

# A voice from the nineteenth century

**Advice for a Young Investigator.** Santiago Ramón y Cajal. Translated by Neely Swanson and Larry W. Swanson. MIT Press, Cambridge, MA, 1999. 150 pp. \$22.50 (ISBN 0-262-18191-6 cloth).

*In my view, some advice about what should be known, about what technical education should be acquired, about the intense motivation needed to succeed, and about the carelessness and inclination towards bias that must be avoided, is far more useful than all the rules and warnings of theoretical logic. This is the justification for the present work, which contains those encouraging words and paternal admonitions that the writer would have so liked to receive at the beginning of his own modest scientific career. (p. 6)*

In this way, Santiago Ramón y Cajal introduces his thoughts on how science should be done. And he should know. Cajal and Camillo Golgi were awarded the Nobel Prize in Medicine in 1906 in recognition of their work on the structure of the nervous system. Cajal is revered as the father of modern anatomy and neurobiology. So great was his reputation and influence on these fields that in 1947, the Cajal Club was founded at an annual meeting of the American Association of Anatomists. The objective of the club is “to revere Cajal, to provide an opportunity for scientists with special interests in the nervous system to fraternize, and to contribute to the welfare of neuroanatomy and neuroanatomists” ([www.faseb.org/anatomy/cajalclub.htm](http://www.faseb.org/anatomy/cajalclub.htm)). Without a doubt, Cajal had something to say about negotiating the peaks and valleys of a career in biology, and much of what he wrote about in 1898 still rings true today.

*Reglas y Consejos sobre Investigación Biológica (Rules and Advice on Biological Investigation)* was originally pub-



**Santiago Ramón y Cajal, Nobel Laureate in Physiology or Medicine, 1906.**  
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lished in Spain in 1898; it grew out of a speech that Cajal presented when he was inducted into La Academia de Ciencias Exactas, Físicas y Naturales in 1887. Cajal hoped that the book would inspire “studious young people...to increase their love for laboratory work” and be appreciated by any veteran professor. It eventually appeared in six Spanish editions and was translated into German and English. In this new edition, Neely Swanson and Larry Swanson have tried to provide a modern translation of the Spanish manuscript (versus a literal translation) while “retaining as much of the original flavor” as possible.

*Advice for a Young Investigator* has nine chapters, a foreword by Larry Swanson, and prefaces to earlier editions by Cajal. Cajal ruminates over such topics as the general methods and stages of scientific investigation and hypothesis development, the best strategies for training students, the

benefits of being able to read more than one or two languages, the importance of writing papers, and the best family life for a scientist. Readers will find Cajal to be matter-of-fact in his advice, idealistic in his passion for science, and amusing in his descriptions of the personality traits that can lead scientists astray in their work or prepare them for success.

Cajal was born in Petilla de Aragón, Spain, in 1852, and died in Madrid in 1934. Although he was the son of a professor of applied anatomy, he entered science through a circuitous path (Cajal 1989). During his willful teenage years, his father found him apprenticeships with a shoemaker and a barber. Cajal, however, fancied himself an aspiring artist; later, the world would benefit from his meticulous attention to detail and passion for accurate illustration of anatomical structures. He graduated with a degree in medicine from the University of Zaragoza in 1873, where he started his academic career as auxiliary professor of Anatomy at the University of Zaragoza in 1875 (Bentivoglio 1999, NPIA 1999).

Perhaps it was this path to biology from his apprenticeships that inspired Cajal’s earnest belief that “the list of those suited for scientific work is much longer than generally thought...discoveries are not the fruit of outstanding talent, but rather of common sense enhanced by technical education and a habit of thinking about scientific problems. Thus anyone with mental gifts balanced enough to cope with everyday life may use them to progress successfully along the road of investigation” (p. 23). This egalitarian view of science as a viable career for any motivated, dedicated person with passion for discovery is embedded throughout Cajal’s book. Moreover, he chides

biographers of famous scientists for often making the path to great scientific achievements seem impossible and beyond the hope of average people:

*Thus it is clear beyond a doubt that great scientific undertakings require intellectual vigor, as well as severe discipline of the will and continuous subordination of all one's mental powers to an object of study. Harm is caused unconsciously by the biographers of illustrious scholars when they attribute great scientific conquests to genius rather than hard work and patience....careful thought should make them realize how discouraging this can be to their readers. (p. 39)*

