

Rocks of Ages: Science and Religion in the Fullness of Life. Stephen Jay Gould. Ballantine Books, New York. 2002. 241 pp. Price: US\$ 12.95.

Stephen Jay Gould is widely known as an outstanding scientist, arguably the best-known evolutionary theorist since Charles Darwin. He remained active both in research and popular writing until his death and spearheaded an intellectual movement to reform the Darwinian logic of how life has evolved. His controversial theories on contingency and punctuated equilibrium are well known. In fact, he was among a rare breed of scientists who bridged a wide variety of fields of geology, biology, planetary science and philosophy. He was also an activist who had fearlessly plunged into a fight against creationism and played a major role in defusing the efforts to make it a law in some of the American states. May be encouraged by this experience, in his book, *Rocks of Ages*, Gould traces the model of warfare between science and religion from the dark ages through the Renaissance period to the present-day struggle between creationists and evolutionists in America. Through his essays, Gould explores for a solution to end the turf war between science and religion.

The book certainly holds a message for all of us who belong to societies that reel under conflicting passions. In this book Gould, a non-believer, develops the principle of NOMA (Non-Overlapping Magisteria) so that two fundamental domains of thought (Gould calls them *magisteria*), can pursue their objectives without being measured by each other's tools of enquiry; science rests on evidence and logic, whereas religion rests on faith and belief. He emphasizes the need for a middle path by maintaining a dignified coexistence and respectful non-interference between the two spheres of thought.

Obviously, this book is directed at some religious groups in the US who had been vocally supporting the introduction of creationism in the teaching curriculum of American schools, which he thinks as a distinct violation of NOMA. Gould had no quarrel with these people if they taught their doctrine in homes and churches, but he was against them imposing these dogmas upon schools. Gould, however, believes that some of the influential 18th century naturalists deserved to be blamed

for generating opposition to the theory of evolution. Gould talks of how some influential scientists of that period used the ideas of natural selection and survival of the fittest mechanically, to interpret some of the moral questions that are not clearly under the purview of science. These ideas were distorted and used to justify the horrendous crimes committed during the World Wars. According to him, this was a clear case of violation of NOMA by the scientists.

Gould explores the history of science and religion through the actions of its protagonists in making his point on how lives of spiritual awareness and rational enquiry could go on, side by side, to enrich human life. He begins his discussion with the story of Thomas, one of the apostles of Jesus Christ, famously known as the Doubting Thomas. Gould argues that Thomas showed his skepticism and his insistence for evidence under a wrong magisterium, for he should have known about resurrection through faith and belief. As Richard Dawkins recently suggested that Doubting Thomas could as well be a patron saint of scientists!

Gould goes onto two famous examples of Victorian heroes in science, Charles Darwin and Thomas Henry Huxley, who had been the principal *bêtes noires* of religious fundamentalists – Charles Darwin for developing evolutionary theory and Huxley for his spirited defence of that theory. Both of them have been traditionally portrayed as two powerful examples of rational thinkers who had rejected the religious philosophy. Gould thinks otherwise. It is true that Darwin and Huxley never had any belief in an 'intrinsically just world, governed by a loving anthropomorphic deity', but they were not dismissive about the role of religion in dealing with certain questions of 'moral contemplation' such as meaning of life or the concept of immortality, which cannot be subject to scientific proof. Gould thinks that Darwin's ultimate celebration as a scientist who subscribed to the principle of NOMA found expression in being buried in the holiest of holy shrines of Anglican Church of Westminster. Gould tries to put a new spin on Darwin's saga, but he may not be oblivious of the fact that it is not just the religion that was against Darwin, many of the influential academics of that time opposed him tooth and nail. Darwin survived mainly because of the vigorous support of his friend Thomas Huxley.

He brings in a lot more historical examples of the turf war between science and religion, and the applicability of the principle of NOMA. In medieval Europe many believed that Christopher Columbus would sail right off the edge of a flat earth. It was the contemporary Christian thinkers like Roger Bacon and Thomas Aquinas who reaffirmed the sphericity of the earth and cleared the web of misconception popularized by a fringe group. Resolution of this controversy can be cited as an example of adherence to the principle of NOMA, wherein the religious thinkers themselves insisted on a scientific fact, established much earlier by Greek thinkers. Gould discusses with some relish, the most famous archetypal clash between science and religion: the drama involving Galileo and his one-time liberal friend and connoisseur of arts and science, later to become Pope Urban VIII, one of the most conservative popes in the history of Christianity. Here, Gould blames the tactlessness of Galileo for his ordeals in pushing his heliocentric theories 'too fast and too far', simplistically miscalculating the reaction of his personal friend who was driven by his own political compulsions. Had Galileo not caricatured the religious views provocatively in his book through a character called *Simplicio*, would the Church exonerate him? Gould makes a case that is somewhat judgmental on Galileo. Who violated NOMA—Galileo or the Church? Although much has been written on the struggle of Galileo against the Roman Church, Gould adds a new dimension to this story, though I think many would disagree.

