

Guest Lecture

HUMAN CREATIVITY FROM PHYSICS TO MUSIC

KIRTHI TENNAKONE

*Institute of Fundamental Studies
Hantana Road, Kandy*

With the origin of life and the development of more and more complex organisms, the order in the planet we live in steadily increased from barren land masses and oceans to a complex and dynamic biosphere. Until the emergence of man, the only cause for this improbable cosmic sequence has been the natural evolution dictated by genetic variation and survival of those species that fitted the environment. Animals in a species follow a strict tradition unique to the species. Individuals in the species do not deviate from their tradition as such behaviour endangers life. The human society was different; the deviant individual who introduced new ideas breaking away from the tradition strengthened the species. This is the human creativity that boosted the order in the biosphere beyond the level of evolution within a short period. Exaptation or the ability to co-opt previously evolved functions to do new things has been the major driving force behind successes achieved through non-traditional thinking. The modernity of humans originated with abstract thinking when methods were devised to create impressions and store information outside the brain. Thus art and music begin abstract creativity; the prelude to science and more specifically to mathematics and theoretical physics. Creations of value originating at one geographical point diffused to other regions, enriching the cultures that adopted them. In many instances when the rate of diffusion happened to be slow, the same creation may have been rediscovered many times. Independent rediscovery before widespread establishment by diffusion is most unlikely when it comes to rare and revolutionary creations of the highest impact. It is amazing that such quantum leaps in the advancement of the civilization have been triggered by the findings of a very few individuals. A vast majority of us are more conservative than creative. The very few who are highly individualistic liberate from tradition and enter into new arenas at the cost of many risks. They are originators of great leaps in civilization. Their new ideas are often ridiculed and opposed until they gain acceptance as self-evident. *"Great spirits have found violent opposition from mediocrities. The latter cannot understand it when a man does not thoughtfully submit to hereditary prejudices but honestly and courageously uses his intelligence"*. The above quote from Einstein further clarifies the point.

The quality assessment of creativity is subjective and not readily quantifiable. However, a few have gained universal acceptance as greatest creators. In art, music, literature and works of engineering the comparisons of creative ability become even more difficult; here the tastes of cultures play a decisive role. Shakespeare, Leo-Tolstoy and some of our poets are truly ingenious, but ranking their relative merits is not meaningful. Also it is hard to say who is greater, Mozart or Beethoven. Similarly, the creativity

displayed in irrigation systems, sculpture and art in Sri Lanka is not second to what appeared elsewhere during the same era. When it comes to the reformers of knowledge, the greatest can be distinctly identified. Aristotle, Isaac Newton,⁴ Albert Einstein and Charles Darwin probably outstands all the others. The first three worked on many themes and made contributions sufficient to consider them as immortal, a central subject of their research was motion and gravitation. Aristotle shifted away from the strict idealism of his teacher Plato and initiated experimental science. Nevertheless, Aristotle taught many things as logical deductions of untested axioms. The famous example was his teaching that heavier objects fall faster when dropped from an elevation. Aristotle's assertion remained unquestioned for nearly two thousand years until Galileo dropped two weights from the leaning tower of Pisa to verify that they reach the ground simultaneously. This episode demonstrates the rarity of creativity and the dominance of conservatism and the tendency for strict adherence to a doctrine.

Sir Isaac Newton (1643-1727) was a genius of the supreme category with unmatched creative powers. Perhaps, no other one single human being has contributed so much to the science and technology and the rationale of thinking. Newton once said that his closest friend is Aristotle but the best friend is "truth". He deeply engaged himself in theory as well as experimentation in mechanics, electricity, optics and alchemy and invented calculus. Above all Newton demonstrated for the first time the ability of the human mind to unify many phenomena to a theoretical framework of quantitatively precise predictive power. The life of Newton is invaluable to students of human creativity. Newton has been a modest person of simple tastes who greatly feared criticism despite his intellectual superiority. Newton always feared Robert Hooke, his contemporary in the Royal Society who was envious of him and complained of plagiarism. It is interesting to note that Robert Hooke, the arch rival Sir Newton wrote the preface to Robert Knox's book "An Historical Relation of the Island of Ceylon", 1st August 1681. The year 1681 was almost the climax of the Newton-Hooke controversy and it is amazing that Hooke had enough patience to write a long preface to Knox's book. As expected, some of the statements in the preface are undoubtedly unnamed references to Newton. In the preface Hooke says "*There are but few who, though they know much, can yet be persuaded they know anything worth communicating and because things are common and well known to them, are apt to think them so to the rest of the mankind. This prejudice has done much mischief*". This statement fits exactly to the expected mind setting of the learned Robert Hooke around the year 1681, when he was on the losing side of the battle with Newton. Presumably what Hooke intended was that if Newton had published his results, this bitter controversy would not have arisen! On the persuasion of Edmond Halley, Newton published the epic monograph "Principia" in 1687 but did not publish his second work "Optiks" until Hooke's death. Unlike Einstein, Newton did not decline political offers and was elected to the British Parliament. It is said that after a long silence he spoke only once. When Newton lifted his hand, the house was astonished, dumbfounded and some shivered fearing what an issue this great man is going to raise. Newton said that a chilly wind is blowing from a partly opened window and to kindly close it.

