Book & Media Reviews

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Science Projects: How To Collect, Analyze, and Present Your Data

by Richard Neuhaus

Gormley Publishing: Waynesburg, PA, 2006. 173 pp. Contains many black and white figures, tables, diagrams, testimonials. ISBN: 978-0979450006 (soft cover). $24.95.

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Science Projects: Book 1. Project Ideas in the Life Sciences

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Science Projects: Book 2. Project Ideas in Chemistry and Biochemistry

by Richard Neuhaus

Gormley Publishing: Waynesburg, PA, 2008. 185 pp. Contains many black and white figures, tables, diagrams, testimonials. ISBN: 978-0979450044 (soft cover). $24.95.

reviewed by James W. Jetter

Science Projects: Book 3. Project Ideas in Physics and Engineering

by Richard Neuhaus

Gormley Publishing: Waynesburg, PA, 2010. 184 pp. Contains many black and white figures, tables, diagrams, testimonials. ISBN: 978-0979450075 (soft cover). $24.95.

reviewed by James W. Jetter

Richard Neuhaus has written four excellent textbooks that young science investigators and their teachers can use to get started on a science fair project. The intended audience is primarily high school students (grades 9−12), although the books could also be useful for advanced middle school students.

The first book in this series is titled *Science Projects: How To Collect, Analyze, and Present Your Data*. This book helps students answer the question, "How do I get started on a proposed investigation?" In addition, the author points out (and I agree) that reading this book is useful to students who have already started or even completed their investigation. Another question the book asks, "What do you hope to prove?" The author develops his answer by discussing how the student can generate a hypothesis and what can be predicted from it. The text goes on to describe how the student should collect, organize, and present rough data in the form of tables and graphs. The author goes into great detail about the advantages and disadvantages of each method of presenting rough data.

Throughout the book, certain points are reemphasized with the aid of the "Guidance Department Owl" and a big box that highlights the key points. For added clarification, flowcharts with timelines show the ideal progress of a generic project. Another useful aid that strengthens key points for the reader is the use of testimonials in various examples. There are additional short chapters on statistics, calculators, and computer packages that do statistical analysis. All in all, this book is a must for secondary school teachers who want a well-written and organized source to aid their students in starting, organizing, and presenting a science project.

There are three other books in the *Science Projects* series, dealing, respectively, with the sciences of life and biology, chemistry and biochemistry, and physics and engineering. Each of these books contains useful appendices summarizing the material on data gathering and presentation presented in *Science Projects: How To Collect, Analyze, and Present Your Data*.

Science Projects: Book 1. Project Ideas in the Life Sciences describes project ideas in the life and biological sciences. This book is divided into four life-science content areas: Bacteria, Plants, Animals, and Environmental Science. In each area, the author focuses on the basics of specific projects. The 65 project topics presented are intended to help students get started and expand upon the basic experiments. Helpful references are included for each experiment or project. Some sample topics in the four areas include:

- Bacteria: Investigating Antibiotic-Resistant Bacteria on Vegetables; Testing for "Salt-Loving" Bacteria; and Testing for Normal Bacteria on the Surface of Plants
- Plants: How Does the Order of Exposure to Different Colors of Light Affect Germination?; Cloning African Violets and Carrots; and Hybridization: Creating Varieties of Indoor Fibrous Begonia by Cross-Pollination
- Animals: Electrocardiogram of a Water Flea; Measuring the Respiration of the Milkweed Bug between Molting Stages; and The Effect of Thyroid Hormone on the Development of Tadpoles
- Environmental: Sampling and Measuring Carbon Dioxide in Air Samples; Locating Sources of Well-Water Contamination; and The Effect of Ground-Up Plastics and Papers on Plant Growth

This book also uses the Guidance Department Owl for key tips. For example, on page 68, the book suggests that the young investigator ask science fair judges about restrictions on projects that use animals and humans. Additionally, Appendix A provides some useful rules for research involving live vertebrate animals.

