BOOKS

Tesla—a Flamboyant Visionary and an Under-Appreciated Genius

Wizard: The Life and Times of Nikola Tesla—Biography of a Genius

Marc J. Seifer
Birch Lane Press, Secaucus, N.J., 1996. 542 pp. $32.00 hc
ISBN 1-55972-329-7

Reviewed by Robert H. March

Though the name Nikola Tesla is hardly obscure, his role in the early development of the electrical industry is not widely appreciated. Nonetheless, there exists a small but ferociously loyal Tesla "cult" that sees him as a neglected genius whose scientific vision was centuries ahead of its time and whose inventions were either purloined or suppressed by jealous rivals and greedy tycoons.

Tesla's most remarkable achievement was to conceive the polyphase ac induction motor, as well as modern power generation and the long-distance transmission system that goes with it. This was back in the 1880s, when the electrical industry was confined to dc lighting systems with a service reach of no more than a few hundred meters.

Thomas Edison recognized Tesla's talent and brought him to work in his US laboratory in 1884, but they soon parted company over Edison's dogged commitment to dc. Tesla's moment of triumph came in 1894, when the Niagara Falls power plant opened service to Buffalo, New York, with a system based largely on his patents, which he had unwisely sold to the Westinghouse Corp.

Fame followed swiftly. Tall, dark and gaunt, with a regal carriage and a penetrating gaze, Tesla fully fit the popular image of a genius. His flair for showmanship gave rise to spectacular public demonstrations, most of them based on his celebrated induction coil. These deeply impressed the press, the public and a string of investors, most of whom would know bitter disappointment. For Tesla was a restless visionary who carried most of his inventions to the proof-of-concept stage and a patent, but he showed little interest in the final polishing into a marketable product. A promising fluorescent light lay neglected while Tesla spent John J. Astor's investment in it on more speculative projects.

Had Tesla teamed with a competent partner, less impatient than he, he might have been fabulously productive. But by predisposition, Tesla was a loner. He remained a lifelong celibate, though hardly an ascetic. A stranger to frugality, Tesla spent money as fast as it came in (or faster) on high living: a suite at the Waldorf–Astoria, dinners at Delmonico's, suits from the finest tailors. He enjoyed the company and the respect of New York's financial and cultural elites.

Tesla's decline began in 1901, when he induced J. P. Morgan to invest in a wireless transmitter designed to reach ships at sea and possibly span the Atlantic. But stung by Guglielmo Marconi's transatlantic success, Tesla decided that mere wireless telegraphy was beneath him. He would build a transmitter with worldwide reach, with hints that it would be upgradable to a system that would provide cheap wireless electric power to the nation and possibly the entire globe. The initial stake quickly ran out, and Morgan refused to sign on to this more ambitious scheme. Since Tesla had impetuously assigned Morgan a majority interest in the underlying patents, it proved impossible to attract new investors, and the transmission tower he had built on New York's Long Island was ultimately scrapped to cover Tesla's unpaid hotel bills.

Indeed, through most of the development of wireless, Tesla designed far more powerful transmitters and selective receivers than did Marconi, but he lacked the latter's determination to build and demonstrate a modest system step-by-step to the point of becoming a commercial success. Tesla rejected an offer of partnership by Lee DeForest, a combination that could well have dominated the development of radio.

Tesla envisaged himself as nothing less than a savior of mankind. Only he could bring cheap electric power to the remotest farm and hamlet, freeing the human race from the burden of manual toil! Feminists may note his conviction that, once sheer muscle power was thus depreciated, the natural superiority of women would assert itself. He was convinced that power transmitted at the extremely low frequencies of global resonance would traverse the planet unattenuated until snatched from the sky by a suitable receiver. He would pursue this unworkable vision to the end of his long life, in 1943, emerging from isolation from time to time to regale the press with boasts of even more fantastic inventions such as "death rays."

Tesla was born in 1856 to a Serbian family living in Croatia and was educated at the Polytechnic in Graz, Austria. His understanding of the science underlying his work was superior to that of Edison or even Marconi, but clearly inferior to that of Charles Steinmetz or of fellow Serb immigrant Michael Pupin. For example, Tesla believed that his transmitters generated non-Hertzian longitudinal aether waves that moved faster than light.

Though biographer Marc Seifer accepts the notion that character flaws contributed to Tesla's downfall, he does support much of the Tesla cult myth, taking some of Tesla's scientific misconceptions at face value. He attributes to Tesla the invention of the laser, and he hints darkly that Morgan suppressed wireless power transmission to preserve the profits of his utility companies. If one discounts these serious demerits, this is a well-researched (but not always well-written) biography that gives an interesting glimpse of the interactions of inventors, financiers and the public in America's Gilded Age.

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Macmillan Encyclopedia of Physics

Edited by John S. Rigden
Simon & Schuster Macmillan, New York, 1996. 1881 pp. $400.00 hc
ISBN 0-02-897359-3

It is a brave venture to compile an encyclopedia of physics from scratch; John Rigden and his five coeditors—Jim McGuire, Helen Quinn, David Schramm, Roger Stuewer and Carl To-

mizuka—deserve great credit for what must have been a demanding task. They have organized about 500 authors, mostly American academics, to write nearly 1000 articles, each occupying an average of two two-column pages. The typography is excellent, and the three volumes are a pleasure to handle. They also, as do others of their kind, present something of a hazard to the casual, distractable reader, who may start off hoping to learn something of Feynman diagrams but be caught and carried away by fiber optics and by fields (electric, gravitational, Higgs, magnetic) to the point of forgetting the original intention.

