JAPANESE EXPERIENCE

No. 2 October, 1979

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HISTORICAL BACKGROUND OF TECHNOLOGY TRANSFER, TRANSFORMATION, AND DEVELOPMENT IN JAPAN

EXCERPTS FROM THE ANNUAL REPORT FOR THE YEAR 1978

by

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I. INTRODUCTION

1. The research activities of the Japanese Experience Project for the year 1978 constituted the first phase of a five-year research period. The major objective of our project is to examine the self-reliant process of development with respect to technology transfer, transformation, and development that Japan has experienced, taking full account of the various development problems that the developing countries face today. The first-phase research activities were carried out exclusively by Japanese scholars whose reference area is Japan. Questions concerning the various aspects of transfer of Japanese technology to the developing countries are to be taken up at a later stage with the collaboration of institutions and scholars of the developing countries.

2. More than twenty papers are being published as the fruit of this first phase of the project. These reports are not presented as conclusive statements but rather are intended to introduce the Japanese experience into a channel of dialogue and academic interaction among those concerned with development issues, by providing materials to be examined at various levels and in various directions. The responses given and questions raised in this dialogue will help shape the work of the advanced phases of the project.

3. After participating in many meetings, symposia, and conferences in connection with the Human and Social Development Programme and also reading the sub-project reports, we have increasingly realized that there may exist a considerable gap between the general understanding of the prospective readers in the third world on modern Japanese history and the contents of reports of each sub-project, and supplementary discussion on what has been assumed by most Japanese scholars seems necessary to make the sub-project reports readable. The present report, therefore, is an abridged version of a background paper, based on the Co-ordinator's own understanding and interpretation of modern Japanese history, depending entirely on the past accumulation of knowledge on the subject in Japan. For the sake of simplicity and readability references and quotations are omitted; these will be systematically arranged at the end of the project period.

II. BEFORE AND AFTER THE MEIJI RESTORATION

1. Arrival of the Kurofune

4. In September 1868 the Japanese government system changed after a period of turmoil of enormous scale that had lasted for more than ten years. The Tokugawa Shogunate had remained in power for about two and a half centuries, controlling 270 feudal clans under a solid centralized administrative system. The Tokugawa Shogunate also monopolized trade by prohibiting the subordinate feudal clans from engaging in trade activities with the outside. This prohibition was aimed at restraining the accumulation of military power by the clans and furthermore at checking the inflow of religion and ideas that might be used for anti-Tokugawa movements.

5. On the other hand, such policies helped to strengthen political integration and to establish a nation-wide market economy in accordance with the development of local industries and cultures corresponding to the status-hierarchy system formulated during the Tokugawa period (in which the classes, ranked in order from top to bottom, were: warriors, farmers, artisans, and merchants). Thus, the basic form of Japanese culture as we recognized it today can be said to have been shaped during the Tokugawa period.

6. Toward the end of the Tokugawa regime, the development of the market economy had enhanced the economic power of merchants and traders to the extent that their power could no more be controlled by the authority. The economy of the feudal clans was being maintained and activated by these merchants, and the economic status of the lower ranking warriors was already as low as that of commoners and craftsmen.

7. The crucial impact came from outside Japan in the arrival of the *Kurofune* ("black ships") in 1853. The commander-in-chief of the East Indian fleet of the United States of America, Matthew C. Perry, came to Japan with a message from the President of the United States asking for the opening of a port.

8. Since the regime knew the strength of military power of the European countries from China's defeat in the Opium War (1840–42), the arrival of the *Kurofune* put the Tokugawa Shogunate in dread of military power of the foreign countries. Moreover, ship-building technology had been almost lost by that time because of the prohibition against constructing big ships.

9. The Tokugawa Shogunate had to lift the policy of seclusionism because there was a great possibility, according to the then American consul in Japan, Townsend Harris, of Japan's suffering a similar fate to that of China if the country remained close. Harris advocated the conclusion of the Treaty of Amity and Commerce as the only way to save Japan from the threat of England and France, since it would become a duty for the United States of America to regulate any actions taken by England and France if the treaty was concluded.

10. A Treaty of Amity and Commerce was concluded between Japan and the United States of America, in 1854 and similar treaties were concluded also with England, France, Holland, and Russia.

2. Advocacy of Imperial Rule and Exclusionism

11. The warrior class was furious with the submission of the Tokugawa regime to the military overpower of the foreign countries. This gave the momentum for the discontented elements to take action against the regime. Criticism of the Shogunate, in the form of objecting to the opening of a port, sprang up from the economically powerful feudal clans located in the western parts of Japan which had been ill-treated by the Tokugawa family.

12. In the course of the protest movement, the discontented warriors who were critical of the conclusion of treaties with foreign powers by the Tokugawa regime gradually turned their eyes to the existence of the Emperor, who was the only person to legitimize the action taken by the Shogunate. Here, they

found their way out, preserving their own class interests by overthrowing the Tokugawa family and at the same time extricating the country from the critical situation.

