (1867). In the 14th and 15th centuries, natural philosophy was one of many branches of philosophy, but was not a specialized field of study. The first person appointed as a specialist in Natural Philosophy *per se* was Jacopo Zabarella (1533–1589) (See Fig serial No. 15-A,Natural Philosophers) at the University of Padua in 1577.

V THE RENAISSANCE

5.1 Scientific Renaissance: Marie Boas Hall (1919 – 2009) [8] the US historian of science and is considered one of the postwar period pioneers of the study of the Scientific Revolution during the 16th and 17th centuries, She coined the term ***Scientific Renaissance*** to designate the early phase of the Scientific Revolution, 1450–1630. More recently, Peter Robert Dear [12] the American author of History of Science and Technology has argued for a two-phase model of early modern science: a *Scientific Renaissance* of the 15th and 16th centuries, focused on the restoration of the natural knowledge of the ancients; and a *Scientific Revolution* of the 17th century, when scientists shifted from recovery to innovation.

The Renaissance was a period in European history marking the transition from the Middle Ages to Modernity and covering the 15th and 16th centuries. It occurred after the Crisis of the Late Middle Ages and was associated with great social change. which began approximately in 1300 and occupied a Part of: 16th century,

5.2 Greek Philosophy precedes Scientific Renaissance: According to Wikipedia [19] and [20] before the Scientific Renaissance, the origin of Greek Philosophy started at the School of Philosophy at Athens, Greece (Fig. 3)

The 14th century saw the beginning of the cultural movement of the Renaissance. The rediscovery of ancient texts was accelerated after the Fall of Constantinople in 1453, when many Byzantine scholars had to seek refuge in the West, particularly Italy. Also, the invention of

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the printing press was to have great effect on European society: the facilitated dissemination of the printed word democratized learning and allowed a faster propagation of new ideas.

But this initial period is usually seen as one of scientific backwardness. There were no new developments in physics or astronomy, and the reverence for classical sources further enshrined the Aristotelian and Ptolemaic views of the universe. Renaissance philosophy lost much of its rigor as the rules of logic and deduction were seen as secondary to intuition and emotion. At the same time, Renaissance humanism stressed that nature came to be viewed as an animate spiritual creation that was not governed by laws or mathematics. Science would only be revived later, with such figures as Copernicus, Gerolamo Cardano, Francis Bacon, and Descartes.

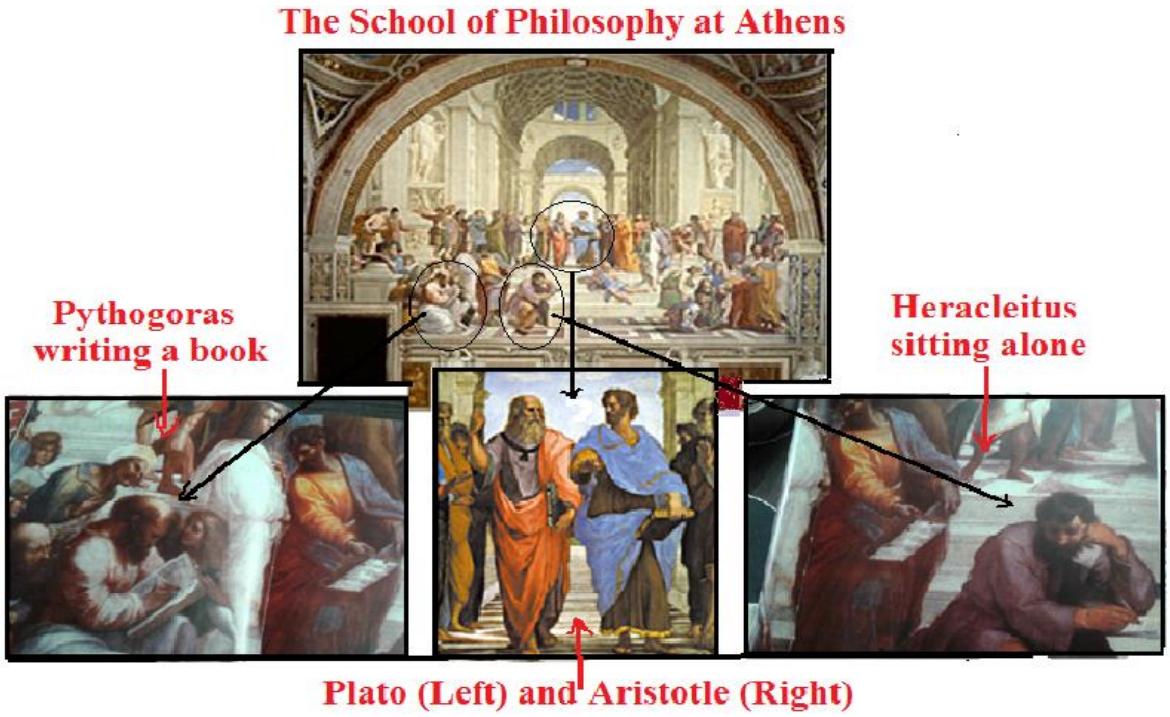

Fig.3 An illustrative figure of the School of Philosophy at Athens

The designation "**Renaissance philosophy**" is used by scholars of intellectual history to refer to the thought of the period running in Europe roughly between 1355 and 1650 (the dates shift forward for central and northern Europe and for areas such as Spanish America, India, Japan, and China under European influence). It therefore overlaps both with late medieval philosophy, which in the fourteenth and fifteenth centuries was influenced by notable figures such as Albert the Great, Thomas Aquinas, William of Ockham, and Marsilius of Padua, and early modern philosophy, which conventionally starts with René Descartes and his publication of the *Discourse on Method* in 1637.]

VI NATURAL PHILOSOPHERS
VII RENAISSANCE PHILOSOPHERS
VIII PHILOSOPHER PHYSICISTS

6.1, 7.1 and 8.1 The Description with pictures and their achievements in brief: Our next work is going to be a Herculian task. In the section VI (6.1) will be given possible numbers of Natural Philosophers; in section VII (7.1) will be given the Renaissance Philosophers and in section VIII

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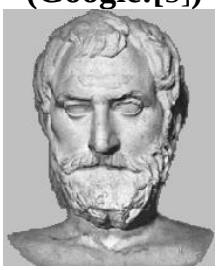
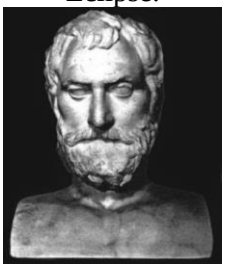
(8.1) will be given the possible number of Philosopher Physicists. The reference year in each case is the year of birth of each scientist.

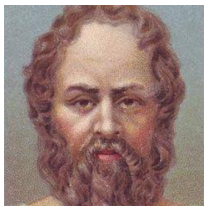
VI NATURAL PHILOSOPHERS (Google:[5])



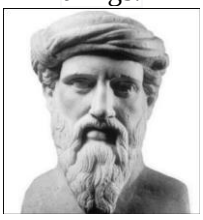
1. Thales of Miletus (626/623–548/545 BC)
The first Greek philosopher scientist who proposed that the world is made up of water and Erh is a disc floating on it. He also explained Earthquakes without assigning it to the work of Gods. In 585 BC, he correctly predicted a Solar Eclipse.



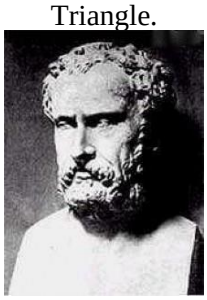
2.Anaximender (610 BC – 546 BC)
Devised a cylindrical model of the Earth



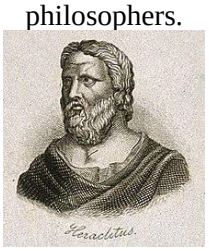
3.Anaximenes of Miletus (585 BC-526 BC)
A Greek inhabitant of Miletus best known for his doctrine that Air is the source for all things.



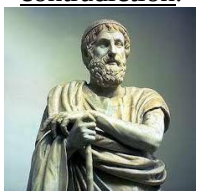
4. Pythagoras (570 BC-495 BC)
Taught that Earth is a sphere and planets move in circles as circle is very much related to right-angled Triangle.



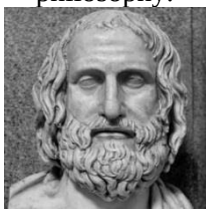
5.Xenophanes (570 BC- 478 BC)
Xenophanes of Colophon was a Greek philosopher, theologian, poet, and social and religious critic. Xenophanes is seen as one of the most important pre-socratic philosophers.



6. Heraclitus (535 BC-475 BC) was a pre-Socratic Ionian Greek philosopher, and a native of the city of Ephesus, in modern-day Turkey and then part of the Persian Empire. He was a scientific cosmologist, a metaphysician, or mainly a religious thinker; an empiricist, a rationalist, or a mystic; a conventional thinker or a revolutionary; a developer of logic or one who denied the law of non-contradiction.



7.Parmenides of Elea (515 BC – 475 BC)
He was a pre-Socratic Greek philosopher from Elea in Magna Graecia. He is thought to have been in his prime around 475 BC. Parmenides has been considered the founder of metaphysics or ontology and has influenced the whole history of Western philosophy.



