Science and Technology in Modern Japanese Development

In those countries that have most recently attained the modern stage of economic development, science and technology have usually been introduced by the public sector and transferred to the private sector when they have become productive. The Japanese experience in the late nineteenth century was typical and one of the earliest examples of this process. In the process of transferring a technology to the private sector, there are critical points at which it must be determined whether imported science and technology will become established in the private sector and flourish in an indigenous, self-perpetuating form, or whether their continued importation into the public sector will be necessary.

The next question is who was instrumental in initiating and transplanting science and technology and who supported this effort. I will discuss this in terms of the following tentative model: First, there must have been a group of native people who could become professional scientists and engineers, and who could act as leaders in the mass education of the people and in material construction. Next, the level of basic education must have been substantially raised from that of a nondeveloped economy for a successful transfer to occur; a modern state needs scientific manpower at all levels of society. Finally, in this process social mobility begins and class differences tend to diminish. Modern science and technology is then diffused and rooted among the populace, and its traditions become perpetuated.

The achievement of these three steps may be the major factor differentiating the countries that are to become technological from those that must experience an ever-increasing technological gap.

We must also consider that the degree of success in the transfer depends to a great extent on the kind of technology chosen. To find the conditions for successful transplantation, we shall examine several selected technologies of entirely different types, some imported and some autochthonous.

EARLY EFFORTS, 1868–85

The Utilitarian Image of Science

It is a common belief among historians of Western science that in premodern times science and technology were distinct activities with different social origins. In spite of the effort made by the Encyclopaedists to liquidate this social interface, the dual structure of science and technology was still maintained, even in
the nineteenth century, by socially separated groups. This was exemplified by such institutional separations as that between the German university and the polytechnical college. However, there was no particular reason for the mid-nineteenth-century Japanese to distinguish between science and technology when facing the impact of the modern West. To the Japanese it appeared that modern science and modern technology grew in a single Western tradition. It was not the science-versus-technology dichotomy but, rather, the traditional-versus-Western dichotomy with which the Japanese were seriously concerned.*

While science in nineteenth-century Europe was still in the main a cultural activity rather than a practical means of achieving economic growth, as is well illustrated by the issue of the theory of evolution, the Japanese image of science in the late nineteenth century was quite modern. It was exclusively utilitarian and pragmatic, planned for national interests if not purely for profit-making, specialized and compartmentalized. Emphasis was on physical and applied science rather than on biological, and hence the style was closest, for that period, to contemporary scientific technology.

* Until the 1880s the Japanese language did not distinguish clearly between ‘science’ and ‘technology’. The separation between the concepts became real only towards the close of the century, when autonomous scientific communities were formed at the university-faculty level.

The Institutionalization of Science

After the Meiji Restoration of 1868, the Japanese response to Western science was dramatically transformed. In the preceding Tokugawa period, Western science was initiated and advocated mainly by scholars in the private sector. Only in the last period of Tokugawa rule were official training institutes for Western naval technology and related sciences opened at Nagasaki and elsewhere. Being hard-pressed by the urgent defence needs of the country, the administration lacked the foresight to build institutions providing modern, systematic education in science and technology. During the first two or three years (1868–70) of the new Meiji government, there was still an influential group that wanted a faithful restoration of the ancient imperial system of government; but the modernist leadership soon followed the policy of Westernization. Scientific education was completely institutionalized. It became firmly programmed in such a way that an institution was first created, and then European and American scientific and technical specialists were invited to meet selected Japanese students within the institution. Outstanding graduates were sent abroad for further study.1

Guidelines for Westernization

In the draft rules for sending students to study abroad, prepared in 1870, the following subjects and preferred countries of study are listed:2

Britain: machinery, geology and mining, steelmaking, architecture, shipbuilding, cattle farming, commerce, poor-relief
France: zoology and botany, astronomy, mathematics, physics, chemistry, architecture, law, international relations, promotion of public welfare

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