working within "normal" traditions are realists. But that is to take for granted more than we know. Many scientists are instrumentalists and pragmatists, still more probably have not got a position on the issue, and the comparison between "normal" traditions is widely recognized to create substantial problems for realism.

Resolution of the second "failure" of SSK is not so easily arranged. If social constructivists were indeed in the business of causally demonstrating the exclusive role of social factors in the production and evaluation of scientific knowledge, then there would be little problem in agreeing that the enterprise had miscarried. Yet Cole's familiarity with the SSK literature, in other respects quite impressive, fails him here. For a quite typical form of social constructivist case-study involves the examination of scientific controversy. How is one to account for variation in scientific judgment when both parties to a controversy have access to the same evidence and, presumably, to the same canons of right reasoning? Here social constructivists have argued that empirical evidence has a causal role but not a discriminating role. If nature is one and the same, then one has to look elsewhere to account for variation in belief and judgment. It is primarily for this reason that methodological—not ontological—relativism has recommended itself to sociologists of scientific knowledge.

Cole wants social constructivists to acknowledge the constraining role of nature in the formation of scientific belief. Amazingly, however, when he gets around to saying what he means by "nature" it turns out to overlap massively with what his opponents mean by "society": "The accepted body of knowledge is the functional equivalent of nature." For Cole the "accepted body of knowledge" is a "cognitive factor" to be juxtaposed eclectically to "social factors." Yet the processes by which members come to acquire "accepted knowledge" are widely designated by the term "socialization," just as the possession of different bodies of knowledge is a major means used to distinguish different social groups. On close inspection, Cole's eclectic sociological compromise looks more well-intentioned than well-conceived. The battle continues.

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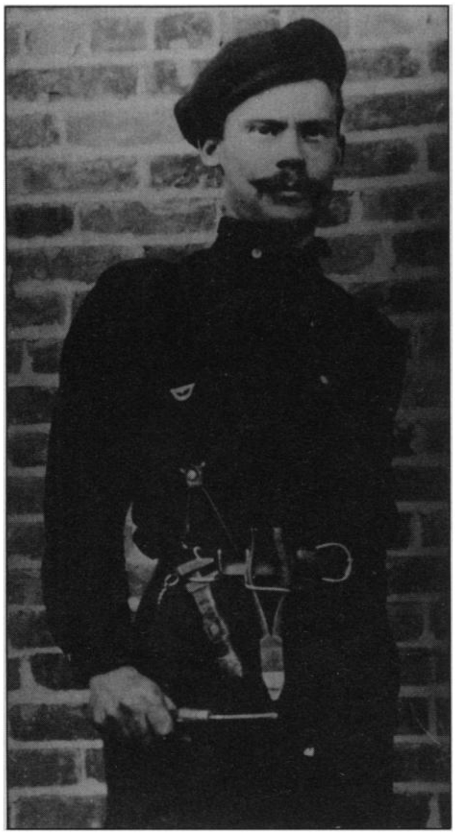
General Inventor

Alexanderson. Pioneer in American Electrical Engineering. JAMES E. BRITTAIN. Johns Hopkins University Press, Baltimore, MD, 1992. xviii, 384 pp., illus. $45. Johns Hopkins Studies in the History of Technology.

If asked about technological innovation in the 20th century, most Americans today would tell you three things. First, they would insist that major breakthroughs come from science. Second, they would inform you that innovation is done by teams and that the age of heroic inventor is long gone. And third, most would tell you that innovation is performed by experts who devote their lives to mastering one esoteric subfield. In this well-researched book James E. Brittain challenges these assumptions by demonstrating how one broadly creative individual helped develop radio and electronics while working primarily in an engineering and not a scientific tradition.

Ernst Alexanderson was born in 1878 in Uppsala, Sweden, where his father taught at the university. Choosing engineering as his career, Alexanderson attended the Royal



Ernst Alexanderson as a test engineer at General Electric, "youthful and well armed with the tools of his new trade." [From *Alexanderson: Pioneer in American Electrical Engineering*; courtesy of the Smithsonian Institution]

Institute of Technology in Stockholm, where he received an engineering degree in 1900. Since the Royal Institute offered few courses in electrical engineering, he spent a year studying at the Koenigliche Technische Hochschule in Charlottenberg, Germany.

While in Charlottenberg, Alexanderson read Charles Steinmetz's book on the theory of AC circuits, and he set his heart on working with the hunchbacked genius of General Electric. Alexanderson was hired by GE in 1902, but only as a draftsman. Eager to move up, he used a combination of patent applications and job offers from rival firms to secure a promotion and by 1904 was working with Steinmetz on electrifying railroads and developing new ways to control AC motors.

In 1910, Steinmetz invited Alexanderson to become a charter member of the Consulting Engineering Department. Steinmetz created this department to complement the research laboratory he had helped found in 1900. Although GE scientists were making progress in developing a theoretical understanding of the incandescent lamp, Steinmetz was concerned that the laboratory was not inventing new products to fill existing market opportunities. Guided by Steinmetz, the consulting engineers worked as in-house inventors, drawing on the laboratory and other company departments to create new products. Profoundly influenced by Steinmetz's vision of engineering, Alexanderson always saw himself as a GE consulting engineer, no matter what his actual title was. In narrating how Alexanderson played this role, Brittain provides a corrective to previous histories of GE that have tended to emphasize the role of the research laboratory in creating new technologies.