8. Anaxagoras (510 BC – 428 BC)
Anaxagoras described the world as a mixture of primary imperishable ingredients, where material variation was never caused by an absolute presence of a particular ingredient, but rather by its relative preponderance over the other ingredients; in his words, "each one is... most manifestly those things of which there are the most in it". He introduced the concept of *Nous* (Cosmic Mind) as an ordering force, which moved and separated out the original mixture which was homogeneous , or nearly so. He also gave a number of novel scientific accounts of natural phenomena. He deduced a correct explanation for eclipses and described the Sun as a fiery mass larger than the Peloponnese, as well as attempting to explain rainbows a nd meteors.

9. Empedocles 494 BC- 434BC
According to him, All things are made up of four elements: fire, air, Earth and water Change and motion are due to the corporeal substances Love] (Aphrodite) and Strife. The sphere of Empedocles Theories about respiration (the clepsydra exp eriment) Emission theory of Vision

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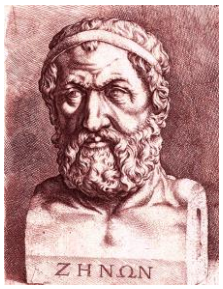
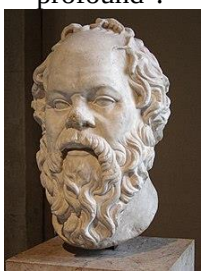
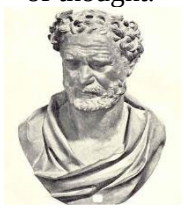


10. Zeno of Elea (490 BC – 430 BC) Zeno of Elea was a pre-Socratic Greek philosopher of Magna Graecia and a member of the Eleatic School founded by Parmenides. Aristotle called him the inventor of the dialectic. He is best known for his paradoxes, which Bertrand Russell described as "immeasurably subtle and profound".



11. Socrates (470 BC-399 BC) Socrates was a Greek philosopher from Athens who is credited as one of the founders of Western philosophy, and as being the first moral philosopher of the Western ethical tradition of thought.



12. Democritus (460 BC – 370 BC) He was an Ancient Greek pre-Socratic philosopher pri marily remembered today for his formulation of an atomic theory of the universe.

13. Plato (428/427 or 348/347 BC) Plato was an Athenian philosopher during the Classical period in Ancient Greece, founder of the Platonist school of thought, and the Academy, the first institution of higher learning in the Western world.

14. Lucretius (99 BC – 55 BC) He was a Roman poet and philosopher. His only known work is the philosophical poem *De rerum natura*, a didactic work about the tenets and philosophy of Epicureanis m, and which usually is translated into English as *On the Nature of Things*. Lucretius has been credited with originating the concept of the three-age system that was formalized in 1836 by C. J. Thomsen.

15. Bernardino Telesio (1509 – 1588) He was an Italian philosopher and natural scientist. While his natural theories were later disproven, his emphasis on observation made him the "first of the moderns" who eventually developed the scientific method.

15. A Jacopo Zabarella (1533 – 1589) He was the first person appointed as a specialist in Natural Philosophy *per se* at the University of Padua in 1577.

16. Francis Bacon (1561-1626) Also known as Lord Verulam, was an English philosopher and statesman who served as Attorney General and as Lord Chancellor of England. His works are credited with developing the scientific method and remained influential through the scientific revolution

17. Hugo Grotius (1583 – 1645) He was a teenage intellectual prodigy, born in Delft and studied at Leiden University. He wrote most of his major works in exile in France. He was a major figure in the fields of philosophy, political theory and law during the sixteenth and seventeenth century

18. Robert Boyle (1627 – 1691) Robert Boyle FRS was an Anglo-Irish

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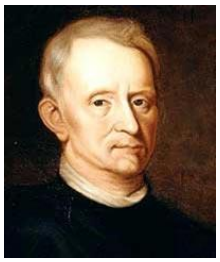
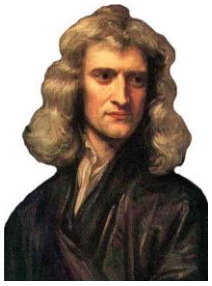
natural philosopher, chemist, physicist, and inventor. Boyle is largely regarded today as the first modern chemistry, and one of the pioneers of modern experimental scientific method.

19. Christiaan Huygens (1629 – 1695)
Christiaan Huygens FRS, , was a Dutch physicist, mathematician, astronomer and inventor. Made Pendulum Clocks. Proposed Wave Theory of Light. Discovered Titan and recognized the nature of Saturn's Rings He is widely regarded as one of the greatest scientists of all time and a major figure in the scientific revolution.



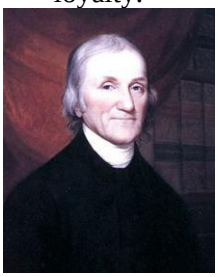
20. Robert Hooke (1635 – 1703)
Robert Hooke FRS was an English scientist and architect, a polymath, recently called "England's Leonardo", who, using a microscope, was the first to visualize a microorganism. Famous for the Law on Elasticity named after him.



21. Sir Isaac Newton (1642 – 1727)
He was an English mathematician, physicist, astronomer, theologian, and author (described in his own day as a "natural philosopher"). Discoverer of the of Gravity and and the Laws of Motion that bears his name. Developed Calculus and studied Optics. He is widely recognised as one of the most influential scientists of all time and as a key figure in the scientific revolution.

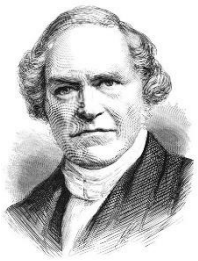
22. Gottfried Wilhem Leibnitz (1646 – 1716)
He was a prominent German polymath and one of the most important logicians, mathematicians and natural philosophers of the Enlightenment.

23. Adam Ferguson (1723 – 1816) He was a Scottish philosopher and historian of the Scottish Enlightenment. Ferguson was sympathetic to traditional societies, such as the Highlands, for producing courage and loyalty.



24. Joseph Priestley (1733 – 1804)
Joseph Priestley FRS was an English chemist, natural philosopher, separatist theologian, grammarian, multi-subject educator, and liberal political theorist who published over 150 works.

25. Friedrich Wilhem Jo (1775 – 1854)
He was a German philosopher. Standard histories of philosophy make him the midpoint in the development of German idealism, situating him between Johann Gottlieb Fichte, his mentor in his early years, and Georg Wilhelm Friedrich Hegel, his one-time university roommate, early friend, and later rival. Interpreting Schelling's philosophy is regarded as difficult because of its evolving nature.



26. William Whewell (1794 – 1866)
Rev Dr William Whewell DD FRS FGS HFRSE was an English polymath, scientist, Anglican priest, philosopher, theologian, and historian of science. He was Master of

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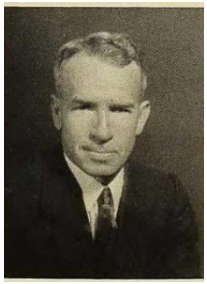
Trinity College, Cambridge. In his time as a student there, he achieved distinction in both poetry and mathematics.

27. George Santayana (1863 – 1952) . George Santayana, was a philosopher, essayist, poet, and novelist. Originally from Spain, Santayana was raised and educated in the US from the age of eight and identified himself as an American,



28. Edwin Arthur Burtt (1892 –1989) He was an American philosopher who wrote extensively on the philosophy of religion. His doctoral thesis published as a book under the title *The Metaphysical Foundations of Modern Physical Science* has had a significant influence upon the history of science.

29. Earnst Mayr (1904 – 2005) Ernst Walter Mayr was one of the 20th century's leading evolutionary biologists. He was also a renowned taxonomist, tropical explorer, ornithologist, philosopher of biology, and historian of science.

30. John Dupre (1952 -) . John A. Dupré is a British philosopher of science. He is the director of Egenis, the Centre for the Study of Life Sciences, and professor of philosophy at the University of Exeter. Dupré's chief work area lies in philosophy of biology, philosophy of the social sciences, and general philosophy of science.

VII RENAISS-ANCE PHILOSO-PHERS (Google: [6])

1. Gemistus Pletho (1355 – 1452) Georgius Gemistus, later called Plethon, was one of the most renowned philosophers of the late Byzantine era. He was a chief pioneer of the revival of Greek scholarship in Western Europe.In 1438-1439, he re-introduced Plato's ideas to Western Europe

2. Leonardo Bruni (1370 – 1444) Leonardo Bruni was an Italian humanist, historian and statesman, often recognized as the most important humanist historian of the early Renaissance. He has been called the first modern historian. He was the earliest person to write using the three-period view of history: Antiquity, Middle Ages, and Modern.

3. George of Trebizond (1395 – 1484) He was one of the most significant figures of the Renaissance. He emigrated to Venice in 1416 and established himself with remarkable rapidity as a teacher of Latin and rhetoric in Venice and the Veneto. In the late 1430s he entered the papal court, then resident in Florence. In 1444, after the papacy had returned to Rome. He had published what became one of the classic Neo-Latin texts of the Renaissance, the *Rhetoricorum Libri V*, to which in Florence in the late 1430s he added the *Isagoge Dialectica*.

4. Ninholas of Cusa (1401 – 1464) Nicholas of Cusa, also referred to as Nicholas of Kues and Nicolaus

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Cusanus, was a German philosopher, theologian, jurist, and astronomer. One of the first German proponents of Renaissance humanism, he made spiritual and political contributions in European history.