13. The Emperor did not have any practical power in politics and administration, yet took part in the decision-making process in a nominal way. In other words, no decision was finalized without the Emperor's consent. The anti-Tokugawa group took advantage of this situation and started accusing the regime of not going through due formalities. Thus, the anti-Tokugawa group, justifying their movement by politicizing the Emperor, gradually developed an ideology advocating the Emperor's rule on the one hand and exclusionism on the other.

14. The powerful Satsuma and Choshu clans, the most radical advocates of the exclusion of foreign powers, were attacked twice (in 1863 and 1864) by the British fleet and the combined fleets of four countries. Smashed by these attacks, both clans gave up the idea of exclusionism and devoted themselves to opposing the Tokugawa family and advocating imperial rule.

15. In October 1867, having foreseen the gloomy future of the regime and recognizing the deterioration of military power, Yoshinobu Tokugawa, the fifteenth Shogun, decided to resign and give up his authority as the highest executive of the nation to the Emperor. This is what is known as the Meiji Restoration.

3. Unequal Treaties

16. Around 1863, when the zeal of exclusionism was at its peak, nearly twenty foreign warships were always stationed in Yokohama port. After penalizing the exclusionism of the Satsuma and Choshu clans, the foreign powers demanded the right to construct a military station in Yokohama. The Japanese government had to provide 66,000 square metres of land and bore all expense required for constructing and maintaining the governor-general's residence, barracks, hospital, powder magazine, etc. In 1869 there were three thousand British soldiers stationed there and a somewhat smaller number of French.

17. In addition to the military station claiming extraterritoriality, the foreign powers did not allow Japan to have autonomy on customs. According to the treaty concluded in 1854, import duties ranged from 5 to 10 per cent of the imported value; this became 5 per cent flat rate in the Edo Treaty concluded in 1866. As a result of this unequal treaty, Japan suffered from excessive imports, drain of specie, damage to local textile industries, and distortion of the industrial structure. The new government continually asked the foreign powers to modify this unequal treaty. However, they refused to do so, demanding, instead, the opening up of additional ports and criticizing the ban on Christian missionary activities in Japan.

18. In such circumstances, such Meiji leaders as H. Itoh and T. Ohkubo gradually became convinced that strong military power was essential to remain self-reliant in international political dynamics, and that a powerful economy was a prerequisite for strong military power. This was the lesson that the Meiji élite derived from the aggressive attitudes of the foreign powers. And this realization led to a national development target which advocated strengthening military power and increasing the wealth of the nation by industrial development.

19. The national development target or basic strategy for nation-building took the form of developing export-oriented industries and import-substituting industries, particularly the ones related to military affairs. In this we can see the early signs of Japanese militarism.

III. CIVILIZATION AND ENLIGHTENMENT

1. Westernization

20. As we have discussed, the principle of "free trade," which brought undue benefits to foreign countries, was accomplished through the unequal treaties

aided by military power. In 1871 the then Premier Sanjo said that modernization of the legal systems and customary laws which were incompatible with those of the Western countries might be the only way for Japan to alter the situation regulated by the unequal treaties. Westernization as a target of modernization was thus set forth. In this connection, a survey mission consisting of political leaders was sent to Europe and the United States of America.

21. The deputy leader of the mission, H. Itoh, admitted the superiority of Western societies in every aspect and strongly advocated the necessity of transplanting Western civilization in order to upgrade Japanese society to the level of Western societies. The official report of the mission stated that the wealth of England was originally based on advantages in her mineral resource endowment; then she was successful in increasing business capacity by the invention of ships, railways, steam generated from fire heat, etc. She monopolized the textile industry and navigation and came to command over the world.

22. The importance of the textile industry and heavy industries—especially iron and steel, shipbuilding, and mining—pointed out by the mission report was channeled into the industrial policy of Japan thereafter.

23. To come back to the problems of unequal treaties, we have to note that it was in 1899, when Japan had gone through her industrial revolution, that extraterritoriality was abolished and autonomy in tariffs was restored.

2. Three Major Reforms

24. Many reforms were introduced by the new government, among which the reforms of the education system, the draft system, and the revenue system are the most important ones to consider when we examine the modernization of Japan.

(i) The Education System

25. The proposed reform of the education system was to give compulsory education to children above the age of six by founding 53,760 primary schools, 256 middle schools, and 8 universities. However, administrative reforms such as the replacement of the clan system by the prefectural one and the creation of the Ministry of Education (1871) were necessary before this plan could be implemented.

