Frontiers of free inquiry

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Although science claims to be a human endeavour entirely guided by rationality and objectivity, history tells us otherwise. At an individual level, a scientist may entertain a firm belief in the correctness of some idea or theory, even though he or she may lack an irrefutable proof in its favour. If the scientist happens to be very distinguished and has credentials as a path breaker in the field, this belief may not be confined to the individual but extend to a whole community following the leader. Such a belief system, if wrongly directed, can retard the progress of science.

Take the example of Isaac Newton, widely considered the founder of modern physics. Amongst other researches, Newton made valuable contributions to optics, the science of light. Yet one of his prejudices concerned the nature of light and it slowed down progress of that branch of physics while he was alive. Newton thought that a beam of light is made of tiny particles. He was very critical of the alternative idea that light travels as a wave. Many scientists who secretly believed in the wave theory could not openly defend it because of the awesome personality of Newton. Thus, important results in support of the wave theory and new experiments showing the typical wavelike effects of interference and diffraction of light began to appear only after Newton was no more.

Albert Einstein, who made revolutionary changes in physics, including the changes in our perception of space and time measurements, could not bring himself to accept another great revolution that had taken place in his lifetime, that of quantum theory. The quantum mechanics as developed by Niels Bohr, Erwin Schrodinger, Werner Heisenberg and Paul Dirac claimed that nature imposes a basic limitation on how accurately one can measure a microscopic physical quantity. Such a basic limitation, called the "uncertainty principle", necessitates rewriting the laws of motion laid down by Newton. Einstein had extensive discussions with quantum physicists like Bohr in which he tried to make a case for the so-called "hidden variables", quantities specifying microscopic details whose lack of information leads to uncertainty. Although this was a reasonable alternative hypothesis, experimental tests to date do not favour it. Ironically, despite his grave doubts on the foundations of quantum theory, Einstein was given a Nobel Prize for his explanation of the photoelectric effect, which uses the very same quantum theory!

Then there are prejudices not confined to an individual but shared by a whole community of scientists. Sometimes, with a majority electing to follow the wrong path, scientific progress may slow down or come to a standstill. Astronomy has several such episodes to show. Starting from the times of Aristotle, the geocentric theory held sway for nearly 18 centuries. The 17th century A.D. saw a gradual transition of the paradigm to the heliocentric theory. The earlier belief of a fixed Earth in a revolving cosmos gave way to one of a fixed Sun around which the Earth and other planets move. But this prompted another belief that our Sun occupies the central position of the Milky Way: a galaxy of billions of stars of which the Sun is one. This lasted for two centuries until improved observations led to a clearer picture of the Milky Way. Largely disc-shaped, it has the Sun nearly two-thirds of the way to the periphery.

Prejudices and controversies, unpleasant though they may be, are part of what leads to progress of science. In the early days of radio astronomy, a group under the leadership of Martin Ryle was one of the pioneers in the famous Cavendish Laboratory of the University of Cambridge. The early primitive radio telescopes were bringing in information about radio sources. What were these objects made of? Ryle believed that they were stars in our Milky Way Galaxy. A newcomer to Cavendish, Tommy Gold believed otherwise. He felt that the majority of radio sources were far away objects well outside the Galaxy. And consequently, they must be much more powerful than radio stars. Gold would raise this point at appropriate occasions during discussions to the great annoyance of Ryle who wanted a unanimous endorsement of his point of view. The situation got worse till one day Gold found himself banned from attending Ryle's Cavendish seminars. He had, however, the last laugh when, a few years later, optical astronomers vindicated his view of the extragalactic nature of most radio sources.

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One could argue that until science discovers the ultimate truth in a field, scientists must theorise and conjecture. As human beings, they are entitled to their prejudices too. But these prejudices should not come in the way of search for truth.

Unfortunately, this does not happen. In fact the situation has got worse in recent decades, largely because of high costs entering the arena of planning a scientific experiment. When in 1919, Earnest Rutherford planned his nucleus breaking experiment his apparatus was designed by the technician in the lab using the laboratory facilities. The total cost was no more than 100 pounds. Today's frontier level experiments have budgets running into billions of dollars. Naturally, there can be tough competitions between scientists for this high finance. Peer reviews arranged to rank competing proposals have to go into details of what is proposed and the credibility of the proposer. Anxious to ensure safe returns on the money to be invested, the referees shirk from supporting unusual or adventurous ideas that do not fit in the existing wisdom. Thus Copernicus, Galileo and Kepler would fail to get their proposals accepted in today's system.

What one would like is greater objectivity for supporting a project. While designing a telescope, the proposer today simply seeks confirmation of the existing picture. Thus we lose the opportunity of unraveling the real mysteries in the universe.

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