5. Basilios Bessarion(1403 – 1472)

He was a Catholic cardinal bishop and the titular Latin Patriarch of Constantinople, was one of the illustrious Greek scholars whoContributed to the great revival of letters in the 15th century. He was educated by Gemistus Pletho in Neoplatonic philosophy.

6. Leon Battista Albert

(1404 – 1472)

He was an Italian Renaissance humanist author, artist, architect, poet, priest, linguist, philosopher and cryptographer; he epitomised the Renaissance Man.

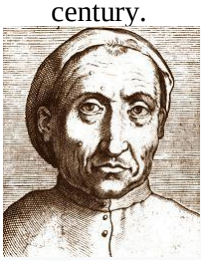
7. Marsilio Ficino

(1433 – 1499)

He was an Italian scholar and Catholic priest who was one of the most influential humanist philosophers of the early Italian Renaissance. He was an astrologer, a reviver of Neoplatonism in touch with the major academics of his day and the first translator of Plato's complete extant works into Latin.

8. Rodolphus Agricol (1443 – 1485)

He was a pre-Erasmian humanist of the northern Low Countries, famous for his supple Latin and one of the first north of the Alps to know Greek well. He is best known today as the author of *De inventione dialectica*, as the father of northern European humanism and as a zealous anti-scholastic in the late-fifteenth century.



9. Pietro Pomponazzi (1462 – 1525)

He Studied at Padua, where he became a medical doctor in 1487. In 1488 he was elected extraordinary professor of philosophy at Padua. From about 1495 to 1509 he occupied the chair of natural philosophy until the closing of the schools of Padua, when he took a professorship at Ferrara where he lectured on the Aristotle's *De anima* (the soul) and entelechy. In 1512 he was invited to Bologna where he remained until his death.

10. Giovanni Pico della Mirandola (1463 – 1494)

He was an Italian Renaissance nobleman and philosopher. He is famed for the events of 1486, when, at the age of 23, he proposed to defend 900 theses on religion, philosophy,

11. Desiderius Erasmus (1466 – 1536)

He was a Dutch philosopher and Christian scholar who is widely considered to have been one of the greatest scholars of the northern Renaissance. As a Catholic priest, Erasmus was an important figure in classical scholarship who wrote in a pure Latin style.

12. Niccolo Machiavelli (1469 – 1527)

He was an Italian Renaissance diplomat, philosopher and writer, best known for The

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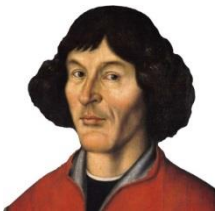
Prince, written in 1513. He has often been called the father of modern political philosophy or political science.



13. Nicolaus Copernicus (1473 – 1543) was a Renaissance-era mathematician and astronomer, who formulated a model of the universe that placed the Sun rather than Earth at the center of the universe, in all likelihood independently of Aristarchus of Samos, who had formulated such a model some eighteen centuries earlier.

14. Sir Thomas More (1478 – 1535) Sir Thomas More, venerated in the Catholic Church as Saint Thomas More, was an English lawyer, social philosopher, author, statesman, and noted Renaissance humanist. He also served Henry VIII as Lord High Chancellor of England from October 1529 to May1532.

15. Francisco de Vitoria (1483 – 1546) Francisco de Vitoria OP was a Spanish Roman Catholic philosopher, theologian, and jurist of Renaissance Spain. He is the founder of the tradition in philosophy known as the School of Salamanca, noted especially for his contributions to the theory of just war and international law

16. Martin Luther (1483 – 1546) Martin Luther, O.S.A. was a German professor of theology, composer, priest, Augustinian monk, and a seminal figure in the Protestant Reformation. Luther was ordained to the priesthood in 1507.

17. Juan Luis Vives (1493 – 1540) He was a Spanish scholar and Renaissance humanist who spent most of his adult life in the Southern Netherlands. His beliefs on the soul, insight into early medical practice, and perspective on emotions, memory and learning earned him the title of the "father" of modern psychology.

18. Bernandino Telesio (1509-1588) He was an Italian philosopher and natural scientist. While his natural theories were later disproven, his emphasis on observation made him the "first of the moderns" who eventually developed the scientific method.

19. Franciscus Patricius (1529 – 1597) He was a philosopher and scientist from the Republic of Venice of Croatian descent. He was known as a defender of Platonism and an opponent of Aristotelianism.

20. Jean Bodin (1530 – 1596) He *was a French jurist and political philosopher, member of the Parlement of Paris and professor of law in Toulouse. He is best known for his theory of sovereignty; he was also an influential writer* on demonology

21. Jacopo Zabrella (1533 – 1589) Zabarella was born into a noble Paduan family. He received

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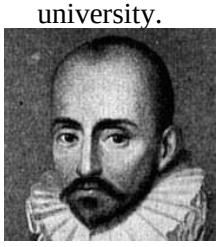
a humanist edu cation and entered the University of Padua, where he received a doctorate in 1553. His teachers included France sco Robortello in humanities, Ber nardino Tomitano in logic, Marcanto nio Genua in physics and metaphysics, and Pietro Catena in mathematics. In 1577 he was promoted to the first extraordinary chair of natural philosophy. He died in Padua at the age of 56 in 1589. His entire teaching career was spent at his native university.



22. Michel de Montaigne (1533 – 1592) was one of the most significant philosophers of the French Renaissance, known for popularizing the essay as a literary genre. His work is noted for its merging of casual anecdotes and autobiography with intellectual insight.

23. Justus Lipsius (1547 – 1596) was a Flemish philologist, philosopher and humanist. Lipsius wrote a series of works designed to revive ancient Stoicism in a form that would be compatible with Christianity. The most famous of these is De Constantia.

24. Francisco Suarez (1548 – 1617) was a Spanish Jesuit priest, philosopher and theologian, one of the leading figures of the School of Salamanca movement, and generally regarded among the greatest scholastics after Thomas Aquinas.

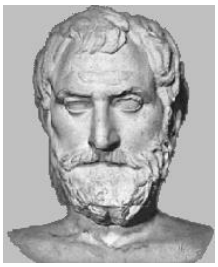
25. Giordino Bruno (1548 – 1600) was an Italian Dominican friar, philosopher, mathematician, poet, cosmological theorist, and Hermetic occultist. He is known for his cosmological theories, which conceptually extended the then-novel Copernican model.

26. Tommaso Campanella (1568 – 1639) was a child prodigy. Son of a poor and illiterate cobble r, he entered the Dominican Order before the age of fourteen,[2] taki ng the name of fra' Tommaso in honour of Thomas Aquinas. He studied theology and philosophy with several masters.

27. Paul Oskar Kristeller (1905 – 1999) was an important scholar of Renaissance humanism. He was awarded the Haskins Medal in 1992. He was last active as Professor Emeritus of Philosophy at Columbia University in New York, where he mentored both Irving Louis Horowitz and A. James Gregor.

28. Paul Richard Blum (1950 - . . . . .) He is a professor of Renaissance Philosophy at Loyola University, Maryland, US; Member of Renaissance Society of America and also a member of Society for Medieval and Renaissance Philosophy.

VIII PHILOSOPHER PHYSICISTS (Google: [7])



1.Thales of Miletus (626/623 BC – 548/545 BC) was a Greek mathe matician, astron omer and pre-Socratic philosopher fro m Miletus in Io nia, Asia Minor. He was one of the Seven Sages of Greece. Many, most

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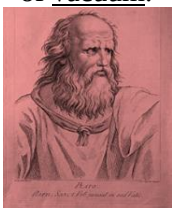
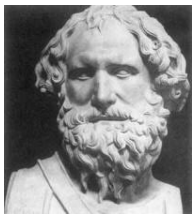
notably Aristotle, regarded him as the first philosopher in the Greek tradition, and he is otherwise historically recognized as the first individual in Western civilization known to have entertained and engaged in scientific philosophy.

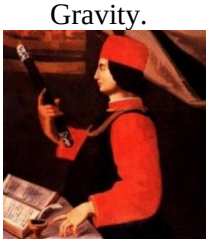
2. Leucippus (Lived in 5th Century BC) have been a philosopher who was the earliest Greek to develop the theory of atomism—the idea that everything is composed entirely of various imperishable, indivisible elements called atoms. Aristotle and his student Theophrastus explicitly credit Leucippus with the invention of atomism. In Aristotelian terms Leucippus agreed with the Eleatic argument that "true being does not admit of vacuum" and there can be no movement in the absence of vacuum.



3. Plato (428/427 BC – 348/347) Plato was an Athenian philosopher during the Classical period in Ancient Greece, founder of the Platonist school of thought, and the Academy, the first institution of higher learning in the Western world.

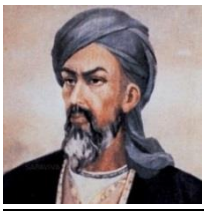


4. Archimedes (288 BC – 212 BC) was a Greek mathematician, physicist, engineer, inventor, and astronomer. He is regarded as one of the leading scientists in classical antiquity. Considered to be the greatest mathematician of ancient history, and one of the greatest of all time. Archimedes anticipated modern calculus and analysis by applying concepts of infinitesimals and the method of exhaustion to derive and rigorously prove a range of geometrical theorems, including: the area of a circle; the surface area and volume of a sphere; area under an ellipse, parabola and hyperbola and the volume of revolution of such figures and the area of a spiral; Well known for the Laws of Floatation, Density and Specific Gravity.

