



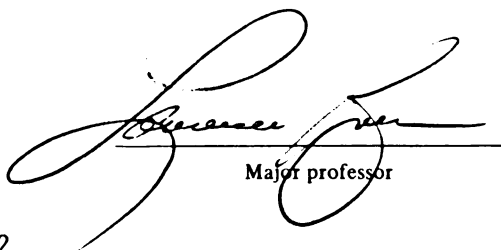
This is to certify that the
thesis entitled
**Science and Society: The Case of
Agricultural Science in Japan**

presented by

Keiko Tanaka

has been accepted towards fulfillment
of the requirements for

Master's degree in Sociology



Major professor

Date November 17, 1992



PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.

| DATE DUE | DATE DUE | DATE DUE |
|-------------|----------|----------|
| FEB 01 1995 | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

MSU Is An Affirmative Action/Equal Opportunity Institution

c:\circ\datedue.pm3-p.1

SCIENCE AND SOCIETY: THE CASE OF AGRICULTURAL SCIENCE IN JAPAN.

By

Keiko Tanaka

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Sociology

1992

ABSTRACT

SCIENCE AND SOCIETY: THE CASE OF AGRICULTURAL SCIENCE IN JAPAN.

By

Keiko Tanaka

This project concerns the intersection of Western science and technology and Japanese society in the period between 1858 and 1912. It particularly focuses on the processes and impact of transforming Japan's agricultural sector based on Western science and technology. In short, agricultural science is used as a case study to develop a strategic understanding of the role of "imported" knowledge in Japanese society at large through its various transformation (e.g., institutions, policies, actors, values, and networks).

The uniqueness and success of Japan's modernization lies in the fact that, by creating a highly centralized political system, the Meiji Government seized full control of and acted as the coordinator of the development of agricultural science. And, this case has useful implications for many developing nations whose governments tend to have very little control over the modernization process.

Copyright by
KEIKO TANAKA
1992

To Yōsuke and Kazuko Tanaka for their unfailing love and support.

ACKNOWLEDGEMENTS

For graduate students, the masters thesis is the first critical hurdle to overcome. I owe special thanks to many individuals who helped me complete this work. My greatest intellectual debt is to Lawrence Busch, who inspired me to begin this research. Without his encouragement, this work would not have been the same. George Axinn, Christopher Vanderpool, and Raymond Jussaume provided me with many useful insights. I would also like to thank my colleagues for their guidance and discussions that enriched my graduate career, including Valerie Gunter, Lai-Si Tsui, Tim Koponen, and Mike Skladany. Kawamura Yoshio and Noda Kimio made invaluable contributions during the data collection period in Japan. I am also grateful to my husband, Douglas Holbrook, who kept his patience and faith in me. Finally, I would like to express my appreciation to my parents to whom I dedicate this thesis. Without their support over the years, I would not have been able to stay in school in this country.

TABLE OF CONTENT

| | |
|---|------|
| LIST OF TABLES | viii |
| LIST OF FIGURES | ix |
| CHAPTER 1: INTRODUCTION | 1 |
| I. SCOPE OF THIS STUDY | 2 |
| II. GOALS OF THIS STUDY | 3 |
| III. WHY AGRICULTURE? WHY SCIENCE? | 5 |
| IV. ORGANIZATION OF THIS WORK | 7 |
| CHAPTER 2: GEOGRAPHICAL AND HISTORICAL SETTING | 10 |
| I. GEOGRAPHY | 10 |
| II. FOREIGN CONTACTS | 16 |
| III. MEIJI ISHIN MOVEMENT | 22 |
| CHAPTER 3: THEORETICAL FRAMEWORK AND METHODS | 32 |
| I. INTRODUCTION | 32 |
| II. SCIENCE AS A SOCIAL NETWORK | 33 |
| III. RESEARCH METHODS | 41 |
| CHAPTER 4: JAPAN'S MODERNIZATION STRATEGIES | 48 |
| I. INTRODUCTION | 48 |
| II. <u>IWAKURA SHISETSU-DAN</u> (IWAKURA MISSION) | 49 |
| III. <u>OYATOI GAIJIN</u> (FOREIGN EMPLOYEES) | 56 |
| IV. <u>RYUGAKU-SEI</u> (OVERSEAS STUDENTS) | 69 |
| V. INDIGENOUS KNOWLEDGE | 81 |
| VI. CONCLUSION | 91 |

| | |
|---|-----|
| CHAPTER 5: INSTITUTIONAL ANALYSIS OF AGRICULTURAL SCIENCE | 93 |
| I. INTRODUCTION | 93 |
| II. REVISION OF THE LAND TAX (<u>CHISO KAISEI</u>) | 95 |
| III. BUREAUCRACY | 104 |
| IV. EDUCATION/RESEARCH INSTITUTIONS | 117 |
| V. FARMERS' ORGANIZATIONS | 138 |
| VI. THE INDUSTRIAL SECTOR | 148 |
| VII. CONCLUSION | 158 |
| CHAPTER 6: CONCLUSION | 159 |
| I. INTRODUCTION | 159 |
| II. FOUR MODERNIZATION STRATEGIES | 159 |
| III. INSTITUTIONAL DEVELOPMENT | 165 |
| IV. CONCEPTION OF SCIENCE | 170 |
| V. A CASE STUDY -- AGRICULTURAL SCIENCE IN JAPAN | 174 |
| APPENDICES | |
| A. The Charter Oath of Five Articles (1868) | 177 |
| B. Selected Members of the Iwakura Mission | 178 |
| C. Chronological Summary of Agricultural Development during the Meiji Period | 179 |
| D. Curricula at the Komaba Agricultural College | 191 |
| E. Curriculum of Sapporo School of Agriculture, March 1877 | 193 |
| F. Types of Agricultural Schools according to the 1883 Regulation | 195 |
| G. Types of Agricultural Middle Schools according to the 1899 Regulation | 196 |
| BIBLIOGRAPHY | 197 |

LIST OF TABLES

| | |
|--|-----|
| 4.1. Public Foreign Employees, 1868-1900 | 59 |
| 4.2. PhD Holders with Experience in Overseas Studies, 1892 | 80 |
| 5.1. Distribution of Farm Households by Farm Size (%) | 103 |
| 5.2. Graduates from the Komaba Agricultural School, or later, Tokyo School of Agriculture and Forestry, 1880-1890 | 123 |
| 5.3. Comparison of Employment of 97 Komaba Graduates, as of 1891 and 1901 | 124 |
| 5.4. Graduates from the Sapporo Agricultural School, 1880-1889 . . . | 126 |
| 5.5. Employments of Sapporo Graduates as of 1911 | 127 |
| 5.6. Changes in the Number of the <u>Nokai</u> Members, 1881-94 | 142 |

LIST OF FIGURES

| | |
|---|-----|
| 2.1. Six Climate Zones in Japan | 14 |
| 2.2. Six Types of Climate in Japan | 15 |
| 4.1. Public Foreign Employees, Five Year Totals of Person-Years by Area of Government, 1868-1900 | 60 |
| 4.2. Overseas Students by Country of Destination | 72 |
| 4.3. Number of Students Sent Abroad by the Ministry of Education, 1875-1912 | 73 |
| 4.4. Number of Students Sent Abroad by the Ministry of Education, 1875-1897 | 75 |
| 4.5. Number of Overseas Students in Agriculture, 1895-1912 | 77 |
| 5.1. Land Tax, 1888-1912 | 99 |
| 5.2. Educational System of 1900 for Agricultural Studies | 130 |
| 5.3. Agricultural Middle School v.s. Agricultural Continuation School | 132 |
| 5.4. Numbers of Four Types of Industrial Cooperative Associations . | 147 |
| 5.5. Number of Factories, 1868-1900 | 151 |
| 5.6. Amount of Capital in Each Productive Sector, 1881-1890 | 152 |
| 6.1. Four Modernization Strategies | 162 |
| 6.2. Dismissal of Foreign Employees and the Returned Overseas Students | 164 |
| 6.3. Network of Agriculture During the Tokugawa Period | 166 |
| 6.4. Network of Agricultural Science During the Meiji Period . . . | 169 |

CHAPTER 1: INTRODUCTION

The industrial development of Japan since its defeat in World War II has been remarkable. No one denies that Japan has become an economic superpower in the last two decades equaling, or even surpassing in some areas, the U.S. and European nations. However, very few Westerners realize that "Japan's miracle" was not merely the result of the rapid and intensive industrialization during the postwar period, but the fruit of a 100-year effort to industrialize and modernize the nation that finally surfaced during the 1960s.

The arrival of Commodore Matthew Perry at Uraga Bay on July 8, 1853 marked a focal point in the transition to modern Japanese history -- the history of its successful transformation into a highly technologically advanced nation. Moreover, signing the Harris Treaty and later other treaties with industrial nations from the West after 215 years of the sakoku policy¹, was the first step for Japan in the modernization process. The period between 1853 and 1912 -- from the fall of the Tokugawa Bakufu²

¹ The sakoku policy (national seclusion policy) began in 1639, and prohibited foreign trade except with the Netherlands, Korea, and Ming China at authorized ports -- Nagasaki and Hirato. Its purpose appeared on the surface a part of the Bakufu's anti-Christianity policies issued since 1587. The real purpose of the sakoku was establishment of the Bakufu's monopoly on trade with the Netherlands and of the Bakuhan feudal system.

² The title "Shōgun" was given to the head man of a warrior family (e.g., the Tokugawa family, the Mori family, the Date family, etc.) as the emperor's military deputy. The Tokugawa family's administration at Edo (Tokugawa Bakufu or Edo Bakufu) remained the de facto government of Japan until the Meiji Restoration of 1868. Although the emperor was the

to the end of the Meiji period -- is a crucial period for understanding Japan's modernization.

I. SCOPE OF THIS STUDY

The objective of this thesis is to examine the intersection of Western science and technology and Japanese society in the period between 1858 and 1912³. In order to achieve this goal, I will focus on one of the many seeds of Western science and technology which were transplanted to Japanese society in this period: agricultural science and technology.

The fundamental questions which will be asked in this project are: (1) How was agricultural science pursued in Japan in the course of modernization during the Meiji period? and (2) How did this knowledge change social relations? In other words, my concern here is to understand the historical interaction between agricultural science and technology and indigenous knowledge on the one hand, and the role of agricultural development in Japan's industrialization on the other, in particular

authority of the Shōgun's administration, the emperor himself was practically a prisoner in his palace in Kyoto. The system of Tokugawa Bakufu administration was referred to as centralized feudalism where feudal lords (daimyo) throughout the country were classified in terms of their relationship to the Tokugawa family. Each feudal lord was allotted the land in koku by the Tokugawa according to his achievement. Although the lord was absolute master of his territory and relatively free from Tokugawa's interference, he was required to spend half his time in Edo, leaving members of his family there as hostages when he returned back to his province. This system of "alternative attendance" (or sankin kōtai) was fundamental to the maintenance of Tokugawa's political authority. See Hunter (1984) and Beasley (1989) for a clear and comprehensive summary of the term in English.

³ During the period between June 19 and September 3, 1858, Japan signed trade treaties with the U.S., England, France, the Netherlands, and Russia. The Meiji period ended in 1912 at the death of the Meiji emperor (Mutsuhito Tennō, the 122nd emperor of Japan), two years prior to the First World War.

social contexts during the Meiji period. Therefore, in order to answer the first question, I will examine first the emergence of various actors who were involved in the development of agricultural science, and second, the social process (e.g., negotiation, persuasion, and coercion) which took place among the actors in the network. For the second question, I will focus on the institutional development which affected agricultural science (e.g., legislation, bureaucracy, farmers' organizations, and various new systems which emerged as industrialization proceeded), and on contributions of this social network of agricultural science to Japan's conception of science.

II. GOALS OF THIS STUDY

From this project, I hope to achieve two goals. The first is a better understanding of the process and mechanism of political and economic development based on agriculture. There are many implications of Japan's experience for developing nations, especially around the issues of coordination and management of modernization strategies. The development process of many Third World nations is currently either manipulated by advanced nations for their benefit, and/or is emasculated by a totalitarian government to increase its power.

Japan's success lies in the fact that the Meiji government assumed the total responsibility for providing human and financial resources necessary for the nation's modernization. The government deliberately minimized influences and pressures from the advanced nations in its efforts to transform an agrarian into a industrial society by limiting the flow of foreign investment and the authority given to foreign advisers of the government (Takahashi, 1969). Members of the samurai class, who lost

their jobs at the abolition of the feudal fief system, were granted stipends by the government for starting new lives as "civilians." The School System Law was enacted within five years after the Restoration to provide education and training to the general population⁴. Therefore, unlike many cases in developing countries, leaders in the government made a strong commitment in guiding the transformation of society rather than feathering their own nest.

The second goal of this project is to increase awareness in the West of Japan's history as an agricultural society. Japan's recent achievement in the world market has helped to draw Westerners' attention to the nation's heritage. Yet, their interest has been limited to aspects of industrial and modern Japan, not of agricultural and ancient or pre-modern society. This is reflected in a long and intense debate over Japan's restrictions on imports of specific agricultural commodities, especially rice from the U.S., that has not reached any compromise.

We know Japan as the best customer for agricultural commodities exported from the West. Yet, strangely enough, few realize the fact that Japan produces agricultural commodities, and that the government spends a large amount for R&D in agriculture (Anderson, 1984; Latour, 1987). This lack of understanding of Japanese agriculture among Westerners stems from the fact that few books on the subject have ever been published in English or other Western languages.

I will be grateful if this thesis contributes toward a greater recognition of Japanese agricultural traditions in the West.

⁴ See Chapter 5 for a discussion of the increase in the rate of children attending elementary school from 1873 to 1912.

III. WHY AGRICULTURE? WHY SCIENCE?

It has often been ignored that Japan's modernization during the Meiji period rested on its agricultural development. After the abolition of the Tokugawa Bakuhān system, the new government's primary financial sources were the land tax⁵ collected from landowners and the export of agricultural commodities⁶. Moreover, many farmers who lost their land moved to the industrial sector for their livelihood, providing human resources for newly built factories. The agricultural sector also provided raw materials for light industry such as food processing, cotton, and silk. Therefore, the development of the agricultural sector during this period is important to understand Japan's successful transformation to an industrial nation.

The Meiji government learned from various reports prepared by those returned from diplomatic missions⁷ in its early days that "science and technology" was the key to strengthening the nation's economy and military

⁵ Before the Restoration, most of the land was owned by daimyō or Bakufu who collected the annual tribute in the form of crops (especially rice). After the Restoration, the government centralized the taxation system with a cash payment of 3% of the monetary value of the land. Further discussion on the land tax and the land tax reform is included in Chapter 5.

⁶ Of total exports (¥15.6 million) during the period between 1868 and 1872, raw material including foodstuffs made up 54.2% (¥8.4 million) and raw silk made up 40.2% (¥6.2 million) (Takahashi, 1969). Their importance in total exports, especially foodstuffs, declined significantly during the Meiji and Taishō periods.

⁷ The most well-known reports are the Iwakura mission (1871-73) report (Tokumei Zenken Taishi: Beiō Kairan Jikki, published in 1878) and the report on the Vienna International Exposition (1873) by Sano Tsunetami (Minister of Agriculture and Commerce, 14 July 1892 - 8 August 1892). Although it was not a diplomatic mission, G. Wagner's report on the First National Industrial Exhibition (1877) was also very influential on the legislation for improvement of agriculture. See Furushima and Saitō (1978) for the detail.

(Bartholomew, 1989; Nakayama, 1974; Tuge, 1961; Watanabe, 1985; Yuasa, 1965). Agriculture was no exception (Furushima & Saitō, 1978; Kashiwa, 1964; Saitō, 1968). The government implemented Western science and technology by the employment of foreign instructors at newly established agricultural schools and research stations, and by the dispatch of students abroad to study agricultural science and technology at colleges or universities. Members of official missions to the West brought back farming machines and tools, exotic seed, and livestock. In short, unlike in Europe where modern science and technology was gradually developed and influenced the transformation of national economic activities, Japan actively sought ways to modernize the nation in a short period by importing science and technology from the West and replacing traditional with Western knowledge.

However, this attempt ended in failure, particularly in the agricultural sector. It was because of "a failure to recognize how specifically situated agricultural science is" (Kloppenburg, 1991:520). Instead, the government began to search for "alternative sources of knowledge production for agriculture," and found them in the experiences and expertise of farmers (Kloppenburg, 1991:520). Therefore, Japan's experience in agricultural development illustrates, first, how modernization was pursued through strengthening the agricultural sector, and second, how science and indigenous knowledge interacted among various actors in a network that developed in the process.

IV. ORGANIZATION OF THIS WORK

A. Language

Foreign words are underlined. Except a small number of Japanese words used often in English (e.g., samurai, Bakufu, Meiji, Taishō), names of persons and places, Japanese words are romanized in accordance with the modified Hepburn system as used in Kenkyūsha's New School Japanese-English Dictionary (Tokyo, 1968). Long vowels are indicated by the use of macrons (e.g., ā, ī, ū, ē, and ō). However, this rule is also omitted in the case of a few well-used Japanese words in English (e.g., Tokyo, Kyoto, Osaka). Moreover, Japanese names are given in the order of the family name proceeding given name, such as Iwakura Tomomi, Kido Takayoshi, and Ōkubo Toshimichi.

When the sex of a subject is unknown (e.g., a farmer, an instructor, a governmental official), I use throughout "he" rather than "he/she" to note that the Japanese females during the Meiji period were excluded from the public sphere. Japanese women were legally restricted from participating in political activities and owning private property. Such organizations as Nōkai prohibited women from membership. Since so few women gained graduate degrees in science, it is accurate to assume that no females taught in the agricultural schools.

B. Organization

This thesis consists of six chapters. Background information on Japanese agriculture and history are given in the second chapter. In the third chapter, I lay out the theoretical framework and methods used for this study. I will use the example of the agricultural network that developed during the Meiji period to argue that science is social

knowledge constructed through the process of negotiation, persuasion, and coercion among various actors in a network. On the discussion of methods, I will emphasize the need for more studies on Japanese agriculture and agricultural science and technology recorded in Western languages to increase understanding of Japan's political and economic structure and policy issues surrounding international trade.

The fourth and fifth chapters focus on the two issues noted earlier: (1) Japan's modernization strategies using science (Chapter 4), and (2) institutional development induced by the importation of Western science (Chapter 5). In the fourth chapter, the following four modernization strategies are examined: (1) the Iwakura mission as an example of an official mission to the West, (2) employment of foreigners, (3) dispatch of students abroad, and (4) the use of indigenous knowledge. Through these strategies, key actors emerged to form the agricultural network as bureaucracies (the central government, the Ministry of Agriculture and Commerce, and local governments), scientists (agricultural schools and experiment stations), farmers (landlords and tenants), processors of agricultural commodities (food, cotton, and silk), and merchants (both domestic and international).

In the fifth chapter, discussion concentrates on the formation of such institutions as the agricultural bureaucracy and education/research system, farmers' organizations, and light industry. I also examine in this chapter how social stratification evolved around land ownership and played an important role in the formation of the network.

In the concluding chapter, I discuss findings from this study to argue that science is the result of a complex social process among actors linked in a network. And, I address how agricultural science was

conceptualized in a particular fashion in Japan through the process of agricultural development and conclude that science is the result of a complex social process among actors linked in a network.

There are three major findings in this study. First, during the modernization process, using the four strategies discussed in Chapter 3, it was the Meiji government that played the central role in the emergence of and interaction among the four actors including the national and local governments, scientists, farmers, and light industry. Their roles were defined in a social network surrounding the agricultural sector through their interaction with other actors, particularly their relationship with the State government. Second, the transformation of the agricultural sector during this period shows clearly that Japan was able to preserve its political, economic, and social independence in the modernization process because it avoided the total westernization of every aspect of society. Third, Japan's translation of science and technology reflects unique ways in which the government controlled means of the development of agricultural science and interaction among the various institutions surrounding the agricultural sector that were established by these four actors in a particular historical setting.

CHAPTER 2: GEOGRAPHICAL AND HISTORICAL SETTING

The path which Japan took to develop a scientific community was rather different from the ones in Europe because of its different historical and environmental conditions. Why did Japan wait till the end of the Edo period to develop "scientific traditions"? What are some factors which connected science and Japanese society in a particular way during the transition from the Edo to Meiji period? I will stress the following as the three pivotal conditions that influenced how Japanese society related to Western science and technology: geography, foreign contacts, and the Meiji Ishin movement.

I. GEOGRAPHY

Japan is a nation of islands -- four main islands and 4,000 small ones¹ -- which extends 3,000 km (1,860 miles) from north to south (Nippon Steel Corporation, 1982). This geography of crescent-shape Japan has affected the development of agricultural science in many ways. Among them, I will particularly discuss about the following four points: (1) the island environment, (2) climate, (3) humidity, and (4) land size.

¹ The four main islands from north to south are Hokkaidō (78,522 km²), Honshū (231,039 km²), Shikoku (18,804 km²) and Kyūshū (44,388 km²) (Yano Tsuneta Memorial, 1984).

A. The Island Environment

In Europe, new information was constantly carried across borders by traders, travellers, and exiles as its market economy expanded. Printing technology along with the availability of translators and Latin as the language for scholars also allowed the wide and swift spread of knowledge. In this environment, scientific knowledge was not regarded as "adopted" from one nation to another since cultural integration took place in more subtle ways.

On the other hand, in Japan from the very early period, any cultural exchanges with foreign societies appeared to have rather drastic effects, and language barriers were hard to break. There were several such major flows of foreign culture that took place in Japanese history from (1) China between the third century B.C. and the late tenth century A.D. (e.g., rice agriculture, the Chinese writing system, various arts and crafts, Confucianism, and Buddhism), (2) Europe, especially Spain and Portugal, from 1543 and 1639 (e.g., Christianity, firearms and gunpowder, navigation techniques, astronomy, and shipbuilding techniques), and (3) Europe, especially England, France, and Germany, and the U.S. after 1853. Characteristics of Japan's foreign contacts in history are discussed below.

Moreover, communication among different locations even within Japan was very difficult before the development of modern communication and transportation technologies. It was Toyotomi Hideyoshi who achieved the unification of Japan in 1590. Hokkaidō became a part of Japan's territory in 1593 and Ryūkyū island was included in 1872.

Nevertheless, as Arnason (1988:241) points out, "the ethnic and cultural homogeneity" was developed in the island environment that made

"the project of unification [at the end of Tokugawa era] easier to realize and legitimize than the attempts to superimpose an imperial regime on the greater diversity of the West."

B. Climate

The second characteristic is particularly important in agricultural science. As Figure 2.1 shows, there are six different climate zones in Japan (Iinuma, 1981; Yano Tsuneta Memorial, 1984). Temperature and precipitation differ significantly among the six cities listed on Figure 2.2 (Teikoku Shoin Co., 1982:40). This diversity in climate from the sub-frigid to the sub-tropic zones has resulted in wide differences in crops, productivity, and practices as well as diet among locations.

For example, rice varieties which exist in Japan are the outcome of continuous modifications which have been made since the Yayoi period (300 B.C. - 300 A.D.) (Higuchi, 1986). Rice originally came from the tropical district of Asia, lying within 30° North and 15° South latitudes. Ogura (1970) points out that the world's rice cultivating countries in Southeast Asia have climates with an almost constant temperature throughout the year with a daily average of 25° to 28° C. Precipitation in Japan is also considerably less than in most of the rice growing countries. Moreover, the difference between the longest and the shortest day is larger in Japan than in Southeast Asian countries. Therefore, varieties of rice grown and rice cultivation methods used in Japan are considerably different from those in Southeast Asian countries (Ogura, 1970).

Before seed exchange societies were organized by veteran farmers in the mid 1880s, each region had its own unique variety of rice that was developed through continuous efforts among farmers for plant breeding

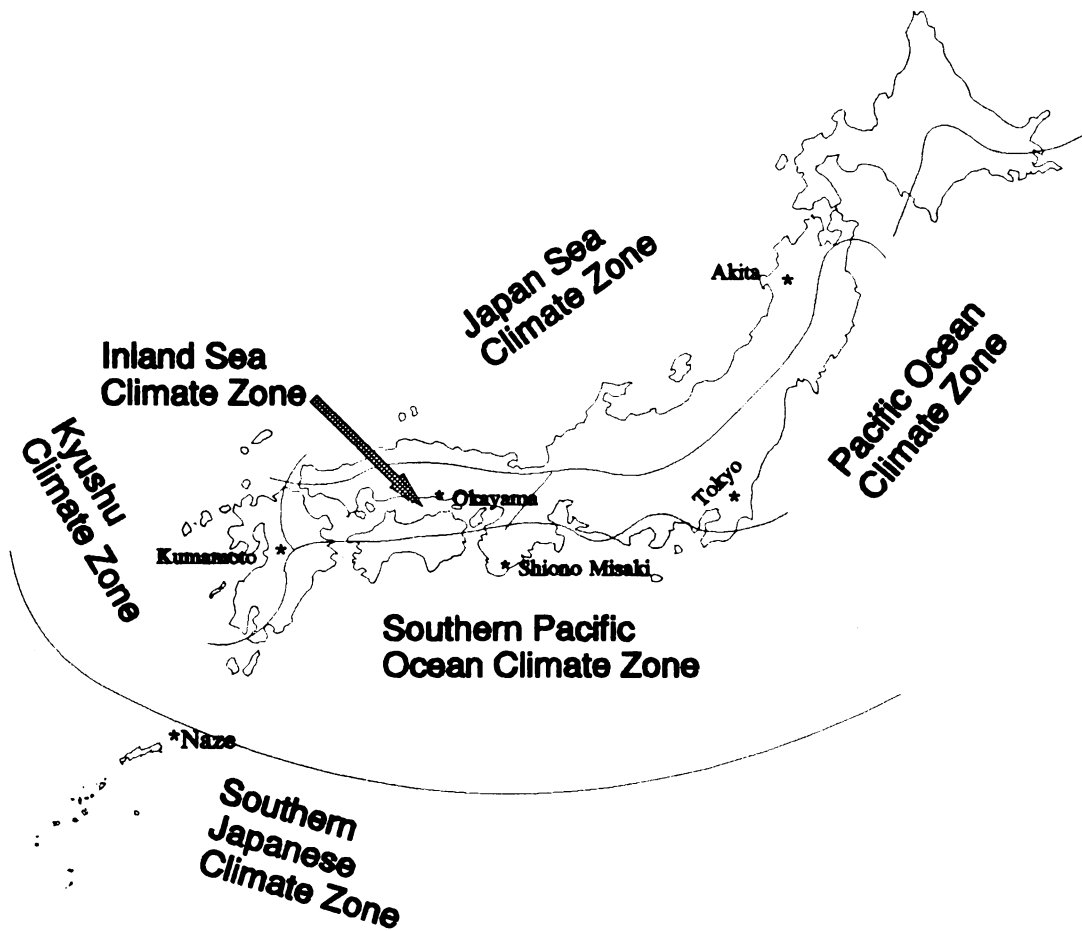
based on trial-and-error. A rice breeding program during the Meiji period emphasized development of cold-tolerant varieties which could be cultivated in Hokkaidō and northern parts of Honshū.

C. Humidity

According to Inuma (1981:29), using Martonne's humidity index², there are four humidity zones: (a) the annual humidity index (AHI) is less than 20 and the summer humidity index (SHI) is less than 5 (Zone I); (b) the AHI is over 20 and the SHI is less than 5 (Zone II); (c) the AHI less than 20 and the SHI is over 5 (Zone III); and (d) the AHI over 20 and the SHI is over 5 (Zone IV). Such northern European countries as France, England, the Netherlands, and Germany belong to the Zone IV, the same humidity zone as Japan, Korea, and other Southeast Asian countries. Yet, the agricultural practices differ significantly between these European countries and Southeast Asian countries.

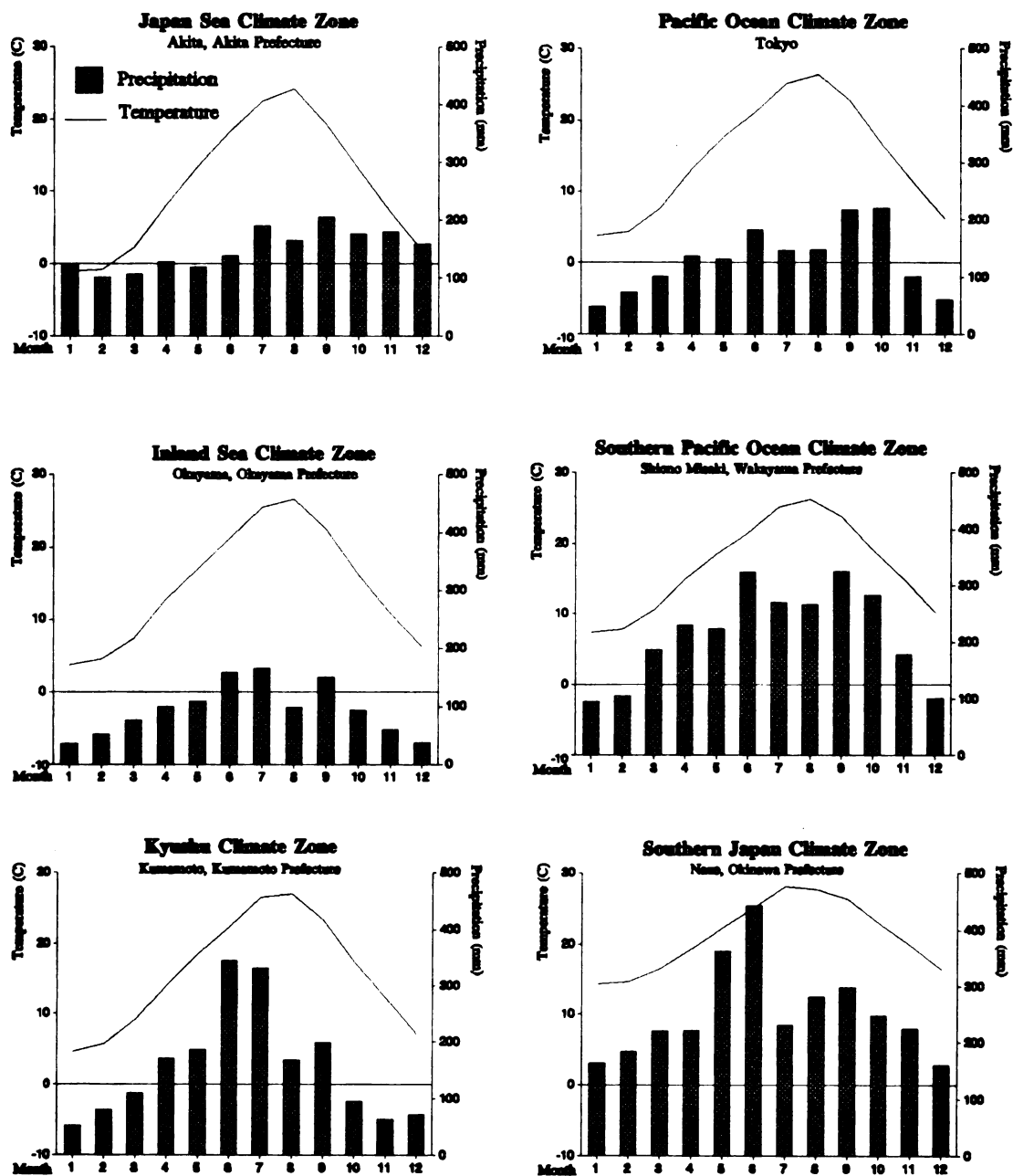
Although both districts belong to the same humid zone, the former is considerably more dry and cool during the summer than the latter. Thus, the northern European farmers do not need to weed their fields as often as Japanese or other Southeast Asian farmers. Instead, the European farmers let each plot of land lay fallow once in three years and plow fields deep in order to kill weeds. It was not until the industrial revolution period when the so-called Norfolk farming methods, including rotation of crops and hoeing up weeds after sowing, started to spread throughout England (Inuma, 1981).

² $I=R/(T+10)$, where I is "humidity index," R is the total precipitation in millimeters during a given period, and T is the average temperature during the same period. Summer includes June, July and August.



Source: Iinuma, 1981; Yano Tsuneta Memorial, 1984.

Figure 2.1. Six Climate Zones in Japan.



Source: Teikoku Shoin (ed.), 1982

Figure 1.2. Six Types of Climate in Japan.

D. Land Size

The last geographical factor that influenced Japanese agricultural practices is land size. About 67% of the total land area is mountains covered with forest, and only fifteen percent (5.5 million ha.) is used for agricultural purposes (Nippon Steel Corporation, 1982). Thus, the average cultivated area per farm household (1.18 ha.) is rather small compared with other nations.

These four geographic characteristics are important in examining Japan's modernization since one of the State's goals envisioned by early Meiji leaders was to establish more "uniformity" in living conditions among locations from north to south and to transform agriculture from small-scale to large-scale by using Western farming tools and machines (Kume, 1977 [1878]). The government succeeded in the former goal, but failed in the latter largely because it ignored important geographical characteristics of Japan that resulted in differences in farming practices from those of its European counterparts.

II. FOREIGN CONTACTS

There were several flows of foreign culture in Japanese history. However, two periods of massive cultural exchange with foreign nations (China and European countries) are of interest here. Moreover, to draw a contrast with the modernization period starting with Perry's visit to Japan, we will look at the period of sakoku.

A. Kentō-shi and Kenzui-shi

Japan's cultural exchanges with China and Korea began as early as 300 B.C. Rice and its cultivation techniques reached Japan from between the third and second century B.C. In the fourth and fifth century, the Chinese writing system, various arts and crafts, and more advanced agricultural methods were introduced via Korea. Confucianism was introduced in the early fifth century, Buddhism in the sixth century.

However, the most important cultural exchanges with China and Korea in Japan's early history were conducted through dispatches of a large number of envoys (e.g., students, priests, and scholars). These envoys to China in the Sui dynasty (589-618 A.D.) were called Kenzuishi (607-630 A.D.)³, and in the Tang dynasty (618-907 A.D.) Kentōshi (630-894 A.D.)⁴.

At the same time, the Japanese government invited many foreign teachers from China and Korea to advance the civilization. These efforts blossomed as Asuka Culture (552-645), Hakuhō Culture (645-710), and Tenpyō Culture (710-794). The level of science and technology also showed remarkable improvement as seen in the metallurgical technique used to build the Hōryūji Temple and the Great Statue of Buddha (16 meters in height). Yuasa (1965) points out that Japan surpassed the level of China

³ In 607, Onono Imoko was sent to the Sui Dynasty by Shōtoku Taishi, the prince who established the Seventeen Articles of Constitution in 604, along with several students and priests to study in China. In the following year, the Sui Dynasty sent Imoko back to Japan with a message from the Sui Emperor acknowledging Japan as an independent nation and its students and priests who taught Chinese culture and technology to the Japanese (Inoue, 1963).

⁴ In the period between 702 and 777, seven envoys were sent to the Tang Dynasty. Each envoy consisted of four ships with approximately four or five hundred members including diplomats, students, and sailors (Inoue, 1963). Because of difficulties in navigation, some of them, such as Abe Nakamaro, never returned home.

and India in scientific techniques of the time such as casting, gilding, dyeing, glassware making, etc.

These contacts with China and Korea indicate that the Japanese responded very readily to foreign culture:

On coming in contact with foreign culture, they went so far as to change completely the political and economic structures of their own country in order that they might be able to elevate the level of their culture while at the same time maintaining their own identity. (Yuasa, 1965:192)

B. Spain and Portugal (1543-1639)

The first European contact with Japan was recorded in 1543 when a Portuguese ship drifted ashore on the island of Tanegashima, south of Kyūshū during the period of warriors and civil wars. The Japanese learned about firearms and gunpowder from these Portuguese sailors. Merchants at such major ports as Sakai imported materials for the mass production of firearms and gunpowder. Within twenty years, Japanese blacksmiths mastered the skill of producing their own firearms and gunpowder. These Western weapons began to be used on the battlefield⁵.

