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The Eyries and Pyres of Thought

High Schooler's Guide to Philosophy and Science

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The Eyries and Pyres of Thought

An R. N. Podar School--TED-Ed Club's presentation

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Philosophy — The Essentials

By Aditya Dwarkesh

"An experiment, like every other event which takes place, is a natural phenomenon; but in a scientific experiment the circumstances are so arranged that the relations between a particular set of phenomena may be studied to the best advantage."

-James Clerk Maxwell

For us, the Universe begins with the Self; and so, an enquiry of the Universe must begin with an enquiry of the Self. To know, we must first know *how* we know; for how will we get anywhere in our search for the truth if our truth-hunting machinery is biased and corrupted from within? We must understand the way our own mind works, and thus shred our machinery of the subconscious fallacies and irrationalities that it may have clung onto, unbeknownst to us.

The most widely held perspective is that there is one great mechanism that leads to most of our knowledge: The reception of empirical evidence followed by the process of induction. This proposed mechanism does not, by any means, answer all the questions we have regarding how we accumulate knowledge, but it certainly nips the large majority of them in the bud.

Today, we shall look at the first half of this mechanism: Empirical evidence.

Naturally, we must first pin down what empirical evidence is, and only speak of its utility after clarifying our notion of it. If I am giving majority of the credit for educating a baby from meaningless sounds and minimal comprehension to where you are now, this must be shown to be an appropriately powerful mechanism.

The most striking question regarding consciousness is that asking for an explication of *qualia*. What are these feelings-hunger, cold, anger, -that we are not only unable to describe formally but also seem to be exclusive to us? It is this-qualia-that gives consciousness its unique and powerful nature.

By empirical evidence, I refer to the predecessors of qualia. Qualia are our qualitative perceptions of the world; empirical evidence-or sense-data-is the qualitative world.

The qualitative world is the pure stream of sensory stimulus, untouched by our interpretations of it. Pure redness, pure coldness, pure roughness, pure greyness, pure hardness: Pure quality. This sense-data is, for us, the raw data upon which we must make our correlations and inferences and thus make sense of the world.

This object is affecting my eyes with a certain shade of ocular irradiation. This object is affecting my hands with a certain degree of mechanical resistance, smoothness, and a certain warmth. These are all sensory input that I receive in order to conclude that the given object is a table.

Empirical data encompasses all that is *external* to us, in a very important sense. Introspection is not external in many important ways, but reception of stimuli is entirely external. *Perception* of stimuli is an altogether different matter, but the stimuli themselves are, to us, entirely external. Only they are capable of giving us hitherto entirely unknown data on the world around us.

The commonly held belief is that the qualitative world cannot sensibly be separated from our qualitative perceptions of it. The existence of entities such as ‘redness’ and ‘roughness’, known as ‘universals’ or ‘attributes’, is also a hotly debated matter in philosophy. In any case, even if these two claims are true, I consider myself to be speaking of it for purely illustrative purposes, and their lack of existence will not be of any hindrance to us.

