

total transportation capacity of these two modes of transportation. Such transportation policy is criticized as having given rise to the ill-advised hiking of railway fares and rates, the deterioration of JNR's quality of service and environmental disruption along roads caused by automobiles.

#### 4. TEXTILES

1. Development of textile machinery technology -- Tadashi Ishii
2. Technology and manpower in the cotton textiles industry -- Takeo Izumi
3. Technology transfer in the cotton textiles industry -- Kozaburo Kato
4. The growth of spinning mills and vertical integration: a comparative study -- Shin'ichi Yonekawa
5. The diffusion of new technologies in the sericulture industry -- Yukihiro Kiyokawa

According to the paper by Ishii, there are three major categories of machinery and equipment in the textile industry: silk-reeling machinery, spinning machinery, and weaving machinery. Ishii traces the introduction of these three categories of machinery into Japan and their subsequent improvement and development. The author also gives a clear picture of the circumstances of the introduction of new technology into Japan and how it was linked to traditional technology.

There was no basic difference between modern technology and traditional technology as far as silk-reeling machinery was concerned. Nevertheless, such machinery was imported in order to put out products with a high degree of value added, as required by the European market. A state-run model factory was established at Tomioka for that purpose. That factory subsequently became a facility for retraining factory girls from throughout the country, who took back with them their newly acquired skills. The new machinery was an imitation of the Western machinery built upon the indigenous technology, thus making it easier for makers to produce and diffuse nationwide. However, since the necessary level of technology was low, and since the limitation of modern machines and production was possible even at very small town factories, the production of silk-reeling machinery did not contribute to the development of the machine industry as did weaving machinery.

In the case of spinning machinery, on the other hand, there was a wide gap between the new machinery and traditional machinery in terms of productivity, and there was no continuity between the old and the new machines. This being the case, from the outset (for instance, from the start of production by the Osaka Cotton Spinning Company in 1883), there was a complete dependence on imported steam-driven machinery and on

imported cotton as well. (In this connection, the traditional Japanese cotton-growing areas were hard hit by the use of imported cotton; see the relevant paper by the small industry study group.) For this reason, the research and development efforts of these factories were confined entirely to cotton blending, with the result that it took a very long time for the machinery in this field to be manufactured domestically. Japanese exports of such machinery did not exceed imports until the end of the 1930s.

The situation with respect to weaving machinery lay somewhere in between that of silk-reeling machinery and that of spinning machinery. Initially, broad-width metal power looms were imported, constituting the main machinery of the large weaving factories controlled by spinning interests. At the same time Jacquard and batten (fly shuttle) technology was introduced, and spread among the smaller weaving operations, eventually coming to constitute the core of Japanese weaving technology. Since traditionally Japanese woven cloth was narrow-width, the newly introduced technology was used to develop wood-and-metal narrow-width power looms, with only later the manufacture of metal narrow-width and metal broad-width power looms. Such a development was made possible by the fact that there was no overwhelming productivity gap between the new and the old machinery, unlike the case of spinning machinery. Also, the products from the intermediate stages of the development of such machinery corresponded to actual market needs. That development of the Japanese weaving machinery technology led subsequently to the Toyoda automatic loom and from there to the development of new technology in the fields of machine tools, motor vehicles, etc.

In order for the newly introduced technology to take root in Japan and then to further develop on its own, it was necessary that there be continuity between it and the traditional technology and no great gap in productivity between them. It was also necessary that there be the intermediate technology and demand for the products manufactured on the basis of the new technology.

In his paper, Izumi discusses the process of the transition from steam to electricity as the source of power (starting around the 1910s) and the technical training that was provided the technicians and workers who were responsible for the consequent increase in productivity. Whereas, as we have already noted, developing cotton-blending technology represented the main efforts in the spinning sector, in the weaving sector Toyoda and other types of automatic looms developed and were manufactured domestically. These looms eventually stopped the import of foreign looms and even made inroads abroad. For example, Toyoda sold the patent rights to the British loom-maker Platt Brothers and Co.

Furthermore, the weavers who used such machinery to full advantage were highly skilled by the Japanese standards of those days. This was made possible by the various types of training provided by the companies,

training centres, and schools. Such efforts corresponded to the thorough rationalization efforts that were made in the cotton spinning industry with the aim of establishing monopolies.

Such rationalization efforts included the early introduction of Taylor's scientific management system and motion studies, which resulted in the establishment of standard motions, thereby making possible a rise in labour productivity because each factory girl was able to handle more machines than before. These efforts required greater motivation, too, on the part of workers.

Kato discusses in detail how a transplanted type of cotton spinning industry won out over the traditional Japanese cotton spinning industry with the successful operations of the Osaka Cotton Spinning Company. Since the transplanted type of cotton spinning industry, as represented by the Osaka Cotton Spinning Company, relied entirely on imported raw cotton, it had strong ties with trading companies. It was able to develop cotton-blending techniques based on the selection and use of raw cotton from throughout the world at prices and in quantities necessary and suitable for international competition.

Yonekawa makes a comparative study of the differences between the main cotton spinning countries during the introduction of modern spinning mills, stating that in the United Kingdom, which led the field in this area, there were many spinning companies with independent mills. In the case of the United States, there was vertical integration except in New England. The managing agency system was dominant in India and there was an even more highly integrated state of oligopoly in Japan than in the United States.

Finally, Kiyokawa discusses in detail the process of the improvement of silkworm varieties and their diffusion. It is pointed out that the initial stage of such improvement was carried out mainly by experimental stations in the provinces and by silkworm egg producers. An important role was played in the diffusion stage by such large silk thread producers as Katakura as well as by the graduates of sericulture training facilities throughout the country.

## 5. SMALL INDUSTRY

1. Salient features of Japanese small industries -- Johzen Takeuchi
2. The shell button industry -- Johzen Takeuchi
3. The brush industry -- Johzen Takeuchi
4. The hosiery industry -- Johzen Takeuchi
5. The bicycle industry -- Johzen Takeuchi
6. Industrialization and labour-intensive industries -- Johzen Takeuchi