The use of firearms on a battlefield affected not only battle strategies but also the development of castle towns (Inoue, 1963; Shōgakkan, 1965). Prior to the Age of Civil Wars (Sengoku Jidai, 1468-1582), a castle town was formed surrounding a castle of the domain family (ryōshu) as the residential area of retainers. With the introduction of firearms, commercial activities began to take place in the castle town where the ryōshu monopolized the production and dissemination of

⁵ When the Mori family attacked the Hakuroku Castle of the Amako family in 1563, among 44 casualties 33 were produced by firearms (Inoue, 1963).

commodities including firearms to its warriors in the castle town. Moreover, in order to prevent the peasant class and soldiers from rebelling with firearms, the blacksmith shops were concentrated in the castle towns.

Thereafter, traders and Catholic missionaries from Spain, Portugal, England, and the Netherlands frequently visited Japan with Western goods and culture that the Japanese had never encountered before. These countries exported their cotton, silk, leather, lead, and sugar, and imported silver, copper, iron, and sulfur from Japan.

Western science and technology was also imported from these European countries during this period. Improvements in ship-building and navigation techniques in Japan during this period was remarkable. For example, most of the ships that sailed between China and Japan during the fifteenth century were of about 100 tons. By the seventeenth century, they were between 200 and 300 tons. Some even reached 800 tons. Compasses, sea maps, and various astronomical equipment were frequently used by Japanese sailors. Hasekura Tsunenaga and others, vassals of Shōgun Date Masamune, crossed the Pacific Ocean to Mexico in the early seventeenth century (Inoue, 1963:275)⁶.

Yet, the Japanese government was afraid of the increasing interference of these Europeans with its political matters and of the strong influence of Catholicism upon the Japanese. In 1639, the Tokugawa

⁶ Hasekura was sent by Lord Date, who was ordered by Shōgun Ieyasu, to negotiate with the king of Spain about trade with Mexico (which was a Spanish territory at the time). On October 28, 1613, he and his 180 crew members left Japan on a Western style sailboat that was built by carpenters of the Tokugawa navy, and arrived in Mexico on January 25, 1614. This event took place 225 years before the famous travel by Katsu Kaishū who crossed the Pacific Ocean on a steamship, "Kanrin Maru," which was made in the Netherlands.

Bakufu prohibited any trade with foreign countries other than the Netherlands and China.

C. Sakoku Policy (1639-1853)

The sakoku, or national seclusion, policy of 1639 made Japan a society which maintained cultural and social isolation from others. This political isolation from the rest of the world during a period of rapid scientific development was the most critical handicap in the flow of new knowledge and materials that hindered the establishment of a strong scientific community.

Nevertheless, this period saw rather successful growth in medicine, mathematics and agriculture, and to a lesser extent astronomy, using knowledge brought from the only two countries that were allowed to trade with Japan: China and the Netherlands⁷. Medicine was useful; there was a strong demand for physicians. And, an accurate calendar was necessary for a society which greatly depended on rice production for its economy. Mathematics was developed outside the scholarly world and used widely for commercial transactions. Various improvements were made in agricultural equipment. Nevertheless, "[f]ear of Christianity" and European expansionism "restricted the growth of the physical sciences" (Bartholomew, 1989:26)⁸.

⁷ For a detailed discussion, see Bartholomew (1989), Murakami (1968), and Yabuuti (1965).

⁸ Prior to the National Seclusion Policy of 1639, Spanish and Portuguese missionaries introduced Western views of the physical world along with Christianity. This seems to have made the Tokugawa shogunate connect "physical science" with "Christianity."

Once prohibitions on imports of Western technical literature were relaxed by Shōgun Yoshimune in 1720, Tokugawa Bakufu controlled the diffusion of knowledge by establishing Bansho Wage Goyō (the Office for Translating Dutch Books) in 1811. Only those books which were appraised as "socially useful" were published and used at schools which were established by the Tokugawa Bakufu and daimyō domains (Bartholomew, 1989; Murakami, 1968).

It was in medical academies, especially those in Nagasaki, that the Japanese scientific movement originated since these institutions required students to learn such subjects as basic biology, chemistry, physics, botany, and those fields which related to medicine. Physicians' contributions to the evolution of science in the transition from the Edo to the Meiji period should not be underestimated (Yabuuti, 1965). By the late eighteenth century, much important progress in astronomy, physics and other technical subjects was made by physicians. The original Meiji scientists came from the Edo physicians and their sons. Indeed, it was "medical science" which prospered most between 1868 and 1920 producing many scientific researchers recognized worldwide such as Kitasato Shibasaburō, Shiga Kiyoshi, and Umeno Shinkichi.

Yuasa (1965:193) describes Japan as a "receiving country." Yet, contrary to his criticism, Japan did and does have a culture of its own. However, the flow of culture and knowledge was one way largely because both China and European countries looked down on Japan as a subordinate country. Thus, we can hardly find much evidence of the influence of Japanese culture on China and European countries except the fascination with Japanese art in Europe in the late 19th century.

China and India were delayed in modernization partly because pride in their own cultures convinced them that they had nothing to learn from the West (Kwok, 1965; Needham, 1954; Rosenstone, 1980; Yuasa, 1965; Watanabe, 1985). More importantly, from the seventeenth century onwards, Western capitalism devastated opportunities for China and India to modernize their nations.

It has been argued that their harsh physical surroundings (e.g., earthquakes, typhoons, volcanic activity, and tidal waves) have contributed to form more pragmatic and receptive attitudes toward their lives in general among the Japanese (Benedict, 1967; Higuchi, 1986). As Yuasa (1965) argues, this is one of the fundamental reasons why Meiji Japan succeeded in the assimilation of foreign culture.

Another reason for this success is that Japan had already begun a transformation towards capitalism on its own when Commodore Matthew Perry arrived at the Uraga Bay in 1853. We will examine the emergence of capitalist economy below.

III. MEIJI ISHIN MOVEMENT

The Meiji Ishin movement resulted in the collapse of Tokugawa feudalism and the establishment of a modern nation state based on oligarchic absolutism. Although debate surrounding its historical significance and revolutionary nature⁹ cannot be introduced in this project because of limited space, I will raise two issues that are important in understanding the transition from the Edo to Meiji

⁹See Inoue, 1968; Ishizuka, & Katō, 1962; Kanai, Sakai, & Naramoto, 1964; Naramoto, 1968; Tōyama, 1962 for this debate.

government, especially the modernization strategies pursued by the Meiji government.

A. The Peasant Class in the Edo Period

During the Tokugawa period, peasants produced rice and other goods largely for annual tributes to their feudal lords and for their own consumption. All the land legally belonged to the feudal lords and their vassals; peasants had only the right to cultivate land which they occupied.

The livelihood of peasants was controlled strictly by laws which forbade them to wear anything other than cotton clothes, to consume luxury items such as liquor, sweets, tofu and beans, or to build a house and furniture that were "not appropriate for the peasant class." There were also many restrictions placed upon farming: prohibition of selling and buying land, strict policies concerning dividing, mortgaging, granting, methods of cultivation, and selection of crops. In addition, peasants did not have the freedom to change occupation or to move from one village to another.

Social relationships in villages were hierarchically centered around the landholding system built on the extended family and servant labor (Fukutake, 1978; Smith, 1959). Rural living was based on "cooperative relations" in which peasants also shared communal fields and forests used for the advantage of the village as a whole. A village was a unit of economic and political activity including taxation. Each village paid tax in kind, most often rice and labor, to the local government officer.

Specialized commercial production of crops (e.g., mulberries and silkworms in central Honshū, cotton and tea in the Kinai, sugarcane in

southern Kyūshū and the southern islands) and handicraft cottage industry (e.g., silk) came to be centered in certain regions according to the climate and geography by the end of Tokugawa period (Smith, 1959; Yagi, 1964; Yamazaki, 1963). There was a solid foundation to support the transition of the mode of production of society as a whole by the time when the Meiji Ishin movement began.

An important consequence of these changes was that a new exchange mechanism arose in the rural communities. This growth of the market economy in rural communities made land, labor, and wealth into commodities. This was the birth of bourgeois social relations: capitalist-farmers and wage-laborers, or landlords and tenant farmers (Inoue, 1979a; Ono, 1941; Smith, 1959). Those who had access to the new equipment and knowledge during the rapid development of new farming techniques were able to increase both land and labor productivity, thus, increasing profits; those who did not could not compete in the market, thus losing their profits and land.

In short, development of an industrial society was made possible by the accumulation of capital, land and labor among merchants and industrial farmers during the last years of the feudal period despite of the legal restrictions of selling and buying the rights of occupancy on their land, and migrating from rural to urban areas. In 1873, the land tax system was enacted. Those farmers who maintained the rights of occupancy in their land were granted by the Meiji government for the first time the legal ownership of their land. Those who were landless were confirmed in either their tenant status or their right to outmigrate from rural villages. It is important to recognize that the transformation from feudal to

capitalist society had already been in progress in Japan far prior to Perry's arrival in 1858.

B. Emergence of a Market Economy

In comparison to Europe and the U.S., the development of capitalism in Japan was peculiar in terms of its origin in rural rather than in urban areas¹⁰. There are two factors underlying the development of the market economy in the countryside toward the end of the Edo period which split the peasantry in two and created a new class relationship between "the haves" and "the have-nots": (1) the spread of specialized commercial production (e.g., tea, cotton, sugarcane, indigo, rapeseed, tobacco, and mulberry), and (2) the growth of home based handicraft industry (e.g., spinning, weaving, paper making) (Japan FAO Association, 1959; Smith, 1959).

A new class system based on the ownership of private property replaced the traditional class structure, called Shi-Nō-Kō-Shō¹¹. At the same time, wealthy farmers became village leaders who stressed the

¹⁰ For more details, see Bowen, 1980; Smith, 1959, in English; and Fukutake, 1978; 1981; Hayashi, 1964; Kanai et al., 1964; Shibahara, 1962; Yagi, 1964; Yamazaki, 1963, in Japanese.

¹¹ "Shi-Nō-Kō-Shō" was the social stratification system in feudal Japan: (1) samurai, (2) peasants, (3) craftsmen, and (4) merchants. It was established by Toyotomi Hideyoshi in the late sixteenth century to differentiate the samurai class from other classes. The samurai monopolized all the privileges as the highest rank. The peasant class was placed in the second highest rank because farming was the nation's economic foundation. In reality, however, this class suffered most from heavy tax burdens and restrictions imposed upon their lifestyles. The craftsmen and merchants combined were called "chō-min" or "townspeople", and also suffered from the restrictions on various aspects of their lives by the government. "Shi-nō-kō-shō" was abolished in principle in the early Meiji period. However, the new social stratification did not replace the old in reality until the end of World War II.

improvement of agricultural technologies and rural communities. Agricultural equipment for threshing and hulling rice, and commercial fertilizers began to be used as commercial crops developed. In addition, different rice varieties were interchanged by them across the boundaries of feudal domains. Numerous books about farming techniques¹² began to be published in the same period. All these technical improvements started voluntarily among farmers to meet the changing political and economic conditions (Japan FAO Association, 1959; Smith, 1959).

Various changes which occurred in the rice economy contributed to the decline of Tokugawa feudalism since the Bakuhau system was supported by annual tributes collected from the peasant class¹³. This economic relationship between farming and science was carried over to the next era as well. The establishment of science, especially agricultural science, in the Meiji period would not have been possible without the surplus extracted from the agricultural sector (Inoue, 1978; Kashiwa, 1964; Ogura, 1970; Ono, 1941).

C. Pressure from Foreign Nations

When Perry brought the "request" from the U.S. president for trade, the Bakufu was at first overwhelmed by the immensity of the steamboats (kurobune or kurofune) equipped with cannons. In spite of the sakoku policy, the Bakufu and many feudal lords were well aware of the power of Western capitalism and technology. The Bakufu first tried to delay a

¹² Major works on agriculture including Nōgyō Zensho (1697) were published after the 1650s by members of the intelligentsia, the village officials or upper level of the peasant class, and samurai who also farmed (Furushima & Saitō, 1978).

¹³ See Smith (1959) for a detailed examination of Edo agriculture.

reply in the negotiation process as long as possible so as to avoid military confrontation with the U.S. and political conflicts within the nation (Beasley, 1989; Bowen, 1980; Duus, 1976). Yet, it was impossible for the Bakufu to maintain the status quo because of the social unrest which already existed as a result of changes in material conditions (Hashimoto, 1982; Inoue, 1968; Kawano, 1989; Najita, 1982; Tōyama, 1962).

By 1860 the samurai class was deeply divided over foreign policy and the position of the Emperor. A strong fear of foreign powers, and desire for establishing a nation-state strong enough to deal with them on equal terms, replaced the Kōbu Gattai movement with the anti-bakufu movement. The latter had two competing parties, the "Taisei Hōkan" and the "Buryoku Tōbaku". They both realized that "Japan could not hope to face the Westerners successfully unless the inherent weaknesses of the decentralized bakuhan system were overcome" (Duus, 1976:61). The decentralized Bakuhan system allowed power to be delegated downward so far that it could not be easily recovered. The system worked well as long as loyalty to the Shōgun and discipline existed among the peasants and the townspeople. So long as the economic and social system of the traditional village remained undisturbed, these supports of government would have not broken down (Smith, 1959).

After having reluctantly signed unequal treaties with the Western powers in 1858, the Tokugawa Bakufu immediately began to "import" Western scientific and technological knowledge to Japan by any means possible. The Bakufu's eagerness with this task can be seen by the fact that four

official overseas missions¹⁴ were conducted in the short period between 1860 and 1867. Each mission took about one year. Three of them had a total of over 100 members for the trip. At the same time, various feudal lords also began to support the effort to import Western science and technologies and to send their young and talented samurai to Western countries for observation and education.

In short, Western science and technology was recognized by the entire ruling class as a critical tool for the establishment of a strong capitalist nation. Moreover, feudal lords used the competition among foreign nations in the new market to pursue their own political struggle. During the Civil War of 1868-1869 (Boshin Sensō)¹⁵, the Western powers were also divided into three positions: those who supported the anti-Bakufu (Britain), the pro-Bakufu (France), and those who remained neutral (the U.S.).

¹⁴ The mission to America in 1860 was headed by Shinmi Buzennokami; the mission to Europe in 1862 by Takeuchi Shimotsukenokami; the mission to Russia by Koide Yamatonokami (1866); the missions to France by Ikeda Chikugonokami (1863), and by Tokugawa Akitake (1867). See Osatake (1989) for details of the missions of 1860, 1862, 1863, and 1867; Miyanaga (1989) for the Takeuchi mission.

¹⁵ Boshin sensō was fought between the supporters of the Bakufu and the anti-Bakufu group. In January 1868, the court ordered a decree that stripped from the Tokugawa its title as Shōgun and its lands. On January 26, Aizu and Kuwana han without the Tokugawa's permission marched on Kyoto to recover the Tokugawa Bakuhān system. The following day they clashed with Satsuma and Chōshū forces at Toba-Fushimi. Although the Bakufu force outnumbered the Imperial troops by a factor of three, they achieved victory in the first battle of the war. In May, Saigō Takamori from the Imperial force negotiated with Katsu Kaishū from the Bakufu force to end this war without another fight.

D. Meiji Modernization

When looking at Japan's experiences during the Meiji Era, there are two unique characteristics of Japanese society that contributed to successful industrialization. The first characteristic has to do with the time period when Japanese society encountered the Western nations, and the second one, as Watanabe (1985) points out, is due to the linguistic unity that Japanese society has enjoyed in its history.

It was roughly one hundred years after the Industrial Revolution in England when Commodore Matthew Perry arrived in Japan. The technological gap between Japan during the Tokugawa Era and the industrialized West was not nearly as wide as developing nations today have with the developed nations. Busch and Sachs (1981) point out that the rise of agricultural research systems in Europe started around 1850¹⁶. More importantly, Japan's development took place in a time of rapidly growing agricultural trade when it was much easier to gain earnings from agricultural exports than today. Furthermore, the Western imperialism of the nineteenth century pressured the Meiji government to cautiously avoid the increasing influence of the Western nations upon the political and economic matters of the nation.

Japanese society is highly homogeneous society compared with other societies with similar geographical environments (e.g., England). Despite regional variations in the usage of words, unlike many southeast Asian countries, Japan hardly suffers from communication difficulties with its

¹⁶ According to Busch and Sachs (1981:132-142), the rapid development of experiment stations began in Germany in the mid-1850s, soon followed by France, and then by the United States, Russia, and Japan in the last quarter of the century. They suggest that Japan established its first agricultural experiment station before the U.S.

own people including immigrants from China and Korea. During the Edo and Meiji Eras, all foreign texts needed to be translated into one rather than several languages, and therefore, were made available to the public in Japan with less time and effort. By the 1880s as foreign instructors in higher education were replaced with the Japanese, all the textbooks were switched from the original to their Japanese translations, and instruction was also in Japanese rather than foreign languages.

There are adverse effects on Japanese society caused by these two characteristics as well. First, the Meiji government paved the way for its own imperialism, colonizing southeast Asian countries including Taiwan, Korea, and parts of China. Second, the idea of cultural supremacy over the Chinese and Koreans grew in the minds of the Japanese public, and resulted in waves of nationalism and later militarism despite a growing number of labor movements and tenancy disputes. It was not until the end of World War II that the Japanese public for the first time tasted the flavor of democracy.

In examining the intersection between Japanese society and science, the three factors discussed above are important because scientific traditions did not emerge suddenly in Japan during the Meiji period. In an earlier phase of scientific development, a priority among scientific fields in Japanese society was induced in response to these nations' physical and cultural endowments (Ruttan, 1982). Not only political and economic conditions but also values and ethics, resulted in a unique approach among the Japanese to Western science and technology where "application" of scientific knowledge was promoted as a part of national goals by the government. In this attempt, science and technology were

recognized as interdependent as Japan was the only country where agriculture and engineering were acknowledged not as technical fields but as scientific fields during the late nineteenth century (Bartholomew, 1989). Furthermore, science and technology were viewed as crucial tools for strengthening the nation's political, economic, and military power¹⁷.

¹⁷ This view was emerged largely from experiences of leaders in both the Edo and Meiji governments during their official missions in the late nineteenth century (See Chapter 4).

CHAPTER 3: THEORETICAL FRAMEWORK AND METHODS

Sir Francis Bacon in the seventeenth century once described scientific research as the antithesis of political action. The Marquis de Condorcet in the eighteenth century called science the most important 'natural threat' to the seekers of political dominance. In 1931 Lord Bertrand Russell told scientists that as 'servants of truth' they must willingly suffer 'privations and persecutions' to defend their professional freedom, whereas Robert K. Merton in 1948 claimed that scientists have typically avoided becoming 'handmaidens of state' by invoking what he called the 'pure science sentiment.' (Bartholomew, 1982:295).

I. INTRODUCTION

Both Western and Japanese scientists criticize the general lack of democracy and of creativity in the contemporary Japanese scientific community¹. They tend to assert that Japan's scientific development was based on the imitation and adoption of Western science and technology².

This view is widely accepted by historians and social scientists who examine the historical development of science in Japan³. In the Meiji Era, Fukuzawa Yukichi criticized Japanese higher education as a "mere adjunct of government" (Bartholomew, 1982:195). Sakurai Jōji, a chemist, and Yuasa Mitsumoto, a physicist and historian of Japanese science,

¹ For more details, see Bartholomew (1989); Jones (1980); Murakami (1968); and Watanabe (1985, 1990).

² The differences are of little import here.

³ See Matsuhara (1966); Murakami (1968); Nakayama (1974); Shidō & Yabe (1990); Watanabe (1985, 1990).

expressed their frustration with the lack of independence among the academics. More recently, Nakane (1970) described Japanese society "as a constellation of mutually exclusivist small groups whose competitive interaction helps insinuate state power into its every nook and cranny" (Bartholomew, 1982:296).

All these critiques of Japanese science share an assumption that science is "historically weak in Japan and [attribute] its weakness to the nature of social structure" (Bartholomew, 1982:296). They share an assumption that science consists of activities of autonomous and independent individuals. However, this notion ignores the existence of a social network surrounding scientists, and leaves many unanswered questions about modern science in particular historical contexts and periods.

In this chapter, I will first survey theoretical arguments made in recent works in social studies of science. Particularly, I will discuss a concept of a social network that evolves in the process of "science in the making" (Latour, 1987), and argue that science is one of the social processes that we encounter in everyday lives. Then, I will introduce methods used for this study.

II. SCIENCE AS A SOCIAL NETWORK

Kuhn (1970:2) contended that science is not developed through "the accumulation of individual discoveries and inventions," as science textbooks describe, but through the replacement of a paradigm by "revolution" which takes place in a larger social context. Yet, he is no exception in his use of the physical sciences or physics in particular as the model of science. Thus, scientific development has been measured by

progress made in such sciences as physics and astronomy rather than the natural sciences (e.g., biology, botany, zoology, and medicine). This tradition comes from the fact that the scientific revolution in Europe began with physics during the sixteenth and seventeenth centuries (Bartholomew, 1989; Feyerabend, 1975; Kuhn, 1970).

It does not seem a coincidence that the scientific revolution in physics and the emergence of the world market economy took place at about the same time. On the one hand, because of a high demand to improve such technologies as navigation, surveying, and calendar making, mathematicians and physicists were financially well supported by merchants and aristocrats such that the so-called "scientific revolutions" in these fields were possible (Bartholomew, 1989; Hessen, 1968). On the other hand, these revolutions in physics induced significant progress in ocean navigation technology and helped many adventurers during the sixteenth and seventeenth centuries to go around the world extending imperial control.

An important peculiarity in the interaction between "science" and Japanese society during the Edo period was that "Japanese science represented a departure from the pattern of development in Europe" because "...Japanese intellectuals first studied Western science: not through physics, but through medicine" (Bartholomew, 1989:4). Japan's indigenous environment demanded different types of knowledge and products on the one hand, and had a particular capacity to supply them on the other. Nevertheless, historical studies of the evolution of science in Japan place their focus mainly on scientists, or on the interaction between scientists and the government even while they recognize science as socially constructed (Bartholomew, 1989; Murakami, 1968; Watanabe, 1985 and 1990 [1976]).

A. Science as a Social Process

Kuhn (1970) rests the selection of a scientific paradigm solely on the debates among scientists, leaving non-scientists as outsiders to the scientific revolution. Thus, despite his insight in recasting our view of science, Kuhn's work is still far from finding a link between science and society.

Feyerabend (1975:19) goes even further by arguing that science "...contains ideas, interpretations of facts, problems created by conflicting interpretations, mistakes, and so on." Therefore, he asserts that science is one tradition among many kinds of knowledge in our society. Feyerabend (1975; 1978) rejects the linear notion of scientific progress and places his emphasis on an "open" society which accepts the maxim "anything goes."

In his view, everyone should be allowed to make a decision as to what knowledge is to be accepted in our society regardless of its grounding in science. However, Feyerabend's approach to science underestimates the fundamental nature of human beings as social beings who constantly seek security by internalizing values, including the supremacy of science, that exist in a society. For Feyerabend it is a matter of individuals constructing reality without any constraints imposed upon them by social institutions such as schools, family, churches, politics, and workplaces.

Both Kuhn (1970) and Feyerabend (1975; 1978) accept the notion that science is constructed through social processes among actors -- scientists in Kuhn's case -- in our everyday lives. Therefore, for both, scientific communities are social systems. However, having rejected the existence of universal rationality, neither Kuhn's totalitarian nor Feyerabend's

anarchist approach -- to use Fuller's classifications (Fuller, 1988:6) -- deals in depth with the question of who and with what criteria certain knowledge is evaluated in society as good or bad in relation to particular political and economic contexts.

The work of Robert K. Merton contributed to establishing a new specialty in sociology, the sociology of science, by recognizing social accountability in knowledge construction. Merton (1973:175) argues that there is interdependence among different social institutional spheres because "[t]he same individuals play multiple social statuses and roles: scientific and religious and economic and political." Therefore, science, though seemingly distinct from other institutional spheres, is only partially autonomous in our society.

More recent works in the sociology of science⁴ dispute the Mertonian justification that science should enjoy a higher degree of autonomy compared with other social institutions. They do so by deconstructing idealized descriptions of scientific practices and of norms among scientists that prescribe their behaviors. They point to the rhetorical constructions of scientific texts that are used in various stages in making science to describe the scientists as loyal to scientific truths and to present their research results as value-free. Furthermore, they argue that "[t]ruth ... is a social phenomenon" (Clarke, 1990:17).

⁴ See Busch & Lacy (1983); Busch, Lacy, Burkhardt, & Lacy (1991); Bijker, Hughes, & Pinch (1989); Cozzens & Gieryn (1990); Knorr-Cetina (1981); and Latour (1987).

B. Social Networks of Science

Science is not an autonomous activity independent from other social spheres. As shown by Knorr-Cetina (1981) and Latour (1987), scientists maintain a variety of resource relationships with colleagues, practitioners, funding agencies, governmental agencies, industrial companies, suppliers of instruments and materials, and their family members. Scientific development takes place as a social process including these various actors with particular interests, motivations, and perspectives surrounding the scientists who work on particular scientific products. We will call these social relations in the context of scientific work social networks of science.

The nature of a particular social network of science greatly depends on its members and socio-historical context. In a capitalist society, it has been suggested that these networks are formed surrounding the profit motive -- not only economic but also political and social -- of actors involved in the process of knowledge production (Bijker et. al, 1989; Knorr-Cetina, 1981; Latour, 1987).

For instance, Knorr-Cetina (1981:7) shows that scientists constantly base their decisions on "the expected response of specific members of [the] community, or to the dictates of the journal in which they wish to publish." This is the case because not only scientists in a given field but also nonscientists have an interest in the outcome of the research. In short, a scientific fact is socially constructed in a network of "transscientific fields" from an infinite number of potential ways of looking at the world.

Both Knorr-Cetina (1981) and Latour (1987) explain the socially constructed nature of science by using case studies of scientists who

attempt to simulate a natural phenomenon and to make it work in their laboratories. However, the phenomenon observed in the laboratory is tightly controlled and managed by the scientists using instruments. Thus, in the process of transferring the research question and outcome outside the laboratory, scientists use various political strategies to organize nonscientists (e.g., foundations, government agencies, farmers, consumers, university administrators, etc.). Therefore, "[w]ithin this 'transepistemic' context scientists are required to handle both natural and social phenomena" (Hagendijk, 1990:48).

Ruttan's (1982:5-6) induced innovation model shows how judgement of a research program is not only based on scientific/technical merit but also "in terms of the consistency of its objectives with changes in the economic environment." Furthermore, he shows very articulately how the agricultural research systems of two capitalist nations -- Japan and the U.S. -- differ from each other in terms of their institutional structure, policies, research goals, and societal expectations.

Both nations began to build their agricultural research and extension systems in the last quarter of the 19th century after having been inspired by the Germans. Nevertheless, they pursued different paths of technological change: a mechanical technology path for the U.S. and a biological technology path for Japan (Hayami, 1975; Hayami and Ruttan, 1971; Ruttan, 1982:10). As result, the U.S. increased output per worker; Japan increased output per hectare.

C. Demand/Supply Model of Science

Works by Bijker et. al (1990), Knorr-Cetina (1981), Latour (1987) and Ruttan (1982) suggest that there are demand and supply sides in the

social network of science. However, it is misleading to consider, following the marginal utility theory of economics, that there is a clear demarcation line between the two and that each actor plays fixed roles on either side. Each actor in the network of a particular scientific program plays both the supply role and the demand role. For example, work by a group of scientists may stimulate work by others. On the one hand, farmers request technical advice from agricultural scientists. On the other hand, indigenous farming practices may give insights to agricultural researchers.

While Latour (1987) and Knorr-Cetina (1981) concentrate their attention on decision making by scientists as producers of knowledge (Fuller, 1988), Ruttan (1982) limits his interest in decision making about scientific programs to the government. These three scholars assume that only scientists practice "scientific research" to advance social knowledge.

In the case of agricultural science, farmers also practice empirical studies in their fields to improve the efficiency of their activities and yields of crops. Despite their training in the most advanced scientific techniques, agricultural scientists in Japan were not recognized as "the agricultural experts" until the late Meiji Era. Instead, it was rōnō (or veteran farmers) with much experience in farming but no training in science who paved the way in the network of agricultural science for the improvement of agricultural production in Japan.

As Fuller (1988) shows, knowledge does not necessarily distribute power to those who create the knowledge, and scientists are often not entirely in control of their own activities. For example, scientific products may be used differently from the original intent of their

creators. As Latour (1987:29) argues, "the fate of what we say and make is in later users' hands."

Therefore, science is constructed collectively. In the process of persuasion, coercion, and negotiation, scientists and/or other actors gain control over the process for producing knowledge. In the era of rōnō, agricultural scientists in Japan struggled to convince farmers that their farming techniques based on science were better than those of the veteran farmers by inviting local farmers to the experiment stations and showing yields of two experiment plots -- one produced based on the rōnō techniques, and the other based on scientific techniques. It was this activity of persuasion among scientists that finally won them the status of "the agricultural expert."

The social constructionist perspective on science is useful in various ways. First, it enables us to compare different societies in bringing about dissimilar types of networks surrounding science. Second, cultural and social conceptions of science in a particular society can be observed from studies of the formation of a particular type of social network in science. Third, this perspective raises key sociological questions in the development and direction of scientific research traditions such as: What conditions make specific social interactions possible? What is the nature of social interactions among particular actors? Why were these social interactions harmonious or turbulent?

Using this social constructionist perspective on science, in the next two chapters I examine the development of agricultural science in Japan during the Meiji Era. In Chapter 4, the main focus is placed on surveying the emergence of actors in the social network of agricultural

science through modernization strategies. In Chapter 5, I investigate how and what type of social network and social relations emerged among these actors surrounding the agricultural sector by analyzing the development of agricultural institutions. In the section below, I discuss the methods used for this study.

III. RESEARCH METHODS

The objective of this research is to examine the process and impacts of the transformation of Japan's agricultural sector based on Western science and technology. Agricultural science is used as a case study to develop a strategic understanding of the role of "imported" knowledge on Japanese society at large through its various transformations (e.g., institutions, policies, actors, values, and networks).

In the following section, I will try to accomplish two tasks: first, to describe the methodological approach that I have used, and second to reflect on its methodological strengths and weaknesses.

A. Methodological Approach

In this study, the research imperatives are, first, to identify roles played by major actors involved in the agricultural transformation process, and second to find the historical linkages between this process and the nation's modernization. I have systematically evaluated two types of literature for these purposes.

First, literature in social studies of science, technology, and knowledge have been examined to provide a theoretical framework for understanding the connection between Japanese society and Western science and technology. In examining Japan's experiences as a case of the

integration between the Western heritage and a non-Western society, this type of work was essential for selecting an analytical strategy appropriate to the types of data that would be collected.

Second, both contemporary and historical literature in Japanese studies on the period, 1853-1912, have been reviewed in order to shed light on the way in which new scientific knowledge and technologies were introduced within the agricultural sector and to note the interaction among major actors in the transformation process. Most of the works focus on activities of one or two actors. By comparing literature written from different perspectives on the historical process I was able to document the diverse interests, needs and problems that each actor held in the agricultural transformation. Furthermore, this helped to understand the interaction between Japanese society and Western science and technology as social processes among the diverse actors within a larger socio-political and -economic context.

Through this literature review process, I identified major four actors: farmers, government (both federal and local), scientists, and the industrial sector. Each actor includes various subcategories. For example, in the group of farmers there are landlords and tenants. In the industrial sector, there are rice merchants, silk manufacturers, food processors, and other non-agricultural industries. Activities of each actor have been analyzed in relation to the economic and political development of Japan during the period.

In this study I have relied on secondary rather than primary sources for most information in order to draw a broad picture of the agricultural network developed among farmers, scientists, government (both federal and

local), and the industrial sector⁵. Statistical information (e.g., changes in agricultural production, the amount of import/export goods, and demography) are also examined carefully as measures of the structural transformation in the agricultural sector. A large portion of these data has come from Ogura Takekazu's Agricultural Development in Modern Japan (Tokyo, 1970). Also, in the fourth chapter, I have obtained from Hazel Jones's Live Machines (Vancouver, 1980) most of the statistical data on the employment of foreigners during the Meiji period.

B. Contemporary and Historical Literature in Japanese Studies

In the last few decades, a large amount of literature on modern Japanese history has been published in English as Japan received more attention as an advanced nation in the non-Western tradition. Contributions have largely come from journalists, social scientists, and historians in England, the U.S., Canada, and other European nations as well as in Japan, who have succeeded in overcoming the linguistic difficulties. Yet, a vast portion of these works deal with the post World War II development of Japan, particularly focusing on its industrial advancement and urban aspects of Japanese lives.

In a historical study such as this project, a review of literature that has been well recorded is the most appropriate method on which a researcher can rely. In Japanese studies, either contemporary or historical, the largest hurdle to overcome is the language. This is

⁵ There are three reasons for not using primary sources for this study including: (1) the constraint on time and resources that has been placed on master's thesis research, (2) the availability of historical studies on Japanese agriculture in Japanese, and (3) the difficulty in reading historical documents of the Meiji period written in an archaic writing system.

probably why there have been so few works in English about the social history of Japanese agriculture and science. Furthermore, this linguistic difficulty has contributed to the concentration of recent studies on Japanese society in its contemporary and industrial aspects.

On the other hand, Japanese scholars are also accountable for this lack of understanding of their own heritage among non-Japanese speaking nationals. Despite their six years of mandatory training in English, most Japanese intellectuals are unable to communicate with English speaking counterparts. Intellectual communication can be achieved only by both Japanese and non-Japanese speaking populations trying to compensate for the linguistic difficulties.

According to Bartholomew (1974:312), "[t]he social history of modern Japanese science is a relatively new field of scholarship and works available in English are...scarce". However, those available in English are quite momentous in that they not only contain important information but also critical approaches to analyze the development of scientific traditions in the social context of Japan. Furthermore, works by Japanese scholars give an essence of their views of science.

Nevertheless, more works in English are needed in this area, particularly those that compare developments of various scientific fields in Japan. Many existing works deal with physics, mathematics, and medical science. Biological (except medical) sciences or social sciences have not been examined intensively. This also indicates the very narrowly defined view of science among historians of science.

The historical study of Japanese agriculture is one area that has a great gap between sources available in Japanese and English. Not only are books on Japanese agricultural science in English scarce, but also those

on Japanese agriculture in general. On the other hand, the volume of books on the subjects available in Japanese is immense. Thus, for those who are interested in rural studies of Japan or historical studies of Japanese agriculture, learning the language becomes a prerequisite.

This gap in the availability of sources between Japan and non-Japanese countries marks the lack of interest in agricultural aspects of Japanese history and society in the West. I suppose the reason for an enormous amount of historical studies on the subject in Japanese is simply that Japan was an agrarian society until the post World War II period. Therefore, historians of contemporary Japan before World War II have inevitably studied the development of agriculture in relation to the industrial sector.

In the area of agriculture, the scarcity of publications in English has contributed to misrepresentations of Japanese society that are shared by the Westerners. By reading current publications in English on Japan, it is hard for one to visualize a country with rice fields scattered around most cities, or even to imagine the existence of remote rural villages that suffer from a lack of laborers to take over farming⁶. It is necessary to communicate to exporters of agricultural commodities to Japan that the meaning of farming for the Japanese is deeply rooted in Japanese cultural history, and that the fear of losing food self-sufficiency is still real to those who experienced food shortages during World War II.

⁶ However, recent works by Raymond Jussaume (1991) and Richard Moore (1990) provide articulate pictures of current Japanese agriculture and rural communities.

C. Reflections on the Methods Used for This Project

This systematic evaluation of literature in accordance with activities of actors is an effective approach to finding the linkages among them in a network. A social network consists of complex relations among an ever growing number of actors that arise as social interaction takes place. In short, unlike looking at a social structure as something rigid, the concept of a network allows us to examine it as fluid and active constantly transforming itself through negotiation, coercion, and persuasion among agents.