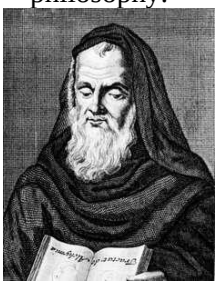


5. John Philoponus (490 – 570) John Philoponus, also known as John the Grammarian or John of Alexandria, was a Byzantine Alexandrian philologist, Aristotelian commentator and Christian theologian, author of a considerable number of philosophical treatises and theological works.

6. Ibn Al Haytham Al Hazen (965 – 1040) Ḥasan Ibn al-Haytham was an Arab mathematician, astronomer, and physicist of the Islamic Golden Age. Referred to as "the father of modern optics", he made significant contributions to the principles of optics and related properties.



7. Avicenna (980 – 1037) is regarded as one of the most significant physicians, astronomers, thinkers and writers of the Islamic Golden Age,[10] and the father of early modern medicine.[11][12][13] Avicenna is also called "the most influential philosopher of the pre-modern era".[14] He was a Peripatetic philosopher influenced by Aristotelian philosophy.



8. Roger Bacon (1220 – 1292) Roger Bacon OFM, also known by the scholastic accolade Doctor Mirabilis, was a medieval English philosopher and

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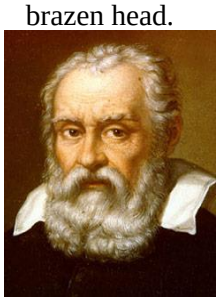
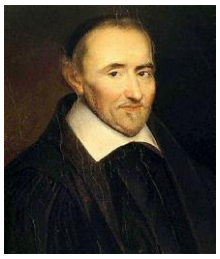
Franciscan friar who placed considerable emphasis on the study of nature through empiricism. He was regarded as a wizard and particularly famed for the story of his mechanical or necromantic brazen head.



9. Galileo Galelei
(1564 – 1642)
Galileo Galilei was an Italian astronomer, physicist and engineer, sometimes described as a polymath, from Pisa. Galileo has been called the "father of observational astronomy", the "father of modern physics", the "father of the scientific method", and the "father of modern science".

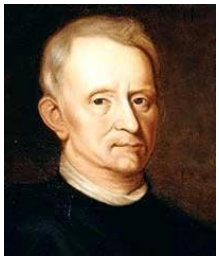


10. Pierre Gassendi
(1592 – 1655)
Pierre Gassendi was a French philosopher, priest, astronomer, and mathematician. He wasa leader of right thinking intellectuals.

10. A Jaques Rohalt
(1618 – 1672)
Rohault was born in Amiens, France, the son of a wealthy wine merchant, and educated in Paris. Having grown up with the conventional scholastic philosophy of his day, he adopted and popularized the new Cartesian physics.

11. Robert Boyle
(1627 – 1691)
Robert Boyle FRS was an Anglo-Irish natural philosopher, chemist, physicist, and inventor. Famous for the Law named after him for the pressure and volume of gases. Boyle is largely regarded today as the first modern chemist, and therefore one of the founders of modern chemistry, and one of the pioneers of modern experimental scientific method.

12. Christiaan Huygens
(1629 – 1695)
Christiaan Huygens FRS, , was a Dutch physicist, mathematician, astronomer and inventor. Made Pendulum Clocks. Proposed Wave Theory of Light. Discovered Titan and recognized the nature of Saturn's Rings He is widely regarded as one of the greatest scientists of all time and a major figure in the scientific revolution



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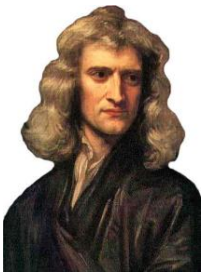

14. Sir Isaac Newton
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15. Gottfried Wilhelm
(1646 – 1716)
Gottfried Wilhelm

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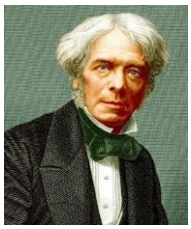
Leibniz was a prominent German polymath and one of the most important logicians, mathematicians and natural philosophers of the Enlightenment. Leibniz developed, as his most prominent accomplishment, the ideas of differential and integral calculus, independently of Isaac Newton's contemporaneous developments. Mathematical works have consistently favored Leibniz's notation as the conventional expression of calculus.

16. Jean le Rond d'Alembert
(1717 – 1783)
Jean-Baptiste le Rond d'Alembert was a French mathematician, mechanician, physicist, philosopher, and music theorist. D'Alembert's formula for obtaining solutions to the wave equation is named after him.

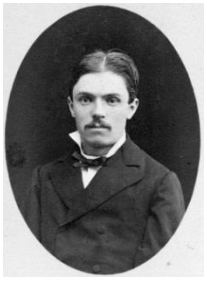


17. Michael Faraday
(1791 – 1867)
Michael Faraday FRS was an English scientist who contributed to the study of electromagnetism and electrochemistry. His main discoveries include the principles underlying electromagnetic induction, diamagnetism and electrolysis.

18. Herman Von Helmholtz
(1821 – 1894)
Hermann Ludwig Ferdinand von Helmholtz was a German physicist and physician who made significant contributions in several scientific fields. The largest German association of research institutions, the Helmholtz Association, is named after him.

19. Earnst Mach
(1838 – 1916)
Ernst Waldfried Josef Wenzel Mach was an Austrian physicist and philosopher, noted for his contributions to physics such as the study of shock waves. The ratio of one's speed to that of sound is named the Mach number in his honor

20. Ludwig Boltzmann
(1844 – 1906)
Ludwig Eduard Boltzmann was an Austrian physicist and philosopher. His greatest achievement was in the development of statistical mechanics, which explains and predicts how the properties of atoms determine the physical properties of matter.



21. Henri Poincare
(1854 – 1912)
Jules Henri Poincaré was a French mathematician, theoretical physicist, engineer, and philosopher of science. He is often described as a polymath, and in mathematics as "The Last Universalist", since he excelled in all fields of the discipline as it existed during his lifetime.

22. Heinrich Hertz
(1857 – 1894)
Heinrich Rudolf Hertz was a German physicist who first conclusively proved the existence of the electromagnetic waves predicted by James Clerk Maxwell's equations of electromagnetism. The unit of frequency, cycle per second, was named the "hertz" in his honor.

23. Sir James Jeans
(1877 – .1946)
Sir James Jeans FRS was an English physicist, astronomer and mathematician.

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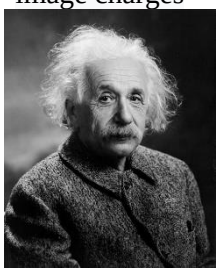
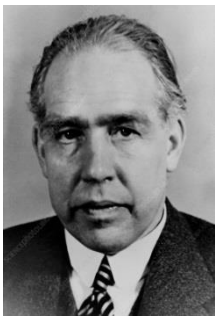
who was the first to propose that matter is continuously created throughout the universe. His other contributions are: Jeans instability Rayleigh–Jeans law Jeans mass Jeans length Jeans equations Jeans's theorem Method of image charges



24. Albert Einstein (1879 – (1955) Albert Einstein was a German-born theoretical physicist who developed the theory of relativity, one of the two pillars of modern physics. Nobel Laureate of 1921 for the explanation of the Photoelectric effect. His work is also known for its influence on the philosophy of science.

25. MMoritz Schlick (1882-1936) Friedrich Albert Moritz Schlick was a German philosopher, physicist, and the founding father of logical positivism and the Vienna Circle.

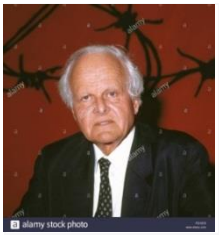
26. Philipp Frank (1884 – 1966) was a physicist, mat hematician and also a philosopher d uring the first half of the 20th century. He was a logical-positivist, and a member of the Vienna Circle. He was influenced by Mach and was one of the Machists criticised by Lenin in Mat erialism and Empirio-criticism.



27. Niels Bohr (1885 – 1962) . Niels Henrik David Bohr was a Danish physicist who made foundational contributions to understanding atomic structure and quantum theory, for which he received the Nobel Prize in Physics in 1922. Bohr was also a philosopher and a promoter of scientific research

28. llse Rosenthal Schneider (1891 - 1990) Llse Rosenthal-Schneider was a German-Australian physicist and philosopher. She is best known for her collaboration and correspondence with physicists Albert Einstein, Max von Laue, and Max Planck. Rosenthal-Schneider earned a PhD in philosophy in 1920 at the University of Berlin, where she first met Albert Einstein

29. Werner Heisenberg (1901 – 1976) Werner Karl Heisenberg was a German theoretical physicist and one of the key pioneers of quantum mechanics. He published his work in 1925 in a breakthrough paper. Famous for the Uncertainty Principle named after him



30. Carl Friedrich Von Weiszaker (1912 – 2007) Carl Friedrich Freiherr von Weizsäcker was a German physicist and philosopher. He was the longest-living member of the team which performed nuclear research in Germany during the Second World War, under Werner Heisenberg's leadership.

31. David Bohm (1917 – 1972) David Joseph Bohm FRS was an American scientist who has been described as one of the most significant theoretical

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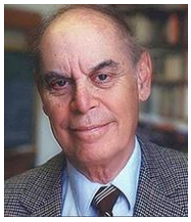
physicists of the 20th century and who contributed unorthodox ideas to quantum theory, neuropsychology and the philosophy of mind.

