UPC2211 Assignment 1
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Why would someone believe that physical science is a paradise of determinism? Is it true?

Physical science explains and predicts phenomena based on empirical evidence. One way by which a scientific hypothesis can be verified is how well it predicts the future. While some natural phenomena in the physical science have been so predictably accurate to convince scientists that physical science is a paradise of determinism, that is not completely true due to the existence of unpredictability in chaotic systems and indeterminism in quantum mechanics.

The appeal of physical science being a paradise of determinism is not difficult to see. Philosophers Pierre-Simon Laplace and Karl Popper defined the determinism of a system by its predictability (Earman). One triumph of the predictability of physical science was the application of planetary gravitation to predict the trajectory of comets. Physicists Galileo Galilei and Isaac Newton formulated the theory of universal gravitation that could apply not just objects on earth but to the terrestrial motion of planets (Cohen). The theory of gravity was later put to the test to predict a comet that periodically appeared about every 76 years (Brown). The comet was so accurately predicted that it seemed only possible if the observed phenomena in physical science were deterministic in nature.

However, one should be wary of extending the appeal of determinism to the entirety of physical science, especially when one defines determinism as predictability. A predictable system implies that its approximate initial conditions approximately determines its future. Even if a system is deterministic, it may not necessarily be predictable, such as in chaotic systems like the logistic map. The logistic map $x_{n+1} = rx_n(1 - x_n)$ is a population model that models a population x_n and how its size changes over time n, based on its growth rate r (May). At a growth rate between 3.57 and 4, slight differences in its initial conditions produce dramatically different results over time, exhibiting chaos and becomes unpredictable. Even for a simple equation, the logistic map shows that a deterministic function does not imply predictability.

Furthermore, natural phenomena can also be indeterministic at the quantum scale. Light and matter can display characteristics of both waves and particles, rendering descriptions from classical physics insufficient to explain. In the double-slit experiment first performed by Thomas Young, electrons fired through two slits resulted in multiple bands instead of the expected two bands on a screen, leading us to describe electron behaviour using waves (Robinson). However, when electrons are observed from the screen, the behaviour collapses from a wave to that of a particle (Gilmore). At the quantum scale, classical mechanics cannot deterministically predict the position and trajectory of an object, and quantum mechanics can only probabilistically determine them. As a result, the prediction of quantum phenomena becomes problematically difficult, much less to say of its explanation.

In conclusion, although physical science may seem like a paradise of determinism because of the predictability of some natural phenomena, it does not hold true in all of physical science, such as in unpredictable chaotic systems and indeterministic quantum mechanics, and one should be wary of extending the appeal of determinism to the entirety of physical science.

(500 words)

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