Yet, it also raises the critical question of determining the size of a network. There has to be a limit to the number of actors included in a network analysis since we simply cannot analyze everybody. Thus, conceptually we must see the network on the move, but methodologically we need to observe a series of frames among its actors as if looking at a reel of film negatives. Justification for selecting actors has to be made by a researcher. Furthermore, he or she has to be aware that there are many possible networks that can be (re)constructed in the process of choosing literature.

Stronger linkages between this theoretical framework of the social construction of science and empirical studies of science is needed. Simply, we need to go beyond a survey of science in general. One possible avenue is to select one historical development of scientific inquiry (e.g., development of a rice variety, a breeding program for tomatoes) and examine social processes that have taken place among various actors in a network.

This will require us to review not only historical literature, but also scientific journals, trade journals, and mass media coverage over a

given time period. By examining different types of literature, a researcher can uncover missing (or hidden) information in one or another type of publication. In addition, both qualitative and quantitative data can be used in such a study, including interviews with various actors in the network, and statistical analysis of assorted variables involved in the particular scientific development.

Furthermore, comparative studies will draw a more concise picture of how science is practiced in different social contexts. Actors in each network surrounding the same scientific inquiry in two or more societies will not necessarily go through the same path to achieve their goals. In many works by critics of Japanese science, this comparative approach has been neglected, resulting in a narrow view of science and its relation with society.

CHAPTER 4: JAPAN'S MODERNIZATION STRATEGIES

I. INTRODUCTION

At the fall of Tokugawa Bakufu, Western science and technologies were introduced to Japan as a part of the modernization policies. For leaders of the Meiji government, the new knowledge from the industrial nations was a necessary weapon to carry out the establishment of a nation-state quickly by increasing wealth and gaining access to military technology so that Japan would eventually be on a equal footing with the Western nations (Hiroshige, 1965; Nakamura, 1965; Nakayama, 1965; Watanabe, 1951a, 1951b; Yuasa, 1952, 1965). Among the modernization strategies used by the Meiji government, four will be examined in this chapter: (1) dispatch of official missions, particularly the Iwakura Mission of 1871-73 (Iwakura Shisetsu-dan), (2) employment of foreigners (oyatoi gaikokujin, oyatoi gaijin, or yatoi), (3) promotion of exchange students to Europe and the U.S. (ryugakusei), and (4) use of indigenous knowledge (nōmin no chie).

Furthermore, in the process of industrialization, the Meiji government did not overlook the importance of improving agricultural productivity to meet the demand to provide a financial source for industrialization and to adjust political, economic and social changes induced by industrialization (Francks, 1984; Fukutake, 1978, 1981; Hayami, 1975; Japan FAO Association, 1959; Ogura, 1970). There were two pathways for the development of Japanese agriculture during this period (Japan FAO Association, 1959). One was to import Western science and technology that improved agricultural production. The other, which had begun in the

latter decades of the Edo period, was to maximize initiatives by farmers to enhance agricultural techniques.

The first pathway included the first three modernization strategies mentioned earlier. The Charter Oath of April 1868 (see **APPENDIX A**) clearly spelled out Japan's new direction that "[k]nowledge was to be sought throughout the world, to strengthen the foundations of Imperial rule" (Burks, 1985a:147). The Iwakura Shisetsu-dan left Japan for almost two years to look for models for agricultural as well as industrial development in Europe and the U.S. Foreign experts (oyatoi gaijin) were invited as consultants and instructors to help improve agricultural techniques. Returned ryūgakusei played important roles in the government, schools, and research institutions in applying Western science and technology to agricultural production.

The two pathways eventually met when so-called expert farmers (rōnō) were appointed to positions in the newly-established agricultural experiment stations and agricultural colleges, and when the wealthy farmers (gōnō) took leadership in the diffusion of science-based agricultural techniques.

II. IWAKURA SHISETSU-DAN (IWAKURA MISSION)

The pressure of powerful nations of the West forced the Tokugawa Bakufu to open its gates in the 1850s and brought Japan into contact with the world. The Bakufu began sending diplomatic missions to America (1860), Europe (1862), France (1863, 1867), and Russia (1866). These

missions were largely concerned with foreign relations, but also with investigating foreign cultures and institutions¹.

Nevertheless, the Iwakura Mission that cost a million dollars is without doubt the most significant diplomatic mission in Japan's modern history in that its members drew a blueprint for the New Japan (Beasley, 1981; Haga, 1978; Izumi, 1984; Kume, 1977 [1878]; Mayo, 1961, 1983; Ōkubo, 1977; Tanaka, 1977). Jones (1980:29) points out that "[p]erhaps the Iwakura Mission best illustrates the various predispositions of Meiji leaders." Moreover, the Meiji leaders learned from their experiences in the West the importance of selective importation of Western knowledge, and the needs of managing Western science and technology to achieve the nation's goals.

A. Overview of the Mission

The Iwakura Mission was organized with three main purposes: (1) to display to Western countries Japan's sincerity and progressive attitude toward modernization, (2) to exchange views with the heads of Western countries about revisions of unequal treaties, and (3) to examine Western society closely for its sources of wealth and power while exploring methods of implementing Western knowledge in Japan (Beasley, 1981; Haga, 1978; Izumi, 1984; Kume, 1977 [1878]; Mayo, 1961, 1983; Ōkubo, 1977; Tanaka, 1977). The mission was led by Iwakura Tomomi (Minister of the Right) as chief ambassador, followed by Kido Takayoshi (Councilor), Ōkubo

¹ The mission to America was headed by Shinmi Buzennokami; the mission to Europe by Takeuchi Shimotsukenokami; the mission to Russia by Koide Yamatonokami; the missions to France in 1863 by Ikeda Chikugonokami, and in 1867 by Tokugawa Akitake. See Osatake (1989) for details of the missions of 1860, 1862, 1863, and 1867; Miyanaga (1989) for the Takeuchi mission; Tokutomi (1991) for the Shinmi mission.

Toshimichi (Minister of Finance), Itō Hirobumi (Bureau Chief of Engineering), and Yamaguchi Naoyoshi (Bureau Assistant Chief of Foreign Affairs)². Several high-ranking officials were also sent, representing each of the departments of the government (e.g., Sasaki Takayuki, Yamada Akiyoshi, and Tanaka Fujimaro).

The mission consisted of 48 members, ranging from ambassadors and commissioners to secretaries, interpreters, clerks and attendants (see **APPENDIX B** for a list of the members). Most of them had never been overseas. In addition to the mission members aboard in the postal ship "America," approximately 60 overseas students accompanied the travel to the U.S., including the first five female overseas students³, and such well-known figures as Dan Takuma, Kaneko Kentarō, Makino Nobuaki, and Nakae Chōmin (Tanaka, 1977; Tonegawa, 1978)⁴.

² From 1869, the Daijōkan (Grand Council of State) was the highest administrative organization. It was headed by ministers of the Left (Sa Daijin) and the Right (U Daijin) and consisted of state councillors (Sangi and Dainagon). The Daijōkan controlled ministries. In September 1871, three bodies called Seiin (Central Chamber), Sain (Chamber of the Left, a legislative body), and Uin (Chamber of the Right, an assembly composed of ministers and vice ministers) were established as part of the Daijōkan. The Central Chamber consisted of the offices of Dajō Daijin (Grand Minister of State), Sa Daijin (Minister of the Left), U Daijin (Minister of the Right) and Sangi (Councillors) (Hunter, 1985:31-32; Kōdansha International, 1983:71).

³ The first five female overseas students and their later contributions included Tsuda Umeko (8 years old at the time) who founded Tsuda Women's English College; Nagai Shigeko (9 years old) who later married to Admiral Uryū Sotokichi; Yamakawa Sutomatsu (12 years old) who became a wife of General Ōyama Isao; and Ueda Sadako (15 years old) and Yoshimasu Ryō (15 years old) -- both returned home due to illness. They were sent by the Hokkaidō Development Office in accordance with Kuroda Kiyotaka's proposal to educate young females in the U.S. to become "models of [Japanese] women" (Tanaka, 1977:24; Tonegawa, 1979:136).

⁴ Dan Takuma later led the Mitsui Zaibatsu or the Mitsui Enterprise. Kaneko Kentarō helped Itō Hirobumi draft the Meiji Constitution, and later served in many positions in the Meiji government. Makino Nobuaki served a variety of posts including ambassador to Italy, Minister of Education,

According to Tanaka (1977), there were three characteristics of the membership of the mission. First, it included the top leaders of the Meiji Government (e.g., Iwakura, Ōkubo, Kido, Itō, Yamaguchi). Second, it included those who were sent to the West by the Tokugawa Bakufu as second ranking officers (e.g., Tanabe, Shioda, Fukuchi, Hayashi, and Kawamichi). Third, it was organized around an age group between the late 20s and 30s (Iwakura, 47, was the oldest among the mission).

Another point to stress is that it was during this mission that critical political factions were formed for determining the direction of the Meiji Government. For example, Ōkubo and Itō seized leadership while Kido increasingly lost his power in the government upon the return of the mission⁵.

Besides the membership, the timing seems peculiar (Chūō Kōron, 1976). The mission, including the three important leaders of the government, left for 22 months (the original plan was one year), four months after the abolition of feudal han system (Haihan Chiken). In his discussion with Tanaka, Satō raises two questions: "Why could they go? Why did they have to go?" (Chūō Kōron, 1976:41). He explains the answer to the first question by noting that there was some sort of consensus among leaders about the future direction of Japan. For the second question, he argues that there was a clear goal in the government to modernize Japan but no knowledge of how to do it. Thus, the government

and Minister of Foreign Affairs. Nakae Chōmin is famous for his involvement with the liberal democracy movement prior to the promulgation of the Meiji Constitution in 1889.

⁵ See Chūō Kōron (1976, 1979); Itagaki (1979); Ōkubo (1976); Tamura (1977); Toriumi (1979) for more details.

needed to send someone, not scholars but leaders themselves, to observe the West.

The mission left Yokohama with the Pacific Mail steamship "America" in December 1871 and arrived in San Francisco in January 1872. The mission members stayed in the U.S. for seven months, far beyond the original plan, and in Britain for four months (August - December, 1872), and visited Europe over seven months (December, 1872 - July, 1873) including France, Belgium, the Netherlands, Germany, Russia, Denmark, Sweden, Italy, Austria-Hungary, and Switzerland. On its return voyage, the mission passed through the Suez Canal to the Indian Ocean and the East China Sea "for brief glimpses of the leading harbors of southern Asia and the treaty ports of southeast China" (Mayo, 1983:359).

The mission went everywhere from government offices, museums and factories to opera, ballet, and circus performances, and tried to observe as much as possible in each country (Beasley, 1981; Haga, 1978; Izumi, 1983; Kume, 1977 [1878]; Ōkubo, 1976; Mayo, 1961, 1983; Tanaka, 1977). In the long journey, the mission members examined not only positive but also negative aspects of industrialization⁶. For example, Kido and Ōkubo visited the east end of London one evening with a guide and one other companion. Both leaders were disgusted with this slum filled with opium addicts, prostitutes, beggars, and gamblers (Beasley, 1981; Izumi, 1984; Tanaka, 1977).

⁶ The five-volume publication of the mission, Tokumei Zenken Taishi: Beio Kairan Jikki, records details of these observations (Kume, 1977 [1878]). It was Iwakura's idea to publish the official record for the public.

B. Differences from the Previous Missions

The Iwakura Mission was far more significant than any previous missions of this type. One difference is that the mission members were more enthusiastic and receptive about learning Western culture and knowledge than the members of previous ones. Mayo (1983:359) points out that "[u]nlike their predecessors on the Shogunate missions to the West in the 1860s, [members of the Iwakura Mission] chose to dress in Western attire, cut their hair in the Western fashion, and eat Western food."

Second, the government seemed to have a clear understanding of the importance of the mission for the future of Japan. That appears to be why the government was willing to send its best leaders abroad. Moreover, before the departure the ambassadors and leaders of the caretaker government (Rusu Seifu) signed an agreement that they would maintain frequent communications and refrain from issuing any new foreign and domestic policies in order to maintain the unity of the Meiji Government⁷.

The mission's attempt at treaty negotiations failed miserably largely because the mission leaders lacked experience in international affairs. However, the members learned about diplomatic practices and international power politics from their mistakes, and redefined their approach to treaty revision to make it more realistic (Mayo, 1961). These political leaders gained their understanding of different components of modernization, such as factory production, the application of science to industry and agriculture, mass transportation and communication,

⁷ This agreement was broken immediately after the mission's departure. The Iwakura mission leaders tried to begin treaty negotiations with the U.S. without the government's approval. The care-taker government issued many important policies including the conscription system (1872), the compulsory education system (1872), and the land tax reform ordinances (1873).

management methods, and international trade. Moreover, they recognized commerce and industry as "means to increase productivity and raise levels of consumption by large numbers of people and not, as Neo-Confucians argued, to produce luxuries" (Mayo, 1983:359).

More importantly, the mission members realized the importance of gradual and selective importation of Western knowledge:

Inspired by the trip, the mission's leaders refined their theory and rhetoric of gradualism. Fundamental change was necessary, they concede, but reform must be orderly, selective, and calculated not to exceed the capacity of the people to understand or accept. Japan must retain its distinctive qualities and avoid shallow, unworkable, or wholesale cultural borrowing (Mayo: 1983:359).

This perspective was clearly the result of the fact that the mission also observed the undesirable aspects of industrialization and recognized the need to minimize them.

C. Significance of Agricultural Science

There were three significant aspects of the mission in the area of agriculture. One is that the employment of some foreigners was set up during the mission. For example, D.W.A. Jones seems to have been selected to teach the Japanese sheep farming while the mission was in the U.S. (Nakamura, 1952). Jones (1980; 1985) argues that it was these types of official missions that helped the government initiate hiring more foreign employees and specialists for modernization projects.

Second, a number of overseas students in various countries visited the mission leaders and expressed their opinions and ideas for the modernization of Japan including what needed to be done to improve agricultural techniques in Japan. For example, Iwayama Takayoshi, who had been studying sheep farming in California, visited Lord Iwakura and asked

if he could come along with the company across the U.S. continent. He suggested to Lord Iwakura at a hotel in San Francisco that sheep farming was beneficial since the Japanese would enjoy both the meat and the textile made from wool (Izumi, 1984:64).

Third, the mission report was published describing the superiority of Western agriculture "in the form of the organic combination of crops and livestock and in the high level of application of modern inputs, such as fertilizers and machinery" (Hayami, 1975:49). Furthermore, the leaders recognized the application of science and technology and the establishment of organizational networks (e.g., agricultural associations, fairs, schools, and experiment stations) as necessary to improve agriculture in Japan.

Importation of agricultural techniques from the West began largely based on the mission report and encouragement from those leaders who accompanied the Iwakura Mission including Ōkubo and Itō who encouraged livestock farming and large-scale farming. In short, the Iwakura mission helped the Meiji Government formulate plans for the reorganization of the agricultural sector and the encouragement of agriculture. Moreover, after the Iwakura mission, the Meiji leaders were able to define the government's role in the social network of the agricultural sector.

III. OYATOI GAIJIN (FOREIGN EMPLOYEES)

Japanese history is difficult to understand without taking into account the use of foreign assistants, or "live machines and living reference books." Its contact with Korea and China began somewhere around in 200-300 B.C. The first contact with European culture began in the mid-16th century via the hands of the Portuguese and the Spaniards. Then,

Dutch learning became the only agent to convey Western science and technology to the Japanese during the seclusion period (see **Chapter 2** for more details).

After the opening of the ports in the mid-19th century, Japan resumed the systematic use of foreign assistants. In the period between 1854 and April, 1868, at least 200 foreign instructors and technicians worked for the Bakufu and some for regional domains (han) (Jones, 1974, 1980, 1985; Ishizuki, 1985; Nakamura, 1955; Nakayama, 1965; Tokutomi, 1991).

There have been many examples of nations using foreign assistants, and there are many similarities with other modernizing countries today in terms of attitudes and activities of foreign employees in Japan during the Meiji period. However, as Burks argues (1985b:187-188), the Meiji Japan experience might be "the earliest, historical example of the use of technical assistance in development [and] ... the most massive borrowing experiment in history" in numbers, varieties of persons selected and the many areas in which they were employed.

A. Overview

The Meiji government began to publish official statistics of foreign employees in 1882. As shown in Table 4.1, the Meiji government sponsored 2,400 foreigners in the period between 1868 and 1900 who gave approximately 9,500 person-years of counsel and aid to utilize their knowledge and expertise to shorten Japan's modernization process (Jones, 1980, 1985; Umetani, 1969; UNESCO, 1975). The British provided most of the person-years (over 4,300); the French about 1,500; Germans and Americans, each about 1,200 (Jones, 1980, 1985; Umetani, 1969; UNESCO,

1975). The largest number of foreigners were employed by the Ministry of Public Works, followed by the Ministry of Education. The majority were in the age group between 25 and 35 years old.

As illustrated in Figure 4.1, during the years 1872-1898 the person hours of the public foreign employees came to a peak in the period between 1873 and 1877 (2,747 persons hours), decreased to half of this amount in the following five-years period, and never exceeded one thousand after the fourth period. On the other hand, the number of private foreign assistants increased to reach the same level as government employees within the first three or four years, outnumbering them by 1877. In 1897, the number of private foreign assistants reached its peak of 760 persons (Umetani, 1971:11).

In the period between 1881 and 1900, the Ministry of Agriculture and Commerce (MA&C) hired 28 foreign employees (144 person-years) from Holland (1), Germany (15), the U.S. (8), and England (4); the Hokkaidō Development Office employed 88 (244 person-years) from Austria (1), Russia (5), Holland (3), China (13), Germany (5), the U.S. (56), France (1), and England (4) (Jones, 1983:226)^a. Prior to the establishment of the MA&C, the Ministry of Internal Affairs hired foreigners to work for the Bureau of Agriculture including 7 Germans in spinning, weaving, and dyeing (Umetani, 1971). Since all foreign instructors in agricultural schools were hired by the Ministry of Education, the total number of foreign employees who contributed to the development of agricultural science would be larger.

^a Not all the foreign employees listed here worked in the agricultural sector.

Table 4.1. Public Foreign Employees, 1868-1900.

| Ministry | Total Numbers of Foreign Employees by Nationality | | | | | | Total | Total Person Years |
|-----------------|---|--------|------|---------|---------|--------|-------|--------------------|
| | England | France | U.S. | Germany | Holland | Others | | |
| Cabinet | 30 | 60 | 9 | 8 | -- | 2 | 109 | 275 |
| Imperial House. | 1 | 2 | 2 | 2 | -- | 1 | 8 | 82 |
| Foreign | 4 | 1 | 6 | 12 | -- | 4 | 27 | 139 |
| Justice | 6 | 14 | 2 | 5 | 1 | 2 | 30 | 163 |
| Finance | 38 | 20 | 13 | 6 | 2 | 9 | 88 | 369 |
| Internal | 26 | 2 | 15 | 43 | 21 | 10 | 117 | 537 |
| Public Works | 553 | 90 | 13 | 24 | 1 | 144 | 825 | 3,220 |
| Commun. | 14 | -- | 1 | 3 | -- | 3 | 21 | 127 |
| Ag. & Commerce | 4 | -- | 8 | 15 | 2 | -- | 28 | 144 |
| Hokkaidō Deveg. | 4 | 1 | 56 | 5 | 3 | 19 | 88 | 241 |
| Govt. Shipping | 29 | 1 | 15 | 1 | 5 | 3 | 54 | 69 |
| Navy | 118 | 69 | 12 | 8 | -- | 8 | 215 | 825 |
| Army | 2 | 75 | -- | 16 | 5 | 10 | 108 | 465 |
| Education | 86 | 39 | 105 | 93 | 12 | 32 | 367 | 1,610 |
| Prefectures | 119 | 27 | 94 | 38 | -- | 37 | 315 | 1,236 |
| Totals | 1,039 | 401 | 351 | 279 | 51 | 284 | 2,400 | 9,506 |

Source: Jones, 1980.

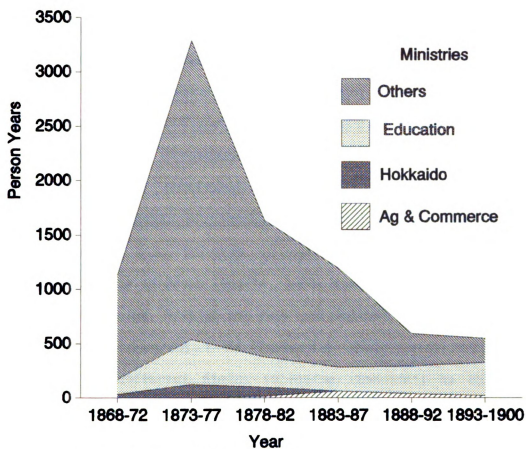


Figure 4.1: Public Foreign Employees, Five-Year Totals of Person-Years by Area of Government (1868-1900).

1. SELECTION AND COUNTRY: Three methods of recruitment were used most commonly to hire foreigners including: (1) recommendations or arrangements made by foreigners who had already been in Japan; (2) recruitment by the diplomatic representatives of various nations; and (3) hiring of foreigners who happened to be already in Japan (Beauchamp, 1983; Jones, 1980, 1985; Umetani, 1969, 1971; UNESCO, 1975).

For example, D.W.A. Jones, who introduced sheep farming into Japan, was recruited during the Iwakura Mission (Nakamura, 1952). Both Horace C. Capron, a former U.S. commissioner of agriculture, and William S. Clark, a former president of Massachusetts Agricultural College (MAC), were recommended by the U.S. government and recruited by Kuroda Kiyotaka, the Bureau Chief of Hokkaidō Development, and Mori Arinori, the Japanese Ambassador to the U.S. to help in establishing the foundation of agricultural science in Japan (Fujita, 1983; Maki, 1983).

In the beginning, British and American employees dominated Japan's foreign assistant programs. As Table 4.1 shows, each nation made contributions to different fields including: Americans in education, prefectural developments (e.g., Hokkaidō), and postal communication; the British in engineering and naval techniques, the French in engineering, army, and law; and the Germans in education, agriculture, medicine, and police (Beauchamp, 1983; Burks, 1985b; Jansen, 1983; Jones, 1980; 1985; Umetani, 1971; Watanabe, 1951b).

The government's attitude towards foreigners in Japan was influenced by situations surrounding treaty revision with foreign nations. By the late 1880s, however, Japan switched its interest in western studies from the U.S. to Germany after the German victory in the Franco-Prussian War (1870-1871) and Itō Hirobumi's visit there for the preparation of the

Meiji Constitution (1882-1884). Thereafter, Japan modeled itself on Germany in every aspect of education and legal structure, though the British exceeded German foreign assistants in numbers.

2. COMPENSATION AND LENGTH OF SERVICE: A majority of foreign employees received large salaries compared to Japanese civil officials (Beauchamp, 1983; Jones, 1980, 1985; Nakamura, 1955; Umetani, 1971; UNESCO, 1975). The Ministry of Education spent half of its budget for support of foreign teachers. According to Beauchamp (1983), three fourths of foreign employees were paid salaries equal to those of Japanese officials in the second and third level. In the period between 1872 and 1898, 35% of the 524 foreign employees in the public sector were paid monthly salaries between ¥100-200; 18%, ¥200-300; and 18% less than ¥100. On the other hand, 51% of foreign employees in the private sector were paid less than ¥50.

For example, Paul Mayet, a German economist who worked for the Ministry of Agriculture and Commerce, received a monthly salary of ¥250. Horace Capron was paid one of the highest salaries at ¥832 (Watanabe, 1951b). During the same period, the monthly salary of Daijō Daijin (Grand Minister of State, or later the Prime Minister) was ¥800; of Sa Daijin (Minister of the Left) and U Daijin (Minister of the Right) ¥600; of Sangi (Councillor) ¥500; Jikan (vice ministers) and the Chancellor of Tokyo Imperial University ¥400; Chiji (prefectural mayors) ¥200; and Japanese instructors in universities ¥5-10 (Nakamura, 1955; Umetani, 1971).

The Japanese government also integrated foreign employees into the Japanese status system based on the level of work performed. There were *e i g h t* ranks and three levels in civil service: hannin, rank eight or the *h i g h e s t* grade in the third level; sōnin, ranks four to seven or the second

level; and chokunin, ranks one to three or the highest level. Prime considerations in the system were prestige, seniority, and salary. Moreover, one's status was shown in such treatment as living arrangement, gifts, cash awards, decorations, pensions, and receptions. Only those who are at the sōnin level or above could attend the New Year reception given by the emperor.

For example, 38% of the 225 foreign teachers who worked for public schools received decorations of some sort; the Third and Fourth Orders of Merit represent 70% of the total decorations awarded to foreigners (Nakamura, 1965:305). The number of foreign teachers who received other types of awards amounted to 177 (78% of the total foreign teachers) including: 65 imperial gifts; 34 money granted or awarded as prizes; 27 permitted imperial audiences or rescripts; 19 granted treatment due rank of chokunin; 14 received life pensions; 5 granted treatment due rank of sōnin (Nakamura, 1965:305). These examples show us to what extent foreign teachers contributed to the modernization of Japan. Moreover, they describe how highly foreign employees were regarded by the Japanese government. Of course, this resulted in "considerable rivalry among yatoi themselves" (Jones, 1980:64).

According to Jones, the overall average length of service for foreign employees was about 5 years. Of 170 yatoi with ¥500 or more monthly salaries, the average length of service was more than nine years. For those sixty-two yatoi who served more than ten years, the average length was eighteen years. "Among all the yatoi, almost 100 served twenty years and at least 13 celebrated a twenty-fifth anniversary. A few others served even longer" (Jones, 1980:70).

3. REGULATIONS: Meiji leaders from the beginning recognized the use of foreign employees as a temporary arrangement until the government could replace them with Japanese trained abroad. There were many struggles for control of foreign employees. Bureaucratic reorganization as well as drafting formal guidelines for hiring foreigners paved the way for the Meiji government to gain control.

In 1870, guidelines entitled "Instructions for Hiring Foreigners" was issued⁹. The Ministry of Foreign Affairs took the responsibility of coordinating the administration of all foreign employees including private ones. The Ministry of Education at the same time coordinated the nationwide employment of foreign instructors. Education officials prepared a set of "Contract Regulations for Hiring Teachers (Kyōshi Yatoijire Jōyaku Kisokusho)". From 1881, however, the Council of State assumed most of the administrative responsibility concerning foreign employees.

Equalizing relations with foreign countries became the most important goal for Japan's diplomatic effort from the early through the mid-Meiji period. In order to control foreign employees, a license system, like an alien registration certificate, was employed and strictly enforced by the government. Other restrictions were placed on foreign employees including residence, trade activities, religious activities, etc.

4. ADMINISTRATIVE POWER OF YATOI: Despite the necessity of foreign assistants, the Japanese government did not give yatoi much administrative power. Even those in high advisory positions were

⁹ See Jones (1968) for the detailed discussion on this official Policy.

supervised by Japanese administrators and were excluded from the process of making important decisions. Jones (1980:106) summarizes as follows:

It was in their tutorial and advisory 'sub-leadership' role that their full significance is to be found. The ability of a foreign employee to contribute effectively to the Japanese in the Meiji period depended in large measure on how he viewed his own role, but clearly the yatoi self-image was to a degree sculpted by the Japanese image of yatoi. And in that image is refracted the whole of the Meiji experiment.

By the peak years in the employment of yatoi in 1874 and 1875, there was already a significant reduction in hiring high-ranking foreign assistants. The Japanese recognized the importance of preserving their own identity and utilizing indigenous accomplishments. More Japanese, especially those who returned from overseas studies, began assuming responsibilities in the administration. In fact, the Meiji government was facing serious financial difficulties because of high expenses for yatoi, ryūgakusei, and other modernization projects.

By the 1880s, many offices in the government hired foreigners as advisors in specific areas needing to be reorganized or developed. In education, this trend toward specialization also became evident in that "[s]tudents of yatoi trained others, and yatoi in the schools were steadily replaced by Japanese" (Jones, 1980:42).

B. Foreign Employees in Agricultural Science¹⁰

The Meiji Government was commended for the renewal of Japanese agriculture with the application of Western science and technology by

¹⁰ Biographical information on foreign employees in agricultural science came from the following literature: Nakamura (1965); Tuge (1961); Yuasa (1952), Umetani (1969, 1971) and UNESCO (1975). Particularly, see Fujita (1983) about Horace C. Capron; and Maki (1983) about William S. Clark.

foreign employees who had already established a reputation and trust in Japan such as Guido Herman Fridolin Verbeck (1830-1898), an American missionary; Gottfried Wagner (1831-1892), a German technologist; and Charles William LeGendre (1830-1899), an American military diplomat (Nakamura, 1966). Initially, the emphasis in agricultural development was placed on Anglo-American large-scale farming to raise foreign plants and livestock.

In the beginning, instructors and consultants were invited from England and the U.S. to the agricultural colleges, experiment stations, Ministry of Agriculture and Commerce (1881), and the Hokkaidō Development Office. These foreign employees included Josia H. Hall, an agriculturalist from the U.S., "to teach cultivation, afforestation, gardening, and cattle-breeding;" D.W.A. Jones from the U.S. for sheep farming; and Edward Kinch (1848-1920) and William D. Cox from England for agricultural management (Nakamura, 1965:315).

In the area of textile industry, E. Home, an English technician, played a fundamental role in establishing and administering a spinning factory in Kagoshima in 1867 -- the first mechanized cotton mill in Japan; Casper Müller, a Swiss resident in Kōbe in 1870, taught the Italian method of silk manufacturing at a government factory in Tokyo; Paul Brunet, a Frenchman, taught the French method of silk manufacturing at a model factory in Tomioka.

The government soon realized that unlike in the industrial sector, direct importation of Western technology in agriculture was unsuccessful because the machines were inapplicable to the small scale of farming and **the** exotic plants and livestock did not always adapt well to the Japanese

climate¹¹. Because of its climate and low population density, Hokkaidō was the only area in Japan which adopted the American model of agriculture. Therefore, the focus for the agricultural development model in Japan except Hokkaidō shifted from English and American to German agriculture. It was because the former two models stressed the large-scale farming techniques with heavy reliance on labor-saving machines while the latter, that emphasized the application of soil chemistry, was considered as more compatible to the small-scale farming (Kashiwa, 1964; Katayama, 1988; Kurata, 1978; Takayama, 1981).

Thereafter, agricultural education and research in colleges and universities emphasized agricultural chemistry and soil science in the German tradition. Johannes Ludwig Janson (1849-?) and Carl Troester were invited from Germany to teach veterinary sciences in 1880 followed by Oskar Kellner (1851-1911) and Max Fesca (1882-1894).

During their stay in Japan, Kellner and Fesca left many contributions to Japanese agricultural science. At the Komaba Agricultural College, they conducted systematic investigations to learn about Japanese agriculture through experiments based on agricultural chemistry (e.g., the first soil testing by Fesca). Fesca submitted to the government his recommendations for social welfare assistance. Kellner submitted to the Japanese government his research reports concerning soil, fertilizer, sericulture, and animal husbandry. Both Kellner and Oscar

¹¹ Some crops adapted well to the Japanese climate include oats, peaches, sweet cherries (Napoleon and Hinode) apples (Kōgyōku, Kokko, and Indo), grapes (Delaware, Muscat of Alexandria, Muscat-Hamburg), tomatoes, cabbages, white potatoes (Early Rose), onions (Yellow Danvers), asparagus, sugar beets, rapeseed (Hamburg), pyrethrum, and hops (Ogura, 1970). Yet, the production of these crops did not increase until after World War I. The demand for vegetables and fruits increased as the food processing industry grew.

Lowe (1855-?) from Germany are today considered to have laid the foundations of agricultural chemistry in Japan by teaching at the Agricultural College of Tokyo Imperial University. In the field of agricultural civil engineering, Dutch engineers such as C. J. Van Doorn contributed a great deal.

Both Paul Mayet (1876-1891) and Gottfried Wagner (1868-1892) from Germany worked for the Ministry of Agriculture and Commerce for some length of time. Mayet was particularly known for social programs that he recommended to the government including fire and home insurance and aid to the poverty-stricken farmer. Wagner contributed to the industrial and commercial sector by training various types of technicians and engineers.

Among all those who contributed to the development of agricultural science, Horace C. Capron, who served as a foreign advisor for the development of Hokkaidō, and William S. Clark, who helped establish the Sapporo Agricultural College, are the most well remembered foreign employees in Japan¹². However, these two were received very differently by the Japanese.

Clark represents an example of the most successful and influential foreign employee "who sought real dialogue...[and communicated with the Japanese] in terms of mutual respect" (Jones, 1985:248). Despite his one-year service at the Sapporo Agricultural School, his strong influence on his students can be seen in the fact that they all converted to Christianity and that Clark's fatherly figure was recorded in their

¹² Further details on the Sapporo Agricultural College, see Ebina (1991).

diaries, letters, and memoirs; also he is still widely known to the Japanese by his famous quote, "Boys, be ambitious!"¹³.

On the other hand, Capron illustrates a case of those foreign employees with advisory positions who were unhappy because of their lack of authority. General Horace Capron (1871-75) had a good record in agricultural experimentation as a U.S. commissioner of agriculture. When he became an advisor to the Hokkaidō Development Office (Kaitakushi), "he provoked quarrels with his foreign staff, driving most of them to other yatoi jobs," and with "lower Japanese officials, though he maintained rapport with Commissioner Kuroda Kiyotaka" (Jones, 1980:86).

Contributions of foreign employees to Japan's modernization were immense during the Meiji period. In the area of agricultural science, those hired by the MA&C, the Ministry of Education, or the Ministry of Internal Affairs worked to define roles of agricultural scientists in universities and research institutions, and in light industry, especially the textile industry. Using the employment of foreigners as the second modernization strategy, the government learned skills to control actors through the enactment and enforcement of regulations.

IV. RYUGAKU-SEI (OVERSEAS STUDENTS)

In the late Edo period, overseas study began in its own right. The Tokugawa Shōgunate sent "formal" overseas study groups first to Holland in 1862, to Russia in 1865, and then to Britain in 1866 (Ishizuki, 1985; Watanabe, 1965). "Informal" overseas students, those without permissions

¹³ See Ebina (1991) about Clark's influence on his students.

from the Bakufu, were sent by regional feudal lords¹⁴, and went on their own¹⁵. The motivation of those overseas students, formal or informal, was "the idea of opening the country in order to rival the West in wealth and power and of increasing Japan's military strength, on the basis of the slogan of Sakuma Shōzan, 'Eastern ethics, Western science'" [Wakon Yōsai] (Ishizuki, 1985:163).

It was the Meiji government after the Charter Oath (See **APPENDIX A**) that instituted it as a policy to train students abroad in order to replace foreign employees. According to Burks (1983, 1985), the total number abroad for the period 1871-1873 was about 350, and for the entire Meiji era 11,248 (3% of all passports issued by the government).

The Ministry of Education began sending graduates of the Tokyo Imperial University overseas for study in 1875. However, it was not until the establishment of the fundamental law on education (1872), or Gaku Sei, and the Imperial Rescript on Education (1890), or Kyōiku Chokugo, when the government officially recognized that sending students abroad temporarily was the best means for acquiring knowledge from the West (Watanabe, 1951a, 1951b, 1953, 1965). It was defined as a strategy to catch up quickly with the advanced nations in the West, and a means to prove to the advanced nations Japan's sincere desire to modernize and learn from their civilizations.

¹⁴ For example, the Chōshū domain sent students to Britain in 1863 including Inoue Kaoru and Itō Hirobumi; the Satsuma domain sent students to abroad in 1865.

