

Preface

Technology is a driving force in transforming society, which in turn shapes technology so that it is workable in a specific social circumstance in history. In the history of the modernization and postwar reconstruction of Japanese society, technology arriving from Western countries played a key role, interacting with already existing traditional techniques or previously imported technologies.

The steam engine attracted intense attention from leaders of Japan on the eve of the Meiji Restoration in 1868. Yet, as Chapter 6 of this volume shows, the more primitive water wheels continued to drive machines throughout Japan. They were used because the Japanese landscape was filled with slopes with running water, and because the constant operation of steam engines demanded the costly consumption of large amounts of coal. To minimize the cost of transportation of coal, steam engines were often used to pump water at coal mines, and to drive locomotives and ships which were easily accessible to the site where fuels were stored.

The introduction of modern technology and modern institutions required some basic changes and new foundations to keep them working in society. Modern technology needed a uniform standard system, including units of weights and measures. The safe and economic operation of modern technological systems, most notably railroads and factories, required modern work disciplines and rigorous punctuality, which was absent until the late 19th century. As Chapter 1 shows, the acquisition of punctuality, the requisite for the successful introduction of modern technologies and institutions, was a gradual process in modernizing Japan.

This volume is a collection of papers I published from 1992 to 2008 on a variety of topics about the history of Japanese technology. With the exception of Chapter 8 on postwar American history, all the

topics contained in this volume are concerned with a certain facet of the history of technology in Japanese society, from the end of the Edo period to the present. The topics covered in this volume are diverse. Some are major themes in the history of Japanese technology; others are rather minor and hitherto unknown. However, the discussions in the following chapters touch on and disclose certain aspects of the nature of technology developed and used by Japanese engineers.

“Part 1: Mechanical Clocks and the Origin of Punctuality” covers time and clocks in modern and pre-modern societies. After the introduction of Western mechanical clocks by Jesuit missionaries in the sixteenth century, the mechanical clock created a unique engineering evolution in Edo society, so that its time-keeping and display function conformed to the seasonally variable time system in use at the time, according to which the length of hours changed, like the ancient and medieval time system in the West, from daytime to night and from season to season. With the introduction of the Western time and calendar system in 1873, Japanese society also introduced modern work discipline, which required strict punctuality in many quarters of society. Chapter 1 discusses the change in conception of time from the Edo to the Meiji period, and the historical evolution of modern Japanese society through observing how punctuality was accepted and consolidated in the society. Chapter 2 deals with the career of Hisashige Tanaka, a craftsman of the later Edo period known for his famous automata machines, and his masterpiece called the Myriad Year Clock, which was a complex time-keeping machine with a solar and lunar model on its top.

“Part 2: Roles and Visions of Foreign Engineers” deals with the work and thoughts of French and British engineers. Tokugawa and Meiji governments employed foreign engineers to build their various modern institutions—factories, dockyards, railroads, and engineering schools. Chapter 3 discusses the construction of the Yokosuka Dockyard, directed by the young French naval engineer François Verny. It describes the various facilities contained in the dockyard, including a school where basic instructions on science and engineering were given to selected young students. Chapter 4 explores how British engineers saw modernizing Japan, by surveying articles on Japan published in

an English journal, *The Engineer*.

“Part 3: Forming Technological Foundations in Modern Japan” covers three different topics about technologies in modern Japan. Chapter 5 deals with the metrological standardization before and after the Meiji Restoration, especially the introduction of the metric system as a standard unit of weights and measures. The establishment of precise units of weights and measures was the fundamental premise for the operation of the modern technological system. In modern Japan, three systems—yard-and-pound, traditional shaku-and-kan, and the metric system—coexisted until after the Second World War. The chapter deals with the gradual process of acceptance and diffusion of the metric system in Japanese society. Chapter 6 outlines the evolution of power technology—water, steam, and electric powers—in pre-modern and modern Japan. This historical overview suggests the close relationship between the use and development of technology on the one hand, and the economic, social, geographical conditions in that period on the other. It shows, for instance, the continued use of water power long after the introduction of steam engines. Chapter 7 discusses the unsuccessful project of trans-Pacific flight in the 1920s and 1930s. Hidemasa Kimura, an aeronautical engineer at the Aeronautical Research Institute of Tokyo Imperial University, assisted on this project and dealt with the controversy over the aeronautical standards. The chapter shows his thoughts on reasonable standardization, and his later involvement with a project of long-distance record-setting flight.