26. A statement of the then Premier made it explicit that the purpose of education was for the individual pupils to explore their potentiality, and so it should be regarded as a productive asset for all. The textbook used initially in the primary schools was a translation of the Wilson Reader from the United States of America. Therefore, it clearly would need to be revised sooner or later so as to meet the needs of the nation. And, in fact, it was revised in 1879 and 1886. However, it should be noted that the basic idea behind the revision, as indicated in a statement by Arinori Mori, the then Minister of Education, was to shift the emphasis from education as a way of exploring the potentiality of the individual to education as a means of achieving the national development target mentioned already.

27. This shift of emphasis was perhaps an expression of the reaction of the Meiji élite to the difficult situation in and out of Japan; the civil war (anti-new regime) of 1878, the rise of the democratic movement demanding mass participation in politics, the establishment of the constitution, and the opening of the diet system. In other words, it was imperative for the new regime to establish itself and to stabilize and develop the country at the earliest possible time. Education was one of the means to achieve this objective.

28. In spite of this change in principle, primary school education was diffused all over the country, and teachers' colleges to supply primary school teachers were established in each prefecture under the new education system. However, a heavy financial burden for the construction of primary school buildings in rural areas was borne by local people in the form of local taxes and donations. Moreover, tuitions and fees were so high

that the majority of farmers could not afford them. The rate of enrollment was as low as 30 per cent in 1877. In addition to the financial burden, farmers could not afford to spare important working hands. In some places farmers revolted against the enforcement of this compulsory education system. Generally speaking, however, the illiteracy rate decreased rapidly with the spread of education within a short period of time, and this was accelerated following the development of industries after 1890.

(ii) The Conscription Law

29. The Ministry of the Army proclaimed the conscription law in 1872. This was a corollary of the abolition of the status-hierarchy system, in which the warrior class had been responsible for defense and warfare. With the abolition of this system, the role that had been played by the warrior class became every man's duty regardless of his former status and occupation. It was reasoned that the defense of a country was analogous to protecting oneself from trouble.

30. The abolition of the status-hierarchy system gave the momentum for the military service to be modernized and democratized. Yet the re-organized system was based on compulsory conscription, not on voluntary enlistment. Of course, even under compulsory conscription there were clauses providing for exemptions and postponements. Among those who were eligible for these clauses were the physically disabled, criminals, bureaucrats, students in national colleges, students studying abroad, professionals such as medical doctors, heads of families (or their proxies), and those who paid 270 yen as a substitute. Consequently, the healthy male population of farm households except for the head or heir became the main source of the national Army. It is clearly suggested that the government's intention behind this conscription policy was to fill the conscription quotas on the one hand and to secure qualified manpower and maintain the family system on the other.

31. As mentioned, those who paid 270 yen were exempted from the military draft. This was one way of raising funds for maintaining the Army. Here we can see the evidence of plutocratic influence in the Japanese Army. Nevertheless, the conscription system could not achieve its initial objective because of these exemption clauses. In fact, the figures in 1876 tell us that 80,000 out of 0.3 million potential candidates were eligible for these exemption clauses and the government could draft barely 14–15 thousand men every year.

32. One reason for the unpopularity of the Japanese Army was the fact that most of the commissioned officers and non-commissioned officers were members of the former warrior class and, therefore, the class structure of feudal society was brought into the Army. The reflection of the class-consciousness of feudal times in the rank-oriented structure of the Army created an inhumane structure and psychology in which the lower-ranking soldiers from non-warrior classes were always victimized. The unpopularity of the Army continued despite the national development target except for the period after the victory of the Sino-Japanese and Russo-Japanese wars. The Japanese Army, however, was able to attract brilliant young men from middle-class families because they were exempt from tuition and fees at military schools, as at normal schools. And these young men became leaders of the modernized army.

(iii) Revenue Reform

33. The revenue reform introduced by the Meiji government was the most important and crucial aspect of the modernization process. The major source of revenue under the new regime, as in feudal times, was land revenue. In feudal times, however, this had not been a stable source of revenue; it was to be paid in kind, and the amount collected fluctuated substantially, depending on the harvest.

34. The new government introduced a revenue settlement over a period of six years (1873–79) in which the land revenue was to be paid in cash. The revenue rate was fixed at 3 per cent of the land value specified in a title-deed. The actual revenue burden at this rate, together with the local village tax

amounted to as much as 34 per cent of the gross produce, which was almost equal to the burden in feudal times. Although farmers' discontent was great, the government could raise a stable fund for industrial development and the strengthening of military power free from market fluctuations and crop conditions. Here again we can see the decisive role played by the agricultural sector in the process of the modernization of Japan.

35. The effect within the agricultural sector of the revenue settlement was the progress of peasant disintegration, which was in practice accelerated by the change of revenue payment from kind to cash and the prolonged low price of rice. In this process, on one hand, wealthy farmers and landlords emerged, who accumulated land and then started investing their surplus in the non-agricultural sector; and, on the other, potential migrants to the urban industrial centres such as tenants and petty part-owners were created.