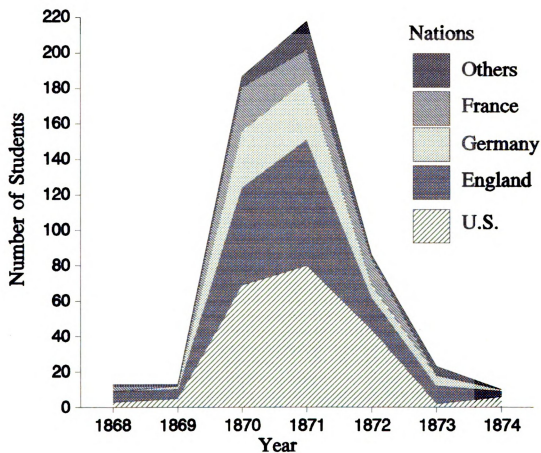
¹⁵ Some well-known students are Niishima Shimeta who later founded the Dōshisha University; Yokoi Saheida; Yokoi Dai; and Katsu Koroku.

A. Dispatch of Ryūgakusei

1. **NUMBERS:** During the period between 1868 and 1896, officially sponsored students made up about 11% of the passports issued. In the period between 1872-1873, about 10.6% of the total budget of the Ministry of Education went to support the expenses of overseas study, the second largest expenditure (Burks, 1983, 1985; Ishizuki, 1972, 1985; Watanabe, 1953, 1965). Figure 4.2 shows the number of overseas students by selected countries of destination in the period between 1868-1874 (Ishizuki, 1972:154;1985:169). In the very early period, the U.S. and England were the most popular destinations for overseas studies, much as they were the most popular sources of foreign employees.

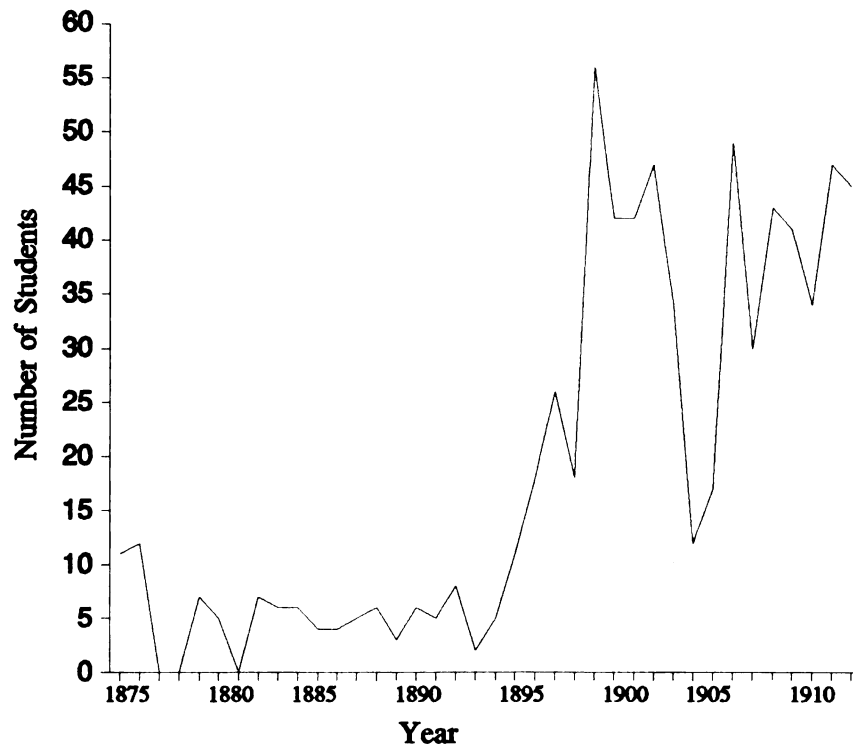
Figure 4.3 shows the number of students sent abroad for study by the Ministry of Education during the Meiji period after the enactment of the loan program for overseas studies in 1875 (Watanabe, 1966:281-282). This shows that the employment of foreigners preceded the dispatch of students abroad. The peak of hiring foreign employees was the year 1874-75 when the dispatch of "high quality students" by the Ministry of Education began. However, the dispatch of ryūgakusei reached its peak after 1900.

2. **COUNTRY AND SUBJECT:** The countries to which students were sent also reflected the subject of study: "England -- mechanics, commerce, iron manufacturing, ship-building, animal husbandry and charitable activities; France -- law, international law, zoology, and botany; Germany -- political science and medicine; United States -- postal communications, technology, agriculture, animal husbandry, commerce, and mining" (Burks, 1985a:151). Between 1868 and 1902, however, 57% of all study passports were to the U.S., and the destinations of students in the U.S. moved from the East to the West in this period.



Note: In case where students visited two or more countries, all were counted.
Source: Ishizuki, 1985.

Figure 4.2. Overseas Students by Country of Destination.



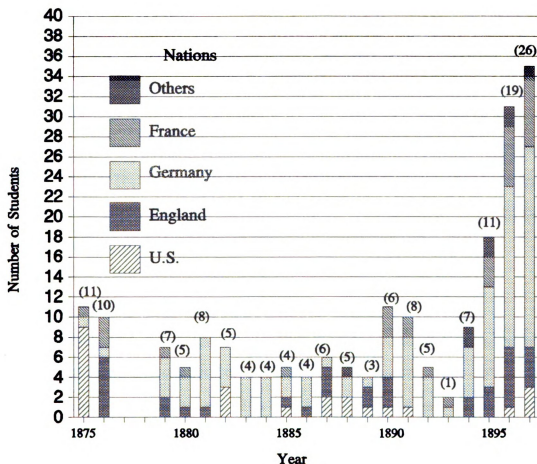
Source: Watanabe, 1966.

Figure 4.3. Number of Students Sent Abroad by the Ministry of Education, 1875-1912.

By the 1880s, the choice of destination shifted from England and the U.S. to Germany, especially among those students sent by the Ministry of Education, as shown in **Figure 4.4** (Ishizuki, 1972:205). The Meiji Government developed a more favorable attitude toward Germany after the German victory in the Franco-Prussian War (1870-1871) and Itō Hirobumi's visit there for the preparation of the Meiji Constitution (1882-1884?). Furthermore, unlike those sent in the first decade of the Meiji period as shown in **Figure 4.2**, students dispatched during this period were frequently allowed to visit more than one country to study.

Ishizuki (1985:175) points out the significance of "the fact that the majority of the overseas students enrolled in the science curriculum." It reflects a realization that science and technology were necessary to increase the national wealth and general enlightenment as well as for the defense of the country. This trend also reflects the large number of graduates of the science curriculum from Tokyo Imperial University during the entire Meiji period (see **Chapter 5**). It was those graduates who were sent overseas by the Ministry of Education to acquire more knowledge for the establishment of science and technology in Japan.

3. OVERSEAS STUDENTS IN AGRICULTURAL SCIENCE: The dispatch of overseas students, specifically for agricultural science, did not begin until the middle to late Meiji period, relatively late compared with such areas as medical science, engineering, and general science. The reason seems to lie in the fact that the importance of agricultural science was recognized later than other scientific fields both in Japan and the West. For example, most of universities in the West did not have a special curriculum for agricultural science at that time. Therefore, students in the early period, who had wished to study agriculture, took the general



Notes: In case where students visited two or more countries, all were counted.

() indicates the total number of students sent abroad each year.

Source: Ishizuki, 1972.

Figure 4.4. Number of Students Sent Abroad by the Ministry of Education, 1875-1897.

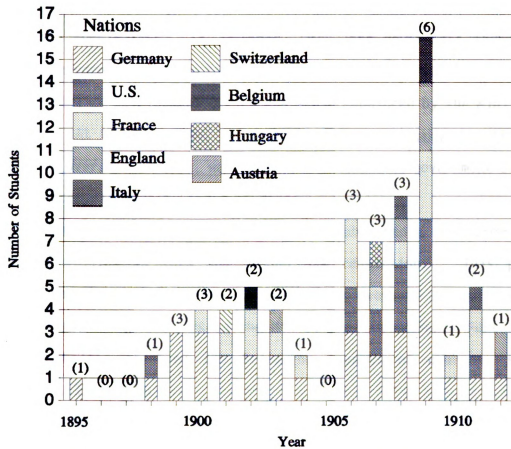
science curriculum instead.

In Japan, the tradition of medical education was carried from the Edo period while agricultural schools and experiment stations were not established until the 1870s (See **Chapter 2**). Most students in agricultural science went to study overseas upon their graduation from these agricultural colleges.

Figure 4.5 shows that Germany was overwhelmingly popular as the destination for studying agricultural science, followed by France, the U.S., and England as Liebig's theory of agricultural chemistry and soil science was increasingly emphasized in agricultural schools (Watanabe, 1965:288-291). The fact that many foreign professors at the College of Agriculture of Tokyo Imperial University were from Germany suggests their strong influence upon Japanese students.

B. Regulating Ryūgakusei

In 1869, the government conducted a survey of Japanese students abroad to evaluate the quality of overseas studies and to draw regulations and guidelines for the studies. The Meiji government prepared "Nine Rules of Conduct" to clearly define the role of overseas studies as a national policy rather than as an enhancement of individual students (Burks, 1985; Ishizuki, 1985). Furthermore, it clarified the following aspects of overseas studies: selection of students, length of stay, subjects to be studied, expenses to be allowed, and supervisory control mechanisms to be used. The new regulations were significant in their "principle of transcending considerations of social status" and their emphasis on "the need for selection according to ability and free competition" (Ishizuki, 1985:167). In short, ryūgaku were to develop human resources to build



Notes: In case where students visited two or more countries, all were counted.
() indicates the total number of students sent each year.

Source: Watanabe, 1965.

Figure 4.5. Number of Overseas Students in Agriculture, 1895-1912.

Japan to be an independent nation supported by military and industrial strength.

Another survey was conducted by the Iwakura Mission to America and Europe to appraise the quality of overseas studies. Based on this report that described the poor progress of overseas students, Itō Hirobumi and others favored a policy to limit the number of overseas students and to issue new regulations. In December, 1873, the government ordered all overseas students to return home except the five female students sponsored by the Hokkaidō Development Office and those sponsored by the Ministry of the Army. At the same time, the program of Kanhi Ryūgaku, or officially sponsored overseas studies, was abolished because the government saw very little accomplishment by those students.

However, the Ministry of Education established a loan program for overseas studies in 1875 and issued new regulations. This program transferred the responsibility for supervising overseas students from the Ministry of Foreign Affairs to the Ministry of Education. Furthermore, the new rules specified the following aspects of overseas studies (Ishizuki, 1972:193):

- (1) Qualification examinations were required to select students who excelled in scholastic ability, health, moral conduct;
- (2) The Ministry of Education would loan to those selected students ¥1,000 annually plus travel expenses (e.g., ¥480 to New York, ¥610 to London) and moving allowances of ¥166; and they had to return the entire loan within 20 years, starting three years after graduation;
- (3) The length of overseas studies was limited to 5 years;
- (4) The overseas students were required to seek guidance from the Office of Overseas Studies for choosing a school abroad and major, and were not allowed to make any changes in these matters; and

(5) The returned students were required to take competency examinations, excepting those who obtained a college degree.

Ishizuki (1985) points out that the improvement in the quality of students came in the period between 1875 and 1881 as a result of these new regulations. The students during this period were different from those of the previous periods in the sense that "[t]hese later students performed a role in displaying the ability of the Japanese to the world, and in promoting the modernization of Japan by Japanese, when they replaced foreign instructors and technicians" (Ishizuki, 1985:177).

C. Roles of Returned Students

The character of overseas studies during the Meiji period becomes apparent when we look at roles played, as well as contributions made, by the returned students. It has been argued that one characteristic of Meiji overseas studies was the strong sense of nationality among those students who studied abroad (Burks, 1985a; Ishizuki, 1985; Watanabe, 1953, 1966). The success of Japan's overseas study experiment seems to come from the fact that Japanese students pursued the goals of the government and nation rather than their own as various memoirs, letters, and diaries of returned students show. Furthermore, the majority of overseas students returned to Japan upon the completion of their studies abroad.

The second characteristic is that returned overseas students took prominent positions in both national and regional governments, educational and research institutions, and private institutions, replacing foreign employees. Almost all Meiji leaders had some kind of experience abroad, or at least were familiar with Western studies. As shown in Table 4.2,

the majority of those with doctoral degrees had experience overseas (Ishizuki, 1972:231).

Table 4.2. PhD Holders with Experience in Overseas Studies, 1892.

| Degree | Number | Experience in Overseas Studies | % with Overseas Experiences |
|-------------|--------|--------------------------------|-----------------------------|
| Arts | 14 | 7 | 50 |
| Law | 18 | 17 | 94 |
| Medicine | 32 | 26 | 81 |
| Science | 26 | 22 | 85 |
| Engineering | 31 | 27 | 87 |
| Total | 121 | 99 | 82 |

Source: Ishizuki, 1972.

Third, education became the prime qualification for leadership positions by the 1880s as an increasing number of competent students returned from abroad. In another words, "[a] new educational elite was substituted for the former social elite and in turn formed a new social and political elite" (Jones, 1980:133). However, family status based on origins remained strong until the third decade of the Meiji period.

In a comparison with overseas study experiences of China during the same period, Ishizuki (1985:184) points out that China's rigid exclusion policy made the returned Chinese overseas students unable to gain an "official and organized base from which to make their influence felt." Moreover, western studies in China were excluded for a long time from the curriculum for official rank. Thus, the diffusion of western knowledge in China was very thin. And, no connection was made between overseas study

and the internal structure of China. In comparing Chinese and Japanese policies of overseas study, Ishizuki (1985:184) argues that "even more fundamentally these objectives arose from a difference in attitude toward foreign countries on the part of the Japanese in contrast with the Chinese."

On the one hand, the dispatch of students overseas was effective in raising individuals with skills and ability to modernize the nation through various institutions. On the other hand, by providing educational support to future scientists, the government increased its influence on their activities in universities and experiment stations.

V. INDIGENOUS KNOWLEDGE

A voluntary movement among the peasants to improve agricultural production began in the late Edo period as "agricultural products were involved deeper in the money economy and exposed to the price fluctuation in the wider market" (Japan FAO Association, 1959:37). In the Meiji period, the following three factors strengthened this tendency: (1) the abolition of the barriers between domains (sekisho) that resulted in the consolidation of the nationwide market, (2) the increased autonomy of farmers with respect to agricultural production (e.g., crop to plant) and their livelihood (e.g., freedom of residence, occupation, and travel), and (3) the exportation of agricultural products (e.g., tea, silk, silkworm eggs).

Efforts farmers made to improve agricultural productivity included selecting superior varieties of rice, developing superior techniques to grow rice (e.g., selecting rice in salt water), inventing agricultural equipment which reduced the amount of labor needed, and holding voluntary

meetings to exchange superior seeds and information about improved agricultural techniques.

A. Farmers' Initiatives

Farmers' initiatives to improve agricultural productivity were expressed in various meetings held by regional agricultural societies to discuss better farming techniques, superior varieties of crops (e.g., rice, cotton, rape) and new farming equipment. Although the origin of these agricultural discussion societies is unknown, their activities reached a peak after the inflation of 1878-81 (Nihon Nōgyō Hattatsu-shi Chōsa Iinkai, 1979).

1. AGRICULTURAL DISCUSSION SOCIETIES: Agricultural discussion societies and seed-exchange societies were organized in various regions by farmers, largely landowners, who had an interest in the improvement of agricultural production. A regular meeting was held usually at either a local temple or school. A renowned rōnō was invited to speak about his experiences and techniques in farming at such a meeting. Although many of these organizations concerned rice cultivation, there were discussion societies for other commodities including the Tea Discussion Society, the Cotton Discussion Society, and the Silk Discussion Society.

Seed-exchange societies were developed as a place for farmers in the region to exchange superior seeds selected by them. It appears that these societies flourished in the northern region, especially Akita Prefecture, since the rice cultivation in this region often suffered from the severe climate (Nihon Nōgyō Hattatsu-shi Chōsa Iinkai, 1979).

One important characteristic of the agricultural and seed-exchange societies is that their members largely came from the landowning class of

farmers. Very few tenant farmers were involved in these activities. The landowning farmers, especially landlord farmers, had a strong interest in the increase in agricultural productivity. Since the land tax was fixed at the land value, the more they produced the bigger profit they made. On the other hand, the tenant farmers had little interest in improving productivity since they paid their tenant fees in kind according to their production.

2. RŌNŌ (VETERAN FARMERS): Prior to 1874, activities of rōnō were not notable because the government emphasized the application of Western farming techniques to agricultural production in Japan. However, at the same time, the agricultural administration was not well defined during this period as it went through numerous reorganizations.

The majority of so-called rōnō, or veteran farmers, came from the landlord or landowner class of farmers. Although they lacked "modern education," they had an understanding of classic literature, arithmetic, and Chinese philosophy. Their research was largely based on their experiences and observations.

With the establishment of the MA&C, the position of rōnō was elevated to that of agricultural experts. Many of them were hired by local governments or the MA&C as consultants, instructors, or researchers. Although there were constant debates between agricultural scientists and veteran farmers, and among veteran farmers themselves, over the validity of their farming techniques, various studies of rōnō were taken up by agricultural experiment stations and helped agricultural scientists understand Japanese farming. The most renowned rōnō during the Meiji

period include Nara Senji, Nakamura Naozō, Funatsu Denjibei, and Ishikawa Rikinosuke as discussed below¹⁶.

Nara Senji (1822-1893)

Nara specialized in rice seed selection. His achievement in selecting "ippon ine," or "nara ine" made him famous in the Shikoku district, and later throughout the nation. After having served in agricultural consultant positions for local governments, he was hired to work at the Mita Botanical Experiment Yard. Nara also invented various pieces of farming equipment.

Nakamura Naozō (1832-1891)

Nakamura worked on rice seed selection, and made contributions to the cultivation of mulberries and tea. In 1875, he was hired by Nara Prefecture to conduct trials of new crops. He traveled around the nation to give lectures on the improvement of agricultural production.

Hayashi Enri (1881-1906)

Hayashi became famous with his lectures on: (1) burying seeds under **the** ground during winter (tsuchi kakomi hō), (2) selecting rice seeds by **soaking** them in cold water (kansui hitashi), (3) horse plowing (bakō), and **(4)** packing rice in straw rice bags. He published several books on his **farming** techniques including Kannō Shinshō.

Funatsu Denjibei (1832-1898)

Funatsu became the director of the experimental farm of the Komaba **Agri**cultural College in 1877. He gave lectures and training sessions on **Japanese** farming at the school. In addition, he traveled throughout the

¹⁶ Biographical information on rōnō came from the following literature: Ono (1941), Nihon Nōgyō Hattatsu-shi Chōsa Iinkai (1979), and Saitō (1968).

nation to teach farmers farming techniques. In 1885, Funatsu was employed by the Ministry of Agriculture and Commerce and worked for agricultural experiment stations. Compared with other veteran farmers, he understood about Western farming techniques and adopted them to his farming techniques.

Ishikawa Rikinosuke (1845-1913)

Ishikawa published numerous books and lectured nationwide. In 1872, he was hired by Akita Prefecture and helped to establish the prefectural experiment station. Ishikawa conducted tests on adaptability of crops including rice, wheat, other grains, and pears. In 1877, he submitted to the Bureau of the Encouragement of Agriculture a proposal and received funds to study methods to prevent rice from spoiling during storage.

Nakai Taichi (1831-1913)

Nakai invented a rotary cultivator-weeder driven by hand called the "taichi guruma" or "tauchi guruma," which is discussed below. In 1883, he began traveling around the south western parts of Japan, giving lectures and training sessions on farming techniques. He studied drainage methods for rice cultivation, and stressed the importance of soil for the improvement of rice production.

Masuda Motohei (1847-1903)

Masuda studied insect control in rice in Fukuoka Prefecture. He published the results of his study in 1894 and 1896. When the Kyūshū Branch of the National Agricultural Experiment Stations was established in 1903, it was assigned to specialize in studies of insect management.

B. Technical Improvements

1. **RICE BREEDING:** Early rice breeding was intended to develop varieties designed "for more tillerings, shorter stem and more grains per stand" (Japan FAO Association, 1959:38). In 1876, a voluntary meeting among farmers was organized in Kyoto for exchanging rice seeds. Similar meetings followed in many regions resulting in the development and diffusion of new rice varieties and improved agricultural techniques throughout Japan.

Sinriki (the power of God) was first selected in 1877 as a high yielding variety and spread widely in the western part of Japan after 1886. In the cold northern part, Kameno-Ō became the most popular variety for early maturing in order to avoid frost damage and for its resistance to both high fertilizer use and disease induced by drying wet paddy fields. In the Kantō area, another high yielding variety called Aikoku gained popularity. Other rice varieties selected by veteran farmers include: Omachi or Wataribune, Takenari, and Sekitori (Nihon Nōgyō Hattatsu-shi Chōsa Iinkai, 1979:688).

2. **CHEMICAL FERTILIZER:** With the spread of these rice varieties, the use of fertilizer also increased, thus necessitating the production of a variety responsive to heavy applications of fertilizer. As communal grounds were taken away from farmers by the government, the application of commercial fertilizer increased: first fishmeal, then cheap soybean cake from Manchuria, and finally phosphate fertilizer.

The importance of chemical fertilizer was introduced at the agricultural colleges (e.g., the Komaba Agricultural School, and Sapporo Agricultural School) in agricultural chemistry classes. The first fertilizer factory was founded in Tokyo in 1898, and "the production of

[superphosphate] fertilizer increased rapidly after phosphate ore began to be imported from the Christmas and Ocean Islands in 1901.

3. HORSE PLOWING: Deeper plowing of land became necessary for the increased use of fertilizer to be effective. It was Max Fesca who recommended plowing deeper. Thus, farmers in some parts of Japan began to use horses and cows for cultivating land as well as a new kind of plow called kakaemottate suki¹⁷. This type required much skill for use, therefore necessitating training in its use.

To meet this need, experienced farmers of different regions met to learn new techniques for agricultural production at local discussion meetings. At these discussion meetings, such famous technical leader-farmers of the period as Hayashi Enri and Yokoi Tokitaka were invited to play the role of teacher. After the meeting, these farmers went around with a new plow "in hand from place to place throughout the country ... heralding a new era in the modern history of Japanese agricultural techniques" (Japan FAO Association, 1959:43).

Horse plowing created the conditions for using more fertilizers by making deeper plowing possible, and helped save labor. As a result, planting a second crop, particularly wheat, in paddy fields became much easier. This encouraged the transformation of wet paddy fields into dry ones to increase the area available for wheat production.

The reformation of field borders from very irregular partitions into regular forms began in 1887 on a large scale in order to make horse plowing easier and more efficient. This induced the government to launch a full-scale project for readjustment of cultivated land in the 1900s

¹⁷ See Japan FAO (1959) for pictures of different plows.

including rearrangement and improvement of the irrigation and drainage systems.

4. NEW EQUIPMENT: In 1892, a rotary cultivator-weeder driven by hand called the "taichi guruma" or "tauchi guruma" was invented. This machine became very popular among farmers since they only needed to push it between the rows of rice plants instead of crawling on the field with a hoe to turn over the soil. However, the use of the taichi guruma required straight rows of rice both in length and breadth. In short, the practice of transplanting seedlings in straight rows began as a result of the development of the taichi guruma, "and of higher yields realized partly owing to better ventilation and more sunlight given to plants through regular and straight spacings" (Japan FAO Association, 1955:49)

A rotary threshing instrument was invented in 1911 replacing the multi-blade stripper (senbakoki) that had been used for the previous 200 years. This machine threshed grain off with steel wires fixed to a rotating drum. The invention of this machine owes much to the development of agricultural engineering at agricultural schools. However, its rapid diffusion reflects the progressive attitude of farmers toward the improvement of agricultural techniques and the availability of investment capital for new equipment in rural communities. The emergence of the rotary thresher helped save labor at harvest time and contributed to the diffusion of multiple cropping in paddy fields.

C. Government Efforts

It was not until the 1880s that the government initiated volunteer efforts among farmers to increase agricultural productivity. The Ministry of Agriculture and Commerce was established in 1881 as the result of

several reorganizations made to the Bureau for the Encouragement of Agriculture (Kannō Kyoku, 1871).

Three major programs were established just prior to the establishment of the Ministry of Agriculture and Commerce. It was in these new programs where rōnō carried the most significant works for the improvement of agriculture. First, the Agricultural Correspondence System was enacted in 1878. It permitted the Bureau for the Encouragement of Agriculture and prefectural governments to correspond with each other through veteran farmers to furnish information on agricultural affairs on a nationwide scale. Experienced farmers were hired in local agricultural experimental stations and agricultural schools including the Komaba Agricultural College and the Sapporo Agricultural College. Their lack of scientific knowledge was offset by the great number of graduates from agricultural schools.

Second, the Advisory Council for Agriculture, Commerce, and Industry, the Advisory Council for the Encouragement of Industry, and the Committee for the Encouragement of Industry were established. The Ministry of Agriculture and Commerce organized the Advanced Conference for Agriculture and Commerce as the consultative body for the three. The Government encouraged prefectural governments to set up similar bodies.

The third program was the Itinerant Instructors of Farming. After 1877, agricultural discussion societies and seed-exchange societies were developed all over the nation led by such experienced farmers as Hayashi and Yokoi. In the same period, great numbers of graduates from agricultural schools came forth. The Itinerant Teachers of Farming was established by the government "with a view to promoting the improvement

and development of agriculture by diffusing scientific agricultural techniques among experienced farmers" (Ogura, 1970:158).

On the one hand, the application of indigenous knowledge to the improvement of agriculture was the result of failures in the adoption of Western large-scale farming techniques. The government realized that farming techniques were not something that could be altered overnight, and that the knowledge of veteran farmers based on their experiences was not inferior to that of Western science and technology.

On the other hand, the impact of several periods of inflation in the 1880s and the depression of 1885 should not be underestimated in explaining the increasing trend to utilize indigenous knowledge in the encouragement of agriculture. For example, the depression of 1885 caused a 20-30% decline in the number of voters. Since the voting right was given to landowners who paid over ¥3 land tax, this indicates that many landowners were losing their land (Nihon Nōgyō Hattatsu Chōsa Iinkai, 1979). Furthermore, dissatisfaction with the government was expressed in the form of riots among the rural population during this period. When the first Diet was called in session in 1890, the necessity to encourage agricultural improvement was discussed extensively since 48% of the House of Representatives came from the agricultural/forestry occupations (Kyoto Daigaku Bungakubu Kokushi Kenkūshitsu, 1958:766-767)

The incorporation of farmers' indigenous knowledge in the encouragement of agriculture helped farmers to enroll in the social network of agricultural science. On the one hand, the close tie between government and the farmers emerged from this process, and a clear separation between the landowning farmers and the tenant farmers emerged on the other.

VI. CONCLUSION

During the Meiji period, Japan used four strategies to modernize the nation including the dispatch of official missions, the employment of foreigners, the support of overseas students, and the application of indigenous knowledge.

The use of foreign assistance and sending students overseas are two commonly used modernization strategies used by developing nations today. In the history of modern Japan, it is essential to recognize that the government was in control of its foreign contacts and modernization process.

The success of Japan's experience in hiring foreign employees lies in the fact that the Japanese government gained complete control of the matter through trial and error. As Jones (1985:224) states:

Most of the friction which marked relations with foreign employees in the early years had its root in the insistence of Japanese officials that they were in charge even though their lack of experience necessarily shifted responsibility to foreign employees. ... By 1875, however, in every activity, the Japanese had succeeded in establishing their managerial function.

Moreover, the Meiji government bore total financing for foreign assistance and devised policies for control of activities of foreign assistants.

Yet, the Meiji experiment lacked coordination in some aspects. The decision to select yatoi from particular nations came from many conflicting and contradictory influences. The same was true with the selection of countries for overseas students. Moreover, there were wide gaps between the industrial sector and other sectors in terms of development, between society and government in terms of the realization of national goals, and between the ruling class and the working class in terms of livelihood.

The case of agricultural science illustrates that "[s]hifts in attitudes [among the Japanese] toward the West, Westerners, and Western influence" reflect the course of Japan's modernization in terms of change in the government's emphasis from importation to adaptation of Western science and technology to indigenous farming practices (Burks, 1985a:147). Japan was selective as to what knowledge it would import from the West. The modernization process was carried out "within the framework of a Japanese Western compromise" (Burks, 1985b:188).

Therefore, the introduction and diffusion of agricultural science and technology was the result of a combined effort among scientists, political leaders, and so-called expert farmers. And, their roles in such institutions as agricultural experiment stations and agricultural colleges were defined in this political process according to the nation's needs in agriculture. Compared with other industrial nations, the Japanese government today supports a large amount of agricultural research (Latour, 1985).

Nevertheless, as we will see in the next chapter, the development of agricultural science also shows how gaps in society emerged in the modernization process. Education became the primary qualification for success in modern Japan creating a new type of "elite" class. The pattern of government protection for domestic agriculture and business, and the close ties among the government and farm and business organizations originated in the Meiji period as "[t]he agrarian hierarchy with the landowners at the top was included into the outer rims of the government's administrative structure" (Japan FAO Association, 1955:35).

CHAPTER 5: INSTITUTIONAL ANALYSIS OF AGRICULTURAL SCIENCE

I. INTRODUCTION

The Meiji period saw rapid growth in agricultural productivity because of the increase in domestic needs for food, raw materials for processing industries, and export surplus to finance industrialization. Between 1882 and 1912, total agricultural production increased 121%, 64% of which was accounted for by rice production, although the agricultural labor force increased only 5%. Land productivity increased 76% while labor productivity increased 117% during the same period (Hayami, 1975).

In the process of modernization, the Meiji government relied on agricultural products for overseas exports to collect enough foreign currency to purchase raw materials and machinery for industrialization. During the Meiji period, the importance of agricultural products declined in export trade from 73.9% to 44.7%, but increased in imports from 17.3% to 56.5% (Takahashi, 1969).

Ogura (1970) identifies seven factors for the growth of agriculture during this period: (1) the abolition of restrictions on product distribution¹, (2) the unification of the nation², (3) population growth

¹ During the Tokugawa period, anyone who wished to cross borders between two domains was required to obtain permission from the feudal lord. Each feudal lord controlled the distribution system of his domain by restricting the flow of merchandise from other domains. The system of sekisho (checkpoints between domains) was abolished when the domains were abolished, enabling the citizens to freely cross borders between two prefectures or urban districts.

from 34.8 million in 1872 to 50.6 million in 1912, (4) urbanization (The total urban population increased from 3,446,000 in 1880 to 9,680,000 in 1910), (5) the growth of income³, (6) the growth of exports from ¥21,622,000 between 1873 and 1877 to ¥437,721,000 between 1908 and 1912, and (7) the Sino-Japanese (1894-95) and Russo-Japanese (1904-1905) Wars⁴. From these factors, we can observe that the industrial and agricultural sectors were interdependent in their development. Although the development of the industrial sector took precedence, Japan's success in modernization lay in the government's coordination between the two sectors.

In this chapter, we will look at institutional transformation in the process of modernization of the agricultural sector, raising the following two questions: (1) How was the agricultural science that was imported from the West incorporated into Japanese agriculture? (2) How did this process relate to the development of industrial capitalism in Japan? To answer these questions, we will examine the formation of such institutions as the agricultural bureaucracy and education/research system, farmers' organizations, and light industry. Moreover, we will seek links among

² In August 1871, the prefectural system was extended to the whole of Japan, replacing the domains by urban districts (fu) and prefectures (ken) with local administration under the central government (Haihan Chiken or Abolition of the Domains). By 1873, real local autonomy, protected during Tokugawa feudalism, ended as the domains lost their identities in the reorganization.

³ Growth rates in the five-year average of the national real income of 1908-1912 from the 1883-1887 level were: 209.4% in primary industry, 395.8% in secondary industry, and 316.8% in tertiary industry. The total growth was 269.2% (Takahashi, 1969:390).

⁴ For more details on the economic development in Japan during this period, see Takahashi (1969).

actors in the social network of agriculture, that emerged in the four modernization strategies discussed in the previous chapter.

II. REVISION OF THE LAND TAX (CHISO KAISEI)

The Meiji period can be divided into two distinct phases of capitalist development according to changes in the definition of "modernization": (1) the Westernization Phase which took place prior to the Sino-Japanese War, and (2) the Nationalistic Phase which began after the Sino-Japanese War (Ogura, 1970; Ono, 1944; Saitō, 1968). In the first phase, Japan was eager to import Western knowledge and techniques based on the notion that modernization equals Westernization or that anything from the West was "better" than what existed traditionally in Japan.

However, Japan's victory in the Sino-Japanese (1894-95) and the Russo-Japanese (1904-05) Wars brought confidence that Japan might not be inferior to the West. In addition, the government began privatizing industry to such large merchant houses⁵ as the Mitsui, Mitsubishi, Sumitomo, and Yasuda, partly in order to increase the government expenditure. These led to the transition to the second phase, that was centered around the encouragement of domestic industries.

Interestingly, the development of Japanese agriculture also saw two different tendencies in its transformation from the first phase to the next though the demarcation line was drawn at the formation of the

⁵ Although their origins were diverse, these merchant houses benefitted from contracts with and patronage from the Tokugawa Bakufu and later the Meiji government. These houses provided the government financial backing for various modernization projects. In return, the government provided protection for their monopolistic position. The legal basis for this close relationship between the government and so-called zaibatsu lasted until the end of World War II. However, information relations continue today.

Ministry of Agriculture and Commerce (MA&C), approximately ten years prior to the Sino-Japanese War (Ogura, 1970; Ono, 1944; Saitō, 1968). In the first phase, the government spent a tremendous amount of energy and money to implement Western agricultural techniques. Large-scale farm machinery, livestock, and exotic seeds were imported from the West and tried out at experimental stations⁶. In the second phase, agricultural development policies focused around traditional Japanese farming.

A. Overview

The most effective reform in the process of industrialization during the first phase, particularly for the agricultural sector, was the establishment of the land tax system (chiso). Hayami (1975:8) asserts that "the land tax and landlordism served to squeeze agricultural surplus out to the nonagricultural sector." Ogura (1970:120) argues even further that "[t]he land tenure system is a basic factor either promoting or hampering the development of agriculture."

The aim of the Land Tax was to create a unified and centralized tax system that assured a stable revenue required by the central government in order to carry out modernization policies. In 1871 farmers gained the freedom to make decisions on land utilization and the choice of crops. In the following year, the government removed the prohibition on the sale and the mortgage of farmland. By this time, as the market economy emerged during the late Tokugawa period (see Chapter 2), land was not equitably

⁶ For example, in 1875, 86 types of seedlings (e.g., fruits, timbers, coffee, cinchona bark, and other plants) were imported from the U.S., China, and Jawa, and 248 types of seeds (e.g., wheat, hay, timbers, vegetables, beets and other plants) from the U.S., Germany, Austria, and France. In 1876, 34 types of seedlings and 403 types of seeds were imported (Tanaka, 1983:228).

distributed. Those farmers with the right of cultivation, which had been provided by the feudal lord, were granted title to their land in the Land Tax Revision projects of 1895. On the other hand, those farmers who had lost their right of cultivation were legally recognized as tenant farmers. These reforms, along with a compulsory education system, transformed farmers into "free economic agents in allocating resources in response to market incentives" (Hayami, 1975:46).

The main provisions of the Land Tax Revision Ordinance in 1873 were as follows:

- (1) Tax should be imposed on the basis of the value of -- not of the yields of -- farmland.
- (2) The tax had to be paid in cash.
- (3) The annual tax was fixed at 3% of the land value regardless of the yields of the year.

Land taxation had four major effects in Japan's capitalistic development. First, collecting tax in the form of "money" rather than "rice" meant the transformation from a commodity economy to a monetary economy. This accelerated the emergence of social stratification within the peasant class that had began during the Edo period, particularly between the landowning class and the tenant class, in rural communities. Second, as a group of taxpayers, the landowning class gained political and economic power. Since "rice" became no longer the determinant for the amount of tax to be paid, farmers began to pay little attention to the quality of rice. Third, however, the grading/inspection system for agricultural commodities was developed to prevent this tendency and to encourage standardization of the quality of rice and other commodities. Fourth, as the agricultural market expanded from the local to the national and international level, the position of the merchant class in the

Japanese economy became clearer and stronger. Coastal urban areas grew as centers of finance and commerce as well as industry.