“Part 4: University, Industry, and the Government in Postwar Society” deals with the relationship between these three sectors in the development of technologies in the United States and Japan. As an exception to this volume, Chapter 8 deals with the strong military involvement with R&D in postwar American society. During the Cold War, the United States government heavily subsidized industry, as well as universities, to develop advanced technologies related to nuclear weapons systems. The chapter surveys the recent historiographical debate over whether such military funding “distorted” postwar American science and technology. In contrast to the United States, Japanese industry concentrated on production for civilian mar-

kets, and the development of technologies for that purpose. The last three chapters investigate the less visible relationship between universities and industry in postwar Japanese society. Chapter 9 discusses this “hesitant” relationship between the two sectors in postwar Japan, which is contrasted with a more active relationship between the two in the prewar period. Chapter 10 examines the role of “Technological Research Associations” organized under the Ministry of International Trade and Industry (MITI) to serve as public forums for academic and corporate engineers, in order to facilitate their cooperation and the exchange of technical information. Chapter 11 discusses the “national innovation system” of Japan, and the role of the government in promoting and coordinating R&D activities in various sectors in the 1990s.

A few words on historical literature closely related to the articles collected in this volume, and the topics covered by them, are in order. Chapter 6, on the development and use of power technology in modernizing Japan, is a translation of a Japanese article originally published as a chapter in *The History of Industrial Technology*, a survey book on the history of industrial technology in Japan. The book, edited by the historians of technology Tetsuro Nakaoka, Jun Suzuki, and others, covers such topics as mining, steel, machinery, railroads, textile, chemicals, information, aside from power technology. A shorter version of the article is reprinted in the *Encyclopedia of the History of Industrial Technologies in Japan*, which comprehensively covers most important topics in the field, and is a good starting point for the study of the history of Japanese technology.

My interest in time and clocks originated from learning about the promotion of punctuality in the movement called “the Movement for the Improvement of Domestic Life,” referred to in Chapter 5, on the introduction of the metric system, as well as in Chapter 1, on the origin of punctuality in modern Japan. After I learned about it, the technological historian Tetsuro Nakaoka drew my attention to the complaint prevalent among employed foreign engineers in the late Edo and early Meiji periods about the Japanese lack of punctuality. I then organized a collaborative and interdisciplinary research into the

origin of punctuality at the International Research Center for Japanese Studies in Kyoto. The outcome of this collaborative research was published as a collection of papers from the participants as *Chikoku no Tanjō (The Birth of Tardiness)* from Sangensha in 2001.

My interest in time and work discipline led to the study of the history of the traditional Japanese clocks called *wadokei*. The research on *wadokei* was done as a part of a large research project, titled “Edo no Monozukuri (Inventions of the Edo Period),” supported by the Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science. The “Edo no Monozukuri” project produced numerous findings from a wide variety of archival investigations into mathematics, science, engineering, and medicine in the Edo period, whose results are now in gradual process of publication.

The last three chapters on the university-industry cooperation in postwar Japan resulted from my participation at a scholarly symposium on this theme. The symposium was organized by science-policy scholars Fumio Kodama and Lewis Branscomb, in collaboration with Japanese and American experts in economics and policy studies. As a historian, I contributed a paper on the history of the apparently inactive and non-existing collaborative relationship between academic and corporate engineers. I have subsequently pursued this historical problem, and tried to examine the important roles of less commercial relationships. But the papers contained in this last part are still exploratory in nature and by no means comprehensive in scope. Readers interested in the postwar Japanese science and technology should consult the more comprehensive work consisting of four volumes, *A Social History of Science and Technology in Contemporary Japan*, edited by the historians of science and technology Shigeru Nakayama, Kunio Goto, and Hitoshi Yoshioka; as well as the above-cited *Encyclopedia of the History of Industrial Technology in Japan* and *Sengo Nihon no Gijutsu Keisei: Mohō kara Sōzō e (The Formation of Technology in Postwar Japan: From Imitation to Creation)*, edited by Tetsuro Nakao-ka. The innovative and engineering activities of corporate engineers in postwar Japan were, however, not sufficiently covered in these volumes. More scholarly research needs to be done on this all-important theme in the history of technology in postwar Japan.

Lastly, it is noted that all the Japanese names cited throughout this volume are ordered as the personal name first, the family name second, contrary to the original order of Japanese names.

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Acknowledgments

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