Handbook of the Psychology of Science, edited by Feist, G.J and Gorman, M.E. (2013). Springer Publishing Company.

For those of us who have received a science education, or who are immersed in science as part of our work, we may take for granted the curious nature of the scientific act, and the fascinating psychology behind the act. We may assume that scientific thinking and behavior is a cultural given – a commonplace and everyday activity. According to Jean Piaget's theory of cognitive development the emergence of scientific thinking skills in adolescence is an inevitable product of an orderly, cumulative, directional sequence of change – a movement from reflexes, simple representations, and intuitive logic toward increasingly logical and adaptive representations of reality. Not only is this view fundamentally false, culturally bounded, and idealistic, it distracts us, with its wonderful simplicity, from the complexity of the psychology of science – the historical, social, personal, and contextual factors that shape scientific thinking and behavior. At the same time, being a developmental psychologist, a 'post-Piagetian', and a 'knowledgeable' individual, I approached reading the *Handbook of the Psychology of Science* with a natural skepticism – as if I already knew what I needed to know about the psychology of science: get on with the job, the inpatient scientist within me exclaims! But I have come away from reading this book with a profound sense of wonder and excitement and humility, with the insight that, building upon the history of science, the philosophy of science, and the sociology of science, the scholars now working to facilitate understanding of the psychology of science are making an invaluable contribution to knowledge, which may ultimately shape cultural evolution.

Given the pressing nature of problems that impact on survival, adaptation, and flourishing as a species, a better understanding of the nature of our scientific thinking and action is fundamental to cultural evolution and our ability to work together to solve problems. The psychology of science is a discipline that facilitates understanding of the thoughts and behaviors of individuals and groups engaged in scientific reasoning, problem finding and solving, theory construction, model building, hypothesis testing, and the creation and application of technology. Although the Psychology of Science is a new, emerging field of study that has struggled for existence at times, it has deep scholarly roots, for example, in the work of Candolle, Galton, Kuhn, Choynowski, Yaroshevsky, Maslow, Tolmon, Simon, Simonton, Feist, and others. This new handbook of the psychology science is a timely book that highlights a new energy and power of purpose in the field. One of the most valuable aspects of the handbook is that it not only provides the reader a deep understanding of the historical landscape (Chapters 1 and 2), future trends (Chapter 20), and postmodern context of the field (Chapter 13), it is a book that reveals an incredibly broad, rich landscape that can be surveyed from many vantage points, with every chapter complementing the other chapters, regardless of the order in which one reads chapters in the book.

A useful starting point to develop an understanding of the psychology of science is to consider the nature of the development of scientific thinking and behavior in children (e.g., Chapters 3 and 9) and, more generally, the challenges associated with scientific thinking in the context of ever-present heuristics and biases (e.g., Chapters 7 and 18). Much like Piaget's starting point, developing an understanding of how scientific thinking and behavior develop is essential for understanding our potential for further cultural evolution. Some of the research reviewed in these chapters highlights the

challenge of developing domain-specific knowledge, metacognitive skills, and approaches to enquiry that allow children and adults to think about their thinking, approach the design of experiments , consider alternative explanations for phenomena, and, ideally, reflect upon and avoid potential sources of bias, including confirmation bias, *a posteriori* hypothesis development, clustering illusions, omission bias, affect heuristics, recency and availability heuristics, and so on. In this context, a scaffolded learning experience is often better than pure discovery learning to facilitate the development of both domain specific knowledge and greater metacognitive expertise in scientific thinkers over time. Furthermore, working in different domains of science also involves working with different types of data, and beyond the challenge of learning domain-specific computational skills there are many barriers to data analysis that can be understood from the deeper, psychological perspective. For example, in Chapter 19, Schunn and Trafton highlight some of the sources of uncertainty in data analysis, including physics, computational, visualization, and cognitive uncertainty. They describe a range of strategies that may be needed to reduce uncertainty in data analysis, including checking for likely errors, focusing on reliable sources, adjusting for known deviations, averaging across sources, acquiring more or better data, and bounding uncertainty. The chapter highlights the psychology of the actor in the process of data analysis.

In the modern environment of networked knowledge and multi-disciplinary teams, it may seen that genius is an outmoded concept, but there is always space for genius levels of performance within a network of scholars, and perhaps genius level performance is needed now more than ever in the history of science. In Chapter 10, Simonton focuses on the origins of creative genius in science and highlights the role of genetics, personality, family factors, education and mentoring in shaping genius level performance. Simonton also highlights many interesting trends in relation to genius, including patterns of lifespan productivity, an apparent bias toward male geniuses in science and engineering, and the role of historical forces in shaping the emergence of genius. Kumar (Chapter 11) takes up the theme of gender and describes how women were traditionally excluded from science and why, despite all the efforts to encourage more gender balance, women are still under-represented in STEM (science, technology, engineering, and mathematics). Given the inter-disciplinary nature of much of modern science, cultivating creativity in science is perhaps best seen as a group-level process, and Hemlin and Olsson (Chapter 20) describe a number of factors that facilitate creativity in this context, for example, openness and respect, strong connections to social networks outside the group, and group leaders who have high quality relationship with those who work with them. On the other hand, conflict and competition within and between groups is also common in science and promoting cooperative dynamics can often be difficult. For example, Schulze (Chapter **) highlights how controversy and conflict often arises in the genesis of innovative ideas and acceptance of new ideas within a community of scholars can be a slow process. Problem focused conflict resolution strategies are often needed to build trust and maintain progress in working groups, and a broader cultural focus on helping people rather than focusing on making a profit or winning a competition will be central for the development of progressive scientific practices into the future.

Other fascinating topics covered in the handbook include a focus on the scientific personality, science communication, the psychology of technological invention, and the psychology of human research

participation. It is rarely the case that a chaptered book approaches anything close to an integrative synthesis, but this book is one of those rare exceptions. Reading this book is a very enlightening experience. The metaphor that comes to mind is that of the knowledgeable farmer who comes to know every inch of his or her land by surveying it from every vantage point and by cultivating it for many purposes. The farmer is focused on sustainable production and the wellbeing and survival of the ecosystem. The rewards in terms of sustainable production, wellbeing, and survival are similar for both the farmer and for those who work to cultivate an understanding of the psychology of science. Deep understanding, constant reflection, and iterative redesign of scientific infrastructures is fundamental for our survival, adaptation, and flourishing. I highly recommend this book to everyone in the academy – it should feature prominently on all our bookshelves and we should talk about it to everyone we meet.