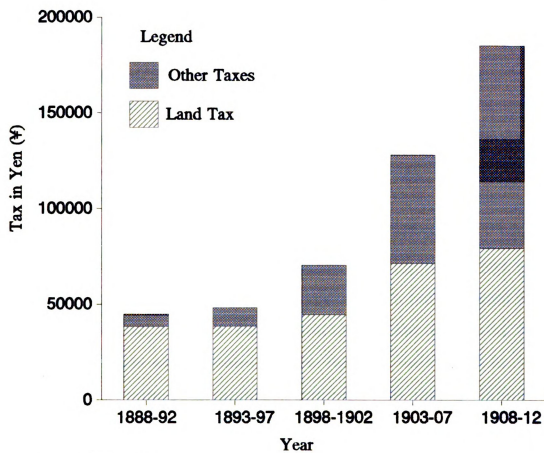
B. The Financing of Japan's Modernization

In the beginning of the Meiji period, approximately 80% of the population engaged in farming. The fixed rate of the land tax did not help to ease the financial burden from the farmers. In some regions, they suffered more from it than under the Tokugawa tax system.

The amount of land tax and its relation to the total tax revenue is illustrated in Figure 5.1 (Ogura, 1970:25). The weight of the land tax on the total federal tax revenue was heavy until the 1890s; it decreased from 80.4% in the period between 1893 and 1897 to 42.9% in the last period of the Meiji. Although there have been many debates surrounding the significance of the land tax in Japan's modernization programs⁷, the government was able to gain substantial revenue from the agricultural sector.

In addition to the land tax, there were local taxes and indirect taxes on consumer goods that were imposed upon the rural population. Although the total number of farming households during the Meiji period decline little due to the factors discussed below, this heavy tax burden pushed a portion of the rural population to migrate to coastal urban areas. Thus, the new land tax system indirectly contributed to the supply of human resources to the industrial sector as well.

⁷ See Francks (1984), Hayami (1975), and Inoue (1979b) for this debate.



Source: Ogura, 1970.

Figure 5.1. Land Tax, 1888-1912.

C. Class Relations

The change in the landholding system, brought by the transition in the exchange process or by the emergence of surplus value in rural communities in the late Tokugawa period, was accelerated by the agrarian reform policies enacted by the Meiji Government. Large landholding based on kinship was replaced with many small holdings, some tenant-operated and others held by self-cultivators; landownership was skewed. The establishment of private ownership and the free contract system enabled farmers voluntarily to sell their land, arranging tenancy contracts with the new landowners. This led to the creation of a class of landless farmers.

1. THE LAND TENURE SYSTEM: One implication of the Land Tax Revision was that it legally acknowledged the existing land tenure system and the class system based on private ownership which had developed during the Tokugawa period, and gave legal protection to the landowning class. In 1883-1884, 36.8% of the total arable land was cultivated by tenant farmers. By 1913, the proportion increased to 45.5% (Ogura, 1970:18).

The Land Tax Ordinance of 1884 not only reconfirmed the continuation of the high land tax rate, but also allowed landlords to enjoy some alleviation of their tax burden because of the increasing gap between the fixed price of land and the rising price of rice. Among them, large landowners⁸ especially had a dominant influence over the improvement of

⁸ Terms relating to the land tenure system are defined as follows (Ogura, 1970:119): (1) landowners (those who own land), (2) large landowners (those who own more than 3 ha.), (3) owner-cultivators or -tenants (those who own more than one-half of the land which they cultivate), (4) landlords (those who let tenants cultivate over one-half of their land), and (5) tenants (those who lease more than one-half of the land they cultivate).

agricultural techniques and the establishment of agricultural institutions. Because they paid the tax based on their land values, a higher yield would bring them higher profit.

It was no coincidence that these large landowners also acted as the "middlemen" in the market engaging in grading and distributing agricultural commodities in addition to supervising the cultivation of part of their land. In other words, they were able to increase their profits so as to control the prices of collected products from their land. Moreover, as leaders in the improvement of agriculture, they stressed those research programs and efforts designed to increase yield per unit of land area and later per laborer.

Eventually, they grew away from farming, or at least from immediate daily concerns in farming. This landlord class accumulated capital from extraction of surplus value from poor farmers, and rapidly gained political power by securing their association with village rulers, officers and merchants. These large landowners often invested their capital in banks and non-agricultural industries.

On the other hand, peasants of the lowest class reduced the size of their landholding, or totally lost their land. The reforms did not improve the living condition of these farmers in Japan since their tax burden was as heavy as during the Tokugawa period. As a result, those who lost their land would commonly sell their labor for a term of service as a day laborer or servant, or as tenant farmers. In so doing, they lost whatever sociopolitical rights were granted with landownership.

2. MIGRATION FROM RURAL TO URBAN AREAS: At the same time, because the freedom of residence and occupation was granted, more peasants or their children left farming and migrated to urban areas for wage labor.

Yet, the total number of farming households did not decrease much because, first, the rate of the population increase was faster than that of the migration to urban areas and increasing division of labor within rural households as discussed above (Hasumi, 1965). Second, if peasants migrated to urban areas, they frequently did so only during the off-seasons of farming. The role of division of labor within households is the third factor that sustained the number of farming households. Because of a rise of fertility rate during this period, an increase in labor for the industrial sector came largely from those children, who were not the first sons of the farming households, with no chance of inheriting a portion of the family farm. Many daughters of rural households were also sent by their parents to be exploited as cheap factory workers.

Nevertheless, the growth rate of the industrial sector was much higher than that of the agricultural sector. During the period between 1877 and 1882, 64.6% of the real net output came from the agricultural sector, while by the 1901-1904 period the industrial sector accounted for 51.5%.

D. Small-Scale Farming

A more important consequence of the Land Tax revision was that it promoted the land-tenancy system which confirmed small-scale farming within Japan's agricultural structure. This new taxation system forced farmers to get involved in the market economy. Because many of them were unable to pay their annual tax, land titles became concentrated in the hands of landlords.

However, the concentration of land titles among landlords did not promote a split into large commercial farms and landless laborers but an

increase in small-scale farming with farm size ranging from 0.5 to 2.0 hectares as we can see in Table 5.1 (Ogura, 1970:68). Because the tax was levied on the basis of the price of farmland, it was much more economical and profitable for landowners to collect rents, mostly in kind, from their tenants rather than operating large-scale farms and paying huge taxes.

Furthermore, landowners did not necessarily own land concentrated in one parcel, but rather had land scattered around the village. Tenant farmers also rented a few plots of land in different locations rather than one area. This made it extremely difficult for large-scale farming machinery from the West to be utilized effectively in Japanese farming villages. Consequently, the technical improvement in agriculture from the Meiji Restoration to World War II was aimed at increasing the relative efficiency of small-scale family farms.

Table 5.1. Distribution of Farm Households by Farm Size (%).

| Year | Total Number | -0.5ha | 0.5- 1.0ha | 1.0- 1.5ha | 1.5- 2.0ha | 2.0- 3.0ha | 3.0-ha |
|------|--------------|--------|---------------|---------------|---------------|---------------|--------|
| 1910 | 5,497,918 | 39.96 | 32.54 | 19.05 | 5.86 | 5.59 | |
| 1915 | 5,535,008 | 35.94 | 32.92 | 19.73 | 5.96 | 5.45 | |
| 1920 | 5,573,097 | 35.64 | 33.23 | 20.52 | 6.17 | 4.44 | |
| 1925 | 5,548,599 | 35.17 | 33.83 | 21.36 | 5.82 | 3.82 | |
| 1930 | 5,599,670 | 34.63 | 34.22 | 21.92 | 5.65 | 3.57 | |
| 1935 | 5,610,607 | 34.02 | 34.20 | 22.37 | 5.75 | 3.66 | |
| 1940 | 5,479,571 | 33.65 | 32.74 | 24.33 | 5.70 | 3.59 | |
| 1947 | 5,909,227 | 41.48 | 31.04 | 15.66 | 6.16 | 3.56 | 2.10 |
| 1950 | 6,179,419 | 40.84 | 31.94 | 15.56 | 6.13 | 3.37 | 2.17 |
| 1954 | 6,105,049 | 32.95 | 32.36 | 18.14 | 8.03 | 5.24 | 3.28 |
| 1960 | 6,056,534 | 38.01 | 31.74 | 16.74 | 6.88 | 3.84 | 2.79 |

Source: Ogura, 1970.

III. BUREAUCRACY

The first major actor in the social network of agricultural science is the national and local governments. Under the slogan of "Shokusan Kōgyō" or "increase in production and founding of industries" (Hunter, 1983:331), the Meiji government also encouraged agriculture by establishing institutions to legislate appropriate policies for the agricultural sector. The first task was to create an agricultural administration within the national government. Then, the government also directed local governments to institute their own administrative mechanisms for the encouragement of agriculture.

A. National Government

Meiji leaders established a political system which concentrated power in the central government. Japan placed its top priority in modernization on war, transportation, communication, and public utilities. As far as agriculture was concerned, the government paid less attention and effort compared with other areas.

However, popular demand made the government recognize the development of agricultural science and technology should be a part of the modernization policies. The Meiji government issued various policies for the encouragement of agriculture to meet these needs of the nation for the following three reasons. First, as stressed repeatedly, most of the national revenue at this period came from land taxes. Second, agricultural commodities occupied important roles as export goods. Third, the large bulk of enlisted men for compulsory military service were farmers.

From its policies we can observe that the national government tried to play a central role in coordinating various actors in the agricultural sector by organizing a national organization of farmers (largely landowners), establishing research stations and schools, and providing direction to the local governments. Each agricultural policy issued during the Meiji period reflects the government's endeavor to increase its control over every aspect of agricultural activities. In order to gain control, the government needed to protect the interests of those who had the most influence and power in rural communities -- in short, landlords.

Changes in the agricultural administration also correspond to the two distinctive phases of Japan's capitalist development: the Westernization Phase and the Nationalistic Phase. In the first phase, the administration was based on the idea that the government should demonstrate new and improved farming techniques by managing model farms with equipment and tools from the West. After having failed in these attempts, the administration changed its focus to protecting and improving techniques of Japanese traditional farming by aggressively exploiting the knowledge and popularity of veteran farmers.

1. THE WESTERNIZATION PHASE (1868-1885): The first half of this phase (1868-81) was characterized by much ambiguity toward agricultural administration and policies. Ono (1941:22) points out that "during this period, it was as if every morning a new institution for the agricultural administration had been established and abolished in the evening." According to Ogura (1970:110), "...the Meiji Government's administration of agriculture did little more than grope in the dark. But as the country grew as a modern nation, a basic note of the development of agricultural administration became clearer."

The agricultural administration during this early period had two characteristics. First, the feudalistic restrictions placed on farming were removed in order to allow farmers as free economic agents to pursue farming as a viable economic activity for the nation in the ever-widening market. Second, the government tried to expand the agricultural sector by encouraging the reclamation of land, commercial farming such as the cultivation of silkworms and mulberries and light industry, and by beginning to import Western agricultural techniques including livestock, new varieties of seeds, and large-scale farming machinery. On the other hand, this effort was to provide the ex-samurai class, especially those who had lost their land with the abolition of the feudal system, jobs and land in order to avoid potential unrest. The most important project in the second half of this phase was the Land Tax Revision Projects that began in 1873. Details of the project already have been discussed above.

In this phase, the government began to introduce extensive Western farming. The effort to import Western agriculture reached its peak by the 1870s. In 1871, a farm implements exhibition room was opened in the Kannō-ryō (Office for Encouragement of Agriculture) to display Western style machinery. The production of Western style farm machinery was started by the establishment of the Farming Implements Section of the Kangyō-ryō (Office of the Encouragement of Industry) in 1875. The Mita Farm Implements Factory was instituted to supply their implements either by lending or selling. Large scale farming machinery from the West was put into operation on newly established farms such as the Hachisuka Farm in Hokkaidō and the Koiwai Farm in Iwate. Furthermore, western techniques were introduced through vocational aid programs to ex-samurai, imports of seeds and seedlings, breeding stock, and fertilizer, and such agricultural

schools and experimental stations as the Naito Shinjuku Agricultural Experiment Station, the Mita Livestock Breeding Station, and the Komaba Agricultural College.

However, these experimental farms were later privatized and changed to tenant farming because the directors of these farms lacked knowledge of and experiences in managing large-scale farms. Furthermore, many of the government's efforts to introduce Western varieties of seeds and seedlings, breeding stock, and fertilizers proved unsuccessful because of limited arable land, the high expense of Western farm machinery, and the lack of experience in using draft animals. Some of examples of early effort in the encouragement of agriculture are listed in **APPENDIX C**.

The newly established Ministry of Agriculture and Commerce consisted of five subdivisions: the Bureau of Agriculture, the Bureau of Forestry, the Bureau of Industry, the Bureau of Mining, the Bureau of Patents, and the Directorship of the Steel Industry. The ministry certainly played an important role in establishing research traditions to improve Japan's agricultural techniques with responsibilities to supervise various experiment stations and promote agricultural scientists in colleges and universities. Its first important task in the early period was to reevaluate the previous agricultural policies for the encouragement of agriculture that ended as utter failure.

There are several reasons for this change in the policy for the encouragement of agriculture. First, the government recognized that large scale farming was unsuitable in Japan because the land tax which used land value as the measurement for tax made it difficult to concentrate a large area of land in the hands of one family. The larger landholding, the higher amount of tax one had to pay. In order to operate profitable rice

production in a large-scale farm, the owner must achieve technical improvement with labor and land saving technology.

Second, farm machines from the West were too expensive for even wealthy farmers to purchase and operate. Most of machines could not be used in irrigated land. Since these machines were imported directly from the West, and domestic production of these machines was still at the immature stage, the cost of maintenance for these machines was enormous. They must be shipped back to the factories abroad, or replaced with new ones.

Third, many Western farming techniques were incompatible with traditional agricultural structure because these techniques were based on large-scale farming. Their main feature was to reduce the amount labor necessary for production at a given amount of land by using machines and draft animals. As mentioned earlier, however, the Land Tax Reform promoted small-scale farming rather than concentrating land in one parcel. Furthermore, the number of farming households did not decline. Thus, these labor-saving techniques were not particularly useful in rural communities with high population density and small-scale farms.

The second task of the MA&C was to issue regulations on the quality of agricultural products. With the growth of exports, the quality of such agricultural commodities as tea and silkworm-eggs declined, raising many complaints from the importing countries. In the case of tea, for example, the government appointed officials in 1874 to supervise tea manufacture in the Office for the Encouragement of Agriculture. Also, the Instruction for the Manufacture of Black Tea was issued in 1874; the Tea Manufactory of the Office for the Encouragement of Industry was established in 1876. Furthermore, in order to standardize the quality of green tea, the

Standing Rules for the Tea Guild were issued in 1884. These were amended in 1886 as the Regulations for the Tea Guild. Similar actions were taken to supervise the quality of other agricultural commodities.

2. THE NATIONALISTIC PHASE (1885-1912): The nationalistic phase in the agricultural sector began slightly earlier than in the industrial sector after the MA&C evaluated characteristics of Japanese farming to revise policies of agricultural encouragement in the period between 1879 and 1889. Since many agricultural policies issued during the last half of the Meiji period by the MA&C were based on ideas that arose during this reflection period of 1879-1889, for practical purposes I have included this period in discussion of the nationalistic phase to illustrate the transition in the agricultural administration.

Advice on the Promotion of Industries

A new approach to the improvement of agriculture emerged around 1885 and 1886 based on the "Advice on the Promotion of Industries" prepared by Maeda Masana, Senior Secretary of the Ministry of Agriculture and Commerce, in 1884. It became a blueprint for Japan's close relationship between private industry and the government. The policy "refuted the opinion then influential in non-governmental circles that the [g]overnment should not interfere with private enterprises" and stressed that it instead "should direct and promote the growth of Japanese agriculture with legal regulations" (Ogura, 1970:156-157). This advice also discarded the policy of introducing Western industries in their Western form, and recommended instead that the government direct and promote the growth of Japanese agriculture with legal regulations. In addition, Maeda presented in the advice two kinds of proposals for agricultural policy: one for the

readjustment of agricultural administration and the other for improvement of agricultural technology.

This new approach also corresponds to the transition of the national policy for economic development in general by providing guidance and encouragement of existing industry rather than transplanting Western technology to Japan without any modifications. So as in the industrial sector with factories, nationally owned and operated farms and factories were sold to private owners in the late 1880s (e.g., Mita Farming Machinery). Ogura (1970:156) argues that the Meiji Government changed its principle for the encouragement of agriculture in the two periods as follows:

The former was carried out under the principle that the [g]overnment should demonstrate model facilities which centered on vocational aid to [the] ex-military class. On the contrary, the latter depended on landowners and experienced farmers to whom the [g]overnment gave guidance and encouragement through such institutions as seed-exchange societies and agricultural discussion societies. This change in agricultural policy corresponded with the switch in 1885 of the general industrial and economic policy from the operation of model farming enterprises by the [g]overnment to protection of private enterprises.

What was later known as Nishigahara Agricultural Experiment Station was established in 1886. The Association of Agricultural Sciences (Nōgaku Kai) announced a plan for the encouragement of agriculture (kōnōgyō-ron saku). The emphasis on a policy of agricultural encouragement was moved from large-scale farming to small-scale farming that was more realistic for Japanese agriculture. At the same time, the methodological approach was changed from Western science and technology to traditional Japanese farming.

B. New Programs by the Ministry of Agriculture & Commerce

The Ministry of Agriculture and Commerce effectively implemented three programs for the encouragement of agriculture, that were designed prior to its establishment: (1) The Agricultural Correspondence System, (2) The Itinerant Instructors of Farming, and (3) The Advisory Council for Agriculture, Commerce, and Industry. The Agricultural Correspondence System was arranged by the Bureau for the Encouragement of Agriculture in 1878 as a nationwide information network among the prefectural governments on agricultural affairs. Under this program, veteran farmers were hired in local agricultural experiment stations and agricultural schools. The lack of farming experiences among agricultural scientists was offset by these farmers.

The MA&C further continued this program as the Itinerant Instructors of Farming (1885) using both graduates of the Komaba Agricultural College and veteran farmers identified by local governments as instructors. The Advanced Conference for Agriculture and Commerce was organized as the consulting body of the later program. The government issued the Regulations for the Advisory Council for Agriculture, Commerce, and Industry in order for local governments to set up a similar body assisting the governor in the encouragement of agriculture. Both programs exhibit the MA&C's conception of its duty as leading the agricultural population to the improvement of agricultural techniques based on its recognition that the previous strategy lacked realistic understanding of Japanese agriculture (Hayami, 1975; Ogura, 1970; Ono, 1941).

The MA&C also realized the importance of maximizing existing initiatives among farmers for the improvement of agriculture. In 1875, the MA&C requested local governments to identify well-known rōnō (veteran

farmers) in their area. Based on this list, the MA&C invited rōnō from all over Japan to Tokyo in 1881 on the occasion of the Second Industrial Exposition, and hosted a National Conference of the Agricultural Discussion Societies (Zenkoku Nōdan-kai) as a part of the Exposition program. It was during this conference that leading veteran farmers formed the Agricultural Society of Japan (Dai Nippon Nōkai) which was modeled after the Royal Agricultural Society of England.

The Government oversaw agriculture from production to marketing. A list of 14 items for improvement was issued by the Ministry of Agriculture and Commerce (1903) including: "(1) the brine assortment of rice and wheat seeds; (2) the prevention of smut disease of wheat; (3) the common use of oblong nursery beds; (4) the abolition of stationary use of paddy field for nursery beds; (5) the planting of rice seedlings in checkrow; (6) the improvement of manure; (7) the extension of improved seeds and implements; (8) the application of horse or cattle plowing; (9) farmland readjustment; and (10) the establishment of agricultural cooperatives" (Ogura, 1970:166).

On the one hand, the Agricultural Society of Japan became an official organization to carry out the government's extension program, facilitating the activities of veteran farmers and the interchange of technical knowledge among farmers at large. On the other hand, it became an organization where landowners were able to voice their interests.

To have these leading veteran farmers in the hands of the MA&C -- as their employer in the Itinerant Instructors of Farming and their advisor for the Agricultural Society -- meant to gain access and control over rural communities since farmers did not dispute the advice of veteran farmers. With the extension program, the MA&C successfully forced farmers

to follow an official policy for increasing agricultural productivity, rice inspection, the prevention of disease, pest management, and the control and inspection of fertilizer.

In 1893, a national agricultural experiment station was established with the enactment of "the Rules on Prefectural Agricultural Experiment Stations." With the enforcement of "the Law of State Subsidy for Prefectural Agricultural Experiment Stations" and "the Agricultural Association Law" in 1899, the agricultural guidance and improvement service moved from the hands of the veteran farmers to the agricultural associations under the direction of the national and local agricultural experiment stations.

On the one hand, in the process of establishing an agricultural network centering around the government, the agricultural improvement program began to focus around rice as its primary interest and sericulture as secondary. It was important to make rice production possible throughout the nation because the demand for rice as the staple food increased as the standard of living improved with rapid industrialization. As the silk industry grew, the demand for efficient ways for producing a large quantity of silkworm eggs with better quality increased.

On the other hand, the government neglected to examine other commercial crops such as rapeseed, soybean, and cotton that had been raised in rural communities since the middle of the Edo period. The importance of these crops in Japanese agriculture declined drastically as cheap imports became available to the Japanese. Although prefectural or local governments saw the necessity of improving the production of regional crops (e.g., apples in Aomori, oranges in Wakayama, potatoes in Hokkaidō), hardly any commodities other than rice and silkworm eggs were

included in national programs for the encouragement or improvement of agriculture. As a result, Japanese agriculture lost the opportunity to become more diversified⁹.

C. Local Government

During the Tokugawa period, local administration was based on the stratification of each rural community (Smith, 1959). A village during this period formed a cooperative unit for the shared use of the water and grassland that was necessary for agricultural production. It was not only a unit of administration but also a unit for taxation. A village was ruled through three administrative positions (shōya, kumigashira, hyakushō) based on regular meetings among villagers (mura yoriai). Each village rendered its annual tribute to the feudal lord; the villagers shared irrigation water and forest for agricultural purposes.

With the abolition of domains (Haihan Chiken), local governments lost their autonomy and independence from the central government. Laws regarding subdivisions of the prefectural administration (gun, shi, chō, son) were established in the 1880's and 90's that described the functions of administration at each level. By these laws, the division of power in local administration was created, permitting an administrative unit at

⁹ This lack of diversification in Japanese agriculture continues today. Production of other crops is region specific. Because of the rice protection policy, the price of rice is substantially higher in Japan than in other countries, making rice production a "security blanket" for farmers. The development of labor saving technology also allows these farmers to engage in rice production part-time and in off-farm employment full-time, thus, providing them with higher household income than the non-farm population. This further encourages farmers to continue to grow rice.

each level to form its own legislative, judiciary and executive body under the supervision of the higher administrative bodies.

Moreover, after the Meiji Restoration, villages established separate organizations for water management, the Water Utilization and Public Works Associations, the members of which were elected by the prefectural governors. Then, the Water Utilization Association Ordinance of 1900 defined the utilization of water and public works as being under the jurisdiction of the local governments (prefectures, counties, towns, and villages).

Irrigation and drainage projects became the most essential part of the farmland readjustment program that the national government tried to impose on the local governments. The State provided a grant of the privilege of tax exemption for landowners in order to encourage land rearrangement and improvement of the irrigation and drainage system since these projects required the cooperation of all the landowners in the area concerned. According to Ogura (1970), the purpose of the Arable Land Readjustment Law of 1899 "was to pave the way for the execution of land replotment works by the following measures: to compel a small number of opponents to take part in the replotment projects; to protect the right of the third parties; to permit the measure to fix the price of the replotted lands at a certain value; to exempt such lands from the registration tax; and to facilitate the collection of the money to administer the projects" (p. 240).

The Arable Land Readjustment Law of 1905, a revision of the older version, attached more importance to irrigation and drainage in order to increase rice yield. Under this revision of 1909, the land readjustment association was authorized to play a central role in these projects. All

the landowners were allowed to become members of the association, resulting in the increasing dominance of the large landholders (or landlords) in the local administration, and legally protecting the land tenure system as a basis for agricultural production.

Despite the radical transformation of the local administration after the Tokugawa Era, villages and cities continued to play their role as rural community units. Moreover, these units continued to embody the nation's foundation. From the point view of the national government, a local government had an important duty to convey national goals in political and economic development to the population at large. Thus, the local governments were used as tools to enforce the tight control of the central government at the local level, rather than as independent organizations that took occasional deviations from the direction that the national government provided.

Although each local administration collected a land tax from farmers that was separate from the national land tax, in order to generate its own stable revenue, local governments depended largely on the national government for grants to support local experiment stations, extension programs, and agricultural schools. Therefore, in agricultural improvement, local governments followed closely the direction provided by the federal government.

Furthermore, the national government granted the right to vote and eligibility for election at both national and local levels to only those who owned land. Consequently, landlords gained political power in the local administration while tenant farmers increasingly lost their voice. At both national and local levels, agricultural improvement programs resulted in protecting the interests of the landlords rather than of the farmers at

large. In addition, as the landlords increasingly moved away from farming, having their lands cultivated by tenants, the close tie between the agricultural administration and farmers deteriorated.

IV. EDUCATION/RESEARCH INSTITUTIONS

The second crucial actor in the network is education and research institutions. One peculiarity of agriculture is that it cannot be modernized overnight but takes a longer time than the industrial sector because of the specificity involved in agricultural production (e.g., climate, soil, crops, size of land). Farming machines and foreign seeds, imported from the West, required substantial modifications to be applied to Japanese small-scale farming. Therefore, a systematic attempt was made to restructure agricultural education so as to decrease the gap between "modern" and "traditional" agriculture, or between "theoretical" and "practical" aspects of agriculture.

In 1872, the compulsory education law was issued and a public education system was organized, modeled after the French system. It was a starting point for the establishment of public education of a modern nation. In 1873, only 28.13% of children attended elementary schools while by 1886 the percentage increased to 46.3% -- 62% for males and 29% for females (Ogura, 1970:333-334). By 1912, the percentage had improved to 98.23%.

The General Regulations for Agricultural Schools were confirmed in 1883, defining the content of agricultural education. For the encouragement of agricultural development, three things were important: "(1) the establishment of a system for agricultural research; (2) the education of technicians who were responsible for the direct instruction

of farmers; and (3) the instruction of farmers who actually were doing the farming" (Ogura, 1970: 336).

At the same time, agricultural encouragement farms were established in the prefectures, following the State's policy of implementing imported Western farming techniques. The results of these experiments with new crops and breeds of livestock were demonstrated at the prefectural exhibitions. However, most of these encouragement farms faded away as the State switched its agricultural policy from large-scale to small-scale farming and established the system for agricultural education.

A. Agricultural Colleges

Two institutions for higher agricultural education were established before any other types of agricultural schools in order to train some students as teachers in agricultural education and to import Western agricultural science and technology. In 1875, the Sapporo Agricultural College (redesigned as the Hokkaidō University College of Agriculture in 1918) was opened to develop agriculture in Hokkaidō -- the last frontier of Japan.

The Komaba Agricultural College was founded in 1877 (reorganized as the University of Tokyo College of Agriculture in 1890) to provide necessary education and training to those who were interested in agriculture.

It is noteworthy that the Sapporo Agricultural College was originally headed by agricultural scientists from the U.S. (e.g., William S. Clark William Wheeler, David P. Penhallow, and William P. Brooks¹⁰)

¹⁰ For the contributions of William Smith Clark, see Maki (1983); for others, see Ebina (1991).

while the Komaba Agricultural College was dominated by instructors from Germany (e.g., Max Fesca, Oskar Kellner, Paul Mayet and Gottfried Wager)¹¹. It was the ecological conditions existing in Hokkaidō and Tokyo that influenced the differences in the curriculum and research agenda of these schools.

1. KOMABA AGRICULTURAL COLLEGE: Komaba Agricultural College was an agricultural training center established in the Naito Shinjuku Agricultural Experiment Station by the Ministry of Home Affairs (Naimusho) in April 1874 (Katayama, 1988). In 1877, the school was renamed the Naito Shinjuku Agricultural School, and in 1878 the school was moved to Komaba and became the Komaba Agricultural College.

The establishment of the Komaba Agricultural College was based on the idea that traditional agricultural methods lacked scientific principles and, therefore, that the transition from traditional to modern agriculture was necessary to improve Japan's agricultural productivity. There were three main objectives for education in the Komaba Agricultural College (Katayama, 1988). The first was to collect and display both domestic and imported agricultural products and technologies. Second, the school was designed to obtain, experiment, and disseminate new theories developed in various scientific fields relating to agriculture. Third, the government hoped the school would produce high quality students with modern agricultural knowledge and techniques.

¹¹ One influence for this preference came from the favorable attitude of the German government toward the renegotiation over the unequal treaty with Japan. Not only in agricultural science, but also other scientific fields, German scholars and traditions dominated in universities and research institutions by the middle of Meiji period (see Chapter 3).

In 1876, the following five British instructors were hired: John D. Cunstance (agriculture), John Adams McBride (veterinarian), Edward Kinch (agricultural chemistry), William Douglas Cox (English), and James Begbie (practicum in English). In addition to these foreign instructors, a veteran farmer from Gunma Prefecture, Funatsu Denjibei, was hired to teach a practicum in Japanese. By 1880, the British instructors were replaced by Germans: Max Fesca (agriculture), Oskar Kellner (agricultural chemistry), J.L. Janson (veterinarian), and C. Troester (veterinarian).

Curriculum: There were two courses, preparatory and main in the curriculum of the agricultural school when it opened in 1877 (Miyoshi, 1982:318). The main course had two majors of agriculture and veterinary. The program centered around the fields of agriculture and chemistry (organic, inorganic, and agricultural) and included physics, geology, botany, anatomy, physiology, accounting, engineering design, survey, survey methods, mechanical engineering, and pharmacy.

An agriculture class involved participating in both lectures and practical training. Each student was required to make a journal about farm management based on his lessons in the practicum. An integral part of chemistry was lab experiments to analyze the chemical content of fertilizer, soil, and agricultural commodities.

When the school was renamed the Naitō Shinjuku Agricultural School in November, 1877, the school established rules for admission and defined itself as "a place that specializes in teaching agricultural fields" (Miyoshi, 1982:316). Six courses were created: preparatory, agriculture, veterinary, agricultural chemistry, and applied agriculture (Shigyōka). Students for the four main courses had to be aged between 15 and 20 to study for three years.

Thereafter, the school regulations were changed four times -- April, 1880, May, 1881, August, 1882, and March, 1884 -- or once every one or two years. **APPENDIX D** shows the curriculums of the college in 1880 and 1882. The school regulations of April, 1880 reflect advice made by the British instructors. Instead of the preparatory and applied programs, the general agriculture and applied agricultural chemistry programs were placed respectively. Gradually, the curriculum began to center around the three main courses, and the preparatory course was neglected.

The change in May, 1881 was due to the switch of instructors from the British to the Germans. The Komaba Agricultural College was defined as an "agricultural school to train students in three programs: agriculture, agricultural chemistry, and veterinary" though the preparatory course remained as a necessary step before the entrance to the main courses (Miyoshi, 1982:318). Although the structure of the school did not change much, the curriculum was altered leaning heavily toward more specialization.

Employment of Graduates: The Komaba Agricultural College became the Tokyo School of Agriculture and Forestry in 1886, and Tokyo College of Agriculture in 1890. **Table 5.2** shows the number of graduates in the period between 1880 and 1890 according to their degrees (Miyoshi, 1982:328).

By 1884, graduates from the Komaba Agricultural College began to take teaching positions in their alma mater. However, in a period when farmers looked down upon higher education in agriculture, the graduates from Komaba and Sapporo had limited opportunities for jobs. Many became teachers at regional agricultural schools, or researchers for federal or

local agricultural experiment stations. Some became bureaucrats in agricultural administration.

In 1887, the Association of Agricultural Sciences (Nōgaku kai) was organized by the graduates who majored in agriculture and agricultural chemistry. In the following year, the organization began to publish its periodical, Nōgaku kai kaihō. Miyoshi (1982) referred to this publication to learn the employment of 97 members of the organization who graduated from the Komaba Agricultural College between 1891 and 1901 (Table 5.3). It is of note that the number of those working at schools declined, but those at experiment stations increased during this period.

According to Miyoshi (1982), in 1901 among the total 183 members who lived outside of Tokyo, 69 had some sort of teaching positions including 29 teachers at agricultural schools, 33 principals for the same, 4 itinerant instructors for a prefecture, and 62 who worked for agricultural experiment stations including 38 technicians and 24 station heads. Among the total 85 members who lived in Tokyo, 37 worked for the Ministry of Agriculture and Commerce, of whom 11 worked for the Ministry's experiment station and 13 for the College of Agriculture.

As Miyoshi (1982) points out, the common career path among these graduates was to take a teaching position, and then transfer to an agricultural experiment station or agricultural administration.

Table 5.2. Graduates from the Komaba Agricultural College, or later, Tokyo School of Agriculture and Forestry, 1880-1890.

| Degree Year | Agriculture | Agricultural Chemistry | Veterinary Medicine | Forestry | Total |
|--------------|-------------|------------------------|---------------------|-----------|------------------------|
| 1880 | 30 | | 15 | | 45 |
| 1881 | | | | | |
| 1882 | | | 20 | | 20 |
| 1883 | | 5 | | | 5 |
| 1884 | | | | | |
| 1885 | 11 | 7 | 15 | | 33 |
| 1886 | 14 | 5 | 5 | 13 | 37 |
| 1887 | 12 | | | 11 | 23 |
| 1888 | 11 | | | 14 | 25 |
| 1889 | | | 7 | | 7 |
| 1890 | 5 | 2 | 1 | 18 | 26 |
| Total | 83 | 19 | 63 | 56 | 226¹ |

¹ Because five of the graduates completed first the agriculture program, then later the agricultural chemistry, the actual number of graduates is 221.

Source: Miyoshi, 1982.

Table 5.3. Comparison of Employment of 97 Komaba Graduates, as of 1891 and 1901¹.

| Employer | 1891 | 1901 |
|---------------------------------------|------|------|
| Ministry of Agriculture & Commerce | 22 | 11 |
| Agricultural Administration Office | 12 | |
| Geology Research Center | 10 | |
| Ministry of Finance | 0 | 7 |
| Prefectural administration | 12 | 5 |
| Agriculture experiment stations | 2 | 14 |
| Tokyo College of Agriculture | 6 | 6 |
| Sapporo Agricultural College | 1 | |
| Agricultural schools | 6 | 5 |
| Junior high schools | 8 | 1 |
| Teachers training schools | 5 | |
| Agriculture teachers training schools | | 1 |
| Agricultural training schools | 1 | |
| Other schools | | 2 |
| Overseas study | 3 | 2 |
| Did not specify occupation | 8 | 6 |
| Dead | 4 | 15 |
| No record | 19 | 21 |
| Others | | 1 |
| Total | 97 | 97 |

¹. Agriculture and Agricultural Chemistry majors only.

Source: Miyoshi, 1982.

2. SAPPORO AGRICULTURAL COLLEGE: The Sapporo Agricultural College was founded by the Hokkaidō Development Office and modelled after the Massachusetts Agricultural College (MAC). The reason for choosing the MAC as its model was probably the influence of Horace Capron (See **Chapter 4**).

This school was different from the Komaba Agricultural College with respect to its emphasis on learning to cultivate and develop the untouched land. Moreover, its original instructors were invited from the U.S. rather than Europe. The American instructors hired by the Office for Hokkaidō Development included: T. Antisell (chemistry, geology), B.S. Lyman (geology, mine engineering), William S. Clark (agriculture, botany), W. Wheeler (mathematics, civil engineering, engineering), D.P. Penhallow (botany, chemistry, agriculture), W.P. Brooks (agriculture), J.C. Cutler (physiology, anatomy, veterinarian), and C.H. Peabody (mathematics, civil engineering).