Cajal has much to say in this book about how to avoid common career pitfalls and difficulties. Indeed, his insights into what qualities and strategies led to a successful career in science at the end of the nineteenth century have been reiterated in more recent works (e.g., Medawar 1979, Sonnert 1995). To Cajal, the best attitudes of aspiring biologists were to be "somewhat headstrong, contemptuous of first place prizes, and immune to the inducements of vanity"; aspiring biologists should also be "endowed with an abundance of restless imagination and spend their extra energy pursuing literature, art, philosophy, and all the various recreations of the mind and body." He felt that students should "really begin to study after leaving the classroom" and that the brightest minds had "the ability to picture something beyond what is taught."

For students, this book is a pep talk and a rallying cry to recruit new troops into the quest for knowledge. For the new investigator, Cajal's advice is pragmatic: choose challenging problems that are a bit controversial; become a master of the appropriate research techniques, and focus, focus, focus; seek collaboration when possible; don't publish until there is really something to say; be civil when disagreeing with the work of others; and, finally, be flexible and "avoid excessive attachment to our own ideas, which we need to treat as prosecutor, not defense attorney" (p. 122). Cajal's long research

career taught him that new discoveries do not always shine favorably on the work that has gone before—indeed, even his own pet hypotheses could fall out of favor over time.

One of the many delights of the book is finding that many challenges faced by biologists today also challenged the scientists of a century ago. I was surprised to read about the problems of inadequate funding, myopic governments, politics, aggressive opponents, perceptions of the relative importance of basic research as compared to applied research, the burden of being buried under a mountain of reprints, and the challenge of balancing teaching, research, and family—it seems that some challenges are timeless. Cajal writes about the problem of dealing with difficult personalities in a humorous chapter entitled "Diseases of the Will" (chapter 5). In these amusing descriptions, readers will probably see caricatures of many people they know in biology or have at least observed at scientific (or faculty!) meetings. Cajal classifies the illustrious failures in science into several categories, including the dilettantes or contemplators, the erudite or bibliophiles, the instrument addicts, the megalomaniacs, the misfits, and the theory builders. The moral of these reflections is that "a scholar's positive contribution is measured by the sum of the data that he contributes. Hypotheses come and go but data remain" (p. 86). It is clear that Cajal pushed his students to err on the side of gathering empirical evidence, pushing for the next discovery, showing tangible original results.

On the down side, women reading this book at the time of its original publication would have found little to encourage them toward a career in science. Any bright, prospective female scientists reading this book would have learned that, according to Cajal, the only way to be involved in science was vicariously, through their husbands. In particular, all of Cajal's viewpoints on balancing the challenges of career and family are geared toward the man of science—finding a compatible woman

of suitable temperament "whose best dowry will be a sensitive compliance with his wishes, and a warm and full-hearted acceptance of her husband's view of life." The end notes reflect his disappointment at seeing many "young men with great talent shipwrecked on the shoals of matrimony." Although these pages can make for trying reading, they do provide insights into the culture of science at the end of the nineteenth century. Clearly, Cajal had few female colleagues who had achieved his degree of stature in biology or other fields of science. Women in biology today have much to cheer about, in contrast to the discouraging career opportunities of a century ago.

Cajal's gendered viewpoints remind the reader that this book was written more than 100 years ago. In places, the dated moralistic and patriotic overtones will seem irrelevant to today's readers. Moreover, Cajal reminds the reader on many occasions that Spain was not a center of science at the turn of the last century. In fact, Swanson and Swanson eventually elected to forego including the translation of two chapters dealing specifically with conditions in Spain because of their limited relevance today.

But these are small quibbles; this historical book has much to recommend it. In this translation, Swanson and Swanson have done an excellent job of portraying Cajal as a man of great perception, humor, compassion, and modesty. His insights are still relevant to new and established students of science. Moreover, these musings are surely based largely on Cajal's personal experiences as a scientist; thus, in the counsel he offers the reader catches a glimpse of the life of a pioneer in the field of anatomy and neurobiology—one of the legendary figures in science. Finally, the book provides a fascinating look at the attitudes and culture of biology at the end of the nineteenth century, making it clear how far we have come. Many nuggets of insight, wit, and reflection are packed in this book, and I look forward to sharing it with future under-

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graduate and graduate student researchers. What luck that this classic has been rediscovered.

