

BOOK REVIEWS

originally meant for warmth and were completely symmetrical. However, asymmetry helps in high-speed flight and birds such as hawks have more pronounced asymmetry in their feathers. Thus 'a feather adapted for warmth was exapted for flight'. In another example, the author mentions how Gutenberg was able to invent the printing press because of his prior knowledge of the wine presses which he then exapted for printing. Exaptation benefits from 'weak ties' or elements of our network which are in the periphery. Since most networks are clustered, individuals who try to bridge these networks can create novel ideas. Among other things, exaptation may be nurtured by 'long, rambling coffee breaks' and by trying to do several problems at the same time.

The seventh chapter entitled 'Platforms' which are natural ecosystems that foster innovation. For example, beavers build dams to protect themselves from predators. However, a more important side effect is that the dam provides an ecosystem for many insects, birds and other creatures to flourish. According to the author, 'platforms create an entire new floor into the adjacent possible'. Various public sector-funded projects have created platforms for inventions like the GPS, internet, etc.

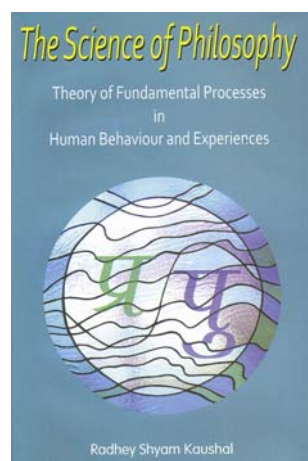
Finally, the author concludes the book with a section entitled 'Fourth quadrant'. He mentions four combinations under which innovation takes place. These are: (1) market/individual, (2) market/network, (3) non-market/individual and (4) non-market/network. He points out that most inventions in the modern world come from the non-market/network quadrant, which is the fourth quadrant. A research university is the main example of such a fourth quadrant institution. However, the presence of a critical mass of people and organizations in both the market and non-market domains is needed to get the full economic value of a scientific idea.

Overall, this book provides a lot of valuable ideas, examples and case studies for researchers in science and technology. The book makes extensive use of analogies from biology and computer science to illustrate the ideas. Various biographical details of individuals and organizations that used the different methods to create new ideas are provided. I found the discussions on the research methods of individual scientists particularly interesting. However, the

book does not give importance to teaching, which can be done in a manner so as to activate many of the ideas presented. Generally, research is learnt by most people from a practitioner, but even accomplished researchers may not be using the full array of the possibilities presented in this book. The book will certainly help researchers who want to learn more about the art of innovative research.

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The Science of Philosophy: Theory of Fundamental Processes in Human Behaviour and Experiences. Radhey Shyam Kaushal. D. K. Printworld (P) Ltd, 'Srikunj', F-52, Bali Nagar, New Delhi 110 015. 2011. xxix + 541 pp. Price: Rs 1150/US\$ 46.00.

This book attempts the impossible task of integrating science, philosophy, consciousness and religious thought within one single treatise. Since one has specialized only as a physicist, one is conscious of one's limitations in reviewing such a book. The word 'philosophy' literally means the love of truth. Therefore, it includes science, since science is a quest for the truth about how Nature functions. The author quotes Einstein saying, 'If philosophy is interpreted as the quest for the most general and comprehensive

knowledge, it obviously becomes the mother of all scientific enquiry'. Perhaps this is why those who do scientific research are still awarded the degree of 'Doctor of Philosophy'. However, science deals mainly with the measurable, whereas philosophy, consciousness and religious inquiry deal essentially with the immeasurable. Basic science, so far as I know, is unable to define what consciousness is or explain how it originated, if at all. The scientist speculates that both life and consciousness are generated as an emergent property when the atoms of matter come into a particular configuration. Erwin Schrodinger made an interesting statement about the ultimate aim of science. He wrote, 'I consider science an integrating part of our endeavour to understand the one great philosophical question which embraces all others: WHO ARE WE? I consider this not one of the tasks but THE task of science, the only one that counts.'

According to the standard model of the origin of the universe, it began with a Big Bang explosion in which energy was in the form of a plasma consisting of quarks, photons, electrons and such elementary particles in random motion. The explosion led to a rapid expansion of the universe and it has continued to expand till now. There could be no life at the origin of the universe since there was no structure and consequently, no consciousness either. The universe of the physicist is a dead universe and the laws of physics do not predict or require the origin of either life or consciousness. According to present scientific knowledge, life appears to have originated accidentally and not intentionally. Consciousness as we know it is believed to have evolved gradually in the course of biological evolution as the structure of the brain became more and more complex.