32. Mario Bunge (1919 – 2020) Mario Augusto Bunge was an Argentine philosopher and physicist who was mainly active in Canada.

33. Bernard d'Espagnat (1921 – 2015) Bernard d'Espagnat was a French theoretical physicist, philosopher of science, and author, best known for his work on the nature of reality. Wigner-d'Espagnat inequality is partially named after him.



34. Gerald Holton (1922 - . . . . .) Gerald J. Holton is an American physicist, historian of science, and educator, whose professional interests also include philosophy of science and the fostering of careers of young men and women. He is Mallinckrodt Professor of Physics and Professor of the History of Science Emeritus at Harvard University.

35. Thomas TKuhn (1922 – 1996) Thomas Samuel Kuhn was an American philosopher of science whose 1962 book The Structure of Scientific Revolutions was influential in both academic and popular circles, introducing the term paradigm shift, which has since become an English-language idiom.

36. Ernan Mc Mullin (1924 – 2011) Ernan McMullin was a philosopher who last served as the O'Hara Professor of Philosophy Emeritus at the University of Notre Dame. He was an internationally respected philosopher of science who has written and lectured extensively on subjects ranging from the relationship between cosmology and theology, to the role of values in understanding science,

37. John Stachel (1928 - . . . . . .) John Stachel is an American physicist and philosopher of science. After holding different teaching positions at Lehigh University and the University of Pittsburgh, he to Boston University in 1964 where he was professor of physics until his emeritation.

38. Abner Shimony (1928 – 2015) Abner Eliezer Shimony was an American physicist and philosopher. He specialized in quantum theory and philosophy of science. As a physicist he concentrated on the interaction between relativity theory and quantum mechanics.

39. Murray Gell-Mann (1929 – 2019) Murray Gell-Mann was an American physicist who received the 1969 Nobel Prize in Physics for his work on the theory of elementary particles.

40. Hugh Everett (1930-1982) Hugh Everett III was an American physicist who first proposed the many-worlds interpretation of quantum physics, which he termed his "relative state" formulation.

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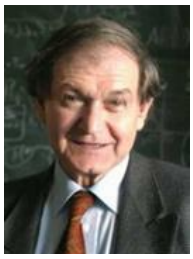


41. Roger Penrose (1931 - . . . .) Sir Roger Penrose OM FRS is an English mathematical physicist, mathematician and philosopher of science. He is Emeritus Rouse Ball Professor of Mathematics at the University of Oxford, an emeritus fellow of Wadham College, Oxford and an honorary fellow of St John's College, Cambridge.

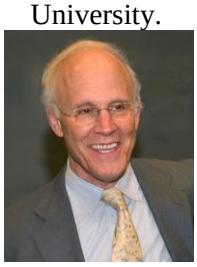
42. Roland Omnes (1931 - . . . . . .) is the author of several books which aim to close the gap between our common sense experience of the classical world and the complex, formal mathematics which is now required to accurately describe reality at its most fundamental level. Omnès is currently Professor Emeritus of Theoretical Physics in the Faculté des sciences at Orsay, at the Université Paris-Sud XI. He has been instrumental in developing the consistent histories and qu antum decoherence ap proaches in quantum mechanics.

43. Steven Weinberg (1933 - . . . . .) Steven Weinberg ForMemRS is an American theoretical physicist and Nobel laureate in Physics for his contributions with Abdus Salam and Sheldon Glashow to the unification of the weak force and electromagnetic interaction between elementary particles.

44. Victor J Stenger (1935 – 2014) Victor John Stenger was an American particle physicist, philosopher, author, and religious skeptic. Following a career as a research scientist in the field of particle physics, Stenger was associated with New Atheism and he authored popular science books.

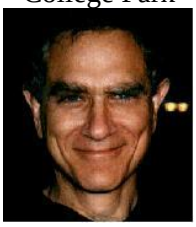
45. James T. Cushing (1937 – 2002) James Thomas Cushing was an American theoretical physicist and philosopher of science. He was professor of physics as well as professor of philosophy at the University of Notre Dame.

46. Allan Franklin (1938 - . . . . .) Allan David Franklin is an American physicist, historian of science, and philosopher of science. Franklin received in 1959 his bachelor's degree from Columbia University and in 1965 his PhD in physics from Cornell University.



47. David Gross (1941 - . . . . .) David Jonathan Gross is an American theoretical physicist and string theorist. Along with Frank Wilczek and David Politzer, he was awarded the 2004 Nobel Prize in Physics for their discovery of asymptotic freedom.

48. Jeffrey Bub (1942 - . . . .) Jeffrey Bub is a physicist and philosopher of physics, and Distinguished Professor in the Department of Philosophy, the Joint Center for Quantum Information and Computer Science, and the Institute for Physical Science and Technology at the University of Maryland, College Park



49. David Malament (1947 - . . . . . .) David B. Malament is an American

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philosopher of science, specializing in the philosophy of physics. His book *Topics in the Foundations of General Relativity and Newtonian Gravitation Theory* (Chicago, 2012) was awarded the 2014 Lakatos Award.

50. Frank J Tipler (1947 - . . . . .) Frank Jennings Tipler is an American mathematical physicist and cosmologist, holding a joint appointment in the Departments of Mathematics and Physics at Tulane University.

51. Dennis Dieks (1949 - . . . . .) Dennis Geert Bernardus Johan Dieks is a Dutch physicist and philosopher of physics He proposed a new interpretation of quantum mechanics, later known as a version of the modal interpretation of quantum mechanics. He also worked on the philosophy of space and time, the logic of probabilistic reasoning, and the theory of explanation.

52. Harvey Brown (1950 - …..) Harvey R. Brown, FBA is a philosopher of physics. He is emeritus professor of philosophy at the University of Oxford and a Fellow of Wolfson College, Oxford, as well as a Fellow of the British Academy. From 1978 to 1984, he was assistant professor at the University of São Paulo.

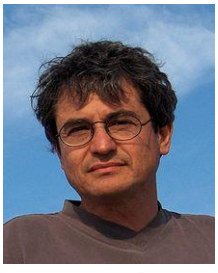
53. John D Barrow (1952-……) John David Barrow FRS is an English cosmologist, theoretical physicist, and mathematician. Most recently, he served as Gresham Professor of Geometry at Gresham College from 2008 to 2011. Barrow is also a writer of popular science and an amateur playwright.

54. David Albert (1954 - ……) David Z. Albert is Frederick E. Woodbridge Professor of Philosophy and Director of the M.A. Program in The Philosophical Foundations of Physics at Columbia University in New York.

55. Simon Saunders (1954 - . . . . .) Simon Wolfe Saunders is a British philosopher of physics. He is noted for his work on quantum mechanics, on identity and indiscernibility in physics, and on structural realism

56. Peter Galison (1955- ……..) Peter Louis Galison is an American philosopher of science. He is the Joseph Pellegrino University Professor in history of science and physics at Harvard University.

57. Lee Smolin (1955 - . . . . .) Lee Smolin is an American theoretical physicist, a faculty member at the Perimeter Institute for Theoretical Physics, an adjunct professor of physics at the University of Waterloo and a member of the graduate faculty of the philosophy department at the University of Toronto.



58. Carlo Rovelli (1956 - . . . . .) ***Carlo Rovelli*** is an Italian

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theoretical physicist and writer who has worked in Italy, the United States and, since 2000, in France. He works mainly in the field of quantum gravity and is a founder of loop quantum gravity theory. He has also worked in the history and philosophy of science.

59. Karen Barad
(1956 - . . . . .)
Karen Michelle Barad is an American feminist theorist, known particularly for her theory of agential realism. She is currently Professor of Feminist Studies, Philosophy, and History of Consciousness at the University of California, Santa Cruz.

60. Tim Maudlin
(1958 - …….)
Tim William Eric Maudlin is an American philosopher of science who has done influential work on the metaphysical foundations of physics and logic.

61. Craig Callender
(1968 - …..)
Craig Callender is a professor of philosophy at the University of California, San Diego. His main areas of research are philosophy of science, philosophy of physics and metaphysics.

62. Jenann Ismael
(1968 - ……)
Jenann . Ismael is a Professor of Philosophy at Columbia University and a member of the Foundational Questions Institute Ismael has been described by John Perry as a leading philosopher of her generation, and her work has been influential in the scholarship of metaphysics and the philosophy of physics.

