

understanding of how the unique properties and applications of those devices depend on the physics, chemistry, and overall properties of optical and electromagnetic components, and on how such components are designed and fabricated.

Optical Metamaterials begins with a brief introduction stuffed with ample references; the remaining chapters extensively cover selected topics: optical properties of metal-dielectric composites; experimental techniques and data treatment; electric and magnetic metamaterials; negative-index materials; applications of nonlinear optics; super resolution with meta-lenses; and optical cloaking.

One stated goal of the authors is to write a textbook for senior undergraduate and graduate courses; indeed, that is quite a commendable and lofty goal for this highly interdisciplinary field! A useful text for advanced undergraduates should, in my opinion, be self-contained, particularly in its presentation of introductory material and unique aspects of a field. It should also systematically develop basic concepts and then elaborate on specific engineering challenges, with worked-out examples. For instance, properties of both exotic and run-of-the-mill metamaterials that might result in a working device must be identified before issues relating to fabrication and characterization are considered.

In its present form, *Optical Metamaterials* is not self-contained, and I would not recommend it as a textbook, even for graduate courses. Less experienced readers will be forced to rely on cited references to develop an understanding of the structural details of unit cells in metamaterials composites or to derive the design equations that characterize such unit cells. When introducing various design equations and performance trends in optical metamaterials, the book merely references certain seminal papers. It barely touches on the design and synthesis of metastructures that meet specific applications—for example, or those involving two- and three-dimensional arrays, input/output interfaces, packaging—nor does it discuss their reliability and performance in benign and adverse environments.

Readers will also need additional background to understand the book's comparison of different techniques or processes that are not common knowledge to graduate students or even to nonexpert researchers. The authors fre-

quently mention the AFM and other modern high-resolution characterization and fabrication tools, whose purpose is to correlate a metamaterial's properties with its micro- and nanostructures; a focus on that correlation was sorely missing in this book. Another concern is the book's presentation of commercial simulation software: The authors used such programs in their research to elucidate the performance of sought-after metamaterials and devices, but fail to present the codes that were used or to follow up their illustrations with worked-out problems. Such details would have helped the reader grasp the concepts and understand the implications of material choices.

I did enjoy reading *Optical Metamaterials* for the purpose that best suits it: a useful overview that could encourage researchers new to this multidisciplinary field to dig deeper in pursuing their goals. The chapters are short and well written: They read like summaries of research papers and not like a textbook. Especially well presented and concise are the chapters on negative-index materials and optical cloaking. The book is unnecessarily brief and sketchy at times, though, and may not be as useful for students and researchers who lack sufficient background in materials science and engineering; such readers will need additional resources to acquire a comprehensive understanding of optical metamaterials. That said, a course textbook even for simple, well-developed subjects carries enormous requirements; for a complex interdisciplinary topic like optical metamaterials, with its novel applications, writing such a text is a very tall order indeed.

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The Hancocks of Marlborough

**Rubber, Art, and the
Industrial Revolution:
A Family of Inventive Genius**

**John Loadman and
Francis James**

Oxford U. Press, New York, 2010.

\$49.95 (274 pp.).

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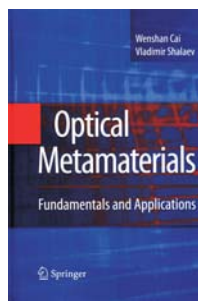
Thomas Hancock (1786–1865) has often been accused of stealing the British patent for vulcanized rubber from

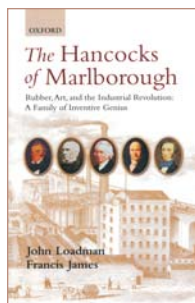
under the nose of Charles Goodyear. He is exonerated by John Loadman and Francis James in their lively biography of him and his brothers, *The Hancocks of Marlborough: Rubber, Art, and the Industrial Revolution—A Family of Inventive Genius*. The book also reveals how Thomas's unrivaled understanding of the technology of rubber production facilitated his independent invention of the vulcanizing process.

The Hancock family story is essentially the story of the British rubber industry. Few important industries have suffered such neglect by historians, which is surprising since Thomas Hancock handed us an unusually coherent and intimate source of information in his *Personal Narrative of the Origin and Progress of the Caoutchouc or India-Rubber Manufacture in England* (1857). His brother Walter was equally helpful in publishing his *Narrative of Twelve Years' Experiments (1824–1836) . . . of Employing Steam-Carriages on Common Roads . . .* (1838), which detailed technical successes that ended in commercial failure when the smart money abandoned the roads and took to the rails.

However, *The Hancocks of Marlborough* is not the book for readers who want an up-to-date history of the British rubber industry. The authors tacitly admit as much in their appendix, "The Evolution of the Rubber Industry Today," a 12-page summary of two centuries of technical and business developments, for which there was insufficient space in their chapters. A more comprehensive account is found in Loadman's earlier monograph, *Tears of the Tree: The Story of Rubber—A Modern Marvel* (Oxford University Press, 2005). The book is also not an orthodox business history of the type that takes a single company as its subject and scrutinizes everything from its balance sheets to its markets and labor relations.

This book is something both less and more than those. It's an intriguing family-business history—great-aunts and all, across five generations (one of the authors, James, belongs to the sixth)—that illuminates the impact of business dealings on fraternal relationships. Brothers and nephews cooperated with and supported—and sometimes competed against and deceived—each other. *The Hancocks of Marlborough* reminds us that talent is a necessary but not sufficient condition for success. Many would have described Thomas and his five young brothers, who left Marlborough for London, as skilled, enterprising, and creative. Thomas, John, and Walter were all mechanically adept





inventors and patentees (rubber, coaches, and steam engines, respectively); William and James were cabinet makers like their father; and Charles was a portrait painter. Only Thomas, however, was successful in business, and only he died both wealthy and respected. The authors imply, but offer no full analysis, that Thomas was as shrewd and determined as he was honest and devout, whereas Walter was obsessed with invention and was a poor judge of character, William lacked ambition, and Charles was the naive victim of his own duplicity; John died young, and it appears James did too.

Besides the family history, the book is a treasure house for anyone interested in inventors and how they managed their intellectual property prior to the reform and consolidation in 1852 of the UK's patent system. Although the cost of a patent that covered England, Wales, and Scotland was not quite as high as the £400 cited on page 24, it was nonetheless very expensive—approximately £100 for both England and Wales, and an additional £100 each for Scotland and Ireland. It is evidence of Thomas's financial well-being that he was able to file at least 14 patents, as he describes it, "for the treatment and application of India rubber," which he collected and republished in 1853 to assert his priority, and that he prosecuted infringements of them in England's notoriously expensive courts. To what extent those patents were also a cause of his wealth merits further analysis. He decided not to patent his second most important invention—the rubber masticating machine—hiding it under a false name ("the pickle") and trusting his co-religionist workers to keep the secret.

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