

BOOK REVIEW

From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States

Reviewed by Walter V. Cropper, Consultant, 1300 Galisteo Pkwy., Santa Fe. NM 87501. Member of ASTM.

REFERENCE: Hounshell, D. A., *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*, The Johns Hopkins University Press, Baltimore, 1984, hardcover, \$37.50, 330 pp + 2 Appendices, Notes, Bibliography, Index, Illustrations.

Subtitled "The Development of Manufacturing Technology in the United States," this very readable book contains much that is of value and interest to all who are involved in standardization activities.

Dr. Hounshell sets the record straight about the role of Eli Whitney and others in achieving interchangeability of parts in manufacturing. The goal of parts interchangeability was originated by General de Gribeauval, who sought in 1765 to introduce standardized weapons with standardized parts so they could be readily interchanged. The French arms-maker Honoré Blanc undertook to achieve uniformity in musket parts under the de Gribeauval system, and it was this new system and practice that Thomas Jefferson introduced into the United States. Whitney, in fact, never really fulfilled his famous contract.

John H. Hall, inventor of the breech-loading rifle, applied new thinking about how interchangeability could be achieved by machines and successfully completed in 1824 a contract to deliver 1000 breech-loaders with interchangeable parts. A committee of the U.S. House of Representatives thoroughly investigated Hall's Rifle Works in 1827 and confirmed that the rifle's components were indeed interchangeable and were produced by machine tools of Hall's own design and make. An important factor in his success was his rationalized design of fixtures and extensive use of gages. But the essential ingredient was his commitment to relinquish individual judgement to the ultimate authority of the gage.

The joining together of the concepts of parts interchangeability and the notion that machines could make things as good as, and faster than, human hands came to be called "armory practice" and eventually the "American system of manufacturing" and importantly extended the Industrial Revolution in America.

An important lesson for standards people is that operating management has to be dedicated to rationalization and objective quality control. These are not "from the bottom up" concepts, but rather have to be constantly reinforced from the top down. Hounshell provides numerous examples where management shortcomings stood in the way of success in applying the American system.

Most notable of these examples are the Singers and their sewing machine and the McCormick Brothers and their farm machinery. In both cases, manufacturing at first was entirely subordinate to marketing. However, when marketing created demand that came to be measured in hundreds of thousands of items per year, mass

production had to be created. In the beginning, this meant employing armies of machine operators and phalanxes of finishers or fitters to make the components and products fit together and work. In these examples the strengths and weaknesses of management are made clearly evident.

The Singer Manufacturing Company endured a continuing crisis from 1876 to 1884 over the quantity and quality of its sewing machines. A technical specialist was hired in 1881 specifically to set inspection procedures; nevertheless, a year later productivity and quality were still far from satisfactory and considerable filing and fitting were required at the final production stages. In 1883, Singer President McKenzie announced a formal decision that "each part commenced in a department shall be finished there to gage, ready for assembling," thereby radically changing production methods throughout the company to achieve true mass production.

Although a new Singer plant in Montreal was designed under this concept, there were many operating problems and both quantity and quality of production were minimal when the plant began operating in 1884. A new assistant superintendent, E. H. Bennett, forcefully imposed efficiency and accuracy throughout the plant while a team of production experts focused on systematizing the plant layout and its works. By mid-1885, a comprehensive set of gages, fixtures, and procedures had been put in place and virtually all problems had been resolved. Bennett joined ASME in 1884, breaking with Singer's tradition of secrecy about its internal workings, and for several years he contributed much to both the Company and Society in matters of standards, precision, and inspection.

Hounshell devotes a highly interesting chapter to bicycle manufacturing, in which he principally demonstrates that the American system is virtually independent of the industry involved or the product being made. This chapter also reinforces the fundamental importance of management commitment to standardization and objective control of processes and products.

The final third of the book deals with the automobile industry, personified by Henry Ford and epitomized by the General Motors Corporation. "There are no fitters in mass production," Ford proclaimed from the beginning. To accomplish this meant using gages and other standards profusely at every stage of manufacturing. New materials and new operations were continuously being devised and evaluated by Ford's scientists, engineers, and technologists. Company standards were steadily updated and expanded. Nevertheless, Mr. Ford was not truly an innovator; this weakness provided General Motors the opportunity of its lifetime. Ford's gigantic internal effort after 1930 to reconstitute itself and regain its former position in the industry is described in the chapter "The Limits of Fordism and the Coming of 'Flexible Mass Production'". This chapter is perhaps less fertile for standards people than most of the earlier ones, but it is no less interesting.

The final chapter, "The Ethos of Mass Production and Its Critics," is not as well focused as this reviewer expected. "Mass production" describes a system characterized by mechanization, high wages, low prices, and large-volume output—not merely, as gen-

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erally supposed, quantity production. The points the critics of mass production attack are regimentation (lack of innovation and change), depersonalization, and the creation of artificial demand through excessive advertising and forced obsolescence. Hounshell makes considerable use of Charlie Chaplin's film *Modern Times* and Diego Rivera's *Detroit Industry* murals to illustrate these criticisms.

Hounshell recounts a number of technological advances and innovations that facilitated applications of the American system, but gives little indication of the extent to which the need for them was generated by the system or the extent to which the firms needing these advances contributed to their development. More attention

perhaps should have been given to the importance of innovation, invention, and technological change to the growth of the American system.

In summary, anyone who has any interest at all in American industry and technology, whether from the standpoint of manufacturing, engineering, research, or even sociology, will find this book both instructive and easy to read. Hounshell's style is graceful but also concise and his scholarship is of the highest order. The footnotes and bibliography leave nothing to be desired, and the index is exemplary. Dr. Hounshell has presented the technical community with a major literary contribution.