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6.1 Table: No.1
(NATURAL PHILOSOPHERS)

No.	PERIOD	Serial No. of Scientists	Total	Grand Total
I	Classical Greece (625 BC – 384 BC)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13	13	
II	Macedonian Era (385 BC – 300 BC)	Nil	00	
III	Helenestic Greece (301 BC – 95 BC)	14	01	
IV	Late Roman Republic(96BC– 27 BC)	Nil	00	
V	Principate of the Roman Empire (100 AD – 500 AD)	Nil	00	
VI	Late Antiquity (500 AD – 1000 AD) (1001 AD – 1500 AD) (1501 AD - 2020 AD)	Nil Nil 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 and 30	00 00 16	30

7.1 Table: No.2
(RENAISSANCE PHILOSOPHERS)

No.	PERIOD	Serial No. of Scientists	Total	Grand Total
I	Classical Greece (625 BC – 384 BC)	Nil	00	
II	Macedonian Era (385 BC – 300 BC)	Nil	00	
III	Helenestic Greece (301 BC – 95 BC)	Nil	00	
IV	Late Roman Republic(96BC– 27 BC)	Nil	00	
V	Principate of the Roman Empire (100 AD – 500 AD)	Nil	00	
VI	Late Antiquity (500 AD – 1000 AD) (1001 AD – 1500 AD) (1501 AD - 2020 AD)	Nil 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17. 18, 19, 20, 21, 22, 23, 24, 25, 26, 27 and 28	00 17 11	28

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8.1 Table: No.3

PHILOSOPHER PHYSICISTS

No.	PERIOD	Serial No. of Scientists	Total	Grand Total
I	Classical Greece (625 BC – 384 BC)	1, 2 and 3	03	
II	Macedonian Era (385 BC – 300 BC)	4	01	
III	Helenestic Greece (301 BC – 95 BC)	Nil	00	
IV	Late Roman Republic (96BC–27 BC)	Nil	00	
V	Principate of the Roman Empire (100 AD – 500 AD)	5	01	
VI	Late Antiquity (500 AD – 1000 AD)	6 and 7	02	63
	(1001 AD – 1500 AD)	8	01	
	(1501 AD - 2020 AD)	8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61 and 62.	55	

Consolidated Grand Total: 30 + 28 + 63 = 121

This is slightly less as Thales of Miletus appears twice, Plato appears twice, Robert Boyle appears twice and Isaac Newton also appears twice. Jacopo Zabarella is both a Renaissance Philosopher and also a Philosopher Physicist and hence the Consolidated total is 121 – 05 = 116

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IX GRAPHICAL PRESENTATION

9.1 Plot a combined graph of the Period (x-axis) and the number of Scientists/Philosophers along the y-axis and the same is shown in Fig.4

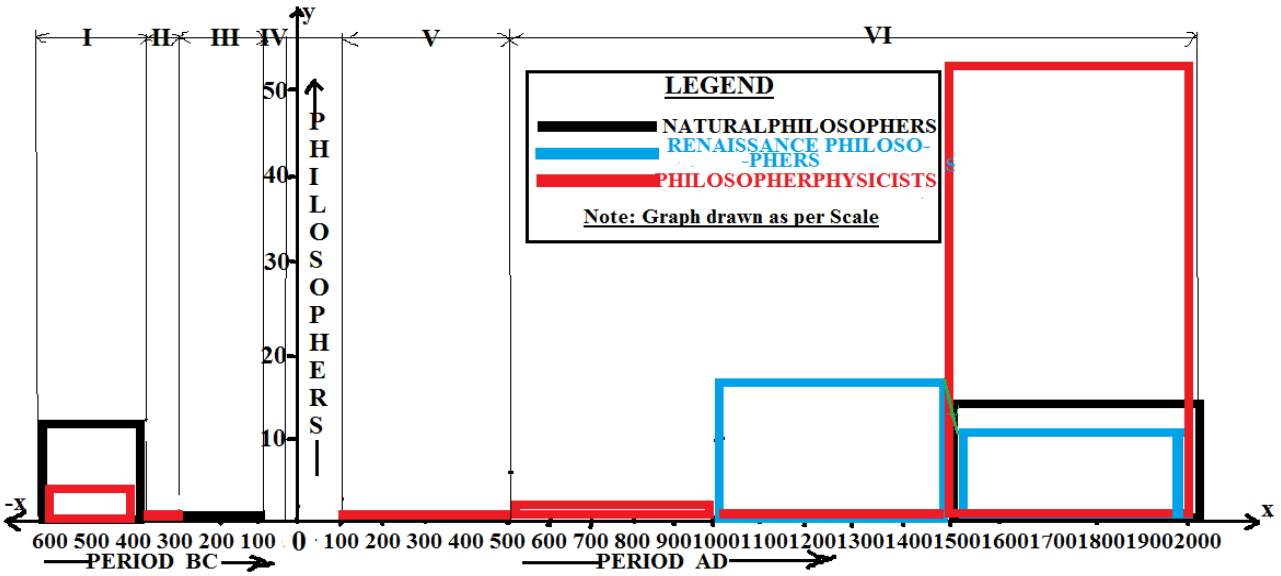

Fig. 4 A Combined graph showing the growth of Natural Philosophers, Renaissance Philosophers and Philosopher Physicists

9.2 Interpretation of the Graph: We have now to interpret the graph so as to make it fit to the title of the Paper. Natural Philosophers are shown in black border, Renaissance Philosophers shown with green border and Philosopher Physicists with red border. The reader has to compare with values shown in the respective tables.

It is seen that there is sufficient number of natural philosophers in period I and abruptly falls to zero in period II and with just one philosopher in period III and thereafter remains in stagnation till the end of 14^{th} century after which there is a revival as on today.

Now coming to the Renaissance Philosophers shown by blue border, they are uniformly spread over the entire periods with a stagnation during the periods III and IV. The transition starts in the V^{th} period and an abrupt rise with a peak from the 15^{th} century onwards till today. The number of Philosopher Physicists outnumber in this period.

X CONCLUSION

10.1 This lengthy paper has to be brought to an end. Out of many research papers published by me this is probably one of the few in which there is no Mathematics which is the language of Physics. Being entirely of a philosophical nature, there is no occasion anywhere to introduce Mathematics and hence even in the "Conclusion", I have to end with 'Philosophy'.

10.2 One may read about the Higgs Boson, Quantum Gravity or the Planck Energy, but the philosophical approach given almost in the entire two volumes of a classical book by Lloyd William Taylor [14] which I have followed during my undergraduate studies in the University of Mumbai

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during the sixties and owning proudly the personal copies of the two volumes. Right at the start in the Preface itself on p.v, Vol.I the author starts with a Philosophy and I quote the same in Italics:

"The Treatises of Natural Philosophy which have hitherto been published, being pretty much alike, both as to Matter of them and to Manner of handling them; It is easy for me to forsee, that amongst those who read This, there will be a great many who will be at first surprised at the great Difference there is between this Treatise and others. To prevent therefore in some Measure this Surprise, and to give what Satisfaction I can in this Matter. I think myself obliged to give an Account of the Observations which I have made upon the Philosophy of the Ancients, and of the Method which I have taken in this Work"

What is given above in Italics, the author, Lloyd William Taylor in the book has taken the same from Rohault* of the seventeenth century.

---

*Jacques Rohault (1618 - 1672), a French philosopher, physicist and mathematician, and a follower of Cartesianism.

10.3 What we have presented in the foregoing treatment with a large number of philosophers in each category shows the importance of both the History and Philosophy of the subject. In fact, many Universities in the US have a separate Department for History and Philosophy of Physics. Leave aside the Philosophical part of it as it may be difficult to understand from a general point of view, but the history of development is highly essential. Here I would like to quote Archibald Geikie [1] which appeared in p.122 of [15]

"In Science, as in all departments of human knowledge and inquiry, no thorough grasp of the subject can be gained unless the history of its development is clearly appreciated"

Charles Joseph Singer (1876 – 1960) in 1920 as quoted by [4] is reproduced here:
"To succeed in science, it is necessary to receive the tradition of those who have gone before us. In Science, more perhaps than, in any other study, the dead and the living are one."

Lord Rutherford: Lord Rutherford (1871 – 1937)[13] in surveying the growth of Atomic Physics in the 20th century concluded with the following statement:
"I have also tried to show you that it is not in the nature of things for any one man to make a sudden violent discovery; science goes step by step, and the work of every man depends on the work of his predecessors. When you hear of a sudden unexpected discovery – a bolt from the blue as it were – you can always be sure that it has grown up by the influence of one man over another, and it is this mutual influence which makes the enormous influence of scientific advance. Scientists are not dependent on the ideas of a single man but on the combined wisdom of thousands of men all thinking of the same problem, and each doing his little bit to add to the general structure of knowledge which is being gradually erected"

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XI EPILOGUE

11. Before closing the Paper, I would like to add two interesting questions posed by the New York Academy of Sciences:

11.1: [10] What Does the Future Hold for Physics: "Is There a Limit to Human Knowledge?"