Science Projects: Book 2. Project Ideas in Chemistry and Biochemistry describes projects in chemistry and biochemistry

that have varying levels of difficulty. The format is similar to that of Book 1, with 36 chemistry project topics and 40 project topics in biochemistry. Here is a sample of project topics:

- Chemistry: Separating Food Dyes from Candy; Investigating Variables That Affect Copper Plating on Different Surfaces; Chemical Analysis of Soil and Sampling Strategies; and Building Your Own Gel Electrophoresis Apparatus
- Biochemistry: Enzymes in "Veggies": How Fast Do They Act?; Separation of Eye Pigments of Fruit Flies; Extracting DNA and RNA from Plant Tissue; DNA Testing and Genealogy; Investigating the Chemical Process of Photosynthesis; Biological Fuel Cell; and Transformation of Bioluminescence Genes

Additionally, Appendix A covers some basic laboratory safety practices; Appendix B discusses basic chemical solution preparation.

Science Projects: Book 3. Project Ideas in Physics and Engineering describes various physics and engineering projects. Continuing in the same format as the previous books, there are nine physics project topics and four project topics in engineering. Listed below is a sample of the projects in each content area.

- Physics: Opposites Attract; Mechanical Things; Things That Spin; Fluids at Rest or in Motion; Electrical Things; Hot Stuff; The Sound of Fury; Let There Be Light; and Invisible Light
- Engineering: General Engineering and Technology; Agricultural Engineering; and Technology Applied to Ideas in Books 1 and 2

Appendix B describes how to measure rotational motion and energy.

In addition to the full-length textbooks, Gormley Publishing (http://www.gormleypublishing.com; accessed Jul 2010) provides short "Neuhaus Science Project Guides". Each guide costs less than $4 and contains a brief yet detailed summary on the following topics:

- *Writing the Science Project Report*, 34 pp. This booklet guides the secondary school science student through the process of writing a thorough report for a science fair project. The material this guide covers can be found in the three textbooks listed above.
- *Preparing for the Science Fair*, 20 pp. This booklet guides the secondary school science student through the science fair experience. It offers insight as to what the student can expect on the day of the science fair.
- *Methods of Chromatography*, 67 pp. This booklet explains basic methods, materials, and techniques for the beginning chromatographer.
- *How To Use a Spectrophotometer*, 45 pp. This booklet explains the theory and the application of the use of a spectrophotometer in a science project. The information is geared toward the secondary school science student.
- *How To Use a Multimeter*, 43 pp. This booklet explains the operation of a multimeter that measures volts, ohms, and amps for use in a science project. The information is geared toward the secondary school science student.

Richard Neuhaus's Science Project series would make a great addition to any science library collection. The author has done a wonderful job helping secondary students and their mentors get started on answer the crucial questions such as "What do I hope to prove?", "How do I get started?", and "How do I organize, write up, and present my science project?" If you are a teacher who wants to improve your skills and the skills of your students planning to present at local science fairs, then Richard Neuhaus's Science Project series is a great starting point.

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Andreas Libavius and the Transformation of Alchemy: Separating Chemical Cultures with Polemical Fire

by Bruce T. Moran

Science History Publications/USA: Sagamore Beach, MA, 2007, 324 pp. ISBN 978-0881353952. $49.95.

reviewed by Robert E. Buntrock

As a budding chemist in the late 1950s, I pounced on a paperback titled *Crucibles: The Story of Chemistry (1)* and read it avidly, squeezing it into my horrific class- and work schedule during my university studies. The giants in the history of chemistry each had a chapter, beginning with the alchemist Trevisan and the alchemist−physician−pharmacist Paracelsus. So when this monograph crossed my desk, my inevitable reaction was, "Libavius? Who's he?" Apparently, there was no mention of him in *Crucibles* or anything else I've read.

As it turns out, Libavius was a late 16th- and early 17th-century educator and the ultimate polemicist, attacking not only Paracelsus but also other would-be scientists, physicians, philosophers, and even the Catholic Church. He was a champion of Aristotelian thinking and rigorous teaching and education. His vehement attacks on other philosophers of the time, both religious and secular, spawned equally vehement attacks from the opposition, with both sides publishing books of several hundred pages. (Polemics still continue, but are now more prevalent as talk shows and blogs.) In the process, he provided the intellectual foundation for chemistry as an emerging science. He also urged the precise use of language in any intellectual endeavor.