Curriculum: The curriculum of the Sapporo Agricultural College is shown in **APPENDIX E** (Miyoshi, 1982:348-349). It was based on the curriculum of the Massachusetts Agricultural College. The period of study was four years with two semesters per year.

With respect to the curriculum, Miyoshi (1982) points out four characteristics in the Sapporo Agricultural College which distinguish it from the Komaba counterpart. First, the emphasis on agriculture was smaller than that on science. Compared with Komaba, less specialization within each field of agricultural science can be seen in the curriculum of Sapporo. Miyoshi (1982) argues that this was the case because the specialization process was slower in the MAC compared with agricultural schools in Europe. Second, the Sapporo Agricultural College stressed

science rather than engineering fields in its curriculum more than the MAC did¹². Third, the school placed importance on liberal arts classes. Fourth, the school provided military training to students from the beginning. In short, the Sapporo Agricultural College was aimed to produce those who would play the role of pioneer in Hokkaidō to develop the land with American-style large-scale farming.

Employment of Graduates: The number of graduates from the Sapporo Agricultural College from 1880 to 1889 is listed in **Table 5.4** (Miyoshi, 1982:354). The total number is considerably smaller than that of Komaba during the same period.

Table 5.4. Graduates from the Sapporo Agricultural College, 1880-1889.

| Year | Number |
|-------|--------|
| 1880 | 13 |
| 1881 | 10 |
| 1882 | 18 |
| 1884 | 17 |
| 1885 | 12 |
| 1887 | 9 |
| 1888 | 17 |
| 1889 | 17 |
| Total | 113 |

Source: Miyoshi, 1982

Table 5.5 indicates the employment of the graduates from the Sapporo Agricultural College. First, like the graduates of Komaba, many went to

¹² The percentage of hours spent in agricultural chemistry classes in the Sapporo curriculum was 35.8%, of the MAC was 27.6% (Miyoshi, 1982).

Table 5.5. Employment of Sapporo Graduates as of 1911.

| Employer | Number |
|--|--------|
| Imperial Forest Management Office | 5 |
| Bureau Office of Patent (the Ministry of Finance) | 1 |
| <i>Basei Kyoku</i> (Cabinet) | 1 |
| Hokkaidō Bureau | 11 |
| Karafuto Bureau | 3 |
| Prefectural Bureaus | 3 |
| Hokkaidō Agricultural Society or others | 3 |
| Formosa (Taiwan) Colonial Office | 9 |
| Korea Colonial Office | 2 |
| Sino Agricultural Experiment Station | 3 |
| Agricultural experimental stations (MA&C; prefectural) | 21 |
| Tōhoku Imperial University, College of Agriculture | 28 |
| Tokyo Imperial University, College of Agriculture | 1 |
| Morioka High School of Agriculture and Forestry | 2 |
| Agricultural schools; Fishery schools | 32 |
| Middle schools | 2 |
| Sino Teachers Training Schools | 2 |
| Companies, Banks | 20 |
| Business | 21 |
| Farming | 13 |
| Overseas studies | 2 |
| Military | 2 |

Source: Miyoshi, 1982.

teaching positions although more Sapporo graduates taught at non-agricultural schools (Ebina, 1991:185; Miyoshi, 1982:355). Second, contrary to the original plan of the Hokkaidō Development Office, few stayed in Hokkaidō to help its development. A high number of graduates from the first to third year worked for the Hokkaidō Government because they signed a contract with the Office to provide five-years of service in Hokkaidō in exchange for tuition and board at the School. Only one third of the total graduates actually stayed in Hokkaidō. Third, compared with the Komaba graduates, less Sapporo graduates worked for the federal government. Finally, more Sapporo graduates got positions in the private sector. In other words, unlike the Komaba graduates, the Sapporo graduates went to work in a variety of fields upon their graduation.

B. Agricultural Schools

In 1886 compulsory education began as a four-year system with the School Ordinance for all levels of school. This unified educational administration under the Ministry of Education, placed prime importance upon public education. In 1907, compulsory education was extended to six years.

The Elementary School Ordinance of 1886 also had provisions that allowed the establishment of an Agricultural Section in the advanced elementary schools, and that defined the Vocational Continuation Schools as one type of elementary school. In the 1890 amendment, an Agricultural Professional Section was allowed in addition to the Agricultural Section. In 1893 the Regulation for Vocational Continuation Schools was proclaimed that laid the foundation for the agricultural educational system. The

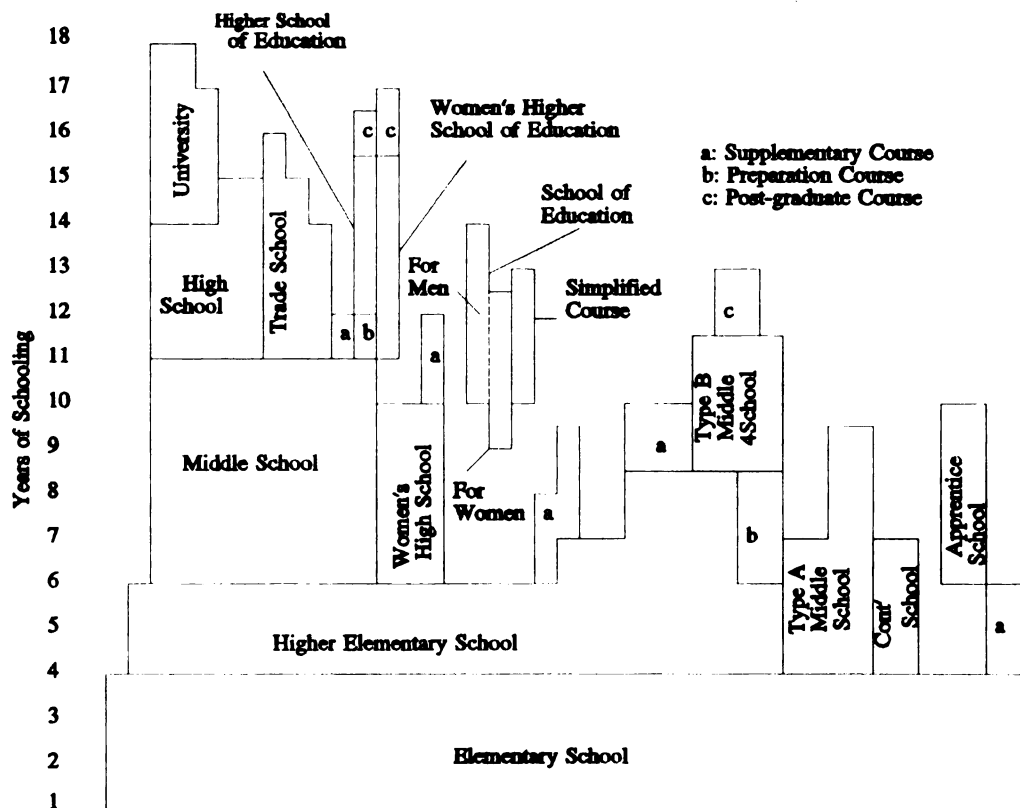
educational system for agricultural studies is described in **Figure 5.2** (Takayama, 1981:107).

Agricultural High Schools: **APPENDIX F** shows two types of agricultural schools at the secondary level that were defined in the General Rules of Agricultural School of 1883. The Type 1 middle school gave training in practical farming to those who had completed the middle level of elementary schools, while the Type 2 trained graduates of elementary level of middle schools in both farming theories and practices. According to Ono (1941), most of agricultural schools at this level organized in the prefectures belonged to Type 2, that was close to the vocational schools; Type 1 seldom existed.

In order to improve the situation in the agricultural high schools, the 1903 Regulations for Vocational Continuation Schools raised the eligibility for the agricultural vocational schools to the graduates of middle schools since the elementary school graduates lacked the basic knowledge of applied agriculture to be learned in the vocational schools. By this time, there were more needs in rural communities for people with advanced knowledge to improve agriculture. In addition, the quality of secondary education reached an adequate level while the number of schools, students, and teachers also increased.

In 1902, Morioka High School for Agriculture and Forestry was formed followed by the establishment of Kagoshima High School for Agriculture and Forestry in 1908, and Ueda Sericulture High School in 1910 (Katayama, 1988; Miyoshi, 1982; Takayama, 1981).

Agricultural Middle Schools & Agricultural Continuation Schools: **APPENDIX G** shows two types of agricultural middle schools according to the 1893 Regulation (Katayama, 1988:178). The total number



Source: Katayama, 1988.

Figure 5.2. Educational System of 1900 for Agricultural Studies.

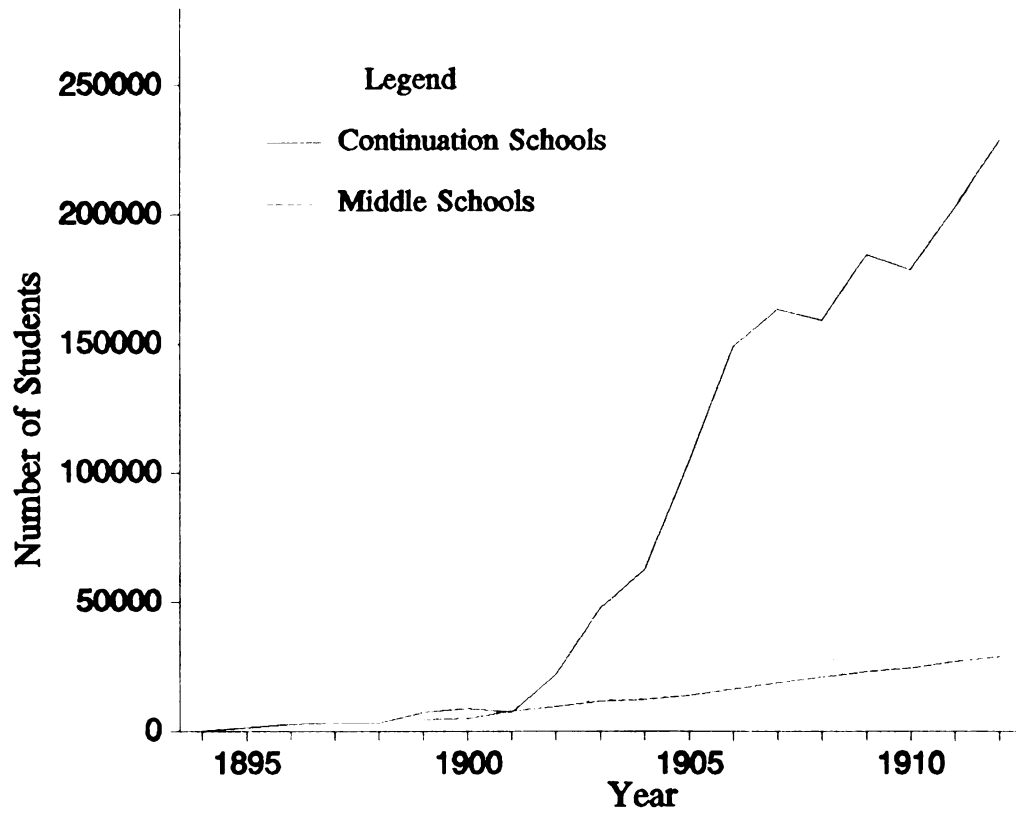
of students enrolled in these middle schools increased during the Meiji period after 1893 as shown in **Figure 5.3** (Katayama, 1988:179).

However, the number of Type B schools did not increase as much as Type A; it took three to four years to double the number of the agricultural schools and students (Katayama, 1988). Overall, the agricultural vocational schools did not successfully find their roots in the middle level of the educational system. This was due to the immature development of the middle level of the educational system in general and the lack of a clear conceptualization of the agricultural school at the local level.

On the other hand, the agricultural continuation schools, which ranked at the same level as the agricultural middle schools, were more popular among farming households as shown in **Figure 5.3** (Katayama, 1988:180).

These agricultural continuation schools were established based on the Regulation for Vocational Continuation Schools of 1893, the Law for National Subsidy of Vocational Education of 1894, and the Regulation for Temporary Agricultural Schools of 1894 in response to increasing voices among the public insisting upon raising the standards of agricultural techniques. Although agricultural education at the elementary and middle school level was a failure, the agricultural continuation schools, which offered classes during the evening, opened the doors of education to rural youths who wished to learn more about agriculture.

According to Ogura (1970:337), "as applications for admission ran short, the principal of the school had to visit local elementary schools at the end of school year to talk some of the boys into coming to the agricultural school." For many farming households, schooling after



Source: Katayama, 1988.

Figure 5.3. Agricultural Middle Schools v.s. Agricultural Continuation Schools.

compulsory education appeared to be "good-for-nothing" to the rural population (Kurata, 1979). They believed that farming was something to be learned from daily practice in their fields, not from books at school desks. Furthermore, those households with high aspirations for their sons -- mostly the second or later sons since the first sons took over the family properties -- rather wished to send them to regular schools so that they would gain opportunities to leave the farm. However, this popularity of the continuation schools over the middle schools shows clearly that farmers viewed schooling of their children as the secondary importance to utilizing these labor force to farming.

C. Research Institutions

In the development of agriculture, the Meiji government focused on the introduction of Western farming techniques by initiating model farms, agriculture encouragement centers, and experiment stations. In order to provide employment to the displaced samurai class, the government encouraged this class to play a leading role in agricultural research programs. After all, it was only the samurai class who had enough education and administrative skills to carry out these efforts.

In 1871, the Tokyo Agricultural Experiment Station was established in Aoyama to grow and breed imported crops and livestock. Similar institutions opened in Hokkaidō such as the Nanae Experiment Farm (1870), and the Nemuro Official Farm (1873). In 1879, the Mita Farm Implements Factory was organized to assemble farm machinery modeled after foreign machines. Organizations such as the Mita Botanical Experiment Yard (1874), the Shimofusa Sheep Farm (1875), the Kobe Olive Farm (1879), and

the Harima Grape Farm (1880) also represent the government's effort to introduce foreign plants and livestock to Japanese farming.

These efforts were followed by the establishment of such prefectural experiment stations as the Kyoto Livestock Experiment Farm (1872), the Yamanashi Botanical Experiment Station (1873), the Miyagi Botanical Experiment Station (1875), and the Niigata Agronomy Station (1875) (Takayama, 1981:66-67). These prefectural research institutions also imported seeds and breeds from abroad, cultivated them, and demonstrated the results to local farmers. They took the responsibility for instructing them in the improvement of agricultural productivity with Western farming methods.

Nevertheless, these efforts by the national and prefectural governments did not bring much progress in agricultural production because of the lack of knowledge of and experiences in raising foreign crops, managing livestock animals, and modifying Western farming methods suitable to Japanese small-scale farming. Because of the lack of progress and high cost of maintenance, by 1890 almost all of these experiment stations and model farms were either abolished or sold to private individuals.

1. NATIONAL AND PREFECTURAL EXPERIMENT STATIONS: After having failed in attempts to copy U.S. and British agriculture, except for the relative success of Hokkaidō, the newly founded Ministry of Agriculture and Commerce (1881) began to explore other options to develop the agricultural sector by synthesizing Western science and technology with indigenous knowledge which had been passed on for centuries in Japan. In 1885, two existing programs were reorganized to improve indigenous farming techniques in Japan: the Itinerant Instructors of Farming System and the Advisory Council for Agriculture, Commerce, and Industry.

After 1877, agricultural discussion societies and seed-exchange societies were developed all over the nation led by such experienced farmers as Hayashi and Yokoi. In the same period, great numbers of graduates from agricultural schools came forth. The Itinerant Teacher of farming was established by the government "with a view to promoting the improvement and development of agriculture by diffusing scientific agricultural techniques among experienced farmers" (Ogura, 1970:158).

The Itinerant Instructors of Farming System was designed to spread better seed varieties and more productive practices already in use by Japanese farmers by having the instructors travel around the country. There were two types of instructors in this program. The Type A instructors consisted of graduates of agricultural colleges, largely Komaba Agricultural College, and received higher salaries and prestige. Most of the veteran farmers belonged to the Type B instructors who lacked knowledge in agricultural science. However, because of the need for more Type A instructors, many veteran farmers were upgraded to the Type A from the Type B. Eventually, these two classifications were removed.

The Advisory Council of Agriculture, Commerce, and Industry, the Advisory Council for the Encouragement of Industry, and the Committee for the Encouragement of Industry also were established. The Ministry of Agriculture and Commerce organized the Advanced Conference for Agriculture and Commerce as the consultative body for the three. The Government encouraged prefectural governments to set up similar bodies.

Meanwhile, the Experiment Farm for Staple Cereals and Vegetables was established to test the superiority of seed varieties of such crops as rice, wheat, and rape, and cultural practices, so that these results could be used in itinerant lectures. In 1893, the Experiment Farm was

redesigned as the National Agricultural Experiment Station with six branch stations throughout the country. These national stations had three purposes: (1) to conduct experiments on technical improvements, (2) to analyze and determine the quality of soil, seed and fodder, and (3) to disseminate results of these experiments through the class "A" itinerant.

In addition, prefectural governments were encouraged to establish local experiment stations. The Rules on Prefectural Agricultural Experiment Stations were issued in 1894. They defined the separation of the experiment stations from the agricultural schools and the agricultural associations. It was not until the enactment of the Law of State Subsidy for Prefectural Agricultural Experiment Stations in 1899 that the total number of experiment stations increased to thirty-three.

By 1893, there were five departments in the National Experiment Station: Agronomy, Agricultural Chemistry, Plant Pathology, Entomology, and Tobacco (Ogura, 1970:323). In order to meet increasing demands for horticultural and animal products, Departments of Horticulture and Livestock were added to the Station in 1902 and 1903 respectively. As the industry expanded after the Russo-Japanese War, the demand for the further specialization of research and instruction increased, resulting in the establishment of independent research stations for livestock in 1916, tea in 1919, and horticulture in 1919.

However, much attention in the research effort both at the national and prefectural levels was given to the increase in rice yield per hectare as a result of using fertilizer and plant breeding. For example, the Kinai Branch Station began experiments on artificial hybridization of rice and wheat in 1904 while the Riku-u Branch Station started to use the pure-line selection method to breed a rice variety adaptable to the cold

northern region. In 1914, the first cold resistant variety, the Riku-u No. 20, was produced from the Aikoku cultivar by the line-selection method.

From the 1900s onward, the nation suffered from a constant shortage of rice. As a result, the State established a policy for self-sufficiency in food. Under these circumstances, plant breeding and application of fertilizer to increase the rice yield became the foremost program in the research institutions. However, it was not until 1916, with the enactment of the Program for Improvement of Rice and Wheat Varieties, that plant breeding programs began to be conducted throughout the nation as grants-in-aid were given to the prefectural experiment stations.

Experiments on the application of chemical fertilizer were started in the first half of the Meiji period, mostly in laboratories at agricultural colleges, and later at experiment stations. After the First World War, chemical fertilizer imported from abroad began to be used widely by farmers as new rice varieties required more application of chemical fertilizer, and as the number of fertilizer manufacturers increased. Thus, from the Taishō to the end of World War II, research on more economical and effective use of fertilizer became the focal point of agricultural improvement programs.

D. Veteran Farmers vs. Agricultural Scientists

Those who were trained as agricultural scientists began to graduate from the Komaba Agricultural College during the period that rōnō (or veteran farmers) received wide respect for their technical knowledge in agriculture among farmers. These rōnō showed little understanding of Western agricultural science and technology and had a preconception that

graduates of agricultural colleges lacked expertise in Japanese farming. The distance between "theory" and "practice" of agriculture was far in the early Meiji period. Farmers at large followed the voice of rōnō, paying little respect to the agricultural scientists who now worked at the local experiment stations or agricultural schools at lower levels.

In fact, many graduates of agricultural colleges became bureaucrats in the federal or local governments. Yet, there were such graduates as Yokoi Tokitaka who actually cultivated paddy fields and raised livestock based on his learning at the agricultural college. They acted as catalytic agents between the "theory" and "practice" of agriculture (Saitō, 1968). Furthermore, it was from their dialogues with rōnō that Japanese agricultural science blossomed.

Agricultural scientists also faced struggles with the agricultural administration. The influence of technical experts such as scientists and administrators with science degrees declined by the 1890s. For example, Maeda Masana was the last chief of the Bureau of Agriculture who had technical expertise. He retired in July, 1890. After Maeda, not only the Bureau, but the entire ministry was dominated by those with law degrees. There were serious possibilities of failure to communicate conceptions of agricultural research, development of resources, and application of results. In fact, Japan's spending on agricultural research decreased during the 1890s to an embarrassingly small amount compared with other nations.

V. FARMERS' ORGANIZATIONS

The third key actor in the social network of agricultural science is farmers. Farmers enrolled in this network through various organizational

activities that were initiated in the early Meiji period, as the government began to incorporate farmers' indigenous knowledge in the improvement of agricultural production. Here, we examine particularly political and economic organizations of farmers'.

A. Political Organizations

Various farmers' organizations were founded in the period between 1878 and 1882 (Ogura, 1979a). The gōnō or rich farmers and landlords took the initiative to create such agricultural societies at the local level as the Agricultural Discussion Society (nōdankai) and the Seed-Exchange Society (hinshu kōkan-kai) "as the medium for introducing new agricultural technology" (Hayami, 1975:53).

In the same period, agricultural administrators in the federal government formed the Agricultural Encouragement Society (Kangyō Kai). In 1878, Matsukata Masayoshi, the Minister of Finance and Chief Officer of Encouragement of Agriculture, went to the Paris Exposition and studied French policies on agricultural encouragement. Upon his return, he advocated the need for establishing farmers' organizations that would promote competitions among farmers for producing high quality agricultural commodities.

Thus, the government tried to encourage and initiate farmers to organize movements to improve agriculture at the grassroots level. Such discussion societies at the national level were also formed by commodities, such as the Grain Discussion Society, Tobacco Discussion Society, Rapeseed Discussion Society, Cotton Discussion Society, Sugar Discussion Society, and Tea Discussion Society. The number of such meetings among farmers reached its peak in 1883, and declined after 1884.

This trend reflects the transition of emphasis in agricultural policies from Western large-scale to traditional small-scale farming, when the government began actively to incorporate these voluntary activities of farmers into formal agricultural policies.

1. **DAI NIPPON NOKAI**: In 1881, on the occasion of the Second National Encouragement of Industry Exhibition (Naikoku Kangyō Hakurankai), the Encouragement of Agriculture Office invited three rōnō per prefecture to Tokyo and hosted the National Agricultural Discussion Meeting. The objective of this meeting was to exchange ideas for the improvement of Japanese agriculture on the following eight topics: (1) harvesting and selection of grains, (2) improvement of grain storage, (3) advantages and disadvantages of horse/cow plowing vs. manual plowing, (4) improvement of livestock breeding, (5) improvement of seed selection and storage, (6) use and manufacture of fertilizer, (7) establishment of farmers' associations, and (8) use of crop rotation.

At this meeting, the Agricultural Society of Japan (Dai Nippon Nokai), which was modeled after the Royal Agricultural Society of England, was organized by participating farmers under the leadership of Shinagawa Yajiro, the vice minister of agriculture and commerce, to distribute technical information through its publications and activities. The society was a joint organization between Tōyō Nokai, formed by graduates of Chiba Shimofusa Sheep Farming School, and Tokyo Dan Nōkai, organized by workers at the Agricultural Encouragement Society and at the Mita Botanical Experiment Yard. In addition to these two organizations, Kondō Nōkai, an organization of graduates of Komaba Agricultural College, joined this effort to institute the Agricultural Society of Japan.

There were three types of members: Honorary Members, Special Members, and Regular Members (Ogura, 1979a:281).

(1) Honorary Members: those from Japan or foreign nations who were highly regarded in the field of agricultural science and agriculture and were appointed by the organization without the voting right.

(2) Special Members: any Japanese who paid ¥3.00 annually as the membership fee and were given the voting right; with the payment of ¥300, no annual fee was necessary thereafter.

(3) Regular Members: any Japanese who paid ¥1.20 annually as the membership fee and were given the voting right.

It is apparent that the Society was not a vehicle for the participation of farmers at large in the decision making process on agricultural matters since only the landlords class of farmers could afford to join the organization. Table 5.6 shows changes in the number of the members. The number of the members declined after 1883, and began to increase again after 1890 (Ogura, 1979a:287). The large number of resignations between 1882 and 1886 was largely due to the agricultural depression in response to a deflationary policy by Matsukata Masayoshi. This also corresponds to the transitional period of the focus in agricultural administration from the Western farming methods to the traditional Japanese farming methods.

Although the Society included many rōnō of the time, in the beginning it stressed the application of Western farming methods to Japanese agriculture according to the government's westernization policies. It was not until the government changed its focus to the encouragement of the traditional Japanese farming methods when the Society began to weigh more on opinions among rōnō, and that membership increased. The rōnō who were members of the Society were at the same time employees of the MA&C.

Table 5.6. Changes in the Number of the Nōkai Members, 1881-94.

| | Admission | | | | Resignation | | | | Total |
|------|------------------|-------------------|-------------------|-------|-------------|---------|-------|-------|-------|
| | Honor. Member | Special Member | Regular Member | Total | Resign | Dismiss | Death | Total | |
| 1881 | 51 | 517 | 1,184 | 1,752 | 2 | - | 6 | 8 | 1744 |
| 1882 | 16 | 620 | 3,708 | 4,344 | 199 | 7 | 31 | 237 | 5851 |
| 1883 | 5 | 258 | 1,931 | 2,194 | 1,029 | 26 | 51 | 1,106 | 6939 |
| 1884 | - | 200 | 725 | 925 | 985 | 54 | 52 | 1,091 | 6773 |
| 1885 | 20 | 93 | 800 | 913 | 1,042 | - | 72 | 1,114 | 6572 |
| 1886 | 4 | 93 | 1,234 | 1,331 | 1,255 | 1,186 | 70 | 2,511 | 5392 |
| 1887 | 2 | 55 | 720 | 777 | 912 | - | 68 | 980 | 5189 |
| 1888 | - | 11 | 554 | 565 | 682 | - | 60 | 742 | 5012 |
| 1889 | 2 | 11 | 413 | 426 | 734 | - | 43 | 777 | 4661 |
| 1890 | 1 | 20 | 456 | 477 | 475 | - | 40 | 515 | 4623 |
| 1891 | 1 | 20 | 554 | 575 | 348 | - | 54 | 402 | 4796 |
| 1892 | - | 29 | 636 | 665 | 349 | - | 36 | 385 | 5076 |
| 1893 | - | 26 | 652 | 678 | 297 | - | 35 | 332 | 5422 |
| 1894 | - | 47 | 1,150 | 1,197 | 410 | 174 | 46 | 630 | 5989 |

Source: Ogura, 1979a.

Moreover, the government established the Advisory Office for Industrial Encouragement (Kangyō Shimonkai) and the Commission for Industrial Encouragement (Kangyō Inkai) in each prefecture to supervise regional activities (e.g., villages, towns, cities) for the encouragement of agriculture. This was done in order for the government to prevent wealthy merchants, landlords, rōnō, and other local dominant figures from rebelling against their authority. By placing them in the government's camp, the agricultural administration was able to systematically implement its policies throughout Japan. Therefore, the Agricultural Society of Japan was not an independent organization among farmers to develop plans for the improvement of Japanese agriculture, but a tool for the national government, especially the Ministry of Agriculture and Commerce, to implement its agricultural policies.

2. ZENKOKU NŌJIKAI: The Agricultural Society of Japan was an umbrella for any organization dealing with agricultural matters including commodity discussion societies, local agricultural societies, the National Agricultural Association, and the Association for Agricultural Science. The National Agricultural Association (Zenkoku Nōjikai) was founded in 1894 to promote agricultural interests and exercise political influence. In 1895, at the First Annual Meeting on National Agricultural Affairs sponsored by the Agricultural Society of Japan, the Association decided to depart from the Agricultural Society of Japan and became a totally independent organization. Later, it became the Imperial Agricultural Association (1910). On the other hand, the Agricultural Society of Japan lost its political influence after this split, and began to concentrate its activities on matters relating to agricultural research and education.

The Agricultural Association Law, which was enacted in 1899,

authorized compulsory participation in the association of farmers who paid more than ¥2.00 annual land tax and owned more than 50 ares of land (the 1905 revision) and the compulsory payment of membership fees (the 1922 revision). Other farmers in the area could join the association by their own volition.

The agricultural association was organized at three levels: village or town, county, and prefecture. A local agricultural association consisted of landowners who engaged in farming. It was required that more than a half, later one third (1905), of the eligible farmers should join the association in order for a local association to be recognized by the national organization. Although the Agricultural Association was not an organization that limited its memberships to large landowners, or landlords who did not farm, its activities centered around preservation of their interests in agriculture (Ogura, 1979b). Moreover, agricultural administrators both at the federal and local levels had strong control over these associations including "giving permission for establishment of associations under their supervision, dismissing directors of the associations, approving or disapproving the decisions taken by the associations, suspending their business, ordering their dissolution, and the like" (Ogura, 1970:250).

B. Union (Economic organization)

The second group of organizations was concerned with the economic activities of farmers. With the abolishment of the han system, the grading and inspection system that had been conducted by the feudal lords, also disappeared. As a result, farmers began to be concerned only with the yield of rice, but not its quality, since there was little price

difference according to the quality. It was not only rice but also silkworm eggs, tea, livestock, and commercial fertilizer that suffered a decline in quality because of increasing demand.

1. TRADE ASSOCIATIONS: In the period from the 1880s to the late 1890s, various laws and regulations were enacted for agricultural inspection and control by the "authoritarian agricultural administration" (Ogura, 1970:160). At the same time, the MA&C encouraged merchants to take responsibly for the improvement of the quality of agricultural commodities.

For example, in 1884, the Standing Rules for the Rice Trade Association were enacted to assign rice merchants the task of inspection and grading. By this law, each prefectural government was required to issue a prefectural mandate that combined landlords and tenants, or rice dealers and rice producers, into one organization, "enabling the Government to exercise control over rice from production through marketing and thereby ensure quality" (Ogura, 1970:164).

However, the inspection by these trade associations only covered rice shipped out of a prefecture. Thus, landlords, as sellers of rice, actively sought ways to reduce the decline in quality in the production stage through their activities in such organizations as the Dai Nippon Nōkai, the Agricultural Discussion Society, the Seed Exchange Society, and other agricultural associations. In order to secure their profit, these landlords ensured that their products would meet the requirements for quality, volume and packaging.

On the other hand, the commercialization of rice production led to the demand for the establishment of rice quality standards throughout Japan. By 1910, the Ordinance for Prefectural Inspection Fees and the

Ordinance for Staple Products Inspection Fees were issued to extend the nationwide inspection from marketing to production. Furthermore, this need for standardized rice quality induced a concern for rice quality as well as the yield in breeding programs and land and water utilization projects.

2. INDUSTRIAL (AGRICULTURAL) COOPERATIVE ASSOCIATIONS:

Cooperative associations were first formed in such industries as sericulture and tea manufacturing "where a rapid expansion of the market came as a result of Japan's contracts with the outside world" (Ogura, 1970:251). Agricultural cooperative associations were developed to protect farmers against exploitation by middlemen and money-lenders after the depression of 1882 that strained the rural economy. The cooperatives, which were organized into national federations, helped to increase the availability of credit and marketing services to small-scale farmers and to protect them against risks from business fluctuations.

The Industrial Cooperative Associations Law of the MA&C was approved in 1900 and provided four kinds of associations -- credit cooperative associations, purchasing cooperative associations, marketing cooperative associations, and utilization cooperative associations. The numbers of four types of cooperative associations and their members are listed in **Figure 5.4** (Ono, 1941:401).

In the beginning, the government provided protection and encouragement for these organizations by exempting the associations from business taxes, and allowing them unsecured loans through the Agricultural and Industrial Bank. By 1908, the government began to subsidize the Japan Central Union of Industrial Cooperative Associations. With the 1909 revision of the Industrial Cooperative Association Law, federations of

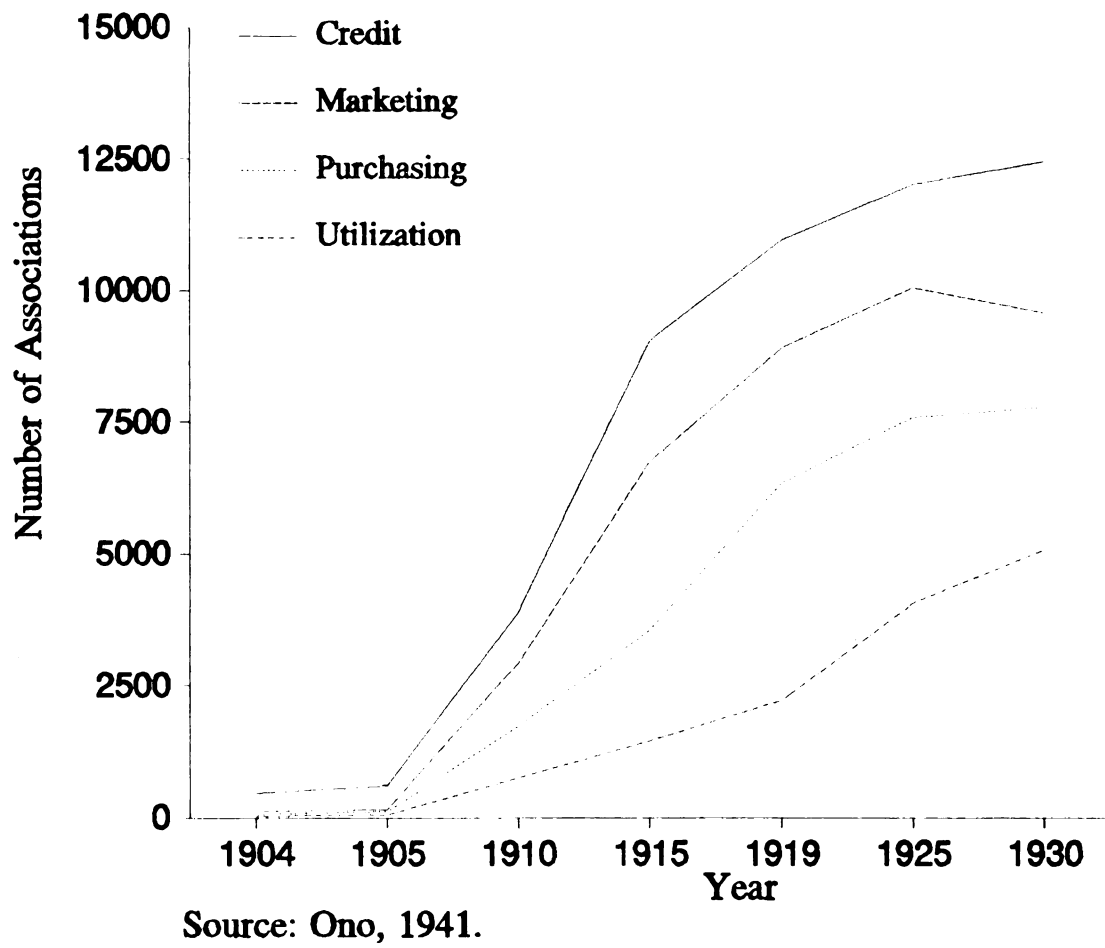


Figure 5.4. Numbers of Four Types of Industrial Cooperative Associations.

credit cooperative associations, purchasing cooperative associations, marketing cooperative associations, and utilization cooperative associations were established respectively. According to Ogura (1970:252), "[t]his revision gave birth to the Japan Central Union of Industrial Cooperative Associations as a national organ whose aim was to expand the organization of industrial cooperative associations and to effect liaison among different lines of cooperatives."

These industrial cooperative associations came under the dominance of large landowners including the landlords despite continuous criticism by the public. Cooperative associations were also formed in forestry, fisheries, livestock farming, and sericulture. As with any other agricultural organizations, democratic reforms in the industrial cooperative associations to reflect the interests of the larger farm population did not take place until the end of World War II.