Modern physics and its leading theories, such as the Standard Model of particle physics, Einstein's theory of relativity, and quantum mechanics, have been remarkably successful in describing the dynamical history of our universe. Large-scale experiments, such as the Large Hadron Collider or the advanced ground- and space-based telescopes, continuously produce new data that extend our knowledge of the world. Nevertheless, our understanding of some physical concepts that seek to explain our universe—dark matter and dark energy, quantum gravity, supersymmetry, and the cosmological constant—remain unresolved

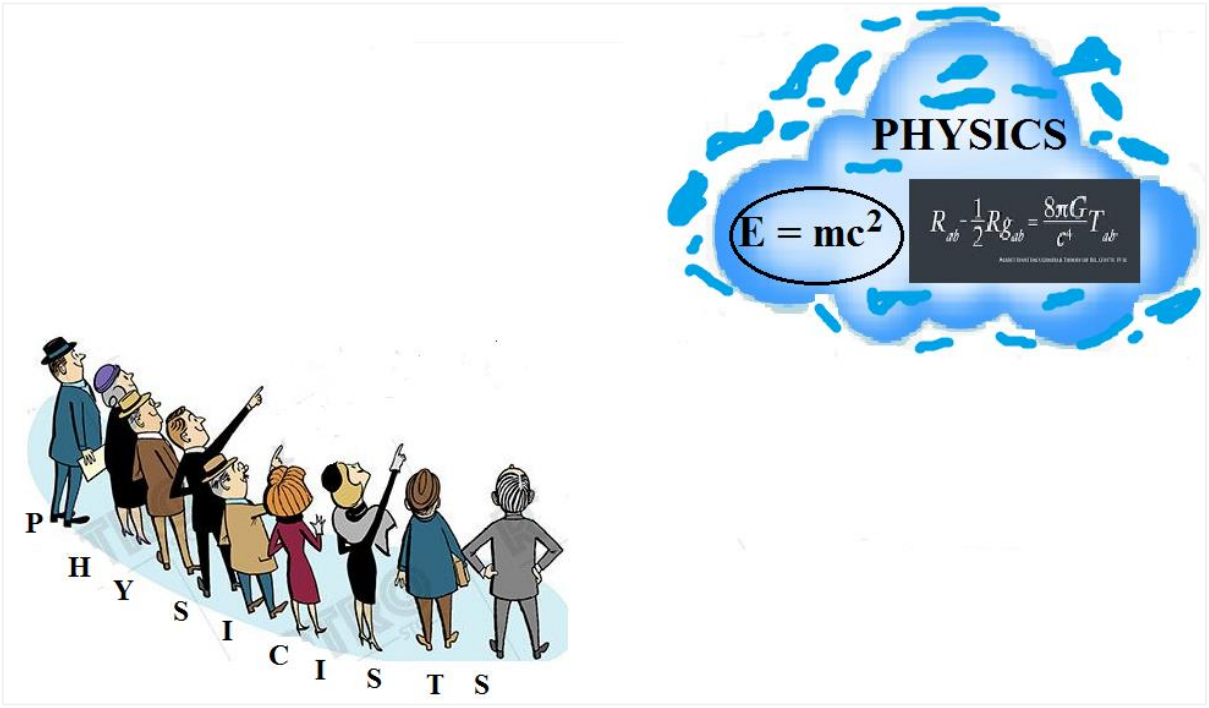

Fig.5 Picture illustrating a team of Philosopher Physicists looking at the Cloud of Future Physics

11.2: [11] Where Do Physics and Philosophy Intersect?

For centuries, physics and philosophy walked side by side in pursuit of their shared goal—understanding the nature of reality. The progress of science has pushed the frontier of physics into the realm of advanced mathematics, which requires technical skill and levels of abstraction attainable only after years of dedicated training. At the same time, most physicists today do not receive training in philosophy and epistemology, few have the time to ponder philosophical implications of their work, and some even doubt the possibility of a meaningful dialogue between physicists and philosophers. However, at its core, physics addresses the fundamental problems that shape our philosophical outlook.

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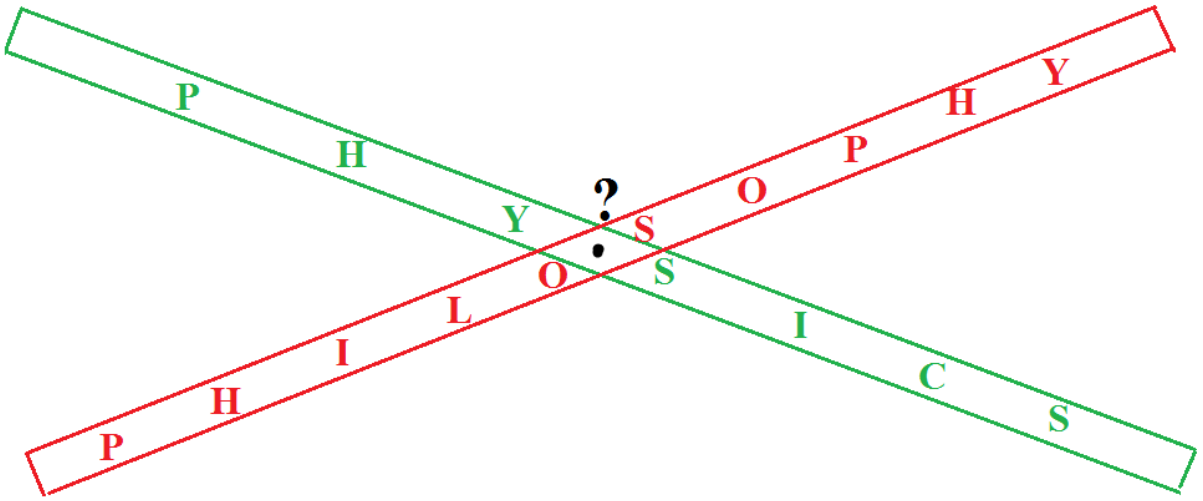

Fig.6 Physics and Philosophy do not intersect

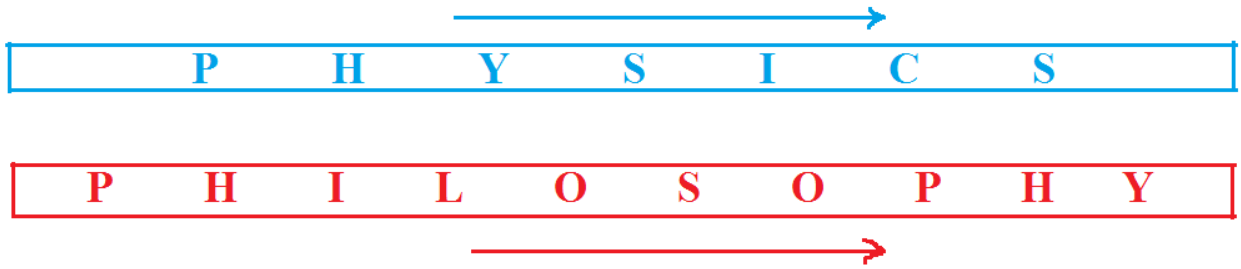

Fig. 7 Physics and Philosophy run parallel

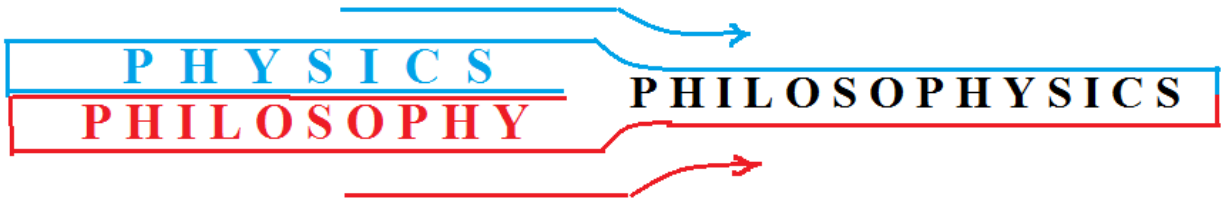

Fig.8 Physics and Philosophy combined to form PHILOSOPHYSICS

11.3 PHILOSOPHYSICS: I am going to introduce to the readers something new formed out of Physics and Philosophy. It should be noted that Physics and Philosophy are two separate entities. The latter is inherent in the former and the separation of the two is a matter of analysis. One can derive Philosophy from Physics but not Physics from Philosophy. Any statements, definitions or laws of Physics contain Philosophy, but it is difficult for ordinary physicists to extract the philosophical part from them as it takes lot of time and generally ignored.

I have dealt at length with the Philosophy in the foregoing text of the paper. But, however, to satisfy readers, I would like to give one or two illustrative examples both from the classical Physics

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and modern Physics.. In the classical let me take velocity of sound in a medium such as air. Newton assumed the motion to be isothermal with no change in temperature with his famous equation, PV = constant where P is the pressure and V the volume. But then came the Philosopher Physicist, Laplace who argued that the compressions and rarefactions in the medium takes place so fast that the process is not isothermal, but adiabatic for which he applied a correction and said that the equation should be $P V^{\gamma}$ = constant where γ is the ratio of specific heats of the medium. This small change was found to be considerable. What is lying with the correction of Laplace is the philosophy of argument. Challenging Isaac Newton itself is a greater philosophy.

Another classical example I would like to give here is regarding the nature of 'Heat'. Earlier concept of Heat as a material substance in the form of fluid called 'Caloric' by the Scottish physicist, Joseph Black (1728 – 1799) was overthrown by the British physicist and mathematician, James Prescott Joule (1818 – 1889) who demonstrated and proved in the year 1843 that 'Heat' is no material substance but 'Energy'. Those days in the 19th century, the term, 'Energy' itself was in its infancy. What Joule demonstrated and showed was a philosophical wonder.

Now, coming for a modern illustration, there is lot of philosophy in the German physicist, Max Planck's(1858 – 1947) Quantum hypothesis which changed the entire world of Physics right from 1901 occupying the entire 20th century and beyond as follows:

Classical Mechanics → Quantum Mechanics → Quantum Electrodynamics → Quantum Field Theory →
→ Quantum Gravity → Quantum Computing

For another modern illustration, I would like to present here the question posed by some of my students in the past. The question is, Sir, tell me in simple terms the essential difference between Isaac Newton and Albert Einstein: My answer was philosophical as well. I said: According to Einstein, Space disappears with matter and Energy but according to Newton, space still remains with the disappearance of matter and Energy. Readers may please note that the statement of Einstein is highly philosophical and it was the background for his General Theory of Relativity which many eminent physicists failed to understand.