As a consulting engineer, Alexanderson devoted much of his energy to the emerging field of radio. In 1904, Reginald Fessenden asked GE to build a high-frequency alternator for use as a radio transmitter. With the alternator, Fessenden hoped to develop a radio system simpler and more powerful than Marconi's design. Drawing on his experience with AC motors, Alexanderson designed several alternators for Fessenden. In addition, he invented in 1912 a magnetic amplifier to control or modulate the alternator's signal. In 1914 he established two-way voice communication by radio between GE plants in Schenectady and Pittsfield, Massachusetts.

At first GE managers showed only lukewarm interest in Alexanderson's alternator, but after America's entry into World War I the U.S. Navy contracted with GE and the Marconi Company to build a large-scale radio station in New Brunswick, New Jersey. This station was seen as vital to national security because the British controlled the transatlantic cables and the Germans had built powerful radio stations in Long Island and Nauen, Germany. Not wishing to be beholden to the British-controlled Marconi Company for this key technology, the Navy turned to Alexanderson to create a distinctive American radio system. Over the next two years, Alexanderson developed an intercontinental radio system, complete with 200-kilowatt alternators and a multiple-tuned antenna. With this system he established reliable voice communications between the United States and Europe, and the system was used by the U.S. government to maintain contact with President Woodrow Wilson during the postwar peace conference.

To sustain these developments in radio, the Navy and GE established the Radio Corporation of America in 1919. Appointed to act as RCA's chief engineer, Alexanderson presided over the installation of a worldwide network of alternators that were used to send radiotelegrams. Although Alexanderson's alternator was replaced in the 1920s by improvements in electronic tubes and short-wave apparatus, several of his alternators were used regularly during World War II and one installed in Sweden in 1920 was still operable in 1986.

Ernst Alexanderson and his son Verner listening to a short-wave receiver [From *Alexanderson: Pioneer in American Electrical Engineering*; courtesy of Verner Alexanderson]

Though his alternator radio system was the high point of his career, Alexanderson was an active inventor for another 40 years. During the 1920s, he perfected a system for sending documents by radio, and by 1929 this "fax" system was used routinely to send drawings between Alexanderson's office and engineers in California. Following on this work, Alexanderson experimented with a television system using a high-speed scanning disk similar to the disk in his alternator. These experiments ended in 1930 when David Sarnoff severed RCA's ties with GE and instead chose to develop an electronic TV system within RCA. Thus in the 1930s and '40s Alexanderson returned to power engineering and designed electronic devices for controlling motors, utility grids, and gun-control systems. During his career, he secured 340 U.S. patents, the last of which, deriving from an interest in using transistors and rectifiers for motor control, was issued in 1973. Alexanderson died in 1975.

In narrating Alexanderson's career, Brittain could have perhaps said more about the organizational context of his work and how he moved his ideas through the GE bureaucracy. GE's strategy and structure changed dramatically between 1900 and 1950, but we do not learn how such changes influenced Alexanderson's work or how his accomplishments altered the firm.

With respect to the common assumptions about technological innovation, Brittain persuasively shows that electronics did not spring entirely from theoretical physics. Much of the creative work involved translating the science into practical devices, and this work was done by engineers such as Alexanderson. In tracing how Alexanderson moved easily between power engineering and radio electronics, Brittain reminds us that innovation is not the result of specialization as much as it is the product of cross-fertilization. Finally, he reveals how strongly electronics was shaped by the work of an individual. All too frequently, both contemporary observers and historians of R&D overemphasize the role of teamwork and downplay the role of individuals in providing original ideas, the vision of a new social and technical order, and the leadership needed to implement the vision. More than anything else, Brittain demonstrates in this fine biography that individual engineers such as Alexanderson have indeed played a profound role in shaping both the technology and the culture of the 20th century.

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Female Functioning

Periods. From Menarche to Menopause. SHARON GOLUB. Sage, Newbury Park, CA, 1992. xiv, 282 pp., illus. $38; paper, $18.95.

Menstrual Health in Women's Lives. ALICE J. DAN and LINDA L. LEWIS, Eds. University of Illinois Press, Champaign, IL, 1992. vi, 301 pp., illus. $37.50; paper, $16.95. Based on a conference, Galveston, TX, 1985.

Twenty-five years ago an activist women's health movement emerged in this country that had broad popular appeal; a representative text, *Our Bodies, Ourselves*, is now in its fourth edition, having sold more than three million copies and been translated into more than a dozen languages. Explicitly feminist, this movement was critical of received medical knowledge and practices on two grounds: diseases primarily affecting women were being neglected (both in federally funded health research and in clinical practice), and entirely expectable events in women's reproductive lives (childbirth, menopause, the late luteal phase of the menstrual cycle) were being interpreted as potential health risks requiring medical management.

Critiques of the latter practice came both from within and from outside scientific communities. It was argued that a reductionist "biomedical model" (a set of concepts embedded in the practices of medicine and other socially powerful institutions) often inappropriately "medicalized" women's lives by focusing on biological events in isolation from their social and psychological contexts. When these biologized representations of women are taken up in the broader culture, they sometimes are represented as offering a scientific basis for resolving controversial social questions. (For example, a July 1970 *New York Times* article was headlined "Women Unfit for Top Jobs" because of the "raging hormonal influences of the menstrual cycle.")

The two books under review report and summarize menstrual-cycle research shaped