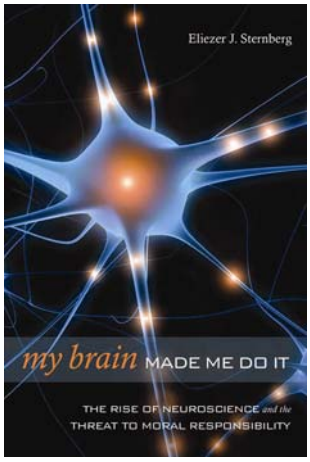

My Brain Made Me Do It. The Rise of Neuroscience and the Threat to Moral Responsibility. Eliezer J. Sternberg. Prometheus Books, 59, John Glenn Drive, Amherst, New York 14228-2119. 2010. 244 pp. Price: US$ 21.00.

The author of this book, Eliezer J. Sternberg is a 22-year-old student of neuroscience and philosophy from Brandeis University, MA, USA. In an effort to marry the two subjects close to his heart, he attempts to dissect one of the toughest dilemmas faced by man since the discoveries in the functioning of the human brain. Do we or do we not consciously control our actions?

We like to believe that we are special; smarter than the rest of the living world. We believe that it is because we 'think' and 'choose' to act using our 'free will'. New developments in neuroscience challenge this belief. Biochemical and neuroimaging studies indicate that every action by us is a result of tiny droplets of chemicals secreted and sensed by microscopic cells residing in our brains. A constant give and take of chemical and electrical signals across an extremely complex network of cells allows us to sense our surroundings and respond. If the brain is carrying out every action and every thought, then where does conscious control and free will come into action? Is there anything 'I' do? Should 'I' feel guilty for the bad deeds that my body performs? Can 'I', as a moral individual, be held responsible for my actions?

Sternberg is articulate and writes with several examples about the concepts on the brink of science and philosophy: 'determinism' and 'free will'. With examples from the literature, mythology, history and science, he explains the origin of the idea of free will and attempts to reconcile neuroscience with it. He divides the book into three sections: the first four chapters address the idea and its implications. Chapters 5–13 talk about scientific developments leading to a doubt about the existence of free will, and finally chapters 14–18 explore the possibility of co-existence of neuroscience and free will.

Each chapter starts with a detailed story-excerpt. The author introduces the main thesis of the book by recalling the 1864 book by Fyodor Dostoevsky, *Notes from the Underground*. This is the story of a man numbed by the paranoia that his life is at the mercy of not just the society, but also his own body. He skulks around trying to defy his mind at every step, doing the opposite of what his instincts tell him to do. Believing that anybody with enough information about him would be able to predict his actions, he makes sudden changes in plans. He is desperate to exercise his free will. Another story follows. The defence lawyers of a criminal whose brain shows a slight increase in a certain chemical, attempt to get him acquitted by suggesting that it was not the man but his brain that was responsible for the crime. As he did not commit the crime of his own 'free will', he should not be held responsible. Sternberg thus starts his book by painting a bleak picture that rise of neuroscience portends death of free will.

Is it possible to pinpoint the time when a conscious decision to act is made? At point *A*, a man is faced with a choice. He is aware of his options and their consequences. At point *B*, he acts. The decision is made between points *A* and *B*. Invoking the philosopher John Searl here, Sternberg explains that if the sum total of the neurological interactions in the man's brain at point *A* is enough to reach the decision he made at point *B*, then there is no requirement of a conscious, free will. However, if it insufficient for the decision at *B*, then we have to consider the presence of a free will and hence, the moral responsibility.

This is logical in theory but misleading, since the author does not convey to the reader the enormity of the 'sum total of interactions in the brain'. Almost a 100 billion neurons are present in the brain of a newborn child, each forming about 1000 connections (synapses). Their permutations and combinations are mind-boggling. This number increases with age and experience. The book does not stress enough on the complexity of brain. Martin Heisenberg, who studies the brain mentioned in a talk delivered at TIFR, Mumbai, 'If our brains were simple enough for us to understand them, we would be so simple that we could not'. The reader should keep this in mind while reading this book. At this very early stage in the book, it is clear where the author is leaning. Our law system, relationships, our likes and dislikes, our reasons to blame and credit, to hire and fire are all based on the belief that people do what they do with full control and awareness. It is not so easy to reject free will.

Sternberg introduces 'neurobiological determinism' by stating that biologists believe that every process in the body is a chain of completely 'determined' chemical and physical interactions. His words: 'It follows, then, that the outputs of the brain are determined by prior processes. Our choices, our desires, our beliefs, our reflections – all are determined by neuronal communication'. And also, '… a neuroscientist could predict your thoughts and actions – your future – if given enough information about your brain'. The author's indignation is palpable, although no neuroscientist worth his/her salt will claim that he/she could predict our actions, no matter how much information is available.

Human behaviour is influenced by three forces: genes, environment, and 'stochasticism'[1]. Stochasticism is unpredictable. There is an inherent uncertainty to properties of matter. Processes like mutations, genetic rearrangement allowing the vast choice of antibodies protecting us from known or unknown disease-causing agents, inactivation of one of the two X-chromosomes are all unpredictable, not deterministic. Differences in identical twins raised in the same environment might also give some examples of biological stochasticism.

Attempting to pinpoint where conscious decisions are made, Sternberg gives examples of neurological disturbances in syndromes like Tourette's, Huntington's and the 'alien hand' syndrome, and how they affect human behaviour. He claims that these are examples of lack of will resulting from trauma to the frontal lobe of the brain. Because damage to the frontal lobe makes decision-making hard, it must be

the 'seat of free will'. The frontal lobe is not well-understood. It is affected in many syndromes, disorders and trauma situations, and is probably the seat of many known and as yet unknown biological processes.