There is some unevenness of treatment, which is natural given the wide range of readers—especially those with little technical expertise—being addressed. Anyone who needs to look up ammeters, for example, may well find Clifford algebra confusing (I certainly did!), but variety of coverage is inevitable, indeed praiseworthy, in a work such as this.

A more pertinent criticism is of redundancy: Is it necessary to have separate articles on ammeters and voltmeters, if both, we are told, are based on the d'Arsonval galvanometer, which is separately described? Since there are cross-references at the end of each article and a well-organized index, a rather longer entry on electrical measurements would surely have given better value. As another example (and not the only other by any means), the five articles whose headings begin with "gravitational" (attraction, constant, force law, lensing and wave) are by different authors and occasion unnecessary overlaps. Unfortunately, none describes how G has been measured; the same is true for most of the other constants of nature. This leaves one (perhaps intentionally) with the impression that physical ideas, especially those of more recent discovery, are more significant than the experiments by which they were brought to light, and this is not wholly commendable.

On the other hand, there are some excellent historical articles, especially the biographical notes on great physicists. Presumably, it was an editorial decision to limit the number of biographies to 50, and only a captious critic would suggest replacing more than a very few among them. For my part, if Edwin Hubble is to appear, I should plead for Arthur Eddington as well, and I should be prepared (but only in private) to suggest sacrificial victims to make room for him—and for Arnold Sommerfeld and Peter Debye and, above all, Henry Cavendish, whose remarkable electrical researches get hardly a mention and whose determination of G gets none. In this connection, I am sad to find nothing about that rather elusive figure, John Michell, who devised the apparatus that Cavendish used for G, invented the torsion balance before Charles Coulomb did and remarked, before Pierre Laplace did, on the possible existence of black holes.

It is hard to squeeze a complete historical story into a small space, and the multiplicity of authors compounds the problem. Thus, in various articles, we find attributed to Coulomb and to Jean-Baptiste Biot and Félix Savart the basic ideas that inspired André-Marie Ampère's theory of the magnetic field, while James Hofmann, who is responsible for the biographical note on Ampère and who has written a detailed study of his work, regards him as having developed his views in a different and highly individual way. A similar discrepancy attends descriptions of Galileo's study of falling bodies: The physicists tend to believe he dropped objects of different weight from the leaning tower of Pisa, but his biographer is dubious. Simon Stevin, the Flemish mathematician and engineer who described the experiment some years before Galileo did, shares Michell's fate in being ignored. On the whole, if one has to judge between the physicists and the historians as narrators, it is the historians who win hands down.

As for the encyclopedia's principal aim—to cover as wide a range as possible of physical ideas in an accessible form—every reader will find a mixed bag, though most will find a great deal to approve. Along with much that is described clearly and correctly, there are occasional errors more serious than simply confusing the Braggs, father and son, or conflating Vitaly Ginzburg and Evgenii Lifshitz into a single colleague of Lev Landau's. For instance, in a derivation of the Coriolis force—a notorious pitfall for textbook writers—the correct form is written, but it does not result from carrying through the verbal description of the mathematical operations, if only because equation 2 is wrong. At a different level, the reader tackling the article on the vacuum state is presented with some wholly mysterious remarks on symmetry while being casually invited to write off infinite energy densities as irrelevant. Here, as with superstrings and other modern concepts, the author was faced with a task of such immensity that he may be forgiven for providing the reader with little more than soundbites appropriate to cocktail party conversation. By contrast, the article on matrix mechanics would genuinely help the reader who has only a vague awareness of matrices.

The longer I look at these volumes, the more I am irritated by little faults—obscurities, omissions, diagrams inadequately captioned or poorly labeled (for example, on page 634, we find two strange elements, $_2Li^8$ and $_6B^{10}$)—yet the more I admire the editors' success in bringing their enterprise to a conclusion. There is much excellence here, and if, as I hope, further editions are called for, the trivial errors can be corrected with patient and critical reading. Failure to explain deep thoughts in simple terms may be beyond repair, but this is not a common fault here. It is admirable for so bold an attempt to have been made.

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Introduction to the Theory of Ferromagnetism

Amikam Aharoni
Oxford U. P., New York, 1996.
315 pp. $70.00 hc
ISBN 0-19-851791-2

Introduction to the Theory of Ferromagnetism is a much needed, thorough introduction and guide to the literature. It is full of wisdom and commentary. Even more, it is Amikam Aharoni at his best—telling a story. His textbook might have been called "The Foundations of Micromagnetics."

Micromagnetics would be interesting enough in its own right, even if it were not as important as it is to information technology. It serves as a prototype of complexity arising from simple laws. As ferromagnetism is not at all well covered in textbooks on electricity and magnetism, Aharoni provides the background physics sufficient to the task. After an introduction that includes nomenclature, Weiss domains, the Bohr–van Leeuwen theorem and diamagnetism, the next four chapters are headed "Molecular Field Approximation," "The Heisenberg Hamiltonian," "Magnetization vs. Temperature," and "Anisotropy and Time Effects."

In chapter 6 he unveils "Another Energy Term" anticipated throughout the first five chapters. The protagonist, magnetic charge, appears on the scene after the stage is set and all the other characters are established. Magnetic charges come from divergence of the magnetization in the bulk and normal components of the magnetization at surfaces. The Weiss domains arise to suppress the magnetic charges. This is called the pole avoidance principle.

The last five chapters are every-