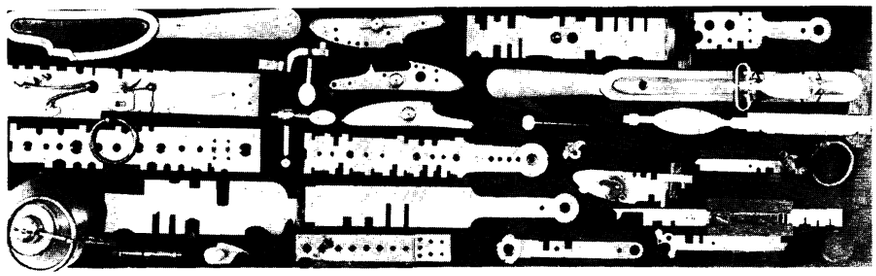


Inspection gauges for U.S. Rifle Model 1841. In 1826, "with the aid of over sixty-three inspection gauges and an impressive stable of machinery," John H. Hall "conclusively demonstrated that his rifles could be made with interchangeable parts. . . . Eight years later Simeon North . . . from Middletown, Connecticut, . . . adopted Hall's gauges and succeeded in making rifles with parts that could be exchanged with those made by Hall at Harper's Ferry." What Hall and North had done was achieved "in a larger, more efficient manner . . . in the mid-1840s when the national armories and private contractors began to produce the Model 1841 percussion rifle and the Model 1842 percussion musket. These were the first fully interchangeable firearms to be made in large numbers anywhere, one of the great technological achievements of the modern era." [M. R. Smith, in *Yankee Enterprise*; gauges from the collections of the Division of Military History, National Museum of American History]

efforts in a certain direction that just happened to be a fruitful one. The core of this fortunate technological dynamism was a capital goods industry that transferred technology and knowledge to new industries and whose own productivity improvements lowered the costs of new technologies and helped diffuse them throughout the economy. Interestingly enough, Rosenberg's explanation does not require that the American System was unique or that it originated in America, only that the mechanized type of production processes flowered more widely and pronouncedly in the United States.

The consequences and concomitant developments of these production methods are covered well in this collection. Uselding examines the development of improved measuring devices; Chandler reports on improved factory and corporate management techniques; and Nelson provides an assessment of working conditions in factories using the American System and their implication for labor unrest and unionization. One consequence that had previously been neglected is the change in buying habits necessary to consume the large volume of products, which Neil Harris terms the rise of an American System of Consumption. He explores this phenomenon through the use of descriptions of consumption patterns and life-styles found in novels, juxtaposed with the known changes in retailing strategies. One theme found in early 20th-century novels was the consumers' need to cope with the standardization of mass-produced goods.

This is an interesting collection of essays presented originally at a Smithsonian Institution symposium by a diverse group of the top scholars in the field. There is a certain amount of repetition of earlier work by a few authors, but for the most part this appears to be fresh material. The scope of its coverage is hinted at by references to Babbage as well as *Babbitt*. Alphabetically these may not cover much ground, but intellectually they encompass the applied sciences and the humanities. The book should, however, have its widest appeal among social scientists of many different persuasions and disciplines. Whatever one's primary focus, all the essays should be readily accessible, written for any intelligent reader, not just specialists.

If there is a drawback, it is that there is no essay putting the topic in the perspective of previous research. Though such literature reviews can easily lose the interest of non-specialists, more might have been done to indicate at least the conventional wisdom concerning the subjects. A certain amount of this comes through in the individual essays, as well as from the combination, but each author typically specifies his view of things, focusing narrowly on one aspect of the topic. Fortunately, there is an excellent bibliography to direct the interested reader elsewhere.

THOMAS WEISS
Department of Economics, University of Kansas, Lawrence 66045

Forging shop, Singer factory, 1880. An illustration of the factory published in 1854 "shows relatively few machine tools compared to the army of workmen at the bench with files in hand." In 1880 "an excellent series of illustrations appeared in a Singer-supported book, *Genius Rewarded; or the Story of the Sewing Machine*. These engravings show quite clearly the transformation that had occurred in Singer manufacturing technology. Whereas most parts of the Singer machine had formerly been cast iron, [the factory] relied increasingly on drop forging and fabrication from bar stock." After 1863 "Singer acquired ever-larger numbers of special-purpose machine tools." Singer's superintendent reported in 1885 that "by the addition of machinery the same number of employees will produce double the number of [machines] they would ten years ago." [D. Hounshell, in *Yankee Enterprise*; illustration reprinted from *Genius Rewarded*]