Gould is an essayist at heart, going by his own admission. His extravagance with words, ideas and style sometimes leaves you dazed with its sheer radiance. I wish the book had been edited a little more carefully to avoid some repetitions, and some of his arguments may be seen as self-serving. That apart, Gould's book is a breathtaking ride across the breadth and width of the historical landscape of science, a guided tour in the company of one of the ablest interpreters of natural history. This tour takes us through a landscape that is dotted with milestones left not only by the great thinkers, but also by little-known savants who made their own small contributions to the expansive human intellect, and in Gould's parlance these men are called 'Rocks of Ages'. This book is a must

read for anyone who lives in conflict-ridden societies and is groping for solutions. Through this book Gould's powerful personality and humanism make a lasting impression on the reader's mind – truly a parting gift from a great mind.

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Fracture Mechanics for Modern Engineering Design. K. R. Y. Simha. Universities Press (India) Ltd, 3-5-819 Hyderguda, Hyderabad 500 029. 182 pp. Price: Rs 225.

Damage tolerance-based design has become mandatory in all the safety-critical, high-technology structural components. The science behind this approach – fracture mechanics – is highly interdisciplinary and has been growing rapidly over the past three decades. Before the 1960s, it was a challenge for the elasticians to develop solutions which take care of the presence of cracks (due to free surfaces formed in a material). Later, it required a combination of analytical and experimental scientists in structural and material sciences to investigate the criteria which can predict crack growth in a material, finally leading to failure due to fracture. The major question posed for the designers and operators is how to identify the existence of a crack, and monitor its growth so that catastrophic failure can be avoided. One could visualize its importance in vehicles such as aircraft, helicopters, railway bridges, dams, multi-storeyed buildings. Besides structural, fatigue and fracture analysis, sophisticated instrumentation, closed loop control and smart systems are required to ensure component integrity in these high-technology structures.

Obviously a total coverage of all sciences required for damage tolerance analysis in a single book is a stupendous task. The book under review covers best the classical theory of elasticity solu-

tions, which are not found in such detail in many books. A good background in this area is essential for both undergraduate and postgraduate students in various mechanical and aerospace disciplines. The width of total coverage in the book is broad. The author touches upon dynamic fracture, fracture control plan, plasticity effects and mixed-mode fracture, so that a student-reader gets a gross picture of the field. However, details in many areas are missing (some of them are essential); but this is understandable since this is a small textbook for a field which is interdisciplinary and growing rapidly. I cannot help but comment that numerical analysis for estimating stress intensity factors has surprisingly received little attention from the author – not even to the extent of coverage on experimental methods. I would have also expected a more reasonable exposition of practical problems, case studies in design and operation and ageing structures/aircraft.

Both students and designers need to supplement a lot from other books and journals. The book, however provides a reasonable bibliography to help the reader. I am also impressed with the number of worked-out examples and exercises provided at the end of each chapter.

In summary, I would recommend this book to those who are planning to enter into the field of fracture mechanics at both academic and design levels.

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Statistics in Genetics and in the Environmental Sciences. Fernholz, L. T. *et al.* (eds). Birkhauser Verlag, P. O. Box 133, CH-4010, Basel, Switzerland. 2000. 183 pp. sFr 98/DM 130.

This book comprises a collection of 12 papers presented at a Workshop on Statistics and the Sciences held in Ascona, Switzerland in 1999. All papers relate to problems of genetics or the environ-

mental sciences in a broad sense, including atmospheric chemistry, debris in space, etc. There is a wide variation in the quality of the papers. Some of the papers are highly theoretical and are only tangentially related to real-life problems, while several others actually start with a real-life problem and then proceed to develop statistical methodologies for solving the problem.

The problems of genetics that have been dealt with statistically comprise several frontline areas of research, including quantitative genetics, microarrays, assignment of offspring to parents using molecular markers and carcinogenesis. Similarly, several frontline areas of research in environmental sciences have also been addressed from a statistical viewpoint, including estimation of parameters for distribution of chemical concentrations, risk assessment of carcinogen exposures, ozone layer breakdown, air pollution and space-debris risk assessment.

The nature of statistical treatment of problems included in the papers is also highly variable. Some of the papers are superficial and discuss statistical methods as implemented in some software packages, without providing any details of the methods themselves. This is a deplorable trend. Some other papers assume that the reader is conversant with details of the scientific problem introduced by the author(s) and then quickly jump to provide statistical solutions. Thus, there is no consistency in scope, style or level across chapters. I must, however, state that most of the papers actually present some new statistical methodology, and are not confined to use of routine or standard statistical methods in the sciences. Most papers are not self-contained. Therefore, the reader will need to spend a great deal of time in studying earlier publications, before being able to comprehend the papers presented in this collection. I did this with respect to two of the chapters of immediate professional interest to me, and was rewarded.

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