not help Nelson, however, whose agency suffered both in the eyes of congressional lawmakers and Alaskans restive with federal game restrictions. It was easy for the latter to claim that their hunting game species for food did no great harm and that federal authorities and sportsmen were the source of most difficulties. Alaskans felt they had a right to shoot wild animals. This was rooted in the "frontier psyche."

Federal funding for conservation was also made difficult because, as late as the 1930's, wild animals were thought to be economically insignificant in the West. The National Conservation Committee, reporting in 1909, had declared most game species "largely exterminated." Then too, the Biological Survey was fatally compromised in the eyes of many scientists and conservationists because of its trapping, poisoning, and shooting of predators.

Though after a protracted legal wrangle General Buckner ultimately received the permit he sought, he was killed in action in the Pacific in 1943 and got little good out of the privilege. The end of the war in 1945 and an unusually severe winter in 1945–1946 resulted in very high losses of wildlife. Since that time, despite continuing friction between state authorities and outsiders, multiplying population, new transportation technologies, better roads, and more industry, a measure of balance has been achieved between conservationists and those of a more utilitarian stamp. Sherwood's book is well written, is based on a thorough understanding of the literature, and sheds light on a number of important peripheral issues.

In his book Tober explores state regulations relating to wildlife in the last half of the 19th century, but necessarily takes up the rights and interests of other groups—private landowners, sportsmen, and market hunters—and the effects of these groups on the growing scarcity of wildlife. The growth and later decline of state authority are tied in with the role of the federal government, and these topics in turn lead to a discussion of changing doctrines governing the ownership of wildlife.

The religious, social, and economic preconceptions of the colonists colored their outlook on wildlife. By the early 19th century, some viewed the existence of large wild animals as a principal factor in the ability of red and white people to live in an uncivilized state some distance from civilization. To one author of a study of Massachusetts mammals in 1840, this was a good reason for game animals to be killed. "The sooner [they] are extinct, the better, for they serve to support a few individuals just on the border of the savage state, whose labors in the family of man are more injurious than beneficial." Domestic animals, this author contended, were "not subject to that drawback, the deterioration of morals." Others were convinced that America's raw materials were limitless, one writing in 1852 that "it is preposterous to suppose that the supplies of coal can be exhausted or even become scarce. The idea is almost blasphemous."

Continual change in the landscape due to the growth of population led to alterations in the numbers and distribution of wildlife. Hunting for "meat and skins" was a factor in American life from the beginning of the colonial period. Not until the 19th century did large-scale "market hunting" develop.

Colonial and later state governments sought to protect desirable species and encouraged the destruction of predators and pest species. Sportsmen, "generally urban, eastern and wealthy," shared these qualities with few other hunters. Though relatively few in number, these men led the effort to conserve game, in part to serve their own interests and in part "in response to what they perceived to be the general interest." Market hunting reached its peak toward the end of the 19th century and was opposed not only on the grounds of the need to conserve wildlife but also on the basis of ethnic and class considerations. The key to diminished stocks of game, however, lay in land use changes that went hand in hand with population growth and development. The combination of hunting and habitat destruction led to the extinction or near disappearance of many species, most notably the passenger pigeon and the buffalo.

Sportsmen attempted to place some distance between themselves and all other hunters, who, it was argued, were more likely to disregard private property rights, in the interest of gaining better access to game species. Though only five states protected the landowner from hunters who trespassed without permission by 1871, virtually all had no-trespassing laws in force by 1900. Since the distribution of the larger game species did not coincide with private property lines, the only solution to the game management problem lay in the imposition of state and federal game laws. Private hunting preserves were tried for a time but were generally objected to on grounds of exclusivity and denial of rights to ordinary citizens. Game laws affecting everyone were seen as the most democratic means of ensuring equal access to all classes, though they were resisted in some quarters. Gradually, a myriad of often conflicting state and local game laws were made more uniform as better scientific information concerning animal species and their habits and distribution became available. Much of this research was carried on by the U.S. Fish Commission (after 1871) and the Biological Survey (after 1885). Tober notes that the concept of state ownership of wildlife has been steadily narrowed in the 20th century in favor of a wider federal role. Gradually, a small political elite brought about public acceptance of intelligent game management, aided by state and federal conservation efforts and clear evidence of the decline in numbers of many species. Sportsmen initially fueled this effort and were later joined by humane societies, the American Ornithologists' Union, and the several Audubon societies. States began assuming responsibility for enforcement of game laws in the modern sense in 1878, but state control was long regarded as an abuse of authority.