IV. ENHANCEMENT OF PRODUCTIVE CAPACITY AND INDUSTRIAL DEVELOPMENT

1. Industrial Development and Foreign Technology

36. It is misleading to state that modern Western science and technology began to be introduced in Japan after the Meiji Restoration. They were known already in feudal times. However, the main emphasis in those days was placed on the introduction of military science and technology. Although the Meiji government continued to import Western military science and technology, one notable difference was that the introduction of science and technology for non-military purposes increased substantially. Another difference is that the introduction of science and technology during the feudal period was in the form of the import of finished goods, while after the Meiji Restoration efforts to reproduce imported technology began to be made. This copying process started with learning the operation, repair, and maintenance of imported machines, for instance, and gradually went on to manufacturing similar ones appropriate for the country.

37. It took a long process of trial and error to learn to reproduce imported finished goods and machinery. For example, an attempt to manufacture textile machines was made in the government machine tool factory, but it resulted in complete failure. On the other hand, efforts to manufacture locomotives were successful. The first railway service was opened between Tokyo and Yokohama via Shinagawa in 1872. Upon the arrival of locomotives designed by Japanese engineers and manufactured in the United States of America, one of them was disassembled immediately after delivery and a similar one was manufactured in 1893. Since the private sector could not afford to take the risk of such venture, government factories had to take the initiative.

38. Industrialization in Japan developed primarily in reaction against the military intimidation by foreign powers, which was directly linked to the economic menace. Therefore, the process of industrialization began with shipbuilding first, then iron and steel manufacturing and mining, unlike in Europe, where the reverse order was typical. The Meiji élite had to face all sorts of difficulties arising from this reverse process of industrial development. It was around the 1890s that Japan reached the stage of industrial revolution, and it was completed with the indemnity from the Sino-Japanese War (1894–95).

39. The second stage of industrialization, starting in the 1910s, was characterized by the establishment of an integrated full-scale operation in iron and steel mills; self-sufficiency in the production of iron, cement, and glass; independence of heavy industries and the chemical industry; and electricity as the major source of energy.

40. The Meiji government established the Ministry of Industry in 1885. This

ministry allocated 3 million yen as a fund for development. Of the 54 per cent of this amount spent during 1873–76, 80 per cent was allocated to the construction of railways and the government mines. The remainder was spent on heavy industries such as shipyards, telecommunications, etc. The pattern of allocation of government funds would provide useful materials for examining the problems of technology transfer in the process of economic development.

2. Five Cases of Technology Transfer

41. According to a historian of scientific technology, there are three areas in which foreign technology was effectively introduced in the Meiji period: the Mint in Osaka (1871), the Tomioka Silk Mill in Gunma Prefecture (1872), and railway construction between Tokyo and Yokohama (1872). However, we would give a brief account on the five cases of technology transfer; production of coinage, railway construction, iron and steel manufacturing, cotton and silk textile industries, and shell button industry.

(i) *Production of Coinage*

42. After a close examination of foreign currencies, it became clear that each coin was strictly standardized in terms of size and quality. From this fact, the government came to realize that the introduction of foreign technology was inevitable.

43. The process of coinage was divided into two parts: a chemical process and a machine process. The technology for the latter process was relatively easy to acquire, but the former process required a basic knowledge of chemistry and metallurgy. However, the technology applied in manufacturing cannon during the late Tokugawa period was of great help in this respect. At the same time, the traditional technology chasing swords and helmets played an important role in designing and chasing the new currency. In this way the new currency, standardized in quality and difficult to copy, began to be produced at home.

44. The government efforts to produce specie at home activated the metal-mining industry. Production of gold, silver, and copper increased with the introduction of new technology, particularly the process which made it possible to collect metal out of refuse. Labor productivity increased drastically with the mechanization of drainage and transportation. Imported technologies in these areas were far superior to the indigenous ones.

45. With regard to mineral resources, the Meiji government inherited the direct control system over the development of mineral resources from the feudal regime. In 1873 the government passed the Mining Act, which prevented foreigners from owning mines and from becoming mine workers. C. Netto, who was invited by the government to run the government-operated Kosaka Mine and later contributed greatly to the spread of mining and metallurgy in Japan while he taught at the Univesrity of Tokyo, also reluctantly admitted the reasons behind the Mining Act of 1873. He was of the opinion that the urgent and easy way to develop mines was to employ foreign experts. However, he was also aware that Japan might become involved in difficult diplomatic problems arising from the influx of less-expensive Chinese laborers if the development of mines were commissioned to foreign hands.

46. While we are considering the subject of specie, it is worth pointing out that the metric and decimal systems were adopted by the government in 1871 when the mint was established in Osaka. It goes without saying that the impact of the metric and decimal systems went beyond the problems of specie, weights, and measures.