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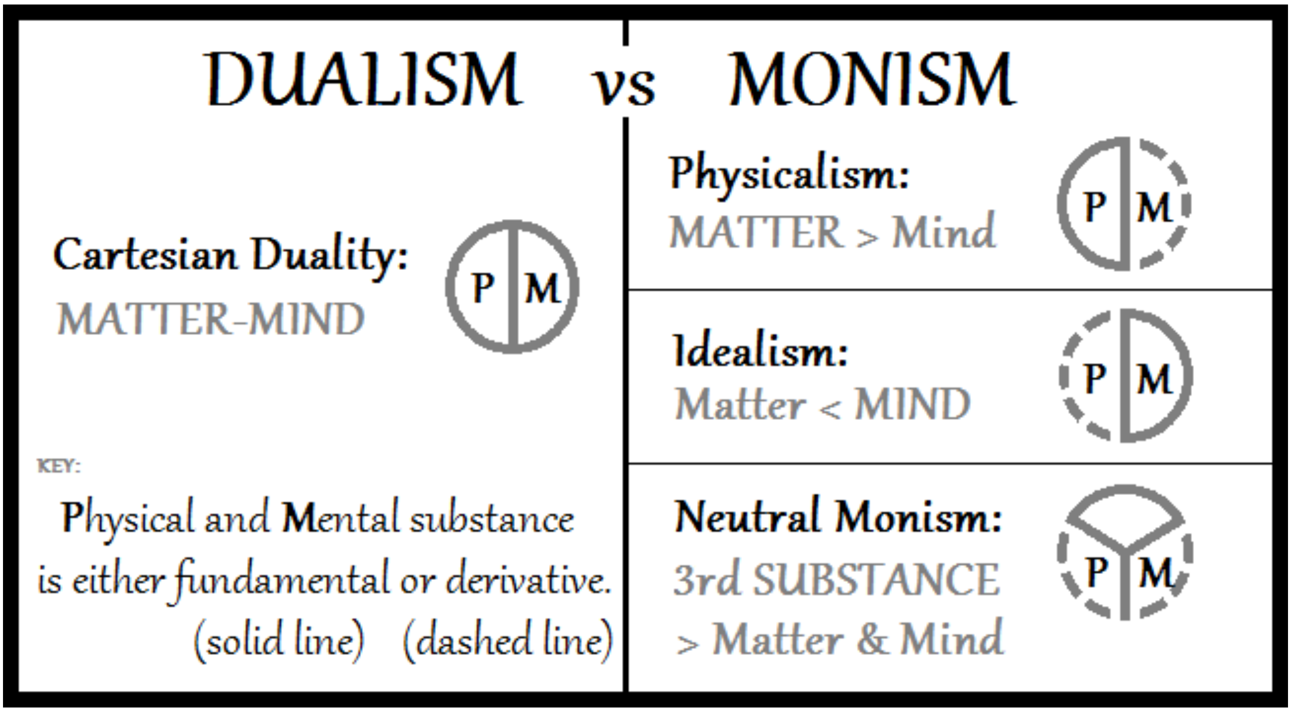
Aditya Dwarkesh is a 16-year-old from R. N. Podar School interested in and fascinated by literature, theoretical/modern physics and analytic philosophy with nothing by his side to guide him on these swampy, unused roads but an immense amount of intense curiosity.

Right through your Cranium

By Kiranbaskar Velmurugan

DUALISM AND MONISM

Previously I discussed how dualism started from Descartes and became a widely popular belief among the non-scientific community. In this article I'll try and elaborate on the different types of dualism and monism that are commonly seen.



An illustration of the ontologies of dualism versus monism showing how physical substance relates to mental substance (i.e. body & mind) as either fundamental or derivative.

The two major types of dualism are substance dualism and property dualism.

Substance dualism: This point of view is often seen in many religions. It says that mental phenomena and physical phenomena are caused by their respective substances which are fundamentally different from each other. These different substances are independent of one another and thus it really facilitates the idea of a soul in a physical body that you see in religions.

Property dualism: Although it agrees with substance dualism on the fact there is an ontological difference between the mind and the body it says that this is not because of different underlying "substances". Instead, the same substance has different properties that can be categorised as physical and mental. So a brain has physical properties such as frequency of neuronal firing, the composition of nerves, etc. and mental properties like thought, sensation of pain, etc.

In opposition to this there was monism which rejected the presence of any difference between the mind and the body and set to explain one of them in terms of the other.

Idealism: This point of view tries to explain the physical with the mental. It says that consciousness exists before everything material and thus gives rise to everything material. It gives priority to the mind.

Neutral Monism: It claims the existence of a third neutral substance, neither physical not mental that the universe is made of and gives rise to everything else that is physical and mental.

The last form of monism is materialism and this is the view that most of this course will focus upon. Let's start off with the history of physicalism and what it is now.

Before physicalism, the theory proposed to explain mental phenomena into physical ones was behaviourism. A view presented by Gilbert Rye and Carl Gustav Hempel, it says that mental states are just patterns of behaviour and dispositions to behaviour, where "behaviour" implies a biological action without any mental process. Speaking would just be noises coming out of one's mouth. But behaviourism fell apart for the main reason that it lead to an infinite regress. For example, one's belief that it is raining will be manifested by them carrying an umbrella only if one doesn't want to get wet. This desire will manifest itself in this manner only if one believes that the umbrella will keep them dry. To analyse beliefs you need desires, and to analyse desires you need beliefs.
The next theory was what was actually called physicalism which claimed that mental states were identical to the states of the brain. Although it seems plausible at first, it doesn't explain how only certain states of brain can be called mental states and others cannot.