As historians of science and chemistry well know, alchemy did not automatically morph into chemistry. Ironically, Libavius himself condemned many self-declared alchemists and instead provided the intellectual foundations for alchemy, termed by him, *chymistry*. The latter was both an art and a useful science, useful to humanity and not just in the making of medicinal potions.

Libavius's contentious positions eventually led to his downfall as a prominent figure in the history of science and chemistry, which is one of the reasons why his life and works have not

received the attention they deserve. Aristotle plus alchemy yielded *chymistry*, but the views of Libavius came to be seen as old-fashioned and antithetical to modern science (as they may well be in many instances). However, this monograph indicates that Libavius, not just Paracelsus and other contemporaries, must be considered among the founding fathers of the science of chemistry. In the process, he could also be considered a father of chemical information, chemical nomenclature, and the teaching of chemistry.

The book's author is a historian of science and medicine. He is also a Latin scholar; this qualification is practically a prerequisite for studying Libavius, as most of the abundantly cited original work is in that language. Also of note is that Chapter 6 is an excellent account of early 17th-century religious debates among Catholics, Lutherans, and Anabaptists, especially the Regensburg Colloquium. The book is therefore of special interest not only to those interested in the history of science, chemistry, and medicine, but also to those interested in the history of philosophy, religion, and Renaissance culture and society.

Literature Cited

1. Jaffe, B. *Crucibles: The Story of Chemistry*; Fawcett World Library: New York, 1957.

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Giant Molecules: From Nylon to Nanotubes

by Walter Gratzer

Oxford University Press: New York, 2009. 272 pp. ISBN: 978-0199550029 (cloth). $24.95.

reviewed by Scott Smidt

Keeping up with the multiverse that is the professional literature can be a challenge, so it is nice to find a well-written and well-researched guidebook to an unfamiliar galaxy. With some reservations, Walter Gratzer's *Giant Molecules* is just such a travelogue.

As might be clear from the full title, *Giant Molecules* binds numerous topics related to polymers, both natural and artificial. The book delves into their histories, envisions their futures, and features plenty of basic chemistry, particularly in the book's beginning chapters, which include discussions of nomenclature, bonding, and stereochemistry.

It would be easy for a book on polymers to be dull. Fortunately, the only thing consistently dry in this book is the humor. If, like me, you hear the words on the page being spoken with an English accent when reading a book by a venerable British academician (think David Attenborough narrating a nature program if the book's author is male), then this author's sense of humor will seem right at home. For example, while discussing the discovery of DNA's structure, Gratzer mentions the effect Erwin Schrodinger's book *What Is Life?* had on many physical scientists who later became biologists: "The book had persuaded many physicists and chemists...that the central biological problems could be tackled by physicists without loss of dignity" (p 87).

This tone pervades the book, which is peppered with anecdotes from the author's long career. In effect we are treated not only to the author's expertise but also to that of his colleagues, such as the protein chemist who described the induced fit of an enzyme and its substrate by noting that "the entry of a substrate or any ligand molecule into the protein should not be thought to resemble a man entering a room, but rather a cow entering a tent" (p 55). This certainly produces a different mental image than the traditional handshake metaphor.

Unfortunately, *Giant Molecules* does not hold up terribly well when considered within the broader context of popular science books typically read from start to finish. I felt the sheer number of topics and examples detracted from the narrative flow; I found myself wishing for fewer topics but more background details of the kind that make a story interesting. However, what is a flaw in one context can be a strength in another. Instructors looking for examples and anecdotes to flesh out new units on polymers or nanotechnology might find *Giant Molecules* a handy starting place. Those who teach chemistry to either biology or allied health students might find interesting tidbits related to proteins, DNA, and other biomolecules. This book can also serve as a useful source of ideas for instructors who require students to write short papers on topics related to chemistry. Simply thumbing through the index illustrates the range of subjects covered. Some entries are what one would expect to find in a book on polymers and other macromolecules: Bakelite, elastomers, graphene, hemoglobin, nanotubes, rubber, and Teflon. Other entries are perhaps more surprising—squid beak and hair styling, for example. (The section on hair styling includes a two-sentence summary of "audacious experiments with chemicals and high temperatures" [p 169]. The second of the two sentences is simply "Many lawsuits ensued" [p 170]. Surely, there is an entire chapter contained in what Gratzer leaves unwritten.) Contributing to the book's usefulness as a jumping-off point for instructors and students alike are the brief bibliography and suggestions for further reading.

