primate adaptations to new environments. The authors have emphasized the need for striking a balance for quality and completeness of the primate genomes versus more number of genomes, and also the challenges in functional elucidation due to the paucity of adequate material either because of sample accessibility or their dwindling numbers.

The book has also devoted chapters (6, 7, 13, 15 and 18) that describe the essential tool kit that a genomic scientist needs to be aware about. Contemporary genotyping technologies as well as the anticipated future developments using microfluidics and nanotechnology and use of next-generation sequencing platforms for transcriptome and genome analysis is likely to enable studies at much higher throughputs, finer resolution and lower costs. Transcriptome sequencing (described in chapter 7) has enabled genome annotation, alternate isoform discovery, gene expression profiling, mutation profiling, non-coding RNA discovery and detection, identification of aberrant transcriptional events and discovery of RNA editing sites. With the leads obtained from GWAS studies and the increasing emphasis on the role of rare variants in diseases, methods are also being developed to capture/enrich genomic regions for targeted resequencing in thousands of individuals. Issues relevant to genomic partitioning have been dealt with extensively in chapter 13. Chapter 18 discusses how genotype imputation has enabled integration and meta analyses of GWAS studies conducted on different array platforms from different studies, increased the power of genome-wide scans, and facilitated and also led to the discovery of causal single nucleotide polymorphism from reference sequences after association studies. With the availability of complete sequences from 1000 genomes project (www.1000genomes.org) and reference databases in diverse populations, genotype imputation would be a key tool in genetic studies.

A few chapters deal with the impact of genomics on common man in terms of testing its impact. It also deals with the uncomfortable domain of ethics in genomics research where sometimes the quest for answers supersedes the responsibility and accountability in handling biospecimens (chapters 9, 10, 20 and 23). These could be important issues which we might need to evolve for setting up national guidelines. Chapter 9 has provided an overview of how genetic testing has become quite widespread and successful in Israel due to the efforts of the socialized medical system, the government national programme for the detection and prevention of birth defects, a central registry of genetic disorders and the availability of a medical genetics unit. Simultaneously, legislation to regulate genetic testing and protect privacy to avoid discrimination has also been implemented. There is also a concern of the custodianship of and access to DNA specimens, and attached clinical and genetic data that are held in biobanks and large disease cohort collections. It is being realized that an exercise in de-identifying or anonymizing the large GWAS dataset is futile, and a need is being felt to devise comprehensive guidelines that not only allow scientific advancements but also respect the patient's confidentiality and rights while protecting the investigators from legal challenges. Chapter 10 has described a few salient points that need to be considered, discussed and implemented in this regard. Chapter 20 deals with issues of direct-to-consumer testing where many companies are now providing genetic tests without recommendations of medical experts. This is especially important for mutations with low penetrance which cause disease in only a minority of patients and could lead to a large number of false positives. Low penetrance genes pose a risk in population-based screening, since by definition many persons who test positive for low penetrance variations might never develop the disease, but this could influence reproductive choice, health behaviour and potential for discrimination on the part of the insurance company or the employer.

The last chapter provides an account of genetic studies that have been carried out over the last 40 years in the Amish and Mennonite populations of North America, represented by a limited number of individuals in the early eighteenth century. This chapter provides a historical account of genetic studies conducted in this population that led to mapping mutations and founders for many diseases, and also the efforts by researchers and companies in setting up facilities in this population, which have not only been useful in rapid genetic screening but also in administering timely dietary interventions to change the course of diseases. Some of the primary objectives of the Human Genome Project – to harness genetic knowledge to heal the sick, prevent disability and reduce medical costs, have been realized through an integration of genetic technologies into a rural pediatric practice. Studies in these populations have also highlighted how discovery in a limited sample size could be applicable to larger populations. The chapter also deals with an important aspect of how for effective community participation for a genetic study, it is imperative that scientists must first commit to caring for individuals.

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Worldviews – An Introduction to the History and Philosophy of Science (Second Edition). Richard DeWitt. Wiley–Blackwell, West Sussex, UK. 2010. 376 pp. Price: AU$ 39.95.

As an academic teaching the subjects 'Research methods' (first year Master's students of sustainable agriculture) and 'Research philosophies and methods' (fourth year research Honours students of agriculture), I enjoy reading new books and new editions of books dealing with themes on the history and philosophy of science (HPS). My enjoyment is because such readings enable me to teach my students better by raising provocative questions and providing new problems to set a context wider than they usually perceive and experience. I was, therefore, happy to get a copy of the new edition of DeWitt book.

