engineering, and tension between scientists and bureaucrats will seem familiar to those versed in the history of military and civilian government laboratories.

The issue of independent discovery is mentioned several times but not really treated. For example, we learn of the radio-frequency duplexer invented by Robert M. Page and the "squegger" oscillator "originated" by Page. It was rather widely known in radio circles that the duplexer, the squegger oscillator utilized to produce pulses in radio-frequency amplifiers, and various cathode-ray tube display techniques were simultaneously or previously in use by E. V. Appleton and by R. A. Watson Watt and others in England. Allison nicely discusses an issue of Allied compromise about 1940–41, in the choice of instrumental techniques regarding the adoption of the U.S. or the British "IFF" radar recognition system for ships and planes. Technological compromise for operational and political reasons is an important fact of life in modern technology.

Allison disagrees with Henry Guerlac and others who see radar at NRL as growing out of earlier ionospheric radio research, but he does not convince in spite of quotations he utilizes. The essential point is that if Taylor, Leo Young, E. O. Hulburt, Ross Gunn, and others at NRL had not thought, experimented, and written about radio engineering and ionospheric physics during the 1920's the NRL would not have been in a position to develop their prototypes of high-frequency and very-high-frequency radar in the 1930's. A similar situation is represented by the early solar physics and geophysics rocket research begun at NRL about 1946 by H. Friedman, R. Tousey, F. S. Johnson, J. A. Jackson, and others. This preparatory work not only achieved valuable results, it produced what would be the primary core of scientific personnel for space science when NASA was formed in 1958.

It would have been profitable had Allison included more comparative history. For example, competition between NRL and private industry over the design and construction of radio equipment in the early 1930's roughly parallels competition at the same time between the National Bureau of Standards and the Carnegie Institution of Washington over intellectual superiority, geographical territory, and instrumental standards in ionospheric radio research. And we can find other comparisons: 35 years after the founding of NRL we see NASA similarly born with funding, yet with goals to be formulated later. Allison concludes his work with a nice overview that might well be read as an introduction.

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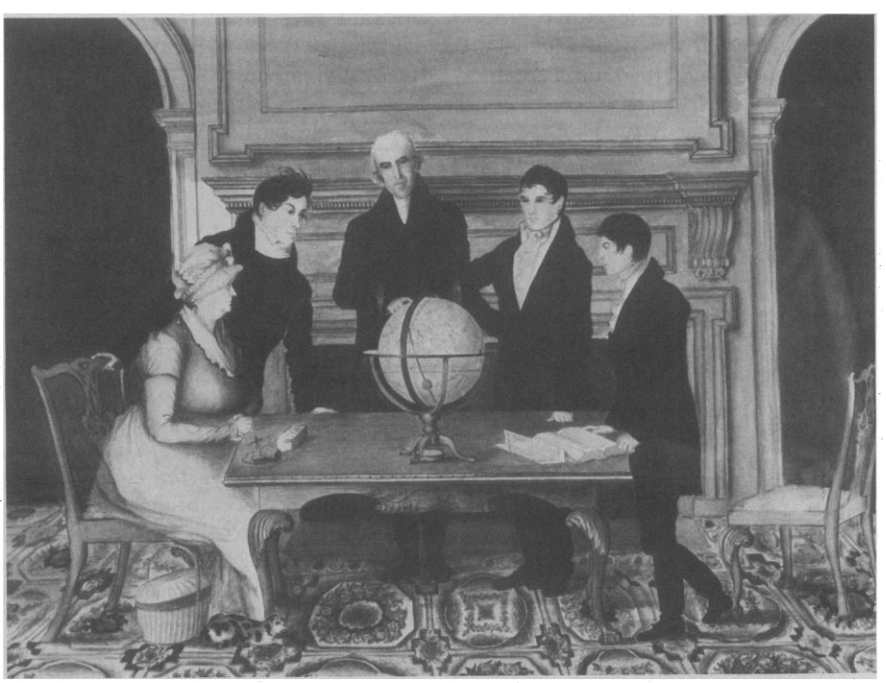
Two American Inventions

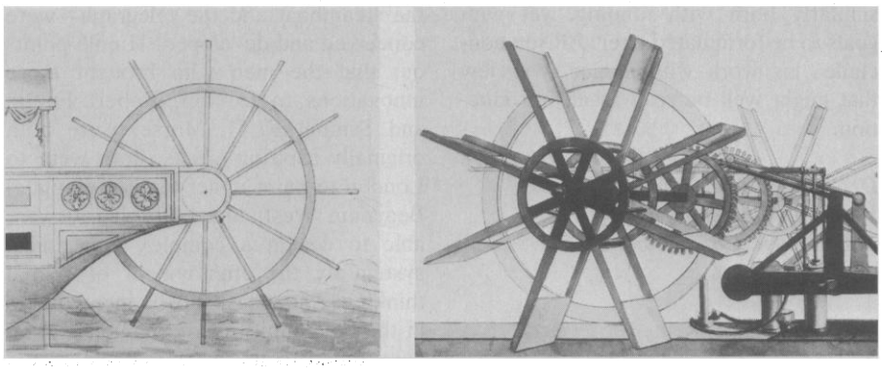
Emulation and Invention. BROOKE HINDLE. New York University Press, New York, 1981 (distributor, Columbia University Press, New York). xx, 162 pp., illus., $22.50. Anson G. Phelps Lectureship Series on Early American History.