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**THE FORGOTTEN MAN**

**Joseph Leidy: The Last Man Who Knew Everything.** Leonard Warren. Yale University Press, New Haven and London, 1998. 352 pp., illus. \$35.00 (ISBN 0-300-07359-3 cloth).

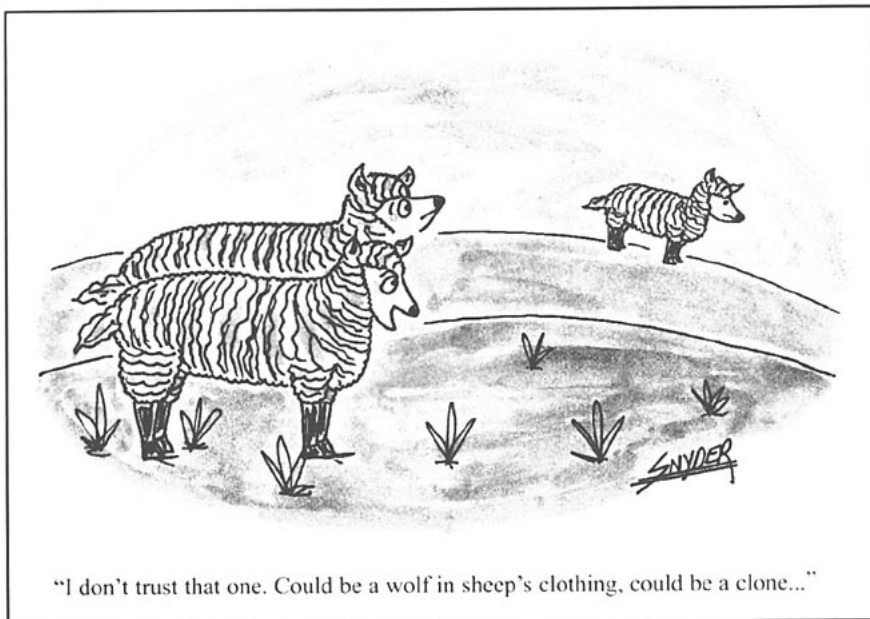
**H**ow can it be that the man who established the field of parasitology, the use of microscopy, and the

foundations of vertebrate paleontology in the United States was practically forgotten scant decades after his death and is unknown a century later, except to specialists in a few small fields? This provocative question is at the heart of Leonard Warren's eminently readable and fascinating biography of a true pioneer of American science. The answer, suggested both by Warren and the extenuating circumstances, appears to lie in Joseph Leidy's research approach and in the socioeconomic atmosphere of nineteenth-century Philadelphia. It is a cautionary tale in some ways; most of us who toil in the fields of science are bound to be forgotten. But few of us are as broadly accomplished in our day, and recognized as such, as Leidy was in his.

Joseph Leidy (1823–1891) is hardly a household name in America, or anywhere else, for that matter. But for amateurs of biological science in the second half of the nineteenth century, the mention of Leidy's name would have called forth intimate knowledge and immediate veneration. Leidy described a host of invertebrate species, marine and freshwater, with particular attention to parasites. He used this knowledge to force cleaner water standards in Philadelphia reservoirs, and he tumbled to the insidious effects and life cycle of the *Trichina* worm well before the Europeans (who

denied his accomplishment and took credit anyway. He amassed a fine collection of microscopes and used them to explore the internal workings of innumerable tiny organisms, as well as of the tissues and organs of vertebrates. He pressed thousands of plants that became the basis of museum collections, along with the animals he gathered from the mid-Atlantic states and the prepared specimens that he bought or obtained by trading during his several European trips. Moreover, Leidy was the first to describe American dinosaurs (as well as many other fossil vertebrates), and he knew what they were; in fact, his reconstruction of *Hadrosaurus foulkii* was an improvement on the much-vaunted restorations of partial material in England, and his mount of this dinosaur (although in a slightly revised position) still delights visitors to the Academy of Natural Sciences in Philadelphia. Leidy was known and respected by all the eminent American and European men of science, including Asa Gray, Benjamin Silliman, James Dwight Dana, Thomas Henry Huxley, and Richard Owen.