Before I go into discussing the book, I would like to mention that a sound understanding of the HPS is critical in the context of Indian high school-, college- and university-science teaching. Bulk of high school-, college- and university-mainstream science teaching in the West includes HPS, at least for background understanding. For example, the curricula include either cultural information or specific human interests that connect with HPS. This is done by incorporating viewpoints of earlier scientists on natural phenomena. The information thus set is situated in a context that will challenge and provoke students by creating opportunities for them to respond with their personal perspectives and views. The driving principle in integrating HPS into mainstream science teaching right from high-school learning – in the West – is to encourage an aptitude and an attitude in students in developing and honing their abilities to consider alternative interpretations of evidence and develop a mindset to compare and contrast[1]. Most importantly, using HPS teachers provoke their students to ask questions such as 'how does one know', and 'what is the evidence to say so', which connect with epistemology. Such an approach provides teachers an opportunity to enable students to recognize and value their previous knowledge – an action basic to constructivistic thinking. My following remark needs to be read disinterestedly. Can we – in India – confidently and comfortably say that the high school-, college-, and university-science education unequivocally meets the above? Is science being taught at every level the way it should be taught and in the way it is being taught in the West? A few exceptions do exist. Learning certain experiments relating to the biophysical world and building a capacity to faithfully reproduce them in the practical-examination hall is, certainly, not science learning. Science learning needs to build the capability (*capability* transcends *capacity*) in students: (a) to acquire and build on epistemological openness, and (b) to not only learn *of* science, but also learn *about* science. Are we – science teachers at different levels in India – using our creative intelligence in enabling our students to learn of and about science in the most convincing manner? Should someone say a categorical yes, none would be happier than me.

I apologize for the digression. This book includes 29 chapters organized in three parts: (i) Fundamental issues, (ii) The transition from the Aristotelian worldview to the Newtonian worldview, and (iii) Recent development in science and worldviews.

Chapter 2 in Part 1 refers to '*truth*' as the basic theme. To me, scientific research is the exploration of truth. My students here and I have had extensive debates and arguments on this point. I am convinced that as scientists, we are constantly seeking strains of truth that hide behind the giant edifice the biophysical world. We seek to understand what is truth, how does it prevail and/or operate, and why so. To verify these, we construct a research question (or a hypothesis), execute experiments, and achieve results, and debate our results as enshrined in the previous explorations of truth referring to the same context. Would it be appropriate to synonymize *fact* with *truth* at this point? But then in reality, what was recognized and valued as a fact at a point of time has been proved that the previously established fact no longer remains valid! Several examples in science history illustrate that facts have 'changed' over time, because of greater levels of understanding! I am aware that this is an oxymoron – something similar to 'mediocrity in excellence' and 'public–private phone booths'! DeWitt (p. 31) indicates that truth is a puzzling notion; I cannot agree more. The questions that hammered me as I read this chapter were: 'Where do distinctions between empirical facts and philosophical facts occur?', 'How can we recognize them?', 'Are they distinctly different?' Today, empiricism (thanks to the worldviews of William of Ockham [estimated 1288–1328; *ontological parsimony*; Ockham's razor], Francis Bacon [1561–1626; *inductive reasoning*; from fact to theory], and John Locke [1632–1704; *Tabula Rasa*; constructed on Baconian empiricism]) drives science. DeWitt exhorts in page 36:

> '… do not think of empirical facts and philosophical/conceptual facts as absolute categories. Most beliefs are based on a combination of empirical evidence and more general views about the sort of world we inhabit.'

and continues further. As a reader, I found these remarks thought-provoking, because at some point of time, I feel dismayed at the grey areas that become evident even in carefully designed and executed scientific experiments in an effort to explore truth. Chapters 4 and 5 explain the principles of logic that regulate scientific methods and the evolution of structured scientific methods set in the broad context of the Duhem–Quine problem (referred to by DeWitt as the *Quine–Duhem* thesis), which enunciated that a scientific hypothesis cannot be tested in isolation. Chapter 5 explores the implications of scientific methods building on Aristotle's and Descartes's axiomatic approaches, Popper's falsificationism, and the hypothetico-deductive method derived from the Duhem–Quine problem.

The second part provides a concise and convincing journey through time from that of Aristotle to Newton, with exclusive sections alluding to principles of understanding of the earth and the universe (thus science in general) as seen and propounded by Copernicus, Tycho Brahe, Kepler and, Galileo.