In light of these difficulties, a new theory called "functionalism" was proposed which overcame many of the difficulties faced by the earlier two. It says that mental states are physical states but not because of the physical constitutions but because of the causal relations. Think of clocks for an example. A clock isn't a clock because of what it is made of but it is a clock because of what it does. So brains, computers, extraterrestrials and any other system with the right causal relations can have minds.

A functionalist analysis of the raining example above would be as follows. I believe that it is raining. This belief is a state in my brain but can also be a state in any other system with the right causal relations. This belief along with the desire to not get wet (another functional state) gives an output or an action, that is me taking an umbrella while going out. So desires and beliefs give a physical output.

These view are only very few of the number of other stances taken by various people. Some say everything from rocks to thermostats are conscious. Some argue that consciousness is nothing but a biological function like photosynthesis. Although other arguments have their own merits and functionalism has its own critics this course will focus more on materialism and problems related to it.

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Koan-tum Mechanics

By Ameya Kunder

CERTAINLY UNCERTAIN

Suppose I give you a ball and ask you to determine the colour and texture of it. Depending on how you perceive these two attributes, you would report to me saying if it is red, blue, green etc. and if it has a smooth or a rough texture. Under given normal conditions, one should not have any trouble determining these attributes. But what if I gave you electrons and asked you characteristics of them analogous to the ones that we discussed above? Let's probe this question further with the help of an experiment.

Consider that an electron has two distinct attributes. For the sake of the discussion let's call the two attributes colour and hardness. An electron can just have either black or white as its colour and either hard or soft as its hardness. These are the only known attributes that are known about the electrons and the facts have been established empirically. What we can do to measure these properties is build two boxes, one for measuring hardness and the other for colour respectively.

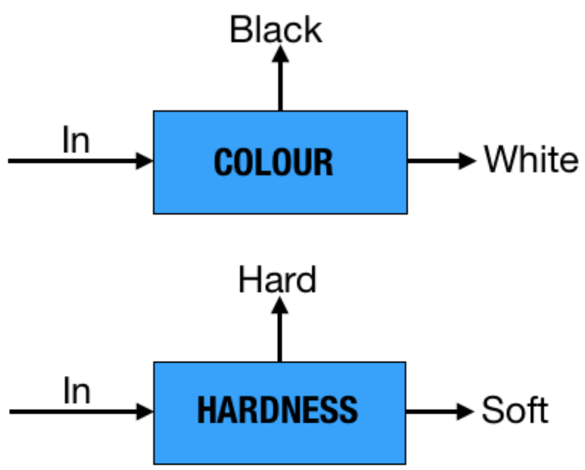

Fig. 1 – The colour and hardness boxes measure the respective attributes of the incoming electrons and release the electrons from the respective output terminals

The incoming electrons have a probability of half (1/2) of being either black or white. Same goes for them being either hard or soft. The principle based on which these boxes function need not be known by us but for the ease of visualization one can think of an extraterrestrial cat of unparalleled intellect and dexterity residing in the boxes which physically separates electrons based on their respective properties.

'Repeatability' is the most important property of these boxes: if all the electrons coming out from the output terminal of one of the boxes are fed into another box measuring the same property then all of the electrons will again be released from the same terminal, thereby retaining their original property. For example, if I pass a few electrons through the colour box and take all the electrons that came out of the white terminal and feed it into another colour box then I can say with assurance that all the electrons that are going to come out of this second box will turn out to be white as well.

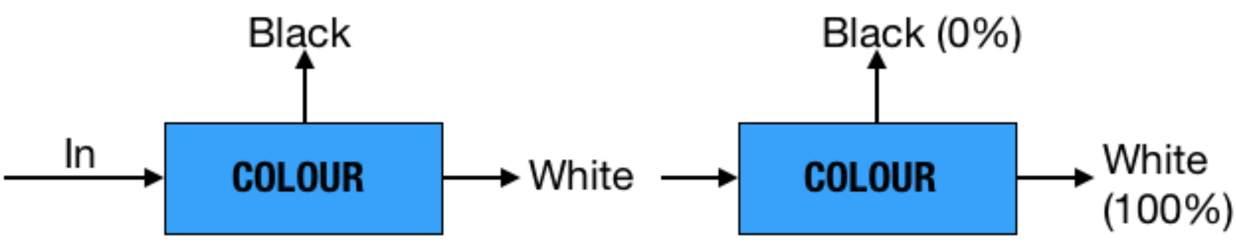

Fig.2 – Repeatability of attributes

A question that arises now is whether the two attributes of hardness and colour are correlated which basically means that if we measure one property of the electron to have a particular value (say, white), should it tell us something about the value of the other property of hardness as well? We can test this by setting up a simple apparatus as shown below. It turns out that the determination of one property in no way suggests some other property of the same electron. The electrons entering the second box will exit the terminals with equal probabilities. Hence, there is no correlation between the two attributes.