So what explains Leidy's eclipse and relative anonymity? Warren paints Leidy as a man who knew everything (his range of expertise was incredible) but who virtually refused to harness his knowledge to the service of any important questions. Leidy was a descriptive scientist, not a theoretician. We have relatively little idea of his views on scientific questions of his day, if he entertained them. Leidy was a provincial man in a provincial and modest city—Philadelphia—which during his lifetime was itself being eclipsed economically and socially by New York, Boston, and Baltimore. Leidy came from a modest family background and so was always an outsider to Philadelphia society; it would not have been seemly to engage in controversies or to draw too much attention to himself. Although Leidy was a Lutheran, he adopted the Quaker ethic of industry and modesty and was reluctant to go beyond what the facts clearly confirmed. As a result, although his



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descriptive work added reams to knowledge of the natural world, it would be seen in later years as the compilation of phonebooks rather than the understanding of how the phone system works. Leidy could move easily from parasites to fossil mammals to microscopic histologic preparations without losing a beat. Visitors to his home marveled at his ability to work serenely in the middle of household bustle. But why not? It was just description.

Leidy was also, in many respects, a victim of his times. In the first place, there was no such thing as a professional scientist. He was probably one of the first in the United States—as Owen and Huxley were in England—to pursue science as a vocation rather than as a pastime funded by family money (his younger rivals in paleontology, E. D. Cope and O. C. Marsh, both had fortunes to support them). Second, there was the Civil War, which devastated much of the budding infrastructure of American science and took a great toll on Philadelphia's society and economy. Third, there was the alleged and actual inferiority of American science to that of Europe. Leidy was respected for his encyclopedic knowledge, but Warren shows again and again that little of intellectual substance passed between Leidy and his European colleagues. Finally, and most important, there was Leidy's lack of interest in surmounting his provinciality, both geographic and scientific. Although he undertook some interesting experiments and had a great deal of forensic knowledge, he was not an experimentalist in the methodical sense, and so he fell out of the vanguard of scientists in the second half of his century and lost touch with their advances.

And yet the respect shown Leidy in his day was staggering. He was either the president or a board member of every local scientific institution or society and most national ones, although he hated politics and never ran for anything. He was simultaneously a curator of several museums, a prosecutor, demonstrator, librarian, lec-

turer, professor, coroner, and secretary. From these posts, as Owen did in England, he cobbled together enough money to form a respectable if fluctuating salary. Politically and economically naive, Leidy survived through the widespread impression of his omniscience in science, which carried over as an illusion of administrative acumen. He knew enough to stay out of arguments, and that was about it. He lost several small fortunes through imprudent investment, and he seems to have had no idea of the political and social forces underpinning the civil uprising that he witnessed in Paris in 1848, any more than he appears to have had a conscience about the persecution of the Irish and blacks in his own Philadelphia. Indeed, when anti-abolitionists asked him if whites and blacks could be the same species, he merely demurred on the grounds that the term "species" was poorly defined.

Warren, a distinguished biochemist who is a professor at the Wistar Institute of Anatomy and Biology in Philadelphia and a professor emeritus at the University of Pennsylvania, clearly explains the state of the fields in which Leidy worked, both as he found them and as he left them. His descriptions of Leidy's discoveries are elegant and delightful: Leidy, for example, was able to elicit a murderer's confession by revealing that the blood cells found on his axe lacked nuclei, and so did not belong to chickens, as the suspect claimed, but rather to some kind of mammal. Leidy was relatively outspoken in defense of public health, and he berated the city government for claiming that its drinking water was relatively free of impurities inasmuch as it made no attempt to control influx from contaminated streams. And he was a great observer: he found eyes in adult barnacles that Darwin was not able to find, even after 8 years of investigation.

