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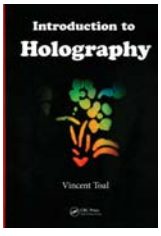
Introduction to Holography

Vincent Toal
CRC Press/Taylor & Francis, Boca Raton, FL, 2012. $99.95 (472 pp.).
ISBN 978-1-4398-1868-8

Last year was the 50th anniversary of Emmett Leith and Juris Upatnieks's seminal demonstration of holography,



the concept that was developed in the 1940s by Dennis Gabor and that earned him the 1971 Nobel Prize in Physics. Since that crucial 1962 demonstration, numerous books have been published that deal with different facets of holography. I vividly recall my own first steps; the excellent textbook *Optical Holography* (Academic Press, 1971) by Robert Collier, Christoph Burckhardt, and Lawrence Lin was a helpful tutor. And yet, even now, the field is far from mature. As proof, consider such impressive recent innovations and practical implementations as digital holographic microscopy, incoherent holography, x-ray holography, holographic television, and holographic tweezers. Consequently, there is room enough for a new book on the technique.

Seeking to fill that void is Dublin Institute of Technology professor Vincent Toal, who can look back to 30 years of teaching and research in optics and holography. Readers will get a sense of that experience from every page of his new text, *Introduction to Holography*. In its outline, the book is reasonably conventional. Part 1 covers the basics of optics; part 2, principles of holography; part 3, practical uses of holography; and part 4, technological applications of holography. But the execution of part 4, my favorite, is rather novel. It goes beyond discussions in existing textbooks by focusing on state-of-the-art developments of both classical and more advanced holographic applications.

It's certainly a matter of taste as to which applications must be treated and which could be omitted without loss of integrity or novelty. In my opinion, the author has found a good compromise between traditional and emerging ones. The book discusses most of the aforementioned holographic innovations. It also presents solid explanations and will encourage the use of such frequently discussed applications as holographic displays, holographic data storage and information processing, computer-generated holograms, and polarization holography. Chapter 15 has a nice section about Nils Abramson's light-in-flight principle and provides a welcome way to bring the elegant visualization of holography into the classroom.

Introduction to Holography is far from being light fare. But the author presents the mathematical derivation for every basic equation that is used in the book. Moreover, the spirit of the subject is not lost in the equations; the author clearly and carefully explains the physics behind the mathematics and offers sophisticated guidance for experimental work. Problems and references for further reading are provided at the end of each chapter.

Toal has written a welcome reference for experienced explorers of the holographic wonderland. But his book will also serve another important purpose brought to mind by the Ludwig Wittgenstein quote he uses at the front of the book: "Explanations come to an end somewhere." Toal's clear presentation provides a starting point for students and other newcomers and might help orient them toward research that will uncover new explanations. In any event, the text is proof that, unlike explanations, holography is far from coming to an end.

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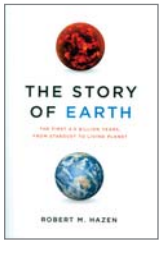
The Story of Earth
The First 4.5 Billion Years, from Stardust to Living Planet

Robert M. Hazen
Viking, New York, 2012. $27.95
(320 pp.). ISBN 978-0-670-02355-4

The story of Earth has been told and retold many times, using a familiar, decades-old outline that leads from its



birth by planetesimal accretion, to its molten infancy, to the origin of microbes, to a long period with no free oxygen, to the rise of oxygen and complex life—and here we are today. *The Story of*

Earth: The First 4.5 Billion Years, from Stardust to Living Planet is a new account by geologist Robert Hazen that brings the outline up to date with the latest research and links the story in a unique and compelling way to the formation of minerals at different stages in Earth's history.

Hazen is a good writer; reading the book is a pleasure, but the content is dense. *The Story of Earth* is neither a casual read nor a scientific text. There are no references and no equations, and in places, I would have welcomed a figure or two. But the descriptions are complete. I would recommend this book to anyone committed to understanding Earth and its history. As an added bonus, the reader will see that history through diverse minerals and gems.

The book begins with the Big Bang and moves quickly to the formation of Earth in the rotating disk of material surrounding the young Sun. The focus then turns to the large impact thought to have ejected from Earth the material that became the Moon. In that chapter, and throughout the book, Hazen describes not just what we think we know but how and why we came to believe it was so. For example, he describes the three competing theories for the Moon's origin that were most popular before the Apollo missions: fission from Earth, capture, and coformation. The compositional and isotope data from the Apollo samples showed that the Moon was essentially material similar to Earth's crust but depleted in volatiles. Consideration of the Apollo results spurred the new idea of impact formation.

An internationally known researcher with a broad interest in Earth sciences and astrobiology, Hazen knows what is happening in those fields and what leads are under investigation. A good example is his discussion of the possible role of methane in breaking Earth out of global, glacial "Snowball Earth" events. Methane is a more potent greenhouse gas than carbon dioxide. But its sources and their variation over Earth's timeline remain an area of research.

Hazen recounts a teacher telling him that if confronted with any mystery rock, he would be right 90% of the time by guessing it to be composed of plagioclase, a component of basalt—good to know if you travel to the Moon or Mars. Basalt, the rock that rules the worlds, was our planet's first covering and is still the most abundant rock on Earth's sea floor and on Mercury, Venus, Mars, and the Moon. But as Hazen explains, it is granite that makes the land as we know it. Granite forms when basalt is slowly melted in the presence of water and the lighter, silicon-rich materials come to the top. The results are of fundamental importance for Earth. The granite collects and floats on the basalt, forming the continents. If not for granite, Earth would be a water world with only small basalt islands like the Hawaiian chain.