(ii) *Construction of Railway*

47. The initial policy of the government toward railway construction and management was that the government would be responsible for the main lines and the private sector for local lines. However, this plan did not materialize because of financial constraints. Some parts of the trunk line were constructed by private companies and later bought up by the government.

48. As far as the development of road transportation is concerned, the central government designed the overall plan and the expense of actual construction was

borne by the local governments. This was basically in line with the policy that had been adopted by the feudal clans. It was in contrast to the case of the railway, in which the concession for railway construction between Edo (Tokyo) and Yokohama had been given to Portman, a member of the American consulate, just before the end of the Tokugawa period.

49. The location of the main railway lines was a controversial issue. The army leaders preferred the central part of Japan on political and defense grounds. However, the final decision was in favor of coastal area along the Pacific Ocean. Transportation problems that the government faced during the civil war of 1878 had an effect on this decision.

50. Although the construction of main lines was aimed at meeting the demand arising from industrial development, it was primarily motivated by political and military requirements. Therefore, the army participated in designing the timetable for railway transportation, and the consideration of profit and loss was out of the matter.

(iii) *Iron and Steel Manufacturing*

51. The Meiji government wanted to build warships at home. This was analogous to the target set by the Tokugawa regime of manufacturing cannon at home. It may not be too much to say that this was the objective of industrialization in the Meiji period. Warship-building required modern science and technology. Development of iron and steel was imperative for this purpose.

52. In 1880 the government established an iron and steel mill at Kamaishi, in the eastern part of Japan, when the small-scale textile industries equipped with 2,000 spindles were being set up in various places. Opinion was divided between an English engineer and T. Oshima, the responsible person on the Japanese side, on such issues as the location of the plant, routes of transporting iron ore, the method of procurement of water and fuel, and above all the working conditions of laborers. The government adopted the plan proposed by the English engineer. However, the mill had to be closed six months after the initial kindling of a furnace due to accidents such as fire and coagulation.

53. Twenty years later (1901) the Yawata Iron and Steel Mill set up by the government went into operation with the technical collaboration of Germany. Again, it ran into trouble one year after its inaugural kindling, mainly because of a design mistake; the plant, modeled after German ones, was not suited to the iron ore and fuel available in Japan. The problem was solved by the import of suitable raw materials from China. A lesson to be learned from this example is that mere transfer of advanced technology and its replication lead us nowhere.

54. In any case, the Yawata Iron and Steel Mill finally found its way and developed to the extent that iron and steel were produced in an integrated production system. However, like other heavy industries in Japan, the raw materials were imported from abroad and the only asset this industry had was skilled manpower and technical know-how. Thus the Yawata Mill was successful from a technical point of view, but, economically speaking, it took more than ten years before it could produce a profit. The increase in demand known as "iron hunger" caused by World War I made this possible. The slogan "Iron is the base for nation-building" supported and encouraged engineers to stand for the long process of trial and error in this industry. Yet it should be noted at the same time that the Yawata Iron and Steel Mill could survive for a long time without making a profit and ignoring people's protest against pollution since, after all, it was a government-operated enterprise.

(iv) *Silk and Cotton Textile Industries*

55. Silk and cotton mills were the leading sectors in the first half of the history of industrialization in Japan. Silk production was recognized as an export industry and cotton production as an import-substitution industry. Cotton cloth had become popular for common people in place of flax, but the consumption of silk was confined to a limited circle. The major producing areas of cotton were the western parts of Japan, while silk was produced mainly in the eastern parts.

56. Silk was the most important earner of foreign currencies. Silk-reeling technology in Japan lagged behind that of China, but it could capture the international market for the following reasons: first, the stagnation of silk production in China because of the Taiping Rebellion (1851–64); second, the spread of corpuscle disease in France, the major producing area in Europe; and, third, the cheap price of Japanese silk, which was almost one half the international price.

57. The author of *Tomioka Diary*, E. Wada, was the daughter of a village headman in Matsushiro, Nagano Prefecture, who was sent to the Tomioka Silk Mill together with sixteen other girls. She was then 15 years old. After working a little more than a year at Tomioka, she came back to her native town and became a technical leader of the newly established silk mill there. According to her observation, the equipment and buildings of the newly established mill at Matsushiro were inferior to those of the mill at Tomioka: wood was used in place of copper, iron, and brass; wire was substituted for glass; and brick floors became earth floors. Though these capital-saving modifications were made to take into account the capital-bearing capacity of the local people, silk was produced fairly well. And those who adhered to the indigenous technology had to face the reality that the silk produced in these poorly equipped mills was sold to the foreign buyers at a handsome price. The Tomioka Silk Mill went bankrupt as a result of the establishment of these capital-saving mills in various parts of Japan, but its historical role should be evaluated.