Warren is realistic and cogent about Leidy's contributions and shortcomings. He feels that Leidy deserved more celebrity, although he recognizes the factors that limited him. But what would Leidy have done with more recognition? He almost rudely turned

down a job at Harvard to remain in his native city, where advancement was slow and socially conditioned. Leidy was often compared in his day to Owen in England and to Georges Cuvier in France, but this comparison is deceptive. Leidy shared their vast compass of detailed knowledge, but he showed neither their interest in scientific issues nor their skill or ambition in political circles. Owen and Cuvier are still respected for their material contributions, but the anti-Darwinian Owen is otherwise forgotten and reviled by history for his opposition to transmutation of species, whereas Cuvier is revered because he did not cast his lot impolitically with the ideals of a degenerating ruling class. Leidy's material contributions are acknowledged by people who work on the same taxa today, but he had no ideas that could be judged to triumph or fail in the light of later developments in his fields.

In perspective, this satisfying and very literate biography says more about the early evolution of American science than its subject of a single man would suggest, and it is well worth reading for its thoughtfulness and thoroughness. As for Leidy himself, perhaps the best words are those that W. C. Fields allegedly wanted for his own epitaph: "On the whole, I'd rather be in Philadelphia."

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## MEETING THE CHALLENGE OF A CHANGING LANDSCAPE

*The Northeast's Changing Forest.* Lloyd C. Irland. Distributed by Harvard University Press for Harvard Forest, Petersham, MA, 1999. 410 pp., illus. \$50.00 (ISBN 0-674-62680-X cloth).

In recent years, several books have been written about the historical forestry and forestry practices of the

northeastern United States (e.g., Irland 1982, Cronon 1983, Whitney 1994, Russell 1997, Foster 1999). *The Northeast's Changing Forest* represents another contribution to this genre and is, thus, not entirely new or ground-breaking. However, Lloyd C. Irland's new book takes a broad approach to evaluating the changing forests of the Northeast, including forest landscapes, forest dynamics, forest industry, policy and management, and economics. In this respect, the book is novel in its attempt to cover an expanse of forestry topics and practices in a historical perspective. However, the breadth of subjects may be the book's biggest weakness as well as its strength. The foreword states that it is written for nonforesters, which I assume is a disclaimer of sorts for the lack of scientific depth, literature coverage, and synthesis in many chapters. Nevertheless, much of the information appears to be oriented toward professional foresters and university professors who teach forestry. The book jacket states that Irland is a consultant based in Maine and that he has worked for the USDA Forest Service, Yale School of Forestry, and the State of Maine.

The book is organized around the idea of the Northeast's five forest types: industrial, recreational, suburban, wild, and rural. I found this approach to be an interesting and novel way to discuss the changing forests of the Northeast; it contrasts with the more traditional approach of organizing chapters around major forestry disciplines, such as ecology, silviculture, management, policy, economics, or wood products. Indeed, many of these topics are discussed in relation to the five categories of forest lands. However, one consequence of Irland's approach is that it tends to diminish or circumvent the fact that the vast majority of forests have multiple uses that span two or more of the five land-use categories. For example, industrial forest lands or privately owned forests are routinely used for recreation. The book would have benefited from the incorporation of a chapter on multiple-use forestry or on the more mod-

ern concept of ecosystem management that links the combined uses among the five major forest categories.

Irland uses metaphors to describe various levels of concerns and policies for the forests, including "town meeting" to describe local issues, "eagle's eye view" relating to conservation biology and landscapes, and "worm's eye view" relating to belowground processes. The use of these metaphors in place of standard scientific jargon or terminology is an indication that this book is more relevant for lay readers than for professional foresters. The nonforester may find these metaphors refreshing, but some professional foresters, academic scientists, and students may find them patronizing.

The depth and organization of the subject matter are highly variable among the chapters, ranging from excellent to poor. The author seems to have a stronger understanding of forest management, forestry practices, policy, and industry and a weaker understanding of forest biology, including ecology, forest history, classification, and silviculture. As a forest biologist, I am qualified, and perhaps predisposed, to judge the forest biology chapters especially critically. For example, chapter 2, which deals with forest landscapes of the Northeast, is a confusing mix of forest type distribution maps, photographs (often of poor quality), tables, personal observations, and hiking stories by the author that provide only a cursory description and synthesis of northeastern forest composition and structure. If this chapter had been organized around SAF (Society of American Foresters) cover types or ecological cover classes, it would have provided a much clearer description of the major climatic, physiographic, and edaphic zones and of how forest cover and composition vary in the Northeast. Moreover, this chapter should have included a succinct discussion of spruce-fir, pine, northern hardwood, hemlock, and mixed-oak forests and their environments. This is not to say that there is not valuable information in chapter 2—but it could have been greatly improved with better

organization and synthesis.

