of "self-organization." The final four chapters purport to demonstrate how Intelligent Design provides the ultimate explanation of all these phenomena.

Meyer, Director of the Center for Science and Culture at the Discovery Institute, emphasizes that our understanding of the Cambrian explosion remains incomplete. He recapitulates the arguments from his earlier book, *Signature in the Cell*, and from his Discovery Institute colleagues Michael Behe, William Dembski, Jonathan Wells, and Douglas Axe, who all maintain that there have never been a sufficient number of cell divisions, nor a sufficient number of years in the history of the universe for unguided processes to bring about animal forms. *Darwin's Doubt* thoroughly reviews the arguments of the Intelligent Design movement and, thus, could save a person the trouble of reading all their previous publications.

Reporting on the discovery that developmental gene regulatory networks are highly conserved and not tolerant of mutations, Meyer asserts that this must have always been the case, thereby preventing the development of varied animal body plans: "The system of gene regulation that controls animal-body-plan development is exquisitely integrated, so that significant alterations in these gene regulatory networks inevitably damage or destroy the developing animal. But given this, how could a new animal body plan, and the new dGRNs necessary to produce it, ever evolve gradually via mutation and selection from a preexisting body plan and set of dGRN's?" (p. 269). The idea that in early metazoan populations such networks, and the interplay among them, might have evolved spectacular diversity before they became so highly integrated is dismissed, even though this idea is central to current research.

Meyer moves to the crux of his argument on page 337: "Neither neo-Darwinian nor a host of more recent proposals [he includes a list] have succeeded in explaining the origin of the novel animal forms that arose in the Cambrian period. Yet all these evolutionary theories have two things in common: they rely on strictly material processes, and they also have failed to identify a cause capable of generating the information necessary to produce new forms of life…. Is it possible that intelligent design – the purposeful action of a conscious and rational agent – might have played a role in the Cambrian explosion?"

The reliance on "strictly material processes" that Meyer finds limiting is the basis of modern (since the 17th century) science. His concern for "generating the information necessary" reflects the Intelligent Design movement's premise that anything really complex requires a blueprint, despite the fact that modern biology has shown that this is not true: DNA is not a blueprint and organisms are not constructed like machines.

In addressing how a designer actually manipulated atoms and molecules to create brand-new life forms, all Meyer claims is that "intelligent agents can act suddenly or discretely in accord with their powers of rational choice or volition, even if they do not always do so…. If body plans arose as the result of an intelligent agent actualizing an immaterial plan or idea, then an extensive series of material precursors to the first animals need not exist in the fossil record…. Mental plans or concepts need not leave a material trace" (p. 375). To quote Nick Matzke, formerly of the National Center for Science Education, this explains the appearance of the first animals and their body plans by saying, in effect, "POOF!"

The author and his institute claim that *Darwin's Doubt* is an important contribution to modern biological science. There are major clues that it isn't. HarperCollins chose to publish this under their HarperOne imprint, and HarperOne describes itself thus: *The most important books across the full spectrum of religion, spirituality, and personal growth*…. A more important clue is found in the last chapter, entitled *What's at Stake*. In science, what would be at stake would be a better understanding of the Cambrian fossil record and the processes of life and evolution. But Meyer instead tells us: "Modern life suspends many of us, so we feel, high over a chasm of despair. It provokes feelings of dizzying anxiety – in a word, vertigo. The evidence of a purposeful design behind life, on the other hand, offers the prospect of significance, wholeness, and hope." A heavy burden for a trilobite to bear!

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*for the confusion this book causes about the evidence and the science of studying the evidence. It rates *four frogs* as a review of the thinking of the Intelligent Design movement.

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TEACHING & THE NATURE OF SCIENCE

Teaching the Nature of Science: Perspectives & Resources. By Douglas Allchin. 2013. SHiPS Education Press. (ISBN 9780989252409). 310 pp. $40.00.

In his recent book *Teaching the Nature of Science: Perspectives & Resources*, Douglas Allchin presents a compelling pedagogical approach for using episodes from the history of science toward improving students' understanding of aspects of the nature of science (NOS). The text admirably synthesizes Allchin's expertise in both the philosophy and history of science, including his understanding of recent research in education that strives to both capture and improve students' NOS conceptions.

Allchin admits in the opening pages that the majority of the text can be found elsewhere as separate works, and while this is the case, two notable features of this book make it particularly worthwhile. First, Allchin has admirably synthesized the separate works and included additional chapters to create a rather comprehensive argument for why and how teachers should use history of science *as a tool* toward helping students learn NOS. Second, while the individual chapters stand alone in helping the reader to understand some facet of how to use the history of science in this way, throughout each there are frequent explicit references to the themes contained in other chapters. Allchin is careful to help the reader see how one or more themes from earlier chapters connect with one another, and this technique indeed synthesizes his points well.

The text is divided into two large sections, with the first half of the book designed to help the reader understand some of the philosophical emphases, both historical and recent in education reform designed to improve students' NOS understanding. In this first section, Allchin draws attention to the increasing emphasis placed on having students learn the nature of science, though he is critical of both research in science education and pedagogical efforts that tend to treat NOS "tenets" as decontextual conceptions that students should learn. Allchin develops his "whole science" model as embodying the notion that NOS should be learned within the confines of an engaging and realistic context and further that the history of science, when properly framed, can be an important tool toward fostering students to learn NOS explicitly, reflectively and meaningfully. His ultimate claim is that such learning will promote a more effective transfer of NOS understanding in the real world, when students encounter situations that require them to be functionally literate about how science works.

In the second section, Allchin illustrates his synthesis across several chapters by providing the reader with three different and detailed examples of how to incorporate the history of science with the "whole science" approach (a case study, role play, and problem-solving inquiry). Again, throughout the text, Allchin explicitly highlights how various aspects of the model he has presented in the first section apply, including attention to how teachers can/should avoid incorrect or inappropriate ways of using history of science.

Two chapters are particularly noteworthy. One is devoted to assessment of students NOS views, and here Allchin highlights several approaches teachers can use to authentically capture students' understanding. The second is his final chapter, written expressly for those teachers who are themselves interested in creating their own lessons that use history of science in the manner Allchin describes. With this chapter, Allchin provides several exemplars readily available for teachers to use, and he gives detailed suggestions for those interested in developing their own.

Throughout, Allchin is sensitive of his readership. He understands the constraints of contemporary science teaching, of the emphasis on high-stakes testing with its unfortunate pressures. He is realistic about the frequency to which teachers have sufficient time to incorporate history of science, and the text nicely argues how it is possible on occasion to use history both to teach relevant science concepts and nature of science at the same time.

Teaching the Nature of Science: Perspectives & Resources is targeted with instructional design in mind, toward best practice for producing scientific literacy, and though the first section may be a little deep for the novice regarding the problems/pitfalls/philosophy of science teaching for nature of science, it is worth reading carefully. Throughout the text are numerous examples from the history of biology, physics, earth science, and chemistry. Readers will appreciate these examples toward supporting the nuances Allchin makes in advocating the whole-science approach. High school and college science teachers should strongly consider reading this text.

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