It is no exaggeration to rank Albert Einstein as a second Newton. No other human being has been so well studied to fathom the nature of human creativity than Albert

Einstein. The most miraculous findings of Einstein originated within the period March to September 1905. In the first paper, Einstein presented a bold suggestion to explain how light could release electrons from metal surfaces. This paved the way to quantum mechanics; the greatest creation of the human mind and perhaps the closest path to the 'truth'. The second paper on Brownian motion which explained how pollen grains suspended in water undergo persistent jittering motion, appeared in May 1905. His relativity paper came in June and $E = mc^2$ was derived in September of the same year.

The United Nations General Assembly declared 2005 as the World Year of Physics to commemorate what Einstein did in 1905 while working as a clerk at the Swiss Patent Office in Berne. Mr. Lebohang Moleko, the Ambassador of the Kingdom of Lesotho who presented the draft resolution at the United Nations General Assembly to proclaim the World Year of Physics said "The aim of this International Year goes beyond mere celebration of one of the greatest minds in physics of the twentieth century. *This year will provide the world with an opportunity for the largest possible audience to acknowledge the progress and importance of this great field of science*".

Relativity which was rejected by many physicists at the beginning gained acceptance and amazed the world giving much publicity to Einstein. Einstein said that its incomprehensibility to the laymen was the cause of attraction. The word relativity was frequently misinterpreted. Once Einstein jokingly said, "I have a theory of relatives. Do not hire them". With the passage of time difficult concepts become clearer. Nowadays, relativity can be made comprehensible to a thirteen year old student knowledgeable in plane geometry. Pythagoras theorem which says that the square on the hypotenuse of right-angled triangle equals sum of squares on the two opposite's sides, is well known. This theorem is not provable; it is an intrinsic property of space where we live. Nearly two thousand five hundred years after Pythagoras, Einstein discovered that there is an analogous theorem relating to space-time, this is relativity. Geometrical interpretation enabled Einstein to combine the 1905 theory of relativity with gravitation to formulate the General Theory of Relativity, the second greatest feat of the human mind.

The third greatest creation in science is undoubtedly, the Darwin's theory of evolution. The rank three is given to Darwin not as a favor to intelligent design but epistemologically this great idea falls below a predictive theory because of the very nature of the subject. The same applies to the theories in cosmology.

How does human brain manage creative work? Almost all creations of the highest quality are not logical deductions. They are intelligent guesses developed further through logical reasoning. A related question is can a sufficiently complex computer acquire creative capability? Algorithmic creativity is not beyond the reach of a robotic Turing machine that could sense the environment. Will such a machine, ever be able to arrive at Einstein's General Theory of Relativity or compose something similar to a Mozart's sonata? Physics has not yet succeeded in giving an answer to the last question.

What made Newton and Einstein so creative? These two men have similarities as well as vast differences. A clear common factor is that both have contemplated in

isolation away from orthodoxy. When the great plague hit England in 1665, Cambridge was closed and Newton returned to his Lincolnshire home and quietly devised calculus and thought about gravitation. Einstein arrived at his marvelous discoveries while working as a clerk in a patent office, not a University or a Research Institution. In fact nothing comparable happened when he was at the Institute of Advanced Study, Princeton. Both were modest and generally silent and possessed extreme powers of mental concentration. Newton though silent had been quarrelsome; very generous to his friends but harsh to the opponents. Einstein was pensive but sometimes quite humorous and in later years behaved as a tired person with an unaccomplished mission.

Are there any intrinsic traits which specifically endow an individual with the qualities of high creativity? Certain genetic, anatomical, physiological or even some pathological conditions may favour brain function towards creativity. The early childhood experience and a conducive environment seem to be more important. It is most likely that intrinsic factors are quite common and evenly distributed through out the globe irrespective of geographical demarcations. Nonetheless, the highest level of creative outputs are not coming out evenly from all nations or different parts of the same nation. At one time it was India, Sri Lanka, China, Egypt, Greece and Arabia, now it is United States of America and Europe. Some very heavily populated countries have earned only one Nobel Prize in physics or none. How can we remedy this situation? Should we convert our universities and research institutions to patent offices or await a plague? Prosperity, politics traditions and conditions of living, certainly have influences beyond ready control. The policy which is maneuverable also counts a lot. Are we adopting the right policy? The thinking that physics, music, history and Sanskrit have no relevance to the economy still floats around. Physics is not only a difficult prerequisite to enter medical schools and to be forgotten later. It is a route to enlightenment. Music, history and Sanskrit have similar virtues of the highest quality. The abundance of hatred, intrigues and sadistic attitudes instead of curiosity and compassion could also be the results of these omissions in our educational curricula. The policy of doing only the relevant kills creativity, breeding social ills and what the policy maker intended is rarely achieved.