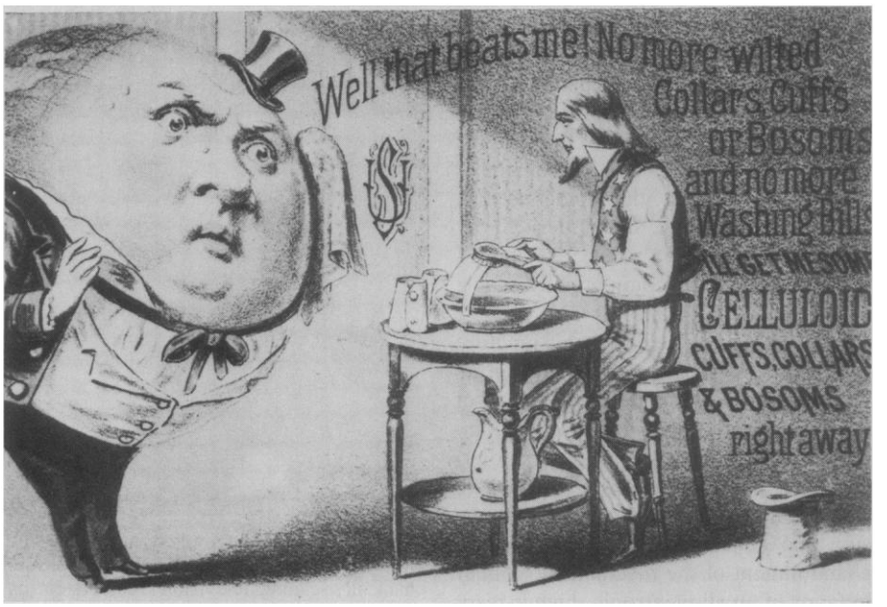
A 19th-Century Material

Pioneer Plastic. The Making and Selling of Celluloid. ROBERT FRIEDEL. University of Wisconsin Press, Madison, 1983. xxii, 154 pp., illus. $19.95.

Celluloid was the first plastic. John Wesley Hyatt invented it in Albany, New York, in 1869 in the course of a long and unsuccessful search for a replacement for ivory in billiard balls. These bare facts are well known by historians

of technology and lovers of trivia, but up until now little additional has been established. Robert Friedel remedies this in this brief volume in which he discusses celluloid's nature, career, and, most important in Friedel's scheme of things, its implications for the greater arena of material culture.

What celluloid was is simple enough: a solid solution of moderately nitrated cellulose (pyroxylin) in camphor, molded under heat and pressure. Hyatt and his brother Isaac had the formulations and necessary machinery for production developed and in place by 1872 as they recognized the invention to be a new and potentially useful substance. What neither they nor any of their contemporaries perceived was anything revolutionary about celluloid. It was one of a number of new materials—hard rubber, vulcanized rubber, gutta-percha, aluminum, magnesium—that became established during the period. Like the promoters of these other products, the Hyatts, their associates, and their successors in the Celluloid Company saw their task as a search for markets.



Advertising card for celluloid collars and cuffs. "Because of celluloid's high price vis-a-vis linen collars and cuffs, promoters had to appeal to customers on the basis of the product's special attributes. The difficulty of doing this was compounded by the failure of celluloid to achieve any measure of fashionableness." [From *Pioneer Plastic*; courtesy of the Warshaw Collection of Business Americana, National Museum of American History]

This search was complicated by the nature of celluloid. Unlike rubber, which it most closely resembled, celluloid did not have assertive properties. Rubber was dark; inexpensive jewelry and combs could be made from it but the items had to be black. Celluloid was white and could easily be colored to any desired shade. As a result, the hallmark of celluloid over the next 20 years became imitation, beginning with its first important use, for dental plates, where though more expensive it could readily be given the correct color. Over the next quarter-century it achieved substantial, but never dominant, shares in several markets including combs, brush handles, and costume jewelry. In each it was used because it could take the appearance of more expensive or traditional materials such as ivory, horn, tortoise shell, and ebony, as the cheaper available materials could not do. Even when marketed for a use where its innate properties gave it advantage, detachable collars and cuffs, celluloid achieved its successes by at least mimicking the appearance of something it was not, linen. The properties of celluloid did not suggest novel products to its promoters. Imitation became its signature and most important function.

Eventually, with the marketing of the first successful photographic roll films by George Eastman in 1889, celluloid found a use for which it was uniquely suited by its innate properties and for which it could and did become the dominant product. Celluloid possessed the nearly ideal combination of transparency, flexibility, toughness, and uniformity, although it did have the drawbacks of flammability and softening at temperatures over 100°C.

Celluloid was the only commercial plastic of the 19th century. Thus, its career established in the minds of both the public and subsequent inventors what a plastic was and should accomplish. Imitation of more expensive substances became one such criterion, applicability to high technology the other. When Leo Baekeland developed the next plastic, Bakelite, in 1907, he knew what he had and how to exploit it. Celluloid had traveled down unknown paths and left behind road maps for those that would follow. This was, Friedel convincingly argues, its great achievement and its legacy.

This generally admirable study is not without weaknesses. It is lacking in depth at many points; for example, there are few hard data on market shares and sales volumes. Friedel argues that in many cases this is because the needed information just was not to be found, despite his having used many novel sources. Also, one thing that has always struck me about celluloid is that it was an American invention whose commercial development took place in the American context during the era before this country became dominant in science and technology. More discussion of the way this context shaped its career would have been valuable. Still, these lacks should not detract overly from the value of this pioneering work.

SHELDON HOCHHEISER
Rohm and Haas Company,
Philadelphia, Pennsylvania 19105

The Establishing of Television

The Great Television Race. A History of the American Television Industry, 1925–1941. JOSEPH H. UDELSON. University of Alabama Press, University, 1982. xiv, 198 pp., illus. $18.95.

The technical development of television coincided with and well illustrates the general transition from electromechanical to electronic control. Late-19th-century innovators saw the possibility of transmitting pictures over a wire, and later by radio; means rapidly to encode and decode presented the first problems. The early solution was mechanical: a rapidly spinning disk perforated with holes arranged in a shallow spiral scanned successive lines across the image in sequence with each rotation of the disk. In Paul Nipkow's 1884 patent the image was scanned onto a selenium cell that generated the analog electrical signal. The transmitted disk modulated light through a synchronized disk at the receiving apparatus, reconstructing the