A similar problem exists with chapter 3, which deals with forest dynamics, past and present. I expected this chapter to be a cohesive and detailed description of how forest composition and structure in the Northeast have changed from the time of early European settlement to the present. This subject, I believe, is a prerequisite for a book of this title and theme. However, the chapter is a strange amalgam of statistics on cubic feet of timber, number of wildlife species, white-tailed deer habitat, historic forest fires, and human disturbance. The author fails to discuss in sufficient detail many of the most important ecological and anthropogenic factors that have affected northeastern forests. This chapter would have been greatly improved with the inclusion of a detailed chronology of Native American impacts; the original forest composition and variation; early European land-use practices; the changing role of fire; forest response to logging and chestnut blight; deer browsing impacts; the increase in natural and exotic invasive species, especially red maple; and ecological processes and disturbance in old-growth forests. Most readers would also want more detail on other profound changes in northern forests, such as beech decline from beech bark disease; sugar maple decline from pear thrips, climate change, acid rain, and elevated CO<sub>2</sub>; oak decline from fire suppression, deer browsing, and the gypsy moth; hemlock decline from the hemlock woolly adelgid; and the loss of, or changes to, wildlife habitat. Although some of these topics are mentioned briefly, none is treated to the appropriate extent or depth. Therefore, many of the most important changes and causal agents for the northeastern forest lack the emphasis and synthesis they deserve.

A much more logical approach is evident in chapter 4, which deals with industrial forests and forest practices. Irland describes the history of industrial forests from past to present—from early logging rivers, to railroad logging, to chemical wood cuts, to the

pulp wood industry, and so on. The chapter continues with sections on the industrial use of Pennsylvania forests, the impacts of deer browsing, a history of harvesting methods, the debate over clear-cutting, and the working conditions of loggers. However, this chapter should have included more information on temporal and spatial variation in silvicultural practices by region, on forest protection (i.e., from insect, disease, and fire) issues, and on changing attitudes about logging practices during the twentieth century. It also should have addressed the question of how the forest industry must change as some major species decline in northeastern forests and others (e.g., red maple) increase. These are important issues that deserve more than brief mention in various places of the text.

The middle part of the book (chapters 5–8) contains fairly well organized chapters on suburban forests, rural forests, recreational forests, and wild forests. In each case, the author addresses historical changes, policy and management issues, biological problems, and future outlook. Each chapter has useful tables and figures with statistics that emphasize the major changes in forest use, forested area, and ownership. The last third of the book (chapters 9–13) covers timber budgets, wood products, forest policy, and future directions for northeastern forests. These chapters are organized in a logical sequence that emphasizes the major historical changes in timber production, economic development, forest policy, and forest conservation.

One subject area that is not emphasized in the book is old-growth forest ecology, management, and conservation policy. A vast amount of information has been published on old-growth forests throughout the Northeast, and a synthesis of these data would have been a nice addition to the book, especially in the chapter on wild forests. Old-growth forests represent a time capsule of sorts, one that gives scientists a view of the original pre-European settlement forest. A compelling way to illustrate the ecological changes

and land-use history impacts in forests of the Northeast would have been to compare the composition, structure, and function of old-growth forests with those of second- or third-growth forests. The conservation and management of old-growth forests is a contentious issue that crosses the five major forest categories outlined by Irland, as well as public, private, industry, and government interests. The book missed another important opportunity by omitting a detailed discussion of old-growth forests in the changing environment of the Northeast.

In attempting to tell the story of how the forests and the practice of forestry of the Northeast has changed over time and the important issues that need to be addressed in the future, Irland has taken on an ambitious task. It is difficult to be an expert in any one of the scientific, products, management, or policy areas discussed in this book and impossible to be an expert in all of the areas. I admire what the author attempted to accomplish, but the book falls short in many important

areas, especially those related to the core subjects of forest ecology, history, old-growth forest, wildlife issues, and forest classification and environment. This book could have been improved by taking on a narrower focus or including experts in certain subject areas to help with the writing. Either approach would have resulted in better consolidation and synthesis of the complex topics related to changing forests in the Northeast. This book may appeal to the layperson who wants some general information about forestry in the Northeast. However, a truly well done book on the subject of the Northeast's changing forests would have been enjoyed and appreciated by both professional foresters and the general public alike.