Tober has written an important and thoughtful book that complements earlier studies of other aspects of the subject. His coverage of a critical era in the conceptualization of state wildlife laws is a valuable contribution to the literature. Both of these volumes deserve wide attention from students of conservation history.

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The Physician Darwin

The Letters of Erasmus Darwin. DESMOND KING-HELE, Ed. Cambridge University Press, New York, 1981. xxxii, 364 pp., illus., + plates. $95.

He diagnosed the Duke of Devonshire as suffering from an inflamed liver. But that is not what the Duke had been so worried about when he turned to Dr. Erasmus Darwin (1731–1802). In an effort to cool the inebriate's red glow, Devonshire had applied a compound of lead acetate to his face, and now his facial muscles were partially paralyzed. Darwin offered several suggestions, reflecting both the state of medical science and the mores of the period. He advised taking the waters of Bath and a twice-daily tincture of guaiacum. These would encourage gout, and so repel the ill humor from its site to a less discommoding

place in the body. But he thought the most effective prescription would be for Devonshire to take a dose of calomel once a fortnight, to have a regular stool, to relax in his garden, and, most important—a recommendation made only with great deference to British custom—to reduce by half the large quantities of wine and liquor he consumed.

The grandfather of Charles Darwin is remembered in our day as elaborating a theory of species transformation in his major medical work, *Zoonomia* (1894–96). His theory bears less resemblance to his grandson's than Desmond King-Hele, the enthusiastic editor of his letters, suggests. Darwin's theory was, nonetheless, an impressive guess in the right direction. Samuel Butler, whose passion for science far exceeded his grasp of it, even thought the elder Darwin's biological speculations superior to those of the younger. But in his own day Erasmus Darwin's reputation rested more on those abilities for which the Duke of Devonshire consulted him.

Darwin often communicated his medical and biological ideas in ways that should have more restrained the editor from trying to unearth a mind of contemporary scientific temper. In the early 1790's, for example, Darwin completed *The Botanic Garden*, 2192 rhyming couplets singing of the sex lives of plants and other intimacies of the vegetable kingdom. To us certainly odd, but the young Coleridge judged Darwin "the first literary character in Europe, and the most original-minded man." In later years, though, he likened Darwin's poetry to "mists that occasionally arise at the foot of Parnassus."

This volume gathers all of Darwin's known letters (save one to be published by its owner), 272 in all. The editor provides admirable notes, detailing the events discussed, giving short biographies, and referring the reader to other literature. Darwin's letters reveal a man of capacious interests, shrewd ideas, and well-placed friends. He wrote to James Watt, who improved the steam engine, about a new design for a carriage; but only to Matthew Boulton, the great Birmingham manufacturer, of his secret plans for a "fiery chariot," a steam-driven wagon; to Benjamin Franklin on electrical experiments; to the financier John Barker about building iron mills on the new Trent and Mersey canal, then in the planning stages. He corresponded with his long-time friend the pottery magnate Josiah Wedgwood over many things: ideas—fuzzy at best—of heat storage and flow; new models for oil lamps; and always finances. (Wedgwood's daughter Susannah married Darwin's son Robert, and they became the parents of Charles.) Darwin reported to all of his friends the latest cures for a variety of maladies. He was especially sanguine about the use of "airs," such as oxygen, in therapy for lung disorders; together he and Watt devised machines to produce and administer these gases. Unfortunately few patients seemed to benefit from the new inhalation technology.