Fig.3 – Lack of correlation between the two attributes

Let us now set up an experiment as given below.

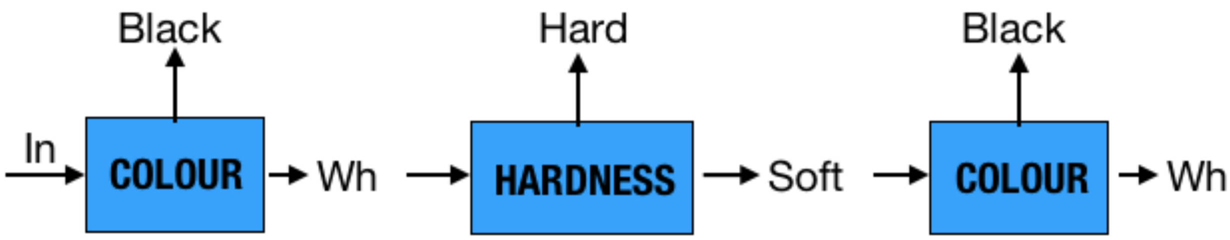

Fig.4 – Are all the electrons that exit the second colour box white and soft?

According to our scheme of reasoning up till now, we can say that:

I. All the electrons that exit the first colour box and enter the hardness box are white.
II. The white electrons exit the hardness box with equal probabilities of being either hard or soft.
III. The soft electrons exit the hardness box and enter the colour box
IV. By the property of repeatability of colour we can say that the electrons that emerge out of the will be soft and white.

Unfortunately , this conclusion is utterly WRONG!

What we instead observe is that even through the second box, half the electrons emerge out as black and half as white! One may doubt the capability and efficiency of the boxes but let me tell you that the cat sitting in there is completely infallible. It seems as if the “whiteness” of the electron is lost as it passes through the hardness box. But if the law of repeatability is true, then shouldn’t we observe the results as we had expected them to be? Is this law somehow not consistent when the path is intercepted by a box which measures a different attribute? What causes this undecidability of these attributes?

Without this bizarre output, we would have succeeded in measuring both the attributes of the electrons simultaneously. This would have been possible with the aid of the apparatus given below (Fig-5). But to our dismay, this won’t be possible since we have observed now that the inclusion of a box to measure some property different from the one that was first measured somehow tampers with this originally known property.

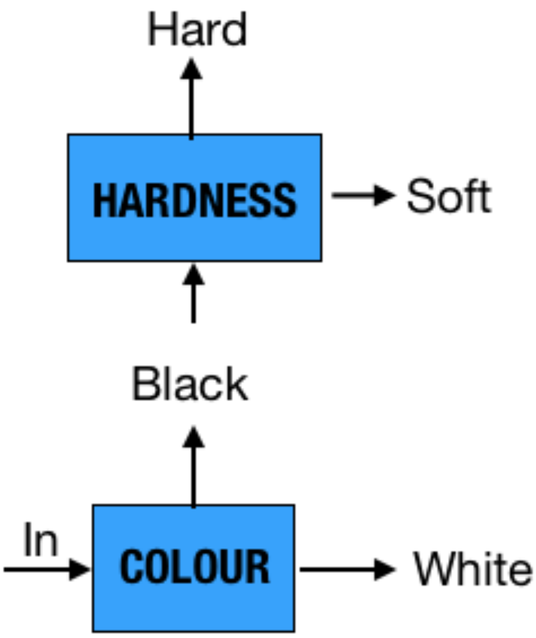

Fig.5 – The measurement of both the properties would not be possible

The basis of Heisenberg's Uncertainty Principle (formulated by Werner Heisenberg) lies in this experiment. In a nutshell, it states that the position and momentum (which can be considered to be similar to the colour and hardness) of an electron can never be measured simultaneously[1]. The mathematical formulation of this principle has been given below where $\Delta\chi$ represents the change in position and $\Delta\rho$ the change in momentum and on right we have a constant[2]. Not only is the possibility of measuring the position and momentum of an electron at the quantum level impossible, but it is utterly meaningless to think of it!