58. In connection with the Tomioka Silk Mill, there is one thing to be noted. The initial success of Tomioka was attributable to the fact that the managers of this mill learned a lesson from the case of failure of a mill located at Maebashi, 40 kilometres north of Tomioka. The main cause of failure was that people resisted learning from foreign experts and hated to introduce a new mode of production because there was no division of labor between sericulture and silk reeling in this town, and the control of wholesale dealers was strong enough to block the introduction of any new system. These two cases suggest to us the importance of channels and agents of technology transfer: the wrong combination of these two invites cultural as well as economic tensions. Generally speaking, how to disaggregate the whole production process (sericulture, silk reeling, weaving, dyeing) economically and where to mechanize ultimately determine the direction of technology transfer. Cotton spinning was no exception.

59. As far as the cotton textile industry is concerned, the disaggregation of the production process (cotton growing, spinning, weaving) was made before the Meiji period. Since this disaggregation took the form of a regional division of labor (i.e., one region specializes in one part of the process), introduction of foreign technology did not bring cultural conflicts. The only problem here was the competition with the less-expensive imported cotton products.

60. Cotton was one of the important cash crops in Japan. Therefore, the development of the cotton textile industry and its competitiveness were of grave concern to the cotton growers. The government planned to establish small-scale cotton mills (2,000 spindles) in various places after a successful trial in the government-operated mill. For this purpose, the government decided to dispose of ten plants imported from England to the private sector, the cost of which was payable on a ten-year installment basis. No interest was charged.

61. The result was far from satisfactory, since two thirds of these mills went bankrupt within ten years' time. The reasons for this poor performance can be listed as follows: First, 2,000 spindles were too few to run the mills economically. Second, the water-wheels used as a source of power were unable to operate efficiently when rice transplanting started or during the summer, when water became scarce. Third, there was a shortage of skilled workers and technical staff and a lack of capital to employ foreign experts, and the supply of raw material was not sufficient in quantity or quality

to run the mills at full capacity.

62. Cotton mills became viable only with the imported modern plant designed to achieve scale of economy. Electric lighting, though quite expensive in those days, began to be used, greatly reducing the risk of fire and also making possible the introduction of the two-shift system learned from India.

(v) *Small-Scale Industry—a Case of Shell Button*

63. In these large-scale cotton mills, Indian cotton began to be used in place of Japanese cotton, which resulted in a disastrous effect on the cotton-growing areas in the western parts of Japan. These areas, however, turned out to be the places where rural-based small-scale industries producing such items as brushes, shell buttons, lenses, etc. had developed.

64. The first modern factory to produce shell buttons was founded by a foreign merchant at Kobe City. Those who learned the technique at this factory were successful in disaggregating the production process into more than ten parts. These disaggregated parts were simplified further to the extent that they could be transplanted to rural areas. These disaggregated parts were developed into rural industries employing the capital-saving and labor-intensive methods, and these industries provided part-time employment opportunities for rural people. The modern factory went into bankruptcy with the development of these rural-based industries which had close linkages with wholesale dealers in urban areas.

3. Characteristics of Labor Management System

65. In both textile industries and small- and medium-scale industries, the majority of workers were daughters of poor rural households. In those days Japanese agriculture was characterized by a deteriorating land/man ratio, exposure to the impact of international economy, mono-culture of rice, and destitution of the rural economy.* Many of these female workers suffered from various diseases, particularly tuberculosis, due to the hard and long hours of labor under inferior working conditions.

66. The twenty years of industrial history in Japan beginning from the end of the nineteenth century were full of tragic stories about these young female laborers. The textile industries, both silk reeling and cotton spinning, began to suffer from a shortage of labor, particularly skilled labor, which enhanced the competition of recruitment among factories. The increase in the cost of recruitment and advance payment and the shortage of skilled workers intensified the degree of watch and restraint over the female workers. Dormitories and compulsory-savings systems were instituted and popularized as preventive measures against desertion. The savings of those who left a job before the end of the contracted term were confiscated. Efforts for the retention and recruitment of workers took different forms in large-scale and small-scale mills: improvement of welfare facilities in the former case and intrigue and violence in the latter.

67. The permanent-employment system in Japan came to be formulated by the 1930s, when the country entered the second phase of "civilization and enlightenment" and the policy to enrich the nation by industrial development. It was motivated by the necessity of retaining capable technicians and craftsmen and of coping with the rise of the labor movement led by leftists. Some may find here a reversion to the quasi-family-type relationship in the management system in Japan. The permanent-employment system has functioned in two ways to date. One has been to create a competitive situation within the enterprise in terms of loyalty and promotion by introducing the job-ranking system. The other

* The destitution of farmers was reflected in the frequent occurrence of tenant disputes. The agricultural policy of the government had been to foster owner farmers, but the tenant disputes forced the government to pass the Tenancy Adjustment Law in 1924. Enforcement of this law was practically borne by the Officer of Peasant Affairs stationed in each prefecture. Successful implementation of the post-war land reform was partly attributable to the detailed records kept by these officers.

has been to direct trade unions' efforts toward pressing managerial staffs hard with respect to their ability to run the business on a sound basis, rather than to promote horizontal linkages with other unions of similar occupational category.