Although the mineralogy of early Earth is interesting, the diversity of minerals soared after complex life began to produce oxygen. Hazen and his colleagues were the first to point out that two-thirds of the 4500 known minerals (including my favorite, turquoise) could not have formed without free oxygen. Indirectly, those gems are biomarkers.

In his final chapter, Hazen looks to Earth's future. All good things must end someday, and so it will be with Earth. As the Sun gets brighter, eventually becoming a red giant, Earth will no longer be in the habitable zone and will be turned to a cinder or outright vaporized. Hazen shows us that final picture and then puts it in context with the near-term effects of human activities. We humans are not destroying Earth; we are only making it uncomfortable for ourselves. In time, the many species we drive to extinction will be replaced by others, and the sea-level rise that will destroy our coastal cities will be a blur in the history of geological change.

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new books

materials science

Oxide Semiconductors for Solar Energy Conversion: Titanium Dioxide. J. Nowotny. *Green Chemistry and Chemical Engineering*. CRC Press/Taylor & Francis, Boca Raton, FL, 2012. $259.95 (393 pp.). ISBN 978-1-4398-4839-5

Physics of Nanostructured Solid State Devices. S. Bandyopadhyay. Springer, New York, 2012. $119.00 (551 pp.). ISBN 978-1-4614-1140-6

Physics of Semiconductors. Parts A and B. J. Ihm, H. Cheong, eds. *AIP Conference Proceedings 1399*. Proc. conf., Seoul, Korea, July 2010. AIP, Melville, NY, 2011. $294.00 *paper* (1096 pp.). ISBN 978-0-7354-1002-2 *set*

Polymer Brushes: Substrates, Technologies, and Properties. V. Mittal, ed. CRC Press/Taylor & Francis, Boca Raton, FL, 2012. $169.95 (324 pp.). ISBN 978-1-4398-5794-6

Semiconductor Research: Experimental Techniques. A. Patanè, N. Balkan, eds. *Springer Series in Materials Science 150*. Springer, Berlin, 2012. $169.00 (372 pp.). ISBN 978-3-642-23350-0

Tellurite Glasses Handbook: Physical Properties and Data. 2nd ed. R. A. H. El-Mallawany. CRC Press/Taylor & Francis, Boca Raton, FL, 2012 [2002]. $249.95 (512 pp.). ISBN 978-1-4398-4983-5

Two-Dimensional Nanostructures. M. Aliofkhazraei, N. Ali. CRC Press/Taylor & Francis, Boca Raton, FL, 2012. $179.95 (307 pp.). ISBN 978-1-4398-6665-8

Viscoelastic Behavior of Rubbery Materials. C. M. Roland. Oxford U. Press, New York, 2011. $98.50 (332 pp.). ISBN 978-0-19-957157-4

miscellaneous

Proceedings of the Fifth Saudi Physical Society Conference (SPS5). A. Al-Hajry et al., eds. *AIP Conference Proceedings 1370*. Proc. conf., Abha, Saudi Arabia, Oct. 2010. AIP, Melville, NY, 2011. $166.00 (315 pp.). ISBN 978-0-7354-0930-9

nuclear physics

The 4th International Conference on Proton Emitting Nuclei and Related Topics. B. Blank, ed. *AIP Conference Proceedings 1409*. Proc. conf., Bordeaux, France, June 2011. AIP, Melville, NY, 2011. $143.00 (218 pp.). ISBN 978-0-7354-0983-5

IX Latin American Symposium on Nuclear Physics and Applications. R. Alarcon, E. Ayala, C. Granja, N. Medina, eds. *AIP Conference Proceedings 1423*. Proc. symp., Quito, Ecuador, July 2011. AIP, Melville, NY, 2012. $179.00 (495 pp.). ISBN 978-0-7354-1003-9

Applications of Nuclear Techniques. M. E. Hamm, R. W. Hamm, eds. *AIP Conference Proceedings 1412*. Proc. conf., Crete, Greece, June 2011. AIP, Melville, NY, 2011. $173.00 (444 pp.). ISBN 978-0-7354-0986-6

Exploring Fundamental Issues in Nuclear Physics: Nuclear Clusters—Superheavy, Superneutronic, Superstrange, of Anti-Matter. D. Bandyopadhyay, ed. Proc. symp., Goa, India, Nov.–Dec. 2010. World Scientific, Hackensack, NJ, 2012. $95.00 (300 pp.). ISBN 978-981-4355-72-8

Radiation Protection at Light Water Reactors. R. Prince. Springer, Berlin, 2012. $129.00 (366 pp.). ISBN 978-3-642-28387-1

optics and photonics

7th International Conference on Concentrating Photovoltaic Systems. F. Dimroth, S. Kurtz, G. Sala, A. W. Bett, eds. *AIP Conference Proceedings 1407*. Proc. conf., Las Vegas, NV, Apr. 2011. AIP, Melville, NY, 2011. $174.00 *paper* (414 pp.). ISBN 978-0-7354-0979-8

Cooperative Optical Non-Linearity in a Blockaded Rydberg Ensemble. J. D.