VI. THE INDUSTRIAL SECTOR

The role which the industrial sector played in the development of agricultural science and technology should not be underestimated (Kamatani, 1965). The industrial sector also enrolled in the social network of agricultural science as the fourth actor. With the abolition of the Bakuhau system, a market economy was firmly established on the ground of the nation-state and extended its function to the world economy from the han economy. Takahashi (1969) argues that there are four reasons why the Meiji government actively sought ways to encourage industrial development including strengthening the national military, providing a financial basis for modernization, increasing revenues from international trade, and allocating jobs for the ex-samurai class.

First, the Meiji government realized that modernization required a vast sum of funds. With the abolition of the Bakuhau system, the government freed a large sum of money that had been expended by feudal lords to support their vassals. The unification of Japan enabled the establishment of one centralized financial structure that took responsibilities for legislative and military expenditures. Furthermore, the government adopted a modern credit system, issuing banknotes and government bonds.

Second, although the late Tokugawa government and feudal lords and the early Meiji government depended on foreign investments to proceed with their modernization policies, after 1873 the government limited the amount of foreign investment that entered into Japan. For example, the government prohibited joint ventures with foreigners based on its observation that many east Asian countries lost their economic and political independence when they allowed a free flow of foreign investments. Also, the former U.S. president Grant, upon his meeting with the Meiji Emperor in 1879, warned of the danger of foreign capital for the nation's independence (Takahashi, 1969). Therefore, from 1873 to 1899, when Japan most needed funds for its modernization, Japan not only refused to depend on any foreign capital, but succeeded in paying back all the foreign debts incurred during the early Meiji era¹³. It was not until the late 1890s that the Meiji government began to actively utilize foreign capital. By this time, however, the government became capable of handling

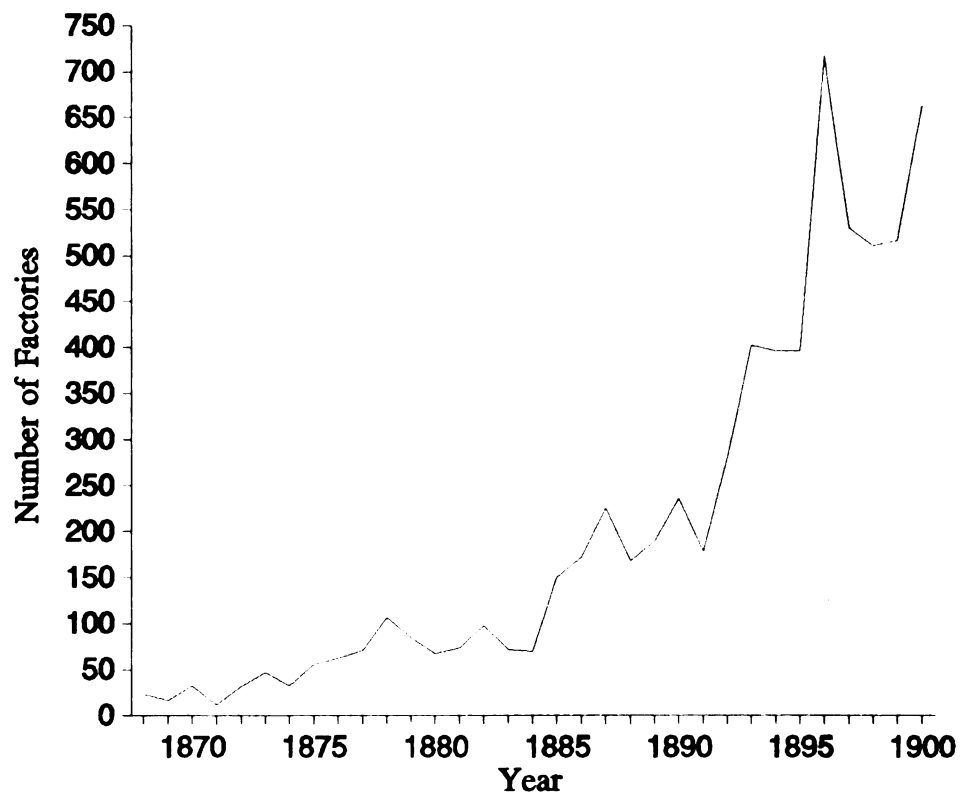
¹³ The debts which the Meiji government paid in full include: \$500,000 from the Oriental Bank in 1868; total of ¥4 million borrowed by 17 feudal lords at the time of the Meiji Restoration from various sources; £1 million in 1870 to build the Tokyo-Yokohama railroad system; and £240 million in 1876 to provide to the ex-samurai class as re-employment funds (Takahashi, 1969:208-209).

foreign capital so as to benefit its economic development without endangering its political position in the world market.

In the development of the industrial sector, the Meiji government adopted a policy to provide encouragement and protection for merchants, entrepreneurs, and industrialists. Many of them came from the ex-samurai class who received benefits from the modern educational system and the ex-samurai re-employment programs. In the government-owned factories, mines, and companies, these ex-samurai gained their economic strength and skills to manage the organizations. With privatization, they not only acquired the ownership and control of these institutions but also political influence, using the previously built connections with the government.

After the depression of 1885, the number of factories increased as **Figure 5.5** shows (Inoue, 1979c:12). It was also a time when a large number of the rural population, who were hit hardest in the depression, left farming and became wage laborers in the industrial sector. According to **Figure 5.6**, total capital in the agricultural sector did not increase as fast and as much as the non-agricultural sectors (industry, finance and commerce, and transportation) (Inoue, 1979c:13). The amount of capital in the transportation industry is notably high. According to Inoue (1979c:13), the prices for railroad companies in the stock market increased from 30.7% of the total transactions in 1887 to 87.8% in 1890. During this period, the cotton industry dominated in the industrial sector.

Prior to World War II, textile, mining, and food processing were among most important industries in Japan. Both textile and mining industries were started by the government and later sold to private owners. The food processing industry was developed mostly during the



Source: Takahashi, 1969.

Figure 5.5. Number of Factories, 1868-1900.

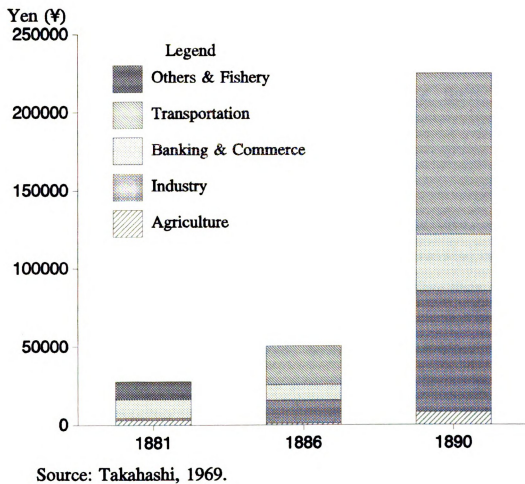


Figure 5.6. Amount of Capital in Each Productive Sector, 1881-1890.

Taishō period, resulting an increase in the area planted to commercial crops such as fruits or vegetables (e.g., mandarin, apples, grapes, pears, peaches, watermelon, tomatoes, cabbages, and onions) and miscellaneous grains (e.g., barley, millet, soybeans, buckwheat) and crops (e.g., mulberry, tobacco, peppermint, and pyrethrum). The development of these three industries was induced by high demands as export products and governmental protection and encouragement.

In this section, I will particularly examine the development of the textile industry and transportation so as to show their links to agricultural development during the Meiji period.

A. Textile Industry

By the late Tokugawa period, commercial agriculture, especially sericulture, played a vital role in the rural economy; raising cocoons and reeling silk became a side job to rice farming for many peasants, especially among the women and children as land tenancy became more common. Cotton was, along with tea, mulberries, and rape, a popular commercial crop that the Edo peasants grew on their fields to gain income.

With the opening of Japan to international trade, Western-style cotton factories were built by feudal lords and the Tokugawa Bakufu and started their operation. The Meiji government encouraged the silk industry by first managing a model factory (Tomioka Textile Factory) that used machines imported from the West, second, selling it to private owners at an extremely low price, and third, offering low-interest-rate loans to silk factories (Inoue, 1979b).

The production of raw cotton and the cotton cottage industry in the rural villages ceased in the Meiji period as more cheap cotton from India

and China began to be imported. The Meiji government also established and operated model cotton spinning factories in Aichi, Hiroshima, Kagoshima, and Osaka. According to Takahashi (1969), cotton thread constituted 36% of the total import expenditures from 1868 to 1877. However, by 1897 cotton thread exports exceeded imports, and by 1908 export of cotton fabrics exceeded its import. It was during these periods that the number of cotton factories fully equipped with modern machines reached its peak.

In distinction to the cotton industry, the amount of investment in the silk reeling industry was rather small despite a large number of factories. According to Inoue (1979c), the mechanization of silk reeling factories was slower than that of cotton factories. It was not until the Taishō era that the number of factories using some kind of motor-operated looms exceeded the ones using manual looms.

Yet, the rise of the silk industry influenced the increase in the number of sericulture households and the total area for mulberry fields. Sericulture became a major source of cash income for the rural population. As a part of the agricultural encouragement policies, different varieties of silkworms were imported from China, Europe, and the U.S., resulting in constant changes in silkworm varieties raised by farmers. On the other hand, this import of foreign varieties stimulated extensive studies on breeding superior varieties of silkworms.

As exports of raw silk increased sharply, the lack of uniformity in Japanese raw silk caused increasing complaints. In a response to the U.S. threat to ban its import of Japanese raw silk, the government established the Reproductive Silkworm Egg Production Station in 1911 (later to become the Sericultural Experiment Station), and the industry began to encourage the selection of superior varieties.

Toyama Kametarō demonstrated cross breeding of silkworms based on Mendel's law of heredity about 1903. However, it was not until the Taishō period that his theory was well adopted into the production of F₁ hybrids - "an epoch-making technical innovation" (Ogura, 1970:543). Furthermore, the rearing methods of silkworms were changed from the "cool rearing" method to the "warm rearing" method, and then to the "compromise method" between the former two as more tests and experiments were conducted by the Sericultural Training Institute of the MA&C. The summer-fall rearing of silkworms was developed by the Tomioka Raw Silk Reeling Mill in Gumma Prefecture at the beginning of the Meiji period, and was slowly diffused among farmers. In addition, the artificial hatching of silkworm eggs was started in 1887. Studies by Kawashima Katsujirō (1889), Yokoyama Chōtarō (1902), and Araki Takeo, Mita Isaburō, and Miura Eitarō (1911) led to the development of a processing device using hydrogen chloride gas. Many egg producers used this artificial hatching using hydrochloric acid, which was devised by Takase Keisaku and Sakamoto Uichi of the Aichi Prefectural Reproductive Egg Production Station (1912-13) for experimental purposes, and it was soon adopted by all egg producers.

Moreover, sericulture training centers or schools were first developed by the pioneers of the silk industry. In 1874, the Sericultural Experiment Unit was started within the Naitō-Shinjuku Experiment Station; in 1884 the Silkworm Diseases Experiment Station (to become the Sericultural Experiment Station in 1887) was founded within the Agricultural Bureau. The Tokyo Sericultural Training School was opened in 1896 to take responsibility for all the educational matters relating to sericulture. From 1910 to 1911, reproductive egg production stations were

established by many prefectures with a large number of sericulture households.

B. Transportation

The development of the transportation sector began to be stressed from the time the Tokugawa Bakufu opened its door to the World. It was perceived as a crucial project in Japan's modernization for strengthening both its military and industries. Loans were provided by the West to the Tokugawa Bakufu, later the Meiji Government, to build the shipping industry and railroad industry. Without these means of transportation, Japan was unable to establish effectively the highly centralized political system.

1. **SHIPS:** The Meiji government sold its steamships, bought from foreign countries or built by the government owned factory, to Mitsubishi Steam Shipping. By 1877, the Japan Postal Ship Company started as a joint venture between the government and Mitsubishi. This development of the shipping industry helped to prevent the domination of foreign countries in the international transportation and the ship building industry. Furthermore, as the amount of exports and imports of agricultural commodities increased, especially the import of cotton and export of silkworm eggs and tea, the shipping industry played a vital role in encouraging the development of the textile industry as well as of commercial agriculture.

2. **TRAINS:** The first railroad in Japan -- 18 miles between Tokyo and Yokohama -- was built in 1872 and operated by the Meiji government. Because the construction of rails required a vast amount of time and funding, the government adopted a policy to encourage the

emergence of private railroad companies. In the late 1880s and 1890s, Japan saw the rise of private railroad companies that completed railway projects.

The construction of the national network by railways was significant in modernizing Japanese society in many ways. For the development of agriculture and agricultural science, the railroads played a major role especially in marketing, allowing agricultural commodities to be made available throughout Japan. This contributed to the emergence of a more uniform life style among the Japanese population. As the diet among the Japanese became more homogeneous and as the amount of agricultural exports increased, the demand for standardized qualities for agricultural products arose as mentioned before.

In addition, the establishment of both domestic and international transportation systems enhanced exchanges of information for agricultural improvement among scientists, farmers, merchants, and agricultural administrators. There is no doubt that the availability of transportation systems was a vital factor in stimulating activities in such programs as the Agricultural Correspondence System, the Agricultural Discussion Society, the Prefectural Agricultural Experiment Stations, and the Agricultural Extension Program. With railroads and ships, in other words, the network among actors increased its size and number of actors involved, extending its level of networking from the local to the national and international levels.

VII. CONCLUSION

In this chapter, we have examined the development of institutions surrounding the agricultural sector including: the Land Tax, bureaucracy (national and local), education/research, farmers' organizations, and light industry.

Unlike developing nations today, Japan during this period succeeded in establishing organizational mechanism to allow effective implementation of the modernization strategies, that were discussed in the previous chapter, and technical improvement. The Meiji government took a pragmatic approach to improvement of the agricultural sector by stressing human capital development through education and training, political empowerment of farmers through various organizations, and development of infrastructure. It is important to point out that this pragmatism of the Meiji leaders emerged from their experiences abroad as students and official mission members as well as from their contacts with foreign advisors in Japan in the period of imperialism.

Agricultural sciences, which were originally imported from the West, were translated within these various organizations so as to meet their goals and interests. Furthermore, these goals were directly tied into the nation's goal to improve the agricultural sector as an essential component of economic development.

In the concluding chapter, we will discuss the significance of the social network of agriculture among these institutions in the transition from the Edo period to the Meiji period. Moreover, we will examine lessons from this Japanese experience.

CHAPTER 6: CONCLUSION

I. INTRODUCTION

In **Chapter 1**, I raised two questions to be answered in this study: (1) How was agricultural science pursued in Japan in the course of modernization during the Meiji period? and (2) How did this knowledge change social relations? In the previous two chapters, I have examined the emergence of actors and institutions in the development of agricultural science. In this chapter, I will first discuss findings from this study. Second, I will argue that unique cultural conceptions of science surfaced in Japanese society, especially in the domains of "control" and "quality," as a social network emerged surrounding agricultural science. Finally, I will conclude this thesis by arguing that science is the result of a complex social process among actors linked in a network.

II. FOUR MODERNIZATION STRATEGIES

The Meiji government brought in the most successful nineteenth century Western sciences and technologies, and established academic and research institutions based on Western models. While this Western tradition immediately dominated the minds of the Meiji Japanese as "the ultimate tool for modernization," in the formation of science various Japanese cultural traditions that were passed on from the Tokugawa Era

remained strong especially in the ways in which science was integrated into society.

The uniqueness and success of Japan's modernization lies in the fact that, by creating a highly centralized political system, the Meiji Government seized full control of and acted as the coordinator of the development of agricultural science.

A. Emergence of Actors

The Meiji modernization policies were largely based on the Charter Oath of Five Articles (**APPENDIX A**) proclaimed by the Meiji Emperor at the Restoration of 1867. The progressive leaders of the time carried out the plan to preserve Japan's independence by opening up the country and building up the nation's military and economic strength through intercourse with the rest of the world. In order to modernize, Japan adopted many aspects of Western culture including the Western system of constitutional government, and promoted the development of its industries with Western science and technology. For the Meiji government, modernization meant Westernization and the application of modern science and technology to expand the productive capacity of every industry including agriculture.

Figure 6.1 summarizes the four modernization strategies used by the Meiji government to improve agricultural production as discussed in **Chapter 4**: (1) the dispatch of official missions to the industrialized nations, (2) the employment of foreign instructors, (3) the use of overseas studies, and (4) the application of indigenous knowledge. Through the modernization process, four major actors emerged surrounding

the agricultural sector: the national and local governments, scientists, farmers, and light industry.

The roles of these actors were defined in a network through their interaction with other actors and those groups outside of the network (e.g., foreign instructors, foreign governments, overseas students in other fields). As Japan carried out its industrialization, the position of the agricultural sector in the national economy became clearer and these actors were enrolled in the network under a shared goal, that is to improve Japanese agriculture.

B. Coordination of the Modernization Process

What made Japan's modernization successful was that the Meiji government maintained its control over implantation of the modernization policies throughout the nation by limiting the participation of foreign nationals in the decision making process and coordinating modernization strategies through various measures.

First, the Meiji government assumed full responsibility for developing its own nation in both finance and management. A large portion of the federal budget in the early Meiji period was expended for various modernization measures including salaries of foreign employees and funding for overseas students without any foreign aid. At the same time, the Meiji government issued strict regulations regarding the dispatch of students abroad and the employment of foreign instructors and advisors to monitor activities of these students and foreign employees. In contrast to the high wages provided by the government, foreign employees obtained very little authority in the federal government, the prefectural governments, or the higher education system.





| Modernization Strategy | Actor |
|--|---|
|  <p>1. Iwakura Mission</p> <ul style="list-style-type: none"> ● Blueprint for Modernization | Government |
|  <p>2. Foreign Employees</p> <ul style="list-style-type: none"> ● Human Resource Training ● Implementation of the Blueprint Above | Government Scientists Industry Local Governments |
|  <p>3. Overseas Students</p> <ul style="list-style-type: none"> ● Human Resources Training ● Implementation of the Blueprint Above | Government Scientists |
|  <p>4. Indigenous Knowledge</p> <ul style="list-style-type: none"> ● Reevaluation of the Improvement Plan ● Consolidation of Indg. Knowledge & Sci. /Tech | Government Farmers |

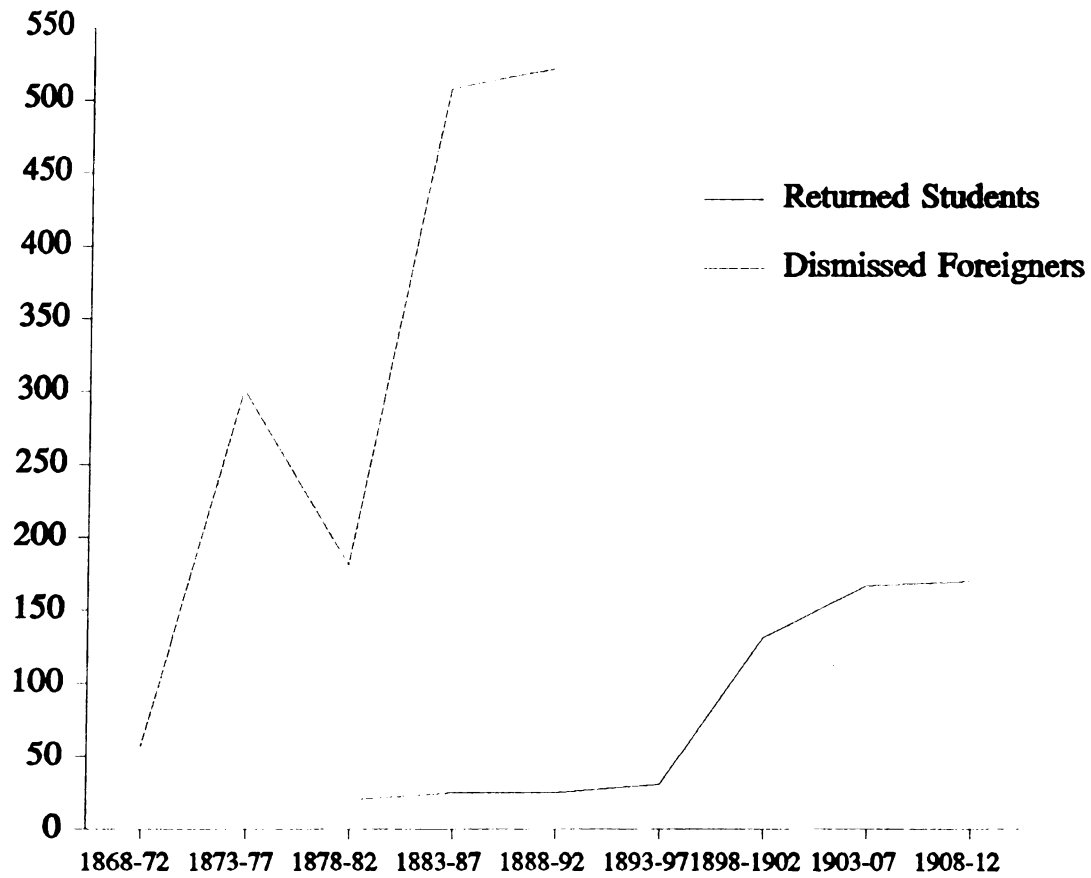
Figure 6.1. Four Modernization Strategies

Second, modernization strategies were largely coordinated at different levels in the transformation to an industrial nation. For example, in the early Meiji period, a large number of political leaders were sent to Europe, the U.S. and Asia to formulate a basic framework for Japan's modernization. By comparing different social systems of these nations the political leaders of the time were able to be selective as to what types of Western systems would be adopted by Japanese society.

Another example of the coordinating effort in modernization is that the foreign instructors were replaced with Japanese instructors as students returned home after the completion of their training in overseas institutions as shown in Figure 6.2. This allowed the government to avoid the problem of providing employment for the highly educated population and to expand its influence on and control over the higher education system.

The last example is that the Meiji government did not overlook the implications of unsuccessful results in its modernization experiments. When attempts to apply large-scale farming methods failed miserably (except some success in Hokkaidō), the newly organized Ministry of Agriculture and Commerce did not hesitate to switch the emphasis in its agricultural improvement policy to small-scale farming. In short, these modernization strategies were coordinated to incorporate them into the existing Japanese cultural practices in farming in order to secure a rise in agricultural productivity.

The primary goal of the nation, perceived by the Meiji leaders, was to preserve Japan's political, economic, and social independence. This was carried out through interaction with the powerful Western nations within the framework of compromise between Japanese and Western ways by



Source: Ishizuki, 1972; Watanabe, 1966.

Figure 6.2. Dismissal of Foreign Employees and the Return of Overseas Students.

coordinating the modernization strategies and limiting the role of foreign nationals as assistants. In contrast to Japan's official definition of modernization as "westernization," Japan was able to transform itself into a modern nation because it avoided the total westernization of every aspect of society.

The transformation of the agricultural sector during this period shows this point clearly. Instead of copying Western large-scale farming, the Meiji government encouraged technical improvement in the agricultural sector within the framework of traditional small-scale farming. As a result, Japan succeeded in increasing agricultural production by 121% during the period between 1882 and 1912 (Hayami, 1975).

III. INSTITUTIONAL DEVELOPMENT

In **Chapter 5**, we examined the development of institutions that represented each actor in the network of agricultural science. In order to understand the impact of Western science and technology in this process, we will compare the network that emerged during the Meiji period with that of the Tokugawa period.

A. During the Edo Period

Social relationships among actors in the network of agriculture during the late Tokugawa period are depicted in **Figure 6.3**. One characteristic of Tokugawa feudalism was that feudal lords maintained their autonomy and independence within their domains. Moreover, under the Shi-Nō-Kō-Shō system (see **Chapter 2**) activities of each social class were clearly defined and only a limited amount of interaction between these social groups was legally allowed. Therefore, the network of agriculture

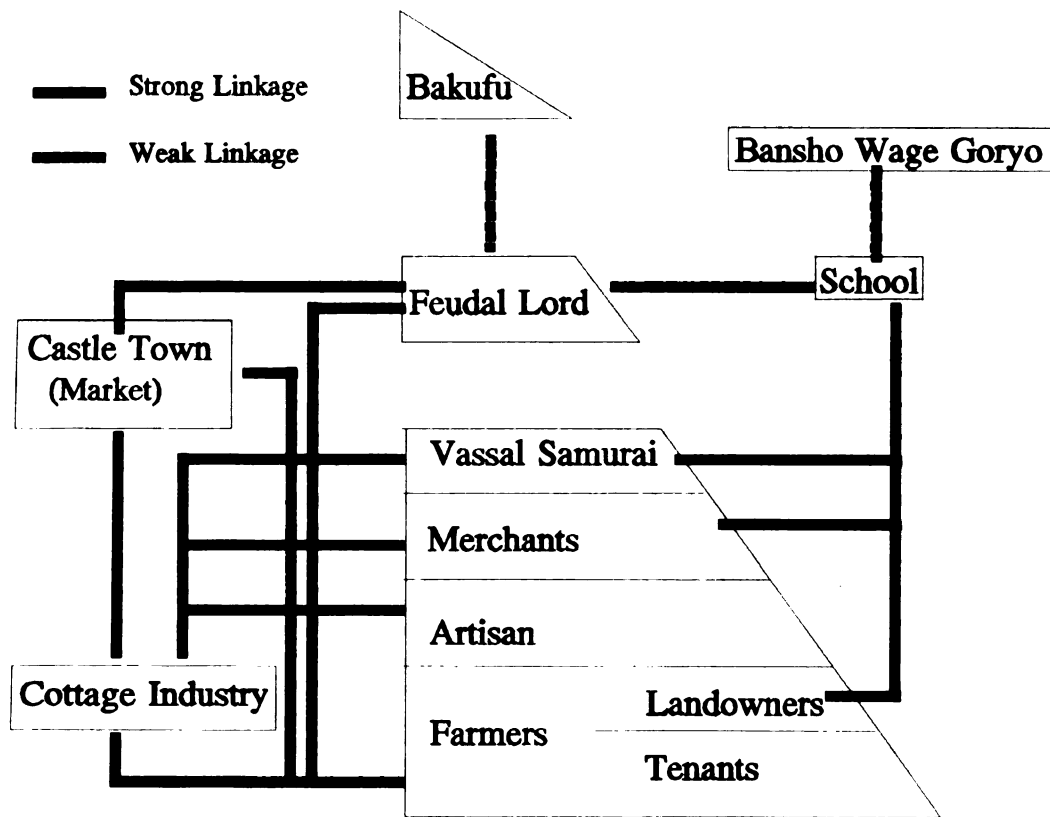


Figure 6.3. Network of Agriculture during the Tokugawa Period.

during the Tokugawa period was loosely defined with very little interaction among actors involved.

However, with the development of a market economy during the last century of the Tokugawa era, more interaction among different social classes began (see **Chapter 2**). The social stratification system lost its significance in restricting economic activities of each social class. Cottage industry and commercial farming made farmers active agents in the market economy. Feudal lords increasingly relied on loans provided by large merchant families to sustain their fiscal budget. And, castle towns became places for economic activities among merchants, artisans, samurai, and farmers.

On the one hand, the emergence of the market economy led to the formation of a social network surrounding agricultural production in each domain. On the other hand, feudal restrictions did not enable the development of a network at the national level. In addition, there were regional differences in economic development and network formation.

Furthermore, although schools were opened in some domains, their subjects were limited to classic studies and Chinese mathematics. If science was taught at these schools, Bansho Wage Goryō (the Office for Translating Dutch Books) determined which books were to be used there. Although education in science and technology was limited, some important books about agriculture were published by samurai who had experiences in farming and by wealthy farmers. Yet, these books were written largely based on their daily experiences in farming and their view of nature according to Chinese philosophy.

Therefore, the social network of agricultural science was at the premature stage during the Tokugawa period. It was not until the Meiji

period that various actors arose enclosing the agricultural sector and formed a social network at the national level.

B. During the Meiji Period

We have already discussed the emergence of four actors in the modernization process during the Meiji period. **Figure 6.4** illustrates the social network of agricultural science that emerged during this period, connecting these actors.

As shown in **Chapter 5**, the national government played the central role in the development of this network, expanding it to the national level. Although the feudal restrictions on agricultural production were lifted at the beginning of the Meiji period, the government maintained its power to coordinate economic activities in the agricultural sector through rules and regulations. This authoritarian influence of the government was extended to education, research activities, and organizational activities of farmers.

Furthermore, activities of local governments were directed and supervised closely by the national government. Thus, although there were smaller networks at the local level connecting local branches of experiment stations, schools, farmers' organizations, the government, and light industry, they all tied into the national network and had little autonomy and independence.

The importation of Western science and technology was crucial in adding "scientists" as another actor in the network. Furthermore, science and technology acted as a catalyst that provoked the interaction among these actors in the network under one goal, that is, to improve agricultural production. When the government perceived science and

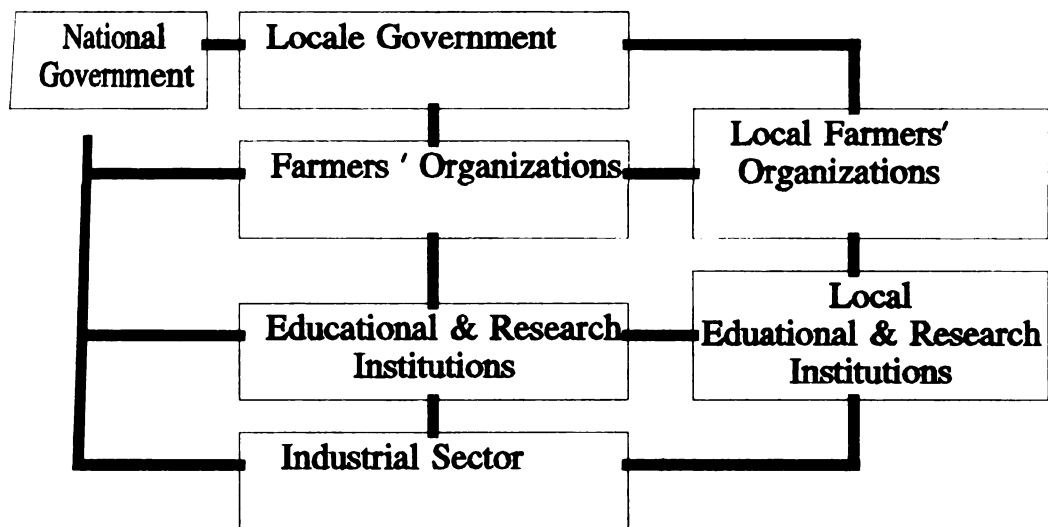


Figure 6.4. Network of Agricultural Science during the Meiji Period.

technology as a means to accomplish this goal, "a social network of agricultural science" was developed, enclosing more actors than that of agriculture during the Tokugawa period, including those with no direct involvement in farming activities (e.g., scientists, light industry).

IV. CONCEPTION OF SCIENCE

The ways in which Japan preserved its cultural and social traditions in the process of westernization (or modernization) can be seen in the example of how Western science was conceptualized as it took root in Japanese society. This cultural conception of science emerged with the creation of an intricate social network of science as discussed in **Chapter 5**. Let us examine the realms of "control" and "quality" to make this point clear.

A. Control

Although Tokugawa intellectuals made few contributions to the advancement of scientific knowledge, early scientists in the Meiji period were recruited from the same kinds of groups who had been serious in studying science during the Edo period. And, like the Tokugawa Bakufu, the Meiji government inspired the scientific community to produce "socially useful" outcomes more than advancing knowledge for knowledge's sake. Furthermore, the Meiji bureaucracy followed patterns that were established during the Tokugawa period.

A more explicit effect of the Tokugawa legacy can be found in the realm of control of knowledge production and diffusion. The Meiji government maintained control and management of the resources from other nations including financial aid and manpower and the diffusion of

knowledge by "setting the goals, paying for and managing the technical assistance, and implementing policies of directed change" (Burks, 1983:6). In short, the hired foreigners played roles of "decision-conditioning, rather than decision-making" (Burks, 1983:6). They were quickly replaced by returned overseas students as well as well-respected indigenous experts who were funded by the State government.

Moreover, the government initiated the formation of a network surrounding agricultural science, placing itself at the center. Most scientific activities took place at public institutions under the supervision of the government. Or, if they were outside of the public institutions, the government still intervened by formalizing them in legal terms. For example, the Itinerant Instructors of Farming System during the Meiji period incorporated rōnō's voluntary activities as instructors in a farming village into the official extension program. By employing scientists and wealthy farmers as official employees of various ministries in the government, their relationship with the government played a more decisive role in the network compared with counterparts in other societies in terms of the selection of research questions and the diffusion of research outcomes. Agricultural education and research institutions were supervised tightly by the government from their budgets to their research goals. Farmers' organizations were also guided by the government.

In short, Western science and technology was used as an essential tool to exercise power in the modernization process. By creating a highly centralized political system, the Meiji Government seized full control of and acted as the coordinator of the development of agricultural science among various actors. Yet, this is not to argue that the government made decisions on agricultural issues alone. The government was able to make

these decisions because of its interaction (e.g., negotiation, persuasion, and coercion) with these actors who represented various interests in the social network.

Meiji political authoritarianism also contributed to the authoritarian manner in the diffusion of scientific knowledge. The domination of the State in the diffusion of knowledge was also reflected in its relationship with prefectural governments. Various agricultural policies which were enacted between 1868 and 1912 showed the Meiji Government's effort to "exercise control over every inch of the country and systematize the encouragement of industry by enlisting in the Government's scheme men of repute and businessmen including rich merchants, landowners, and experienced farmers" (Ogura, 1970:167). Moreover, this tradition of authoritarianism surrounding scientific activities has been passed from one generation to another and is still alive and strong today.

Inflexibility and hierarchical relationship among Japanese academics have been criticized for over a century. In an academic meeting a young scientist is not likely to criticize works by senior scientists. Similarly, in a classroom students are unlikely to question what they are taught by their teacher. As in so many other Japanese organizations, young academics with wide recognition for their achievement rarely held higher positions in research and educational institutions than their seniors with less accomplishment. A recent issue of Science reports that "women are barely represented in the elite institutions" such as Kyoto University, Tokyo University, and Osaka University although 8% of scientists and engineers in Japan are women (Science, 1992:1378). In short, scientific knowledge, or any knowledge, in Japan is handed down

from one generation to another in a culturally defined hierarchy based on age and sex.

B. Quality

"Quality" is another concept that emerged as Western science and technology boosted the rise of industrial capitalism in Japan. With the integration into a national and international market, commodities were increasingly required to meet uniform standards of quality. This led the national government, prefectural authorities and agricultural associations to take the initiative in using science and technology to produce this uniformity out of the diversity of traditional cultivars and farming practices.

Traditionally, rice breeding focused on the improvement of yield. In the period between 1886 and 1926, Shinriki (Power of God) was considered the superior variety in the West, Kameno-o in the North, and Aikoku in the Kantō district. In short, each district had its own variety with a different quality. However, as the inspection and grading system developed, "uniform quality" became another variable along with "yield" in determining rice breeding programs. At the present time, "taste" was emphasized in the development of rice varieties. Therefore, a "good rice variety" has changed its meaning over time according to Japan's economic, political, and social conditions.

The concept of quality also played a vital role in technical advances in silkworm production. As the export of silkworm eggs and silk products increased, the textile industry recognized the need to improve the ways in which raw silk was produced in the rural villages. As shown in **Chapter 4**, a substantial silkworm breeding program was conducted in the

Reproductive Silkworm Egg Production Station, and reeling methods were changed based on the results of experiments conducted at the station.

Whether to value quality over quantity, or how to set the standards of quality are very important questions to be answered in making science because the answers inevitably direct ways in which a particular avenue of scientific research is pursued. Moreover, this question of quality is not solely answered by the institution of science, but also by that of the government, consumers, industries, and practitioners. Thus, a social network of science plays a significant role in setting the quality of scientific products -- whether agricultural commodities or not.

V. A CASE STUDY -- AGRICULTURAL SCIENCE IN JAPAN

In the case of agricultural science, not only scientists but also farmers themselves practiced research to advance their knowledge and techniques of farming. And, the close tie of farm organizations with both national and prefectural governments influenced agricultural research policies and practices as well as farm and rural policies. Thus, agricultural science during the Meiji period was constructed through negotiation, persuasion, and coercion among actors who emerged in the process of Japan's modernization.