$$\Delta\chi\Delta\rho \geq \frac{\hbar}{2}$$

Fig.6 – The mathematical formulation of the uncertainty principle

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[1] For further understanding of the topic: https://www.youtube.com/watch?v=TQKELOE9eY4

[2] $\hbar$ is a constant equal to h/2π, h being the Planck's constant and having a value of 6.626 × 10^{-34} m^2 kg / s

KOAN-CAVE

Daibai asked Baso: "What is Buddha?"
Baso said: "This mind is Buddha."

A monk asked Baso: "What is Buddha?"
Baso said: "This mind is not Buddha.”

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Ameya Kunder is a 15 year old studying in R.N. Podar School having wide ranging interest in natural sciences and philosophy. Apart from possessing inquisitiveness in these fields, he keeps the willingness to explore the vast sphere of music.

Relatively Simple

By Pulkit Malhotra

"The aim of scientific work is truth. While we internally recognize something as true, we judge, and while we utter judgements, we assert."

-Gottlob Frege

It was 8th July 1661. A young boy of 18 by the name of Isaac Newton had just taken admission into Trinity College on the recommendation of his uncle, who himself was an alumnus of the esteemed college. Newton started noting and questioning every subject he came across - from astronomy to philosophy - into his notebooks, which later came to be called *Quaestiones quaedam philosophicae* (Certain philosophical questions). These underlined the main questions that disturbed Newton's mind and led to the development of the famed Scientific Method.

Initially interested in mathematics, which grew to formulate calculus and binomial theorem, his interest grew into physics after watching the dispersion of light passing through a prism. H, therefore started his study of light and its properties. His work and experiments, focusing mainly on the dispersion of light by a prism, was first reported to the Royal Society in 1672. The main aim of this work was, described in his own words, *"My Design in this Book is not to explain the Properties of Light by Hypotheses, but to propose and prove them by Reason and Experiments."* This work was hotly debated upon by the Royal Society. The main opposer to Newton's theory of light was Robert Hooke.

Hooke was a proponent of the wave theory of light, developed by Descartes, which held that light was made up of white wavelengths. Colored light occurred when white light passed through a lens or prism and became corrupted. This was the reigning theory during the 1600's. However, Isaac Newton saw things differently, as he so often did. When experimenting with light passing through prisms, he noticed that the colored light refracted out of one prism could be reassembled back into a single beam of white light is allowed to pass through a second prism. Therefore, he hypothesized, that color must have been present in light all along and not caused by the corruption of the prism, as Hooke believed. Newton called his new discovery the particle theory of light-since light must have some substance in order to contain color.

There were fierce debates between these two on the topic. The feud grew so bitter that Newton had to postpone the publishing of his book on the subject till after Robert Hooke's death in 1703. In 1704, *Optiks* was published, laying down all the work he had done on the topic. His interests changed again and In 1679, Newton returned to his work on mechanics by considering gravitation and its effect on the orbits of planets with reference to Kepler's laws of planetary motion.

On 14 November 1680, A big comet passed through the earth, observed to have a majestic long tail and reputedly being visible even in daytime, making it one of the brightest comets of the 17th century. It was observed until 9 March 1681.

Fig.1 – The Great Comet of 1680 Over Rotterdam by Lieve Verschuier

Newton was in awe of the comet and saw a great opportunity to apply his findings of celestial motion to this heavenly body. At the same time, the Astronomer-Royal, John Flamsteed, being aware of Newton's work in mechanics, wrote to his friend, James Crompton for Newton :

"The late Comet appear'd before sunrise in November, I saw it not but Cuthbert did, but by what I learnt from Others, I concluded that having past the Sun it would appear after his setting in December, accordingly looking for it on Friday last I saw a very small tail under Aquila reaching up to middle, between tail and the bright Star in the Shoulders nearer the tail and extended down to the Horizon. On Saturday night the 11th Instant it reached up to the Bolt of the Sagitta, the head not yet visible. On Sunday the 12th I first got sight of the head and by its distances from Aquila and the Planet. I determined its place in 1S 5°-02' with 9°• 44' North latitude. The tail now reached above the middle Star of the Sagitta being 35 degrees long, but not directly turned from the Sun. This night I have seen the tail again which is 60 degrees in length. I believe scarce a larger hath ever been seen 'tis above a Moon broad its motion decreases in Swiftness, and I believe we shall see it longer then any been seen of late. When I have got some more observations

of it I shall be able to tell you how long it will last and where it will pass. At present I dare not pretend to that knowledge."