Any book this wide-ranging is likely to contain a few errors, however. As I have no real expertise in polymers, I'm sure I missed some, so buyer beware. In any case, most seem fairly minor, from straightforward typographical errors and an incorrect molecular structure (p 125) to an improper use of the word chromatid (p 90) and a definition of the dalton as a unit of mass that appears to be 50 years out of date (p 2).

In short, although it does not always satisfy as a book to read cover-to-cover, *Giant Molecules* will serve as a suitable launching pad for anyone who wants an introduction to big molecules and their uses, from DNA computing to pykrete.

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Organic and Physical Chemistry of Polymers

by Yves Gnanou and Michel Fontanille

John Wiley and Sons: Hoboken, NJ, 2008. 632 pp. ISBN 978-0471725435. $ 105.

reviewed by Stephen R. Pruett

The title reflects the ambitious goal of this book and hints at the challenge facing the authors. The back cover describes the book as a "text for advanced undergraduate and graduate students in physical and/or polymer chemistry, and a practical reference for researchers and professionals in the polymer industry". This is an English version of the authors' original French text, published in 2003, with the authors listed as the translators. Some parts of the book have been updated, however, as indicated by post-2003 references at the end of several chapters, and text describing Chauvin, Grubbs, and Schrock's 2005 Nobel Prize in the section dealing with metathesis polymerization (p 344).

The book has four major sections. The first six chapters introduce the structure, morphology, and characterization of polymers. Polymerization, postpolymerization reactions, and designed macromolecules (such as functionalized, block-and-graft polymers) are the topics of the subsequent four chapters. The thermal, mechanical, and rheological properties of polymers, including processes such as extrusion, injection molding, and so on, are presented in three chapters. The last three chapters are a compendium of naturally occurring polymers and their derivatives, synthetic linear polymers, and synthetic three-dimensional polymers. These chapters also provide details about such polymers' syntheses, properties, and applications. This last section will be useful for readers seeking to understand the differences between the numerous synthetic polymers in use.

Throughout the book, the authors present the physical chemistry of polymers in detail. The short chapter dealing with molecular interactions, for example, includes equations for the energies of dipole−dipole attractions, dipole-induced dipole, and dispersion forces. Both statistical and classical thermodynamics are presented in the chapter devoted to polymer thermodynamics. The discussion of kinetics is thorough, with an exceptional compilation of rate constants for the various steps in free-radical polymerization.

In terms of organic chemistry, the authors present the full spectrum of monomers, polymers, and reaction types. Stereochemistry and its significance are presented throughout the book. The discussion of postpolymerization reactions is excellent, particularly the discussion of the effects of morphology on chemical reactions. I was delighted to learn what mercerization does to cotton!

The book has some weaknesses that could have been ameliorated by stronger editorial influence from the publisher. Awkward word choices and syntax appear sporadically throughout the book, as do errors in diagrams. Some terminology is not consistent with a modern text; two examples are the use of *valence angle* for *bond angle* and the use of *electroaffinity* to explain the relative stability of anions. Such terms may confuse undergraduate students. In addition, the absence of end-of-chapter problems or exercises will pose a challenge to an instructor using this textbook. Curiously, the authors list secondary sources almost exclusively. With the exception of Chapter 10, there is no primary literature cited in the references at the end of each chapter. I was disappointed to be unable to track a particular reaction, diagram, or set of data to a specific journal article.

That said, however, polymer chemists and engineers will enjoy having a copy of this book on their shelves. It treats a large number of topics, and readers will discover new and interesting chemistry throughout.

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