The strength of Sternberg's book is the wealth of information about philosophers and their ideas, which he provides to the laypersons. He explains 'emergent properties', that the 'whole' is more than the sum of its parts, suggesting that free will could be an emergent property of the determined interactions between neurons. Often the author explains experiments and ideas without commenting on the results. Benjamin Libet's recordings of brain activity, Laplace's 'demon', and Descartes and his 'ghost in a machine' are such examples. Antonio Damasio's 'somatic marker hypothesis' suggests that our experiences leave 'bodily markers' upon our nervous system. Sternberg does not mention that today, these markers would be explained as new synapses.

Sternberg's writing technique is often self-indulgent. For example, he tells the story 'The Appointment in Samarra' to explain the difference between fate and determinism. He tells lengthy stories of Hercules and Hera, and Les Miserables. While charming, they do not add a great deal to his arguments. The book is entertaining and informative, but often groundless in its conclusions. Embarrassingly, Sternberg compares the rejection of free will by scientists to the historical rejection of the ideas of continental drift or quantum mechanics. He mentions Bohr and Heisenberg, but does not credit 'uncertainty' to explain the randomness in human behaviour. Sternberg appeals to scientists to study the 'conscious agency' scientifically, as the theoretical tools needed are already available! In his opinion, the boundlessness of our experience and reasoning cannot be explained by 'determinism' and hence free will must exist.

A wonderfully witty discussion on the meaning of free will is found in the essay 'Is God a Taoist'[2]. In this conversation between God and a mortal, God says, 'I could no more choose to give you free will than I could choose to make an equilateral triangle equiangular. I could choose to make or not to make an equilateral triangle in the first place, but having chosen to make one, I would then have no choice but to make it equiangular'. Another interesting idea comes from Carter[3] that nature, of which our brain is a part, has created an illusion of free will giving us an apparent sense of responsibility necessary for smooth functioning of human society. Thinkers have also stated that if there is no free will, and no responsibility, it is necessary to rethink our laws and our punishments, and revise our societies[4]. The impression that we are making free, conscious decisions is in fact only a reflection of signals we receive from our surrounding, our genes, and the stochastic processes beyond our control.

1. Cashmore, A. R., *Proc. Natl. Acad. Sci. USA*, 2010; http://www.mit.edu/people/dpolicar/writing/prose/text/godTaoist.html
2. Smullyan, R. M., 1977, **107**, 4499–4504.
3. Carter, R., *Exploring Consciousness*, University of California Press, Berkeley, 2002.
4. De Duve, C., *Vital Dust*, Basic Books, New York, 1995.

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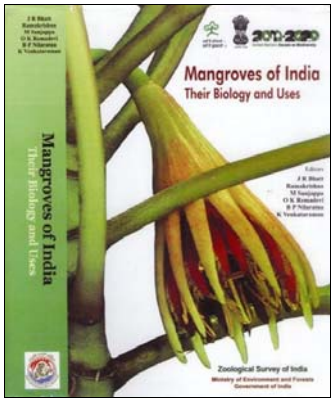

Mangroves of India – Their Biology and Uses. J. R. Bhatt *et al.* (eds). Zoological Survey of India, Prani Vigyan Bhawan, M-Block, New Alipore, Kolkata 700 053. 2013. XIV + 640 pp. Price: Rs 2950/US$ 160.

Mangroves – considered a tropical beauty and surviving many odds for their existence in the transition zone between land and sea, have evolved many unique characters such as the ability to tolerate high salinity, extreme tidal conditions, higher wind velocity, high temperature and muddy anaerobic conditions. With characteristics such as viviparous germination, strong network of respiratory roots, stilt and prop root system and salt excreting leaves, they are able to survive in a hostile environment. Mangroves are immensely helpful to the human society with their valuable ecosystem services, such as protection of coastline from storm surges, maintenance of water quality, sequestration of carbondioxide and provision of livelihood through fisheries, honey, tourism and innumerable products of commerce. In short, there is no other habitat which occurs under such an adverse condition and still serves the cause of human beings so well. The manner in which mangroves withstood the super cyclone which battered and devastated Odisha in 1999 and the Indian Ocean tsunami in 2004 which ravaged Tamil Nadu and Kerala, notwithstanding the Andaman and Nicobar islands, underscores their importance in protection of the coastline of India. Many publications have come out on the biology and biodiversity of mangroves, besides other topics. However, a comprehensive publication covering various vital aspects of mangroves was a long felt need. This book meets the above requirement admirably well.

The impressive foreword by the Honourable Minister of State for Environment and Forests (MoEF), Government of India (GoI), Jayanthi Natarajan, adds to the value and importance of the book. She is appreciative that this compilation of research on mangroves is being brought out during the UN Decade on Biodiversity (2011–2020) and India's Presidency following the hosting of the Eleventh Conference of Parties (COP-11) to the Convention on Biological Diversity in October 2012 at Hyderabad. What is significant is that this book has been released on the International Day for Biological Diversity, 22 May 2013, the theme of which (water and biodiversity) is quite relevant to the subject of this book.

This book is the outcome of a Workshop on 'Mangroves in India: Biodiversity, Protection and Environmental Services' sponsored by MoEF, GoI, during 2008 at Bengaluru to analyse the current status of knowledge on the mangroves in India with reference to their biology and uses. It is appreciable that a detailed exercise has been undertaken to