According to the Keplerian view current at the time a comet travelled in a straight line; and so a comet observed in November to be passing near the Earth towards the neighbourhood of the Sun, and one observed two months later to be passing near the Earth but away from the Sun, were thought to be different comets moving in nearly parallel but opposite directions. Flamsteed, who rejected the traditional view, thought them to be one and the same comet. After consideration Newton concurred with him, and five or six years later worked out a possible parabolic path for the comet as it moved about with the Sun as focus, a result which was based on three of the observations supplied by Flamsteed.

Newton replied to him on 28 February 1681 in a long detailed letter, which started out:

"I thank Mr Flamsteed for his kind mention of me in his letters to Mr Crompton. And as I commend his wisdom in deferring to publish his hypothetical notions till they have been well considered both by his friends & himself, so I shall act the part of a friend in this paper not in objecting against it by way of opposition but in describing what I imagine might be objected by others & so leaving it to his consideration. If here after he shall please to publish his Theory & think any of the objections I propound need an answer to prevent their being objected by others, he may describe the objections as raised by himself or his friends in general without taking any notice of me."

It goes on further to describe Newton's Idea mathematically.

The orbit was taken to be an ellipse of very high eccentricity, with a period of 575 years; perihelion, the point where the comet approached nearest the Sun, was reached on 7 December 1680, and lay about 300,000 miles from the Sun's surface. The major axis is about 69 times that of the Earth's orbit, and the minor axis is about 0·9 times. At its furthest point (aphelion) the comet is less than 11 diameters of the Earth's orbit above (north of) its plane, despite the fact that the planes of the two orbits are inclined at 61 degrees to each other.

I	4 Nov. (O.S.).	1680
K	11 Nov.	
L	19 Nov.	
M	12 Dec.	
N	21 Dec.	
O	29 Dec.	
P	5 Jan.	1680/1
Q	25 Jan.	
R	5 Feb.	
S	25 Feb.	
T	5 Mar.	
V	9 Mar.	

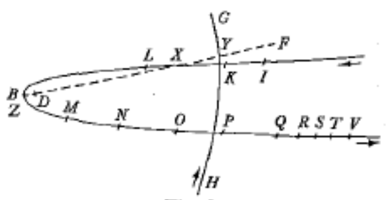

Fig. 1

Fig.2 – Diagram in Principia

Records were collected from observers in Europe and America and notably from Halley who was then in Paris. On 11 December, the comet was approaching M and the Earth was in the neighbourhood of K. The tail was observed stretching eastwards (leftwards) from M and in the line DM produced.

More details were further worked out in correspondence with Newton, who incorporated the results in the second edition of the *Principia*.

With the help of Flamsteed and Hooke, Newton deduced that the elliptical form of planetary orbits could only be the result from a centripetal force inversely proportional to the square of the radius. He presented his findings to Edmund Halley in November 1684, who further presented it to the Royal Society on 10th December 1684. The presumed title of the manuscript was *De motu corporum in gyrum* ("On the motion of bodies in an orbit") . The title of the document is only presumed because the original is now lost. Its contents are inferred from surviving documents, which are two contemporary copies and a draft.

Edmund Halley was hugely impressed by it. He had seen a similar comet in 1682 and thought that its motion could be periodic too. After seeing Newton's theory, he applied his theorems to the observed comet and found its period to be 75/76 years. This comet later came to be known as the famous Halley's Comet. Its next appearance is scheduled to be in 2061.

Halley was so blown away by it that he motivated Newton to further develop his ideas on planetary motion. On 5 July 1687, with encouragement and financial help from Halley, Newton published his magnum opus, *Philosophiæ Naturalis Principia Mathematica*.

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Pulkit Malhotra is a student of RN Podar School. He has a long standing interest in theoretical physics and wants to pursue that field further. He is interested in the deep secrets of the cosmos and their philosophical implications.