This book might also have been titled "Spatial Thinking and Invention," for its major theme is as much, or more, the role of nonverbal, spatial, or visual thought in the inventive process as the role of the emulation motive. Brooke Hindle is senior historian at the National Museum of American History (Smithsonian) and one of the major contributors to the history of American technology. Here he examines the process by which two prominent American inventions—the steamboat and the telegraph—were conceived and developed. Hindle points out that the men who brought these innovations to fruition, Robert Fulton and Samuel F. B. Morse, were both originally aspiring artists, both went to London to paint under (and to emulate) Benjamin West, and both clearly were able to design a complex mechanical system by the employment of spatial thinking. And, as he shows, many others in the community of mechanicians who contributed to these new developments had formal training in the graphic arts. The point is further emphasized by a series of well-chosen illustrations from the inventors' own pens.

The book is a substantial contribution to the literature on nonverbal thinking by historians of technology. This subject has been relatively neglected by psychologists in favor of the study of language processes in cognition, although, as Hindle points out, the interest in differences in right and left brain function does include a concern with nonverbal processes. Note might also have been made of the work of Roger Shepard (Stanford) on mental images and the role of visual imagery in scientific creativity. Hindle's case studies make one wonder again at the social process by which thought has come to be regarded as isomorphic with



Watercolor of the Samuel F. B. Morse family, circa 1810. "The extensive visual imagery associated with . . . Morse offers a fine opportunity to move through his art career and through his telegraph career as well, by way of images. Already in his day the record of a leading artist who played a major role in developing a science-based technology had to be explained. The one approach that ties together these two apparently diverse careers, other than bare coincidence, is the perception of that mental manipulation of images that lay at the center of each effort." [National Museum of American History; reproduced in *Emulation and Invention*]



Paddle wheels patented by William Thornton (left) and Robert Fulton (right) in 1809. Fulton's "success on the Hudson established paddle wheels as the form his successors would use. Thornton [who was commissioner of the Patent Office], knowing well the characteristics of Fulton's 1807 boat, . . . granted himself a steamboat patent incorporating a stern paddle wheel. This stimulated Fulton to take out his patent based upon the side paddle wheel his boats were already using." [New York Historical Society and American Society of Mechanical Engineers, respectively; reproduced in *Emulation and Invention*]

language. Is there a professional ethnocentrism involved here that values only the cognitive modality of the scholar and scientist and relegates the visual thinking of those who work with their hands to a kind of limbo?

In the concluding chapter, "The contriving mind," Hindle makes some interesting observations on the way in which the American patent system and the American educational system have combined to obscure the realities of the process of invention. Patents and prizes are "terminal awards" that do not "have to confront directly the inventive process or the manner in which mechanical creativity functioned" (p. 130). They function, of course, as testimonials of priority, and are obviously relevant to emulation and achievement motivation. But for the historian of technology the question of priority is something of a red herring that distracts attention from the essentially collective nature of the innovative process. Likewise, the dogma that technology is merely an application of available scientific knowledge was increasingly enshrined in 19th-century scientific institutes and schools of "scientific" engineering and has fundamentally obscured the role of nonverbal, nondigital spatial thinking in the actual process of invention.

Hindle's *Emulation and Invention* will help to move the history of technology forward to a fuller recognition of the social and psychological context of the innovative process.

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A Third Look at Middletown

Middletown Families. Fifty Years of Change and Continuity. THEODORE CAPLOW, HOWARD M. BAHR, BRUCE A. CHADWICK, REUBEN HILL, and MARGARET HOLMES WILLIAMSON. University of Minnesota Press, Minneapolis, 1982. x, 438 pp. + plates. $16.95.

Problems of social change have long represented a compelling, if undeveloped, heartland of sociological inquiry. The early classics included monumental investigations of social change and the family, such as Thomas and Znaniecki's *The Polish Peasant in Europe and America* (1918–20) and E. Franklin Frazier's *The Negro Family in the United States* (1939). Both works brought refreshing vigor to the field with emphasis on the historical, ecological, and dynamic aspects of family patterns. Though soon dampened by postwar functionalism, concern with social change returned with even greater momentum during the 1960's through developments in family and demographic history. The empirical study of family change and history has never been more lively in the social sciences than at present. *Middletown Families* is part of this development and of a broader movement to assess, explain, and predict the course of social change.

The story of *Middletown Families* began in the mid-1920's when Robert and Helen Lynd arrived in Muncie, Indiana (Middletown is the pseudonym), with a research team to conduct a study of Protestantism for the Institute of Social and Religious Research. Robert Lynd had just received his B.D. from Union Theological Seminary and would soon return to New York City and Columbia University for a doctorate in sociology. With serious interests in history, social science, and philosophy, Helen Lynd was several years away from the start of a long career on the faculty of Sarah Lawrence College. The Lynds' initial plan soon evolved into an unparalleled community study with the ambition of shedding light on the process and effects of social change. Writing in *Middletown* (1929), they observed that "we today are probably living in one of the eras of greatest rapidity of change in the history of human institutions . . . it would be a serious defect to omit this developmental aspect from a study of contemporary life." To bring this dimension to their snapshot of Middletown, the Lynds assembled a wide range of documents and statistics on the community in 1890. Had funds and more time been available, they would have added data points between 1890 and the 1920's, the period of extraordinary institution-building and modernization. The limitations of a two-wave design still enabled a perception of the 1920's in Middletown as "the most recent point in a moving trend." Robert Lynd expanded this design by returning to the city midway in the Depression decade for a short period of fieldwork. Out of these data and some thoughtful comparisons with the earlier project came *Middletown in Transition* (1937), a study that centered on responses to the Great Depression.

If Middletown seemed to have become a laboratory for the study of change by the end of the 1930's, the concept soon lost favor in the postwar era. The arrival of a second-generation research team in 1976 brought Middletown back to life among sociological endeavors. Headed by Theodore Caplow, Commonwealth Professor of Sociology at the University of Virginia, and funded by the National Science Foundation, the third Middletown project encountered a city that had doubled in size (to about 80,000) and perhaps in social complexity as well. A small teachers' college in the 1920's was now a large state university. But the