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Use the Web to explore the fascinating lives of men and women of science.

For a general look at scientist biographies, a good place to start is [www.ac.by/science/people.html](http://www.ac.by/science/people.html), a list of links to interesting Web sites compiled by the National Academy of Sciences of Belarus. This site makes it easy to find out more about famous scientists, Nobel prize winners, and who's who in science. Brief illustrated biographies of scientists such as Leonardo da Vinci and Gregor Mendel can be found at Strange Science's Web site, [www.turnpike.net/~mscott/bios.htm](http://www.turnpike.net/~mscott/bios.htm). And for a comprehensive A-Z database of scientist biographies, check out Eric's Treasure Trove of Scientific Biography, [www.treasure-troves.com/bios/bios.html](http://www.treasure-troves.com/bios/bios.html).

A Louisiana State University Libraries Web site, "The Faces of Science: African Americans in the Sciences" ([www.lib.lsu.edu/lib/chem/display/faces.html](http://www.lib.lsu.edu/lib/chem/display/faces.html)), covers the past, present, and future of African-American scientists working in such fields as biochemistry, biology, genetics, medicine, and zoology. Biologists include Alfred O. Coffin, a zoologist who was the first African American to obtain a doctorate in the biological sciences, and Mary Styles Harris, a geneticist who has been instrumental in promoting awareness of breast cancer in the African-American community.

4000 Years of Women in Science ([www.astr.ua.edu/4000WS](http://www.astr.ua.edu/4000WS)) lists and provides brief descriptions of historical women in science, be they science scholars, biologists, chemists, doctors, or nurses. The list can be rearranged by alphabet, field of study, or time for easier searchability. Notable female scientists include Barbara McClintock, recipient of the 1983 Nobel Prize in Physiology or Medicine; Dorothy Crowfoot Hodgkin, winner of the 1964 Nobel Prize in Chemistry; and Jeanne Villepreux-Power, a famous European naturalist of the nineteenth century. After checking out the biographies, visitors can test their new knowledge by taking a quiz or completing a crossword puzzle. A list of hyperlinks to other Web sites on women in science is also available.

Other sites of interest include:

Biographical Dictionary: [www.s9.com/biography/index.html](http://www.s9.com/biography/index.html)

Electronic Nobel Museum Project: [www.nobel.se/enm-index.html](http://www.nobel.se/enm-index.html)

Lives, the Biography Resource: [members.home.net/klanxner/lives](http://members.home.net/klanxner/lives)

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**Enigmatic Microorganisms and Life in Extreme Environments.** J. Seckbach, ed. Kluwer Academic, Dordrecht, The Netherlands, 1999. 687 pp., illus. \$360.00 (cloth).

**The Expressiveness of the Body and the Divergence of Greek and Chinese Medicine.** S. Kuriyama. MIT Press, Cambridge, MA, 1999. 340 pp., illus. \$29.50 (cloth).

**Flora of the Northeast: A Manual of the Vascular Flora of New England and Adjacent New York.** D. W. Magee & H. E. Ahles. The University of Massachusetts Press, Amherst, MA, 1999. 1213 pp., illus. \$69.95

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**The Illustrated Flora of Illinois: Ferns.** 2nd ed. R. H. Mohlenbrock. Southern Illinois University Press, Carbondale, IL, 1999. 240 pp., illus. \$39.95 (cloth).

**In Search of Deep Time: Beyond the Fossil Record to a New History of Life.** H. Gee. The Free Press, New York, 1999. 267 pp., illus. \$26.00 (cloth).

**Migration and Colonization in Human Microevolution.** A. G. Fix. Cambridge University Press, New York, 1999. 236 pp., illus. \$69.95 (cloth).

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**The Scientific American Book of the Brain: The Best Writing on Consciousness, I.Q. and Intelligence, Perception, Disorders of the Mind, and Much More.** The Editors of Scientific American, with an introduction by Antonio R. Damasio. The Lyons Press, New York, 1999. 340 pp., illus. \$35.00 (cloth).

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**Science as a Way of Knowing: The Foundations of Modern Biology.** J. A. Moore. Harvard University Press,

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