Religious thinkers fundamentally disagree with this scenario. According to them it is impossible to generate the visible structure in the universe, including life-forms such as our own body, without any intelligence directing the phenomenon. They argue that if it takes intelligence and directed ingenuity to build a computer or a space-vehicle, does it not take intelligence to build a tree or a human body out of the chaotic state of the early universe? So according to religious philosophers intelligence was there first, in the form of a universal consciousness (as distinct from our personal psyche)

which directed and structured the universe, producing life and eventually the human being. This philosophical debate whether matter is primary and generated consciousness by getting structured, or consciousness is something apart from matter which directed the development of the structure is as yet an unsettled matter. Sir James Jeans wrote in the book *The Mysterious Universe* that the probability of the structure in the universe arising spontaneously out of random motions of particles is about the same as the probability of a hundred monkeys strumming randomly at typewriters, producing all the sonnets of Shakespeare!

These are basic questions which are beyond science at present. There cannot be anything that is anti-science because if one can disprove a scientific theorem, it ceases to exist and is no longer a part of science. However, there is a lot that is beyond science at present. Richard Feynman gave a beautiful definition of science saying, 'Science is a body of knowledge, some of which is nearly certain, some rather uncertain but NONE of it is completely certain.' Since the law of conservation of energy has never been observed to be violated in any of the scientific experiments till now, it follows that consciousness (if it does exist) does not carry energy. Otherwise one could, by exerting one's consciousness, add energy to a billiard ball undergoing collision with another and that would violate the law of conservation of energy. What then could be the nature of universal consciousness, if it does exist? Can it inform a system and direct it without contributing any energy to it? Can it be like the wave function in quantum mechanics whose development in time somehow directs or corresponds to the development of the physical system it represents, without contributing any energy to it?

Take a simple example of a seed lying in the soil of the earth. If it has a single living cell in it, it lies dormant in the soil for months and when the rains come and the conditions are right there sprouts a little plant from it, becoming a huge tree in a few years. That single living cell in the seed is able to change the kinematics of all the atoms in the soil around it and in the atmosphere for maybe a few hundred years! If that single living cell is not there, the seed just decays, becomes a part of the soil and the kinematics of the atoms in and around it is completely dif-

ferent. In both cases, the laws of science are not violated. So what gives direction to the kinematics of the atoms? That is the directive 'intelligence' in a single living cell! Consider another hypothetical question. In a thought-experiment, imagine that a chemist is able to synthesize my entire body in his laboratory, starting from atoms of hydrogen, oxygen, carbon and so on present in my body. Would that synthesized body be living and have the consciousness (awareness) I have at present? Or would it be just a dead body? Scientists have not yet been able to synthesize even a living amoeba in the laboratory starting from dead chemicals. We do not know what life is and how it originated; we have some guesses, but not proof as yet. Similarly, we use our consciousness to study the universe and do scientific experiments, but our science cannot tell us what we are using! So, if we cannot even define what consciousness is, the entire gamut of consciousness phenomena lies beyond the frontiers of present-day science. It has been suggested speculatively by some scientists that the collapse of the wave function in quantum mechanics is brought about by the observation of the system by a conscious observer and not by a camera, thereby trying to connect consciousness with physics.

What distinguishes a human being from any machine or computer, however complex, is his or her capacity to be 'aware'. This awareness is not a thought-process for one can be aware of one's thinking too. Also, one is aware even if one is not thinking. This awareness is the intrinsic quality of consciousness. It is what makes human beings capable of creativity. It is somewhat of a mystery how the human mind makes a totally new discovery. The capacity to wonder, to stay with a question or a problem and then suddenly have a deep insight which brings something that was not known already into the field of the known is this creative capacity. Thomas Kuhn in his book *The Structure of Scientific Revolutions*, talks of this sudden paradigm shift as a leap in our understanding or perception, as distinct from the dogged addition of more information on data within that paradigm. The discoveries of relativity or quantum mechanics have been such creative leaps in physics. Creativity in art and music is of a similar nature. But we have no explanation of how this awareness arises and functions. Otherwise, our

brains can be likened to a complex computer, programmed by our genes, language, experiences and culture, all of which are held in our memory.

This book is a feeble attempt at trying to bridge the gap between science, religion and philosophy. In my view, it does not succeed in doing that. The result is it is neither truly scientific nor religious nor philosophical. The fault is not entirely that of the author. He has just taken on an impossible task. When science is unable to even define, much less explain, what consciousness is, how can it explain human interactions and behaviour? The author tries to bring in science and mathematics into a realm where they are not applicable. His language is not precise, the English poor and the arguments confusing. The book makes for tedious reading. For instance, he tries to discuss what would happen if a simple pendulum had a living bird tied to the string instead of a metal bob! He classifies human beings as the common man, the scientist, the philosopher and the yogi, but leaves out the artist and the technician. He draws parallels which are difficult to comprehend, such as those between electromagnetic interactions and human interactions. It seems to me inherently impossible to give a physical or mathematical theory of human behaviour, but the author makes an attempt to develop one.

This book would be regarded as naïve and confused by scientists, philosophers as well as scholars of religion for it does not do justice to any of these disciplines. It is a good source of a lot of references and quotations of eminent people, but it fails to develop any consistent philosophical or experimental basis. This may be an unfair criticism in view of my own limitations of understanding, so the interested reader is invited to study the book and form his/her own opinions.

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