The Philosophy that is inherent in Physics, I give a special name *'Philosophysics'*

11.4: It is worthwhile to consider the philosophical saying of 3 eminent physicists. How Philosophy is related with Physics for Sir Isaac Newton is shown in Fig.9 and that for Max Born is shown in Fig.10.For Philosophers both the figures are encouraging. But, Albert Einstein (Fig.11) stuck on to Physics. But, for the that inscription given in the figure is just Philosophy and only philosophers can analyze that and get the meaning.

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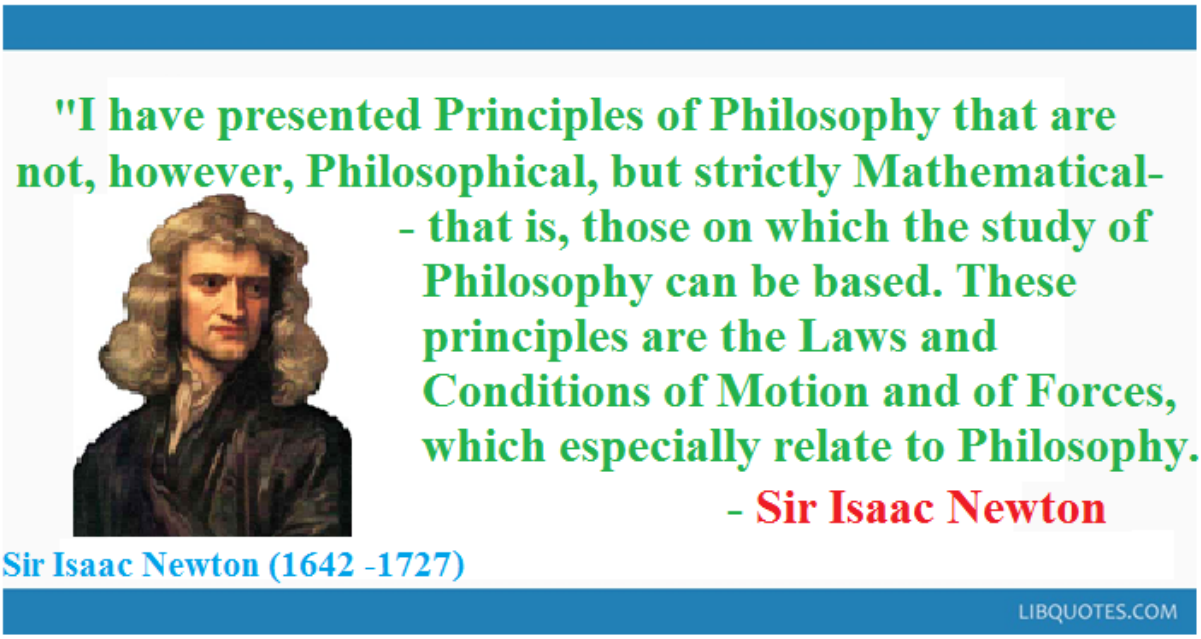

Fig. 9 Display of a Quote from Sir Isaac Newton

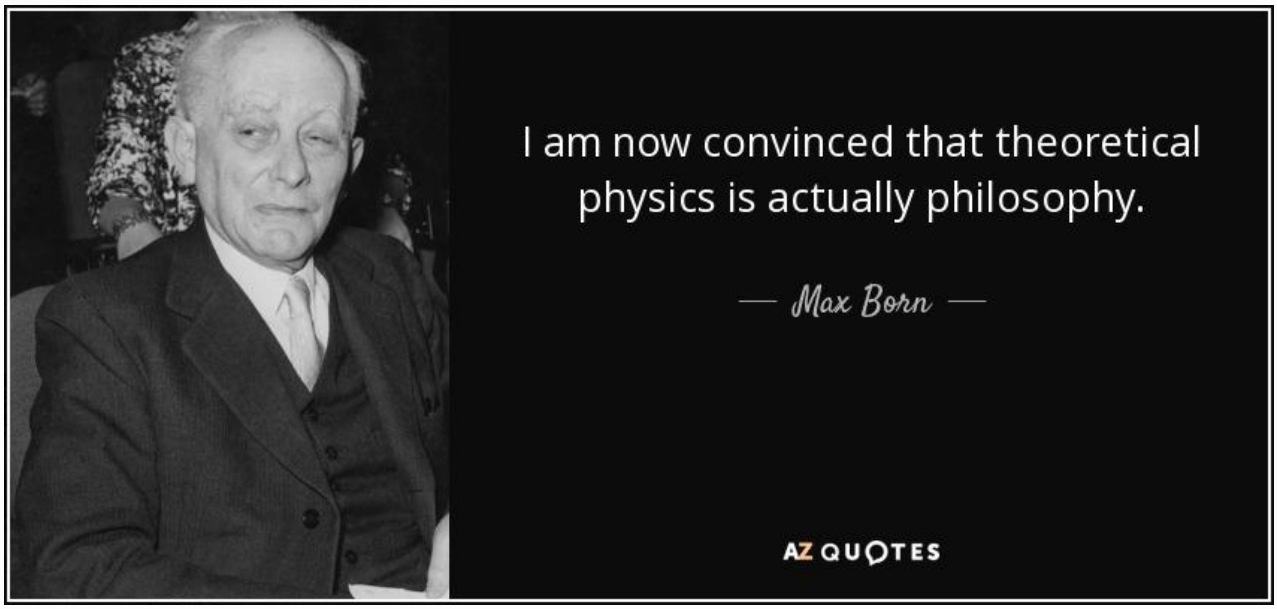

Fig. 10 Display of a Quote from Max Born (1882 – 1970) famous for the statistical interpretation of
Quantum Mechanics

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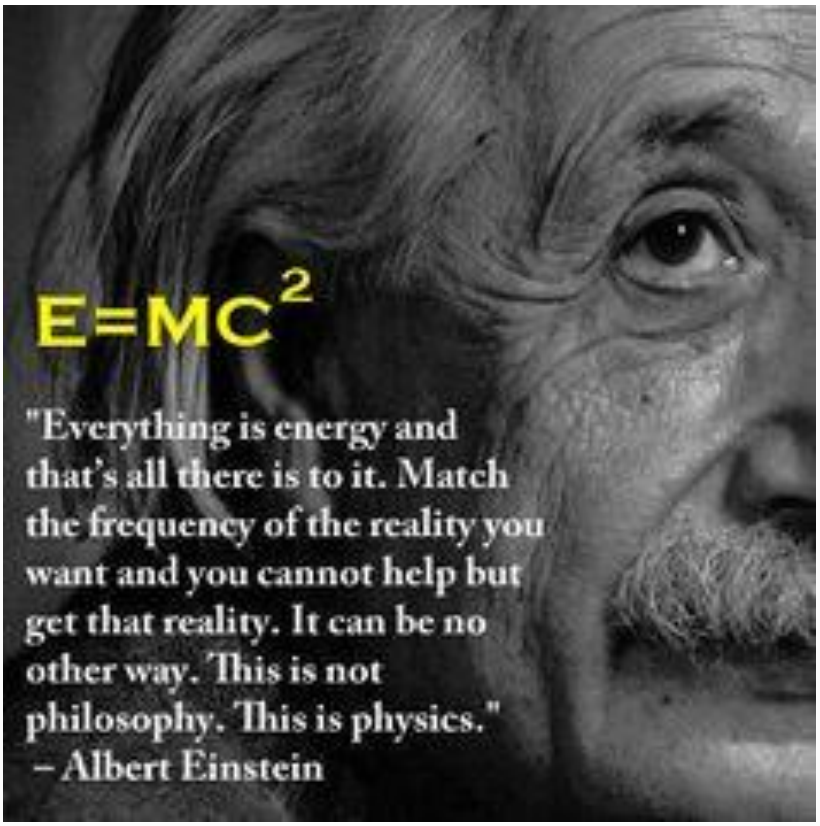

Fig. 11 Display of Quote from Albert Einstein (1879 – 1955)

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BIOGRAPHY

Dr.(Prof.) V.C.A. Nair* (b.15th Aug. 1939) is an Educational Physicist, Counselor, Research Guide and Consultant. He did his Masters in Physics from Mumbai University, India and Ph.D. from Shri. JJT University, Rajasthan also in India He is a Research Guide and distinguished alumnus of JJT University. He is also a Chancellor designated Resource Person in the area of Physics of the University. He has to his credit over 4 decades of teaching Applied Physics in eminent Polytechnics in Mumbai and having taught nearly 16,000 students since 1965. He has published a number of research papers in Physics and Geophysics in International and UGC@ recognized Journals some of which can be seen in the net 'Google Search' when the name of the author or his e-mail is clicked in that style. He has successfully guided 3 Ph.D Scholars of Shri JJT University leading to their Ph.D Degrees. He is a Life Member of Indian Society for Technical Education which is an all India body. He had been to USA a number of times and visited eminent Universities such as Stanford, Harvard, MIT, 3 Universities of California at Berkeley, Los Angeles and also at Davis, University of Princeton at New Jersey, Roosevelt University at Chicago, University of Chicago and University of San Francisco. At present Dr. Nair is a Research Guide for Physics at Shri JJT University, Rajasthan-333001, India . He is a member of the Editorial Board of this Journal. His Ph.D. Thesis is in Geophysics and he is working on topics such as Volcanoes, Earthquakes, Tides, Clouds, Global Warming and Climate Change. – Editor

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