Dr. Darwin died fat. He preached the medicinal virtues of natural foods taken when needed, which was, for him, often. He left his heirs, including two illegitimate daughters, a goodly sum, the result of sound investments, a lucrative practice, and his keen desire to turn a shilling—he boasted to Watt that "I write for pay, not for fame." This volume will contribute modestly to his fame. It will contribute immodestly to the accounts of Cambridge University Press.

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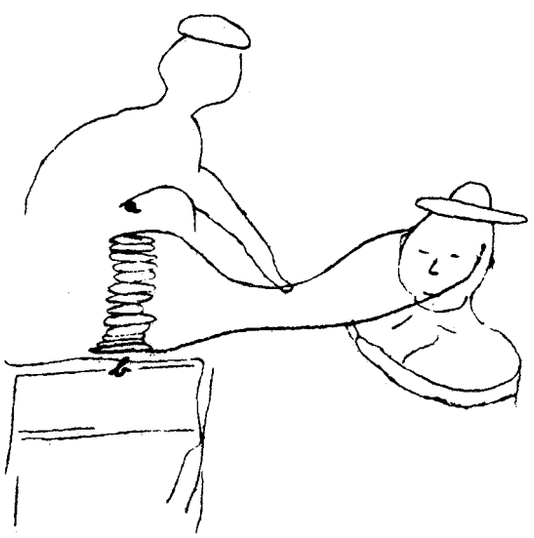

Galvanic pillar as drawn by Erasmus Darwin in a letter to Georgiana, Duchess of Devonshire, November 1800. "The Galvanic pillar may consist of about 30 or 40 half-crown pieces, as many pieces of Zinc of similar dimensions, and as many circular pieces of cloth, which must be wetted in salt and water. Two thick brass wires . . . communicate from each extremity of the pillar to each temple. The temples must be moistened with brine. . . . The shock is so great as to make a flash in the eyes, and to be felt th[r]ough both the temples, every time one of the wires is lift'd from the pillar, and replaced. So that 100 shocks may be given in a minute. I have one patient here . . . who has used it daily for giddyness with good success. I should be extreemly happy to show your Grace the application of Galvanism, the effects of which would surprize you, I am sure." [Touched-up version, from *The Letters of Erasmus Darwin*]

Electrophysiology

The Biophysical Approach to Excitable Systems. A Volume in Honor of Kenneth S. Cole on His 80th Birthday. Papers from a symposium, Woods Hole, Mass., 1980. WILLIAM J. ADELMAN, JR., and DAVID E. GOLDMAN, Eds. Plenum, New York, 1981. xii, 258 pp., illus. $29.50.

Among membrane biologists few techniques are more valued than the voltage clamp; the many membrane processes inherently dependent on voltage are best studied when the voltage is controlled by the investigator and not the membrane. Among American physiologists few investigators have had more significant careers than K. S. Cole, the inventor of the voltage clamp. It is wonderful that the inventor has lived to see his invention applied to so many tissues and cells with such important results.

Cole's invention of the voltage clamp is only one part, a small part if measured in quantity, of his life's work. And this collection of papers published in honor of his 80th birthday reflects Cole's wide range of interests. Sections deal with membrane channels, membrane transport, and stimuli and drugs. The opening section of five papers is devoted to the electrical characteristics of membranes, mostly nonlinear properties in the frequency domain as measured by sinusoidal or wide-band signals with many of the properties of noise.

Frequency domain measurements have much greater resolution than the usual measurements of transients; this resolution has proved helpful in the measurement and analysis of linear electrical properties arising from the complex structure of tissues. But so far, as is illustrated by several papers in the book, the extra resolution of frequency domain measurements has not been very productive in analyzing the inherently nonlinear properties of membranes. The significant properties of nonlinear membrane channels have been hidden by the detail of data at many frequencies and voltages