68. The seniority system in wage payment popular in Japanese enterprises is one in which loyalty and contribution to the enterprise are basically measured by the length of career. This has the advantage of securing a livelihood for all employees, but an individual's skill or talent tends to be evaluated relatively low under this system. It is important to note that this system was supported by the trade unions during the periods of inflation immediately after the war and of the high economic growth starting from the mid-1950s.

4. Appropriateness—Technology, Commodities, and Market

69. It is important for human and social development not to apply foreign technology naively, but to make it appropriate carefully. Technology can be made appropriate if it is used to produce appropriate commodities and can find appropriate markets. Let us illustrate with an example.

70. One of our collaborators, A. Tamaki has pointed out that land was excessively developed compared to the availability of irrigation water in the late seventeenth and early eighteenth century. The only frontier left for Japan in the Meiji period was Hokkaido. The development officers of the Meiji government relied on the advice of foreign experts. They recommended the introduction of North American-type agriculture, with the development of dairy farming and cultivation of potatoes. It appeared to be a reasonable proposal, suited to the ecological conditions of Hokkaido, and in fact it proved to be successful in some places. However, ironically enough, such success did not come from the application of North American but of Danish-type farming.

71. It is interesting to notice that, in parallel with the long and desperate efforts to naturalize the Danish-type agriculture, the settled farmers in Hokkaido also persistently tried to grow rice in this semi-arctic region. Efforts to improve seed were continuously made by farmers, universities, and the government experiment stations. Hokkaido today is the largest rice-growing area in Japan.

72. As the farmers were aware by experience, the length of daylight required for rice growing was longer than mainland Japan. A more important reason for the farmers to grow rice was that the satisfaction obtainable from rice was much greater than from wheat. It is a recent finding by nutritionists that the calories obtained from rice produced per unit of land is twice as high as from wheat. The adherence of the farmers to rice cultivation was thus proved to be rational. I do not know how the development officers and foreign experts in those days would react to the present-day rice cultivation in Hokkaido. However, what should be stressed here is the fact that the farmers in Hokkaido have kept on growing rice despite the fact that the labor input required for rice cultivation was three times as much as for wheat.

TECHNOLOGY TRANSFER, TRANSFORMATION, AND DEVELOPMENT: THE JAPANESE EXPERIENCE

PROGRESS REPORT January 1 – June 30, 1979

I. CHARACTER OF THE PROJECT ACTIVITIES IN 1979

The J. E. Project has entered into the second phase of its activities in 1979. A brief outline of the activities for the year 1979 and their characteristics will be given as follows.

1. *Consortium Formation Activities*

The fresh efforts will be made to restore the position of the consortium formation activities up to the level originally envisaged. Major activities will be to collect information concerning the ongoing as well as completed research projects together with the scholars concerned of the developing countries. One of the tangible outcomes of these efforts will be to publish a bibliography on "*Economic Development and Technology in Japan*" which will contain books, articles and papers on the subject written in foreign languages. This is expected to articulate the subject area that the J. E. Project is dealing with and also serve the purpose of opening the avenues toward future research collaboration with the scholars concerned of the various countries.

2. *Research Activities*

1) In view of the fact that the main emphasis of the research activities in the first phase was placed on an introductory inquiry in each subject, the major efforts of the second phase will be made on promoting in-depth, more specific and original research centering around the analysis of "hard technology" as proposed in the five-year research schedule (see our Newsletter, "*Japanese Experience*" No. 1).

2) After one year's experience, each sub-project is now ready to geer its research efforts into more crucial areas and periods in line with the main objective of the Project. This has become possible, to our judgements, through the academic dialogue and interaction among collaborate scholars in different sub-projects in the process of research, and by way of responding to the comments and reflections on our Project expressed by the experts in and out of the United Nations University in various forms.

3) As we have already pointed out in our *Administration Report* submitted last year (Dec. 25, 1978), it has become increasingly clear that the collaborate scholars to our Project need more insights and experiences concerning the various problems that the developing countries face today. It seems to be highly productive for them to have an opportunity to witness these problems with their own eyes. We are convinced that the benefits accrue from this arrangement would well exceed the cost involved in it.

4) Two plans are under serious consideration in this connection. One is to hold a joint meeting in some developing countries (e.g. India) with the closely related Projects under the Human and Social Development Programme to discuss the problems associated with research and related activities for further improvements and for intensifying a horizontal linkage among sister Projects. It is desirable and highly beneficial for the sub-project leaders of our Project to participate in the meeting to promote communication among those who share common interests and also to have an opportunity to face with the development issues directly.