The third part includes discourses on modern-period landmarks in scientific thinking from Einstein's theory of relativity. Through a set of logically driven chapters, DeWitt renders an exposé of quantum theory and offers pointers to the theory of organic evolution. The latter are pitched on concepts promulgated by Charles Darwin and Alfred Wallace. Contemporary understanding of organic evolution is the synthetic quintessence of different biological exploratory routes trialled and perfected in the 20th century. Information generated by field biologists through the study of natural populations, by laboratory biologists through regulated experiments, and by empirical biologists using mathematical models enabled with sophisticated computer software have contributed much to our present understanding of evolution. Nonetheless, we cannot deny that issues lacing on philosophical and conceptual nature are clouding the clarity of science and scientific methods. DeWitt's remark in pages 339–340 necessitates self-introspection:

> 'There seems to be a common belief that the evolutionary account forces on us some sort of dismal, less interesting view of the universe and our place in it. But the evolutionary account need not be taken in any sort of negative light. Evolution forces us to view our place in the big scheme of things in a very different way.'

Reading this remark, I was reminded of Carl Sagan[2]:

> 'Our posturings, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light. Our planet is a lonely speck

in the great enveloping cosmic dark. In our obscurity – in all this vastness – there is no hint that help will come from elsewhere to save us from ourselves.'

Science is similar to a knife: in the hands of a deft surgeon, the knife does good by curing the sick; whereas, in the hands of an evil person, it does bad by exterminating life. Are we using our wisdom to explore science and teach it in a manner so that we promote only the good of it? Or, has science made us to turn headstrong thinking that we can control the biophysical world as we desire?

This well-presented and easily readable book, left me dazed and wondering about myself and my place in the world and the universe!

1. Henke, A., Höttecke, D. and Riess, F., Paper presented at the 10th International History, Philosophy, and Science Teaching Conference, University of Notre Dame, South Bend, USA, 2009; http://www.nd.edu/~ihpst09/papers/Henke_MS.pdf (accessed on 24 May 2011).
2. Sagan, C., *Pale Blue Dot: A Vision of the Human Future in Space*, Random House, New York, 1994, p. 429.

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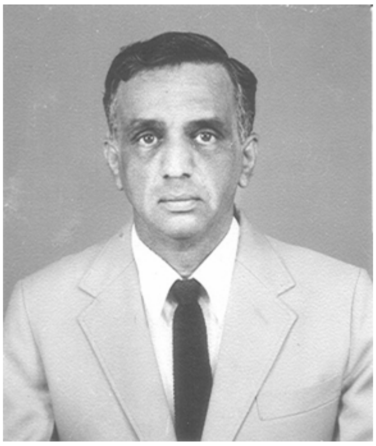
PERSONAL NEWS

Nuggehalli Raghuveer Moudgal (1931–2011)

N. R. Moudgal, an eminent reproductive biologist and endocrinologist from the Indian Institute of Science, Bangalore, India, passed away on Sunday, 8 May 2011 at Dublin, CA, USA, after battling cancer for the last few months. He was born in Mysore in 1931 and obtained his Master's and Ph D degrees in biochemistry from the University of Madras. After postdoctoral work at the Hormone Research Laboratory, University of California, San Francisco and spending a year as a Wellcome Trust Fellow at the Department of Immunology, St Mary's Hospital Medical School, London, UK, he returned to India as a CSIR Pool Officer at the All India Institute of Medical Sciences, New Delhi. He worked at the Department of Biochemistry, Indian Institute of Science, Bangalore, as an Assistant Professor and rose to the position of Professor; he also served as Chairman of the Department of Biochemistry and Dean of the Science Faculty. During his long career spanning more than 40 years, Moudgal made seminal contributions: he was the first to initiate research in the areas of endocrine biochemistry, reproductive physiology and primate biology using immunological methods. He had conducted systematic studies using highly characterized antibodies to gonadotrophins to block their action and demonstrated the critical role of these hormones in follicular maturation and implantation using rodents and non-human primates as models. His pioneering work using antibodies to luteinizing hormone formed the basis of further studies on immunological approaches to human contraception. He successfully demonstrated the need for



follicle stimulating hormone for the initiation of spermatogenesis in non-human primates and humans. He was instrumental in establishing the finest bonnet monkey facility in India and contributed nearly 150 scientific papers using exclusively non-human primates as models. He was the first Indian scientist to present his research work at the prestigious Laurentian Hormone Research Conference in Canada. He also developed a vibrant group and trained a large number of graduate students and postdoctoral fellows, who are currently leaders in science. He was a Fellow of the Indian Academy of Sciences and the Indian National Science Academy, and also a Member of the Endocrine Society, USA and Society for Study of Reproduction, USA. He had received several awards, including the S.S. Bhatnagar Award.

Moudgal was not only a great scientist, but also a kind-hearted human being. He will be remembered for his dedication to science and also for his positive attitude towards life in general. He was a source of inspiration and brought the best out of everyone around him. He will be missed dearly. He leaves behind two sons and a daughter, six grandchildren and a large number of colleagues.

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