5) The other plan is to hold an international symposium in Tokyo where the problems of technology transfer, transformation and development will be discussed by the experts from seven Asian countries, our collaborate scholars, and other experts within the country. This would provide a valuable opportunity especially for our collaborate scholars to discuss the subjects of their own inter ests with the scholars of the developing countries. The Proceedings of this symposium will form a supplement to the *Annual Report of 1979*.

II. MAJOR AREAS OF INQUIRY IN EACH SUB-PROJECT

1. *Technology and Urban Society*

This year the emphasis will be placed on the inquiry into the problems of industrial area developed between Tokyo and Yokohama and the resultant problems of housing. Concurrently, however, the relationship between a local city (Kanazawa) and the metropolice (Tokyo) will be studied, and such problems as urban riots and/or mass violence occured in Kanazawa (our research base for studying the urban problems in local city) will also be taken up for an inquiry.

2. *Technology and Rural Society*

We have studied the relationship between irrigation technology and rural society taking the case of canal irrigation system in the Azusa basin, Nagano Prefecture last year. An attempt will be made this year to examine the relationship between reservoir irrigation system and rural society taking the case of Hyogo Prefecture where approximately 54,000 reservoirs are being used for irrigation system. In this case study, two types of reservoir irrigation will be examined; the first type is the reservoir which is linked with canal system, and the other is the reservoir depending its water supply entirely on the natural streams. It is also planned to conduct a resurvey of farm management in the former case where one of the sub-project member had done an intensive field survey in 1956.

3. *Iron and Steel Industries*

This study group will take up two major issues this year. The first one is to examine the formative process of manpower and skilled labor, particularly the nucleus technicians. The second one is to study the case of technology transfer from Japan to the outside. The case of technology transfer to Malaya during the pre-war period will be examined this year.

4. *Development of the Transportation System*

This sub-project will deal with three areas of transportation system. The first area is the development of the urban transportation system in which the collaboration and interaction with the members of Technology and Urban Society are expected. The second area is the development of the local transportation system. The third area is the development of railway transportation system in which the major efforts will be made to review the technological aspects of its development.

5. *Textile Industry*

After the introductory inquiry in the first phase, the focus of an inquiry in the second phase will be more specific: 1) comparative study on management and finance in the cases of Japan, India, England, and the United States of America; 2) improvement and dissemination of technology in silk yarn production—comparative analysis of Japan and China; and 3) interaction between textile industry and textile machines manufacturing industries in Japan.

6. *Small-Scale Industries*

We have examined the problems associated with the technology transfer in the cases of shell buttom and optical lense manufacturing industries last year. Two industries will be taken up this year; bicycle and watch manufacturing industries both of which are known for their complicated production systems. An attempt will be made to have a joint collaboration with two study groups; one is the sub-project dealing with the development of Niigata Prefecture and the other is the joint research project organized by the Institute dealing with the problems of linkage between small-scale industries and rural areas in Pakistan.

7. *Mining Industries*

This sub-project is divided into two study groups dealing with coal mining and metal mining. The former group will take up this year the coal mines in Hokkaido and examine the relationship between technological development and organizational problems, particularly the organization of labor. The second group will attempt at examining the differences between metal mining industries under

the public sector and the private sector.

8. *Area Studies*

The area selected this year for the study of regional or area development is Niigata Prefecture. Beside being the rice growing area of Northern Japan, Niigata is famous for the small scale industries manufacturing tableware and ironware. The focus of this year, therefore, will be on the role of these small-scale local industries in the regional development. In this respect, two towns in Niigata Prefecture, Tsubame and Sanjo, will be studied. The former specializes in the tableware manufacturing primarily for export, while the latter produces ironware mainly for the domestic markets.

III. SUMMARY OF ACTIVITIES AS OF JUNE 30, 1979

Both consortium formation and research activities of our Project are being carried out without much difficulties. The followings are some of the indicators to show the magnitude of our activities.

(1)	Number of collaborate institutions.	31
(2)	Number of collaborate scholars.	47
(3)	Number of sub-project meeting held.	15
(4)	Number of field survey conducted.	6
(5)	Advisory Committee Meeting held.	1
(6)	Planning and Co-ordinating Meeting held.	1
(7)	Publications and documents collected.	69
(8)	Publications and documents donated.	70

(9) Newsletter No. 2 will be issued in July and No. 3 in August. English version [*Japanese Experience*] will be issued at the end of September, 1979.

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No. 2
The NEWSLETTER is published by
THE UNU PROJECT TEAM
INSTITUTE OF DEVELOPING ECONOMIES
42 ICHIGAYA-HOMMURA-CHO
SHINJUKU-KU TOKYO-162 JAPAN

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