In this network, Western science and technology was synthesized with indigenous knowledge and resources available in Japan during the period. Thus, Japan's translation of science and technology reflects (1) the unique ways in which the Meiji government controlled the development of agricultural science and (2) the relationship among various institutions surrounding the agricultural sector that were established by the State and prefectural governments, scientists, farmers, and private industries. On

the other hand, in this process of institutional development, the Japanese shaped not only their conception of science, but also of knowledge in general and of nature.

It is not a matter of defining who are "scientists" in the network, but examining who is, and how participants are, "enrolled" in the process of making science. In order to gain full control and coordination of the knowledge production process, the Meiji government from the early period initiated the construction of a network organizing the agricultural sector and positioning itself at its center. Moreover, the government directed actors in the network in terms of providing funds for education and research institutions and farmers' organizations, sending its representatives as official members of these organizations, and enacting regulations and rules for overseas activities of other actors in the network. Thus, the government successfully gained control of the decisions as to what and how agricultural research projects should be pursued.

At the same time, scientists and wealthy farmers gained access to the decision making process through their informal connection with agricultural administrators. For example, Marshall (1982) points out that until the beginning of the 1900s, ex-university administrators or faculty often were employed as officers by the Ministry of Education, or other ministries in the government. Rōnō were employed by the Ministry of Agriculture as instructors in agricultural extension programs. Nevertheless, as Marshall notes, the rising conflict between scientists and the government from the late Meiji period to the end of World War II was due to bureaucratization in the government and differentiation between bureaucratic and academic personnel. Furthermore, rōnō lost their

positions as leaders in the improvement of agriculture as graduates of agricultural colleges gained more respect and credibility in the rural villages through their achievements at the agricultural experimental stations.

The rise of the textile industry, and fertilizer and food processing industries during the Taishō Era, affected the formation of agricultural science in Japan as well. It was these industries that particularly showed interest in improving the quality of their products in order to secure their profit and supported research and development efforts in public and the private research institutions.

For a country like Japan that adopted Western science and technology relatively later than other industrial nations, the recognition of science and technology as a national political project restrained science from becoming "an enterprise with a strong tradition of rhetorical freedom" (Bartholomew, 1982:341). However, as Bartholomew argues, science has "very weak institutional freedom", and "scientists are loyal to scientific truths in the narrow sense, but scarcely at all to the scientific community -- let alone the general society -- in any broader, active sense" (p. 341). Therefore, the strong political influence on science in Japanese society cannot necessarily be ascribed exclusively to the nature of Japanese social structure. On the contrary, if there are any idiosyncrasies in Japanese science, they are the result of the social nature of science that produces a social network among actors compatible with the political and economic contexts of a society in a particular historical setting.

APPENDICES

APPENDIX A

The Charter Oath of Five Articles (1868).

- I. An Assembly widely convoked shall be established, and thus great stress shall be laid upon public opinion.
- II. The welfare of the whole nation shall be promoted by the everlasting efforts of both the governing and the governed classes.
- III. All subjects, civil and military officers, as well as other people shall do their best, and never grow weary in accomplishing their legitimate purposes.
- IV. All absurd usages shall be abandoned; justice and righteousness shall regulate all actions.
- V. Knowledge shall be sought for all over the world, and thus shall be strengthened the foundation of the Imperial Polity.

Source: McLaren, W.W. (ed.) 1979 [1914].

APPENDIX B

Selected Members of the Iwakura Mission.

| <u>TITLE IN THE MISSION</u> | |
|--------------------------------|--|
| Name (age) | Later Positions |
| <u>CHIEF AMBASSADOR</u> | |
| Iwakura Tomomi (47) | One of founders to establish the constitution and the parliamentary system. |
| <u>VICE AMBASSADORS</u> | |
| Kido Takayoshi (39) | Minister of Education; the Counselor of the Cabinet. |
| Ōkubo Toshimichi (42) | Minister of Home Ministry. |
| Itō Hirobumi (31) | Prime Minister; one of founders to draft the constitution. |
| Yamaguchi Naoyoshi (33) | Officer of the House of Councilors; a member of the House of Nobles. |
| <u>1ST SECRETARIES</u> | |
| Tanabe Yasukazu (41) | Officer of the Chamber of Elders. |
| Shioda Atsunobu [Saburo] (29) | Ambassador of the Peking Mission. |
| Fukuchi Genichirō (31) | Newspaper reporter for the government; a member of the House of Representatives. |
| Ga Noriyuki (32) | Member of the House of Nobles. |
| <u>2ND SECRETARIES</u> | |
| Watanabe Hiromoto (24) | President of an Imperial Universities; a member of the House of Nobles. |
| Komatsu Seiji (25) | Judge (<u>Daishin-in</u>) |
| Hayashi Tōsaburō [Tadasu] (22) | Embassador in many countries; the Minister of the Foreign Affairs. |
| Nagano Katsujirō (29) | Officer of the Hokkaidō Development Office |
| <u>3RD SECRETARY</u> | |
| Kawamichi Kandō (28) | Director of the Foreign Documents; Principal of a female high school. |

Source: Tanaka, 1977.

APPENDIX C

Chronological Summary of Agricultural Development during the Meiji Period.

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|------|---|--|---|
| 1859 | *Ports were opened for international trades. | | |
| 1867 | *The Imperial government was announced to be restored (Meiji Restoration). | | *Rice Cultivation in Early Meiji: increasing use of high yield varieties; selection of <u>Akage</u> variety for northward expansion of rice cultivation; improvement of nursery beds; increase in use of commercial fertilizers; development of rotary weeder; use of petroleum oil for plant hopper control; import of "cylinder method" of underground drainage. |
| 1868 | *Charter Oath was proclaimed. *The domain barriers (<u>sekiho</u>) was abolished. | *Communal land placed under the private ownership of farmers. *Exports of silkworm eggs reached a peak. *The inspection office of silkworm eggs was established. | |
| 1869 | *Feudal fiefs was returned to the Emperor. *Feudal social stratification system was abolished. *Guilds was abolished. *Currency system was reformed. | *Offices for development of Hokkaido and Tohoku began their operations. *Export of silkworm eggs began to decline. | *Kamifusa Experimental Cattle Farm was opened. *A slaughter house for cattle was opened in Tokyo. *Livestock and machineries for livestock farming were imported. |
| 1870 | | *Prefectural regulations for land reclamation was enacted. | *Imported varieties of cotton seeds from the U.S. were distributed to farmers in different regions. |

APPENDIX C (cont'd)

| GENERAL EVENTS | | GENERAL EVENTS IN AGRICULTURE | | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|----------------|---|---|---|---|
| 1870 | <ul style="list-style-type: none"> *The feudal fief system was abolished and the prefectures were established. *Iwakura Mission left Japan. *New Currency Act was enacted. | <ul style="list-style-type: none"> *Government-owned barren and wastelands sold. *The restriction on peasants' choosing crops for planting was lifted. | <ul style="list-style-type: none"> *Seeds from various foreign countries were distributed to the Office of Land Reclamation (Kaikou Kyoku). *Imported seeds of vegetable, fruit, peanut, others (e.g., olives, quinine, hop) were distributed to local governments. *The Western agricultural chemistry was first introduced. | <ul style="list-style-type: none"> *Western Farm Machinery Exhibition Yard was opened in Tokyo. *Agricultural experiment stations were opened in Aoyama, Komaba and Kasumigaseki. *Ito Hirobumi bought farming equipments in the U.S. *Kuroda Kiyotaka bought farming equipments in the U.S. *Opened a livestock farm in Aomori. *Horace Capron was invited as an advisor of the Hokkaido Development Office. *Imported wheat and barley seeds were distributed. |
| 1872 | <ul style="list-style-type: none"> *School System Law was enacted. *Conscription Law was enacted. *Tomoka Silk-Reeling Factory was founded. *Ordinance for the establishment of national banks was enacted. | <ul style="list-style-type: none"> *Restrictions on the sale of land was removed. *Titles to land issued. *Exporting inferior tea raised problems. | <ul style="list-style-type: none"> *Ten-Year Plan for Hokkaido development based on Western farming methods was established. *Naito-Shinjuku Experimental Station was established. *Dutch engineers were employed for improving flood control. *An experimental sheep farm in Kyoto was established. *Foreign instructors for livestock farming were invited to Kyoto. *Development of tea farms began. *Vegetable seeds and fruit tree seedlings were imported from Europe, the U.S. and China. | |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|------|---|---|--|
| 1873 | | <ul style="list-style-type: none"> *Land Tax Survey was completed. *The Land Tax Reform Ordinance was enacted. *Regulations for the Control of the Production of Raw Silk, and Regulations for the Control of Silkworm Eggs were enacted. *Restriction was lifted on the export of grain. | <ul style="list-style-type: none"> *Ministry of Education established regulations for agricultural schools. *Results of experimental cultivation of a Chinese variety of peach were obtained. *Brought back farming equipments from England and the U.S. by Iwayama Sotarō. *Sent Tanaka Yoshio and Tsuda Sen to the Vienna International Exposition. *Ministry of Military began to import breeding horses. *The Shinjuku Experiment Station started a test cultivation of foreign varieties of wheat and barley and other stations followed this effort. |
| 1874 | | <ul style="list-style-type: none"> *Arid land in Tōhoku and Hokkaido was transferred to private ownership free of charge. *The land was began to be divided into public and private properties. | <ul style="list-style-type: none"> *A test cultivation of fruit seeds from the U.S. began. *Cotton seeds from the U.S. were cultivated at the Naito Shinjuku Experiment Station. *A South Carolina variety of rice was imported. |
| 1875 | *Rice stipends of samurai class was changed to money payment. | <ul style="list-style-type: none"> *Tea began to be exported directly without medium of foreign firms. *Ordinance for Silkworm-Eggs Manufacturers' Association was enacted. | <ul style="list-style-type: none"> *Shimo-osa Sheep Farm was established. *Government requested each prefecture to recommend veteran farmers for disseminating agricultural information. *A plan for distributing sheep to farmers was formulated. *Began an experimental cultivation of coffee. |
| 1876 | | <ul style="list-style-type: none"> *Ownership of land was classified into public and private. *Farmers' movement for reduction of land taxes intensified. | <ul style="list-style-type: none"> *Established Sapporo Agricultural College. *A seed exchange meeting was opened in Kyoto. *Horse plowing teachers were invited to Tōhoku district. *Productions of 109 rice varieties were estimated by unit acreage sampling in the Shinjuku Experiment |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|--------|---|--|---|
| (1876) | | | Station. |
| 1877 | <ul style="list-style-type: none"> *Satsuma Rebellion broke out. *The First National Industrial Exhibition was held. *Samurai stipends was paid off with Government bonds. | <ul style="list-style-type: none"> *The rate of land tax was reduced to 3%. *Regulation Concerning the Leasing of Bulls and Studs was enacted. | <ul style="list-style-type: none"> *Komaba Agricultural College was established. *Agricultural Promotion Stations and Nita Seed-Breeding Station was established. *Agricultural discussion societies and seed-exchange societies emerged in various locations. *The <u>Shinriki</u> variety of rice was selected. |
| 1878 | <ul style="list-style-type: none"> *Ordinance was enacted for the establishment of the stock exchange. *The Country, Ward, Town and Village Organization Law was enacted. *The Prefectural Assembly Regulation was issued. | <ul style="list-style-type: none"> *Export of silkworm eggs considerably decreased. | <ul style="list-style-type: none"> *Agricultural Correspondence System was established. *An imported rice variety was distributed and planted for testing in various prefectures. *Voluntary meetings among farmers were frequently held. |
| 1879 | <ul style="list-style-type: none"> *School System Law was abolished in favor of School Ordinance. *Inflation. | <ul style="list-style-type: none"> *The Local Tax Regulation was amended. | <ul style="list-style-type: none"> *A fair for Raw silk, cocoon, and tea was held in Yokohama. *Silkworm varieties was switched to <u>Akajuku</u>, <u>Matamukashi</u>, and <u>Hakuryu</u>. *"Warm rearing" method of raw silk began to be used. *Nita Farm Implements Factory was established. *Customary practices for lowland rice cultivation was investigated by the government. |
| 1880 | <ul style="list-style-type: none"> *Ward, Town, and Village Councils Law enacted. | <ul style="list-style-type: none"> *A project for soil survey was started. | <ul style="list-style-type: none"> *Planting of <u>Unshu</u> mandarin orange variety began to increase. *Distributed the rest of Saigon rice seeds to 8 prefectures. |
| 1881 | <ul style="list-style-type: none"> *Matsukata's currency reform began. | <ul style="list-style-type: none"> *Ministry of Agriculture & Commerce was established. | <ul style="list-style-type: none"> *Recommendations for the Development of Animal Husbandry |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|--------|--|---|---|
| (1881) | | <ul style="list-style-type: none"> *Regulations for the Advisory Council for Agriculture, Commerce and Industry were issued. *Yokohama Joint Depot for Raw Silk was established. *Agricultural Society of Japan was inaugurated. *The division of land into public and private properties was completed. *The demand for fishmeal increased. | <ul style="list-style-type: none"> were published. *National Conference of the Agricultural Discussion Society was held under the sponsorship of the government. *A long oblong shaped seed bed was recommended. |
| 1882 | <ul style="list-style-type: none"> *Ordinance for the establishment of the Bank of Japan was enacted. *Association of Textile Firms founded. | <ul style="list-style-type: none"> *Imports of soybean cake began. *Import of Japanese tea was banned by the U.S. *The rice price dropped considerably. | <ul style="list-style-type: none"> *Kellner and Pesca carried out soil and fertilizer studies. *Selecting rice using salt water and germination of rice were tested. |
| 1883 | <ul style="list-style-type: none"> *Economic depression worsened. | | <ul style="list-style-type: none"> *Sericulture was added to the General Regulations on Agricultural Schools. |
| 1884 | | <ul style="list-style-type: none"> *The government decided to rivet the land price at the current rate. *Standing Rules of Trade Associations established for tea and rice. *"Advice on the promotion of Industries" was issued. | <ul style="list-style-type: none"> *Takabayashi Kenzō devised tea steamer and roller. *Advisory Council for the Livestock Industry was established. *Kyoshin-Gumi for Improved Sericulture was established in Saitama Prefecture. *<u>Kawanata</u> silkworm species were bred from <u>Matamukashi</u> species. *Silkworm Diseases Experiment Station was established within the Agricultural Bureau. *Improved drainage method was introduced. *Rice improvement associations were successively founded. |
| 1885 | <ul style="list-style-type: none"> *Supplement land survey began. *Principles for the Prevention of Insect Pest Damage to Rice Fields | | <ul style="list-style-type: none"> *Itinerant Instructor System for farmers was established. |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|--------|--|---|--|
| (1885) | | <ul style="list-style-type: none"> was formulated. *Merger of private forests into the Imperial property was started. *Standing Rules for the Sericulturists' Association was issued. *Some rock phosphate and calcium superphosphate were imported. | <ul style="list-style-type: none"> *A rotary type of multi-blade thrasher (<u>Senbakoki</u>) invented. *Pyrethrum seeds were imported. *The apple production increased in Tohoku. |
| 1886 | <ul style="list-style-type: none"> *Reform of the monetary system was completed. *Imperial university, middle school, and elementary school ordinances was proclaimed. | <ul style="list-style-type: none"> *Regulations for the Inspection of Silkworm Eggs were enacted. *Registration Law was enacted. | <ul style="list-style-type: none"> *Hayashi Enri gave training in cultivation with horse plow at <u>Kannosha</u>. *Many improved farming techniques were spread throughout Japan. *The <u>Shinriki</u> variety of rice was introduced to various localities. |
| 1887 | | <ul style="list-style-type: none"> *The draft regulation on tenancy was prepared. *The number of landlords who farmed themselves declined. *Cotton and rape production reached a peak. *Winter irrigation for paddy field was disapproved. *Tokyo Artificial Fertilizer Plant was established. | <ul style="list-style-type: none"> *Improvement of silkworm species was begun on large scale. *Progress was made in research on the rearing of Chinese strain silkworms and on the artificial hatching of silkworm eggs. |
| 1888 | | <ul style="list-style-type: none"> *Consumption of rice increased markedly. *Import of rice began to gradually increase. *The industrial production of calcium superphosphate was started. *Some demand for beef appeared in urban areas. | <ul style="list-style-type: none"> *Mita Farm Implements Factory was sold to private ownership. *Western large-scale farming was put into practice in Hokkaido's Hachisuka Farm and the Koiwai Farm in Iwate Prefecture. |
| 1889 | <ul style="list-style-type: none"> *Railroad between Tokyo and Kobe was opened. *Meiji Constitution was promulgated. | <ul style="list-style-type: none"> *The farm land price was revised. *The Land Tax Reform Ordinance was amended. | <ul style="list-style-type: none"> *Readjustment of land was carried out actively. *Graduates of the <u>Kannosha</u> worked most actively as teachers of horse plowing. *The <u>Aikoku</u> variety of rice was selected. *Phosphate fertilizer was strongly recommended for rice cultivation by Kellner and Kozai. |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|------|--|--|--|
| 1890 | *First financial panic occurred. | *Agricultural Survey was conducted. *Irrigation Association Ordinance was enacted. *Civil Code was promulgated. | *The establishment of the Agricultural Department in the Tokyo Imperial University was decided. *The national agricultural experiment station was founded. *Use of Manchurian soybean cake began, marking the first large increase in use of commercial fertilizers. *A "compromise method" of raising silkworms began to be used for raising silkworms. *The application of fertilizer to mulberry trees increased. |
| 1891 | | *Agricultural Association Bill submitted to the Diet. *Output of domestic cotton yarn exceeded the amount of the imported. | *The horse plowing on dried field was performed in Tohoku area. *Pyrethrum began to be used as insecticide. *The National Epizootic Laboratory was established. |
| 1892 | *Railroad Construction Law was enacted. | *First cooperative credit association was established in Shizuoka Prefecture. *The sericultural production expanded considerably. | *Steam pumps were first used for drainage in Niigata Prefecture. *"Taichiguruma," or rotary inter-tillage weeder, was invented by Nakada Taichirō. *The "Shinriki" variety of rice began to spread widely. *Chisagata Sericultural School was founded in Nagano Prefecture. |
| 1893 | *Mitsui & Yasuda Banks were founded. | *Rice Exchange Law was enacted. | *Irrigation by steam pumps was performed in Fukui Prefecture. *The "Kameno-ō" variety of rice was selected. |
| 1894 | *Sino-Japanese War broke out. *Export tax on cotton thread was removed. | *The Rules on Prefectural Agricultural Experiment Station were issued. | *National Agricultural Society was founded. |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|------|---|---|--|
| 1895 | <ul style="list-style-type: none"> *Sino-Japanese War ended. *Formosa became Japanese colony. *Sumitomo Bank & the Banking Division of Mitsubishi founded. | <ul style="list-style-type: none"> *Horse-Breeding Investigation Council was inaugurated. *Horse-Breeding Association was set up. *Raw Silk Inspection Law was enacted. *Civil Code was enacted. *Fruits and vegetables of foreign origin began to be sold in Tokyo. | <ul style="list-style-type: none"> *Toyama Kanetarō experimented artificial crossing of rice around this time. |
| 1896 | | <ul style="list-style-type: none"> *Laws concerning Hypothec Bank of Japan, and Agricultural & Industrial Bank were enacted. *The Import tariff on cotton was lifted. *Raw Silk Inspection Houses were established. *Insect Pest Control Law and Cattle Plague Prevention Law were enacted. *The landownership was legislated by the Civil Code. *River Law & Forests Law enacted. | <ul style="list-style-type: none"> *Five tons of ammonium sulphate was first imported. *The long oblong shaped nursery bed was adopted widely. *Soaking wheat seeds in warm water was adopted for prevention of smut. *Stud farms established. *Rice cultivation was developed in Hokkaido due to selection of a cold and disease resistance variety, <u>Bōzu</u>. |
| 1897 | <ul style="list-style-type: none"> *Gold standard was established. | <ul style="list-style-type: none"> *First Agricultural & Industrial Bank, Hypothec Bank of Japan founded. *Raw silk production first surpassed that of Italy & France. *Stallion Breed Inspection Law, and Customs Tariff Law were enacted. *Export Trade Association Law was enacted. *Prefectural agricultural associations took over responsibilities for the inspection of rice. *The import of rice suddenly increased considerably. *The Hokkaido Uncultivated State Land Disposal Law was enforced. *The indigo plant production reached a peak. | <ul style="list-style-type: none"> *Sprayers were imported. *The bordeaux mixture was applied to vineyard. *Farming in Hokkaido was developed further: using plow, harrow, and cultivator; planting wheat, corn, Irish potatoes, hemp, sugar beat, and hops as major crops; and raising hogs, poultry, and dairy cows. *Food processing plants were set up in Hokkaido with subsidies from government. |
| 1898 | | <ul style="list-style-type: none"> *System of monopoly control over tobacco was put into effect. *Silkworm-eggs Inspection Law was enacted. *Value of raw cotton imports exceeded value of raw silk exports. *The sugar consumption tax was imposed. | |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|--------|---|---|--|
| (1896) | | <ul style="list-style-type: none"> *The number of milk cows increased gradually. | |
| 1899 | <ul style="list-style-type: none"> *The extraterritoriality was abolished. *The tariff autonomy was recovered. | <ul style="list-style-type: none"> *Agricultural Association Law was enacted. *Farmland Adjustment Law was enacted. *Fertilizer Control Law was enacted. *Cattle & Horse Breeders' Association Law was enacted. *Hokkaido Colonial Bank Law was enacted. *Land tax was raised. *Law on State Subsidies for Prefectural Agricultural Stations was enacted. *Manufacturing and sale of sprayers were started. *The milking and milk processing industries developed. | |
| 1900 | | <ul style="list-style-type: none"> *Water Utilization Association Ordinance was enacted. *Agricultural associations was set up in Hokkaido. *Industrial Cooperative Associations Law was enacted. *Staple Products Trade Association Law was enacted. | <ul style="list-style-type: none"> *Seed growers' cooperatives, rice and wheat improvement cooperatives, cocoon-raising cooperatives, and other small hamlet organizations were encouraged to be formed. *The method of soaking wheat seeds in warm water began to spread throughout the nation. |
| 1901 | <ul style="list-style-type: none"> *Severe bank panic occurred. | <ul style="list-style-type: none"> *Horse Castration Law, Cattle Tuberculosis Prevention Law enacted. | <ul style="list-style-type: none"> *The plow with blade applicable to both sides began to be sold. *Rock phosphate of high quality was imported from Christmas and Ocean Islands. *Tomita Jimpei developed a new drain system. *The bordeaux mixture was widely applied to vegetables and fruit trees. |
| 1902 | <ul style="list-style-type: none"> *Industrial Bank of Japan was opened. *The Anglo-Japanese Alliance Treaty was concluded. | <ul style="list-style-type: none"> *Hokkaido Land & Water Utilization Association Law was enacted. *A Japanese cotton spinning factory was build in China. *Hypotheac Bank Law revised. *Rules on Prefectural Livestock Breeding Stations were issued. | <ul style="list-style-type: none"> *A new short soled plow was invented. *Mendel's laws were first introduced into Japan. *Department of Horticulture was added to National Experiment Station. |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|------|--|---|--|
| 1903 | | <ul style="list-style-type: none"> *The Hypothec Bank began to finance the farmland adjustment projects. | <ul style="list-style-type: none"> *Department of Livestock was added to National Experiment Station. *The compulsory 14 items for agricultural improvement were issued by the Ministry of Agriculture. *School ordinance was proclaimed concerning higher education in agriculture. |
| 1904 | <ul style="list-style-type: none"> *Russo-Japanese War broke out. | <ul style="list-style-type: none"> *Customs duty on imported rice was first levied. *The Emergency Special Tax Law was enacted, advancing the rate of land tax. *The government monopolized the production and sale of tobacco. *The canning industry developed because of the War. *The demand for silk expanded in the U.S. | <ul style="list-style-type: none"> *Paper sacking of fruits on tree was started around this year. *Experiments on artificial hybridization of rice and wheat began to be conducted at National Experiment Station. *Temporary Horse Breeding Investigation Council was established for the encouragement of horse breeding. |
| 1905 | <ul style="list-style-type: none"> *The Treaty of Portsmouth was signed. | <ul style="list-style-type: none"> *The government monopolized the sale of salt. *Farmland Adjustment Law was revised so as to encourage irrigation and drainage projects. *Silkworm Infection Prevention Law was enacted. *Consumption of soy bean cake exceeded that of fish meal. *Production of calcium superphosphate began to expand. *Agricultural Association Law was revised. *The number of filature mills suddenly increased. | <ul style="list-style-type: none"> *Sowing machine for paddy field and the straw rope making machine were invented. *Prefectures began to designate the improved varieties of rice and to encourage the cultivation of them. |
| 1906 | <ul style="list-style-type: none"> *Railroad Nationalization Law was enacted. | <ul style="list-style-type: none"> *Horse Administration Bureau was established in the Ministry of Agriculture and Commerce. *Industrial Cooperative Association Law was revised. *Customs Tariff Law was revised. *Regulations for the Encouragement of Arable Land Readjustment & Land Improvement were enacted. | <ul style="list-style-type: none"> *Capacity generated by hydraulic power surpassed that by thermal. *Toyama Kametarō developed P₁ of silkworm. |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|--------|---|--|--|
| (1906) | | *The Japan Nitrogenous Fertilizer Co. was established. | |
| 1907 | *Compulsory education system was extended to six years. *The postwar panic raged over the country. | *Regulations for the Granting of Bonuses for Mulberry Farm Expansion were enacted. *Tenancy disputes arose. *Power sprayers began to be manufactured around this year. *Export of raw silk exceeded that of China. *Bull Breeders Inspection Law was enacted. | *A new rice variety, "Asahi," was selected. *Light traps were designed for use against rice stem borer. *Research on high fertilizer tolerance varieties began to be conducted at experiment stations. |
| 1908 | | *Fertilizer Control Law was revised. *Water Utilization Law was enacted. *Government began subsidizing Japan Central Union of Industrial Cooperative Associations. *Soybean production reached a peak. | *A machine was invented to make straw mat. |
| 1909 | | *New Farmland Adjustment Law was enacted. *Industrial Cooperative Association Law revised. *The Central Union of Industrial Cooperatives was organized. | |
| 1910 | *Korea was colonized. | *Agricultural Association Law revised whereby National Agricultural Society was reorganized into Imperial Agricultural Association. *Ordinance for Prefectural Inspection Fees, Ordinance for Staple Products Inspection Fee was issued. *The Tax Law was revised, raising the land tax rate. *The Greater Japan Artificial Fertilizer Co. was established. | *First Hokkaido Development Plan was put into effect to bring upland agriculture under government direction and push forward its development. *Selection of pure line of rice was started. |
| 1911 | *Tariff autonomy rights was returned. | *Hypothec Bank of Japan Law and the Agriculture & Industry Bank Law were revised. *Customs duty on imported rice was revised. *Sericultural Industry Law was enacted. *Regulations for the Encouragement of Disease & Insect Pest | *Peddling type of thresher was invented. *Reproductive Silkworm Egg Production Station was established. *Fruit production expanded. *Koike's acid hatching method was widely accepted. |

APPENDIX C (cont'd)

| YEAR | GENERAL EVENTS | GENERAL EVENTS IN AGRICULTURE | EVENTS IN AGRICULTURAL SCIENCE AND TECHNOLOGY |
|------|----------------|--|--|
| 1911 | | <p>Prevention were enacted.</p> <p>*Indigo plant and sugar cane productions stopped.</p> <p>*Sugar industry was established in Formosa.</p> <p>*The import duty on sugar was raised.</p> | |
| 1912 | | <p>*Production of calcium superphosphate reached a peak.</p> | <p>*Electric light began to be used for trap lamp of rice borer.</p> |

Source: Japan FAO Association, 1959; Ogura, 1970.

APPENDIX D

Curricula at the Komaba Agricultural College.

| YR | MAJOR | April, 1880 | August, 1882 | March, 1884 |
|----|-------|------------------------|--------------------------|--------------------------|
| F | A | *Agriculture | *Agriculture | *Agriculture |
| I | G | *Geology | *Geology | *Organic Chemistry |
| R | I | *Botany | *Plant Physiology | *Qualitative Analysis |
| S | C | *Zoology | *Trig. Survey & Mapping | *Meteorology |
| T | U | *Survey | | *Finance |
| | L | *Higher Mathematics | | *Gnl Physics |
| Y | T | *Farming Practice | | *Trig. Survey & Drafting |
| E | U | | | *Agricultural Accounting |
| A | R | | | *Infantry Training |
| R | E | | | |
| | V | *Anatomy | *Comparative Anatomy | *Organic Chemistry |
| | E | *Animal Physiology | *Histology | *Qualitative Analysis |
| | T | *Inorganic Chemistry | *Physiology | *Comp Anatomy |
| | E | *Botany | *Pharmacology | *Physiology |
| | R | *Internal/Surgical | *Microscope Analysis | *Pharmacology |
| | I | Pathology | *Shoe horses | *Animal Histology & |
| | N | | | Microscope Analysis |
| | A | | | *Horseshoe |
| | R | | | *Infantry Training |
| | Y | | | |
| S | A | *Agriculture | *Agriculture | *Agricultural |
| E | G | *Gnl Veterinary | *Entomology | *Finance |
| C | I | *Gnl Entomology | *Gnl Veterinary | *Trig. Survey & Drafting |
| O | C | *Animal & Plant | *Horticulture & Forestry | *Plant Histology |
| N | U | Physiology & Pathology | *Ag. Economics & Law | *Entomology |
| D | L | | | *Gnl Veterinary |
| | T | | | *Infantry Training |
| Y | U | | | |
| E | R | | | |
| A | E | | | |
| R | | | | |
| | V | *Anatomy Practice | *Comp. Anatomy | *Comp Anatomy |
| | E | *Zoology | *Physiology | *Surgical Operation |
| | T | *Organic Chemistry | *Surgical Operation | *Genl Pathology |
| | E | *Microscope Analysis | *Diet | *Diet |
| | R | *Internal/Surgical | *Obstetrics | *Obstetrics |
| | I | Medicine | *Internal/Surgical | *Pathology Theory |
| | N | *Hospital Practice | Pathology *Dissection | *Surgical Medicine |
| | A | | *Hospital Practice | *Vet Hospital Practice |
| | R | | | *Infantry Training |
| | Y | | | |

APPENDIX D (cont'd)

| YR | MAJOR | April, 1880 | August, 1882 | March, 1884 |
|----|-------|--------------------------|--------------------------|---------------------------------|
| T | A | *Catl. Breedg. & Dairy | *Farming | *Agriculture |
| H | G | Farming | *Livestock Mgt | *Farm Management |
| I | I | *Horticulture & Forestry | | *Livestock Breeding & Mgt |
| R | C | *Farming | | |
| D | U | | | |
| | L | | | |
| Y | T | | | |
| E | U | | | |
| A | R | | | |
| R | E | | | |
| | V | *Obstetrics | *Horse Diagnosis Method | *Vet Hospital Practice |
| | E | *Pharmacology & Pharmacy | *Veterinary Epidemiology | *Dissection |
| | T | *Shoe horses | *Animal Immunology | *Horse Diagnosis Method |
| | E | | *Parasitology | *Vet. Epidemiology & Immunology |
| | R | | | |
| | I | | | *Livestock Mgt & Breeding |
| | N | | | *Parasitology |
| | A | | | *History of Vet Medicine |
| | R | | | *Infantry Training |
| | Y | | | |

Source: Miyoshi, 1982.

APPENDIX E

Curriculum of Sapporo School of Agriculture, March 1877.

| Field | Subject | Class | Hours (%) | |
|-----------------------------|----------------------|---|-----------|-----------|
| I: Agriculture | Agriculture | Agriculture | 10 | 49 (22.3) |
| | Horticulture | Landscape Gardening; Fruit Culture | 6 | |
| | Livestock Farming | Vet. Science & Practice; Stock & Dairy Farming | 9 | |
| | Practice | Manual Labor | 23+ | |
| II: Science | Chemistry | Organic & Practical Chemistry; Ag. & Analytical Chem.; Quantitative Analytical Chem.; Chem. Physics & Inorganic Chem. | 30 | 77 (35.8) |
| | Physics | Physics | 6 | |
| | Biology | Botany; Zoology; Human Anatomy & Physiology; Microscopy | 19 | |
| | Geology | Astronomy & Topography; Geology | 10 | |
| | Mathematics | Geometry & Conic Sections; Algebra including Logarithms | 12 | |
| III: Engineering | Drafting & Surveying | Trigonometry & Surveying; Mathematical Drawing & Plotting; Mechanical & Topographical Drawing; Freehand & Geometrical Drawing | 15 | 27 (12.6) |
| | Engineering | Mechanics; Railroads & Hydraulic Engineering | 12 | |
| Liberal Arts I: Language | Language | Japanese | 6 | 35 (16.3) |
| | Foreign Language | English; History of English Literature; English & Japanese Translations; English & Japanese Compositions | 22 | |
| | Public Speaking | Elocution; Extempore Debate; Original Declamation | 7 | |
| Liberal Arts II: | Others | Psychology; Political Economy; Book-keeping | 12 | 12 (5.6) |

APPENDIX E (cont'd)

| Field | Subject | Class | Hours (%) | |
|----------|---------|----------------|-----------|-------------|
| Training | | Military Drill | 16 | 16 (7.4) |
| Total | | | | 215 |

Source: Miyoshi, 1982.

APPENDIX F

Types of Agricultural Schools according to the 1883 Regulation.

| Type | Type 1 | Type 2 |
|------------------|---|--|
| Purpose | To produce those who practice farming | To produce those who manage farms |
| Educational Goal | Mainly practical training | Both theories and practices |
| Curriculum | Morals; Arithmetic and Geometry; Physics and Chemistry; Botany and Zoology; Planting and Livestock Breeding; Agricultural Economics; Agricultural Bookkeeping | Morals; Algebra; Geometry; Trigonometry; Drawing; Physics; Chemistry; Zoology; Botany; Geology; Agricultural Chemistry; Agricultural Engineering; Planting and Livestock Breeding; Agricultural Economics; Agricultural Bookkeeping; Agricultural Laws |
| Years | 2 | 3 |
| Weekly Hours | Lecture: 12 Practicum: 30 | Lecture: 18 Practicum: 18 |
| Eligibility | Age of 15 years or older Graduates of middle level of elementary schools | Age of 16 years or older Graduates of elementary level of middle schools. |

Source: Ono, 1941.

APPENDIX G

Types of Agricultural Middle Schools according to the 1899 Regulation.

| Type | | Type A | Type B |
|------------------|---------|---|---|
| Educational Goal | | Mainly practical training | Both theories and practices |
| Curriculum | Regular | Morals; Reading; Calligraphy; Composition; Arithmetic; General Science; Gym | Morals; Reading; Composition; Mathematics; Physics; Chemist; Natural History; Economics; Gym |
| | Applied | Soil; Crops; Agricultural Production; Livestock Breeding; Sericulture; Disease/Pest Management; Climate | Soil; Fertilizer; Crops; Horticulture; Agricultural Production; Livestock Breeding; Pest/Disease Management; Climate; General Forestry; General Veterinary; General Aquaculture |
| Years | | Within 3 years | 3 years (with one year extension if desired) |
| Weekly Hours | | 27 hours (lectures/practicum) | 30 (lectures/practicum) |
| Eligibility | | Age of 12 years or older Graduates of elementary schools (4th grade) | Age of 14 years or older Graduates of the higher level of elementary schools (8th grade). |

Source: Ono, 1941.

BIBLIOGRAPHY

BIBLIOGRAPHY

- Anderson, Alun M. 1984. *Science and Technology in Japan*. London: Longman.
- Arnason, Johann P. 1988. "Paths to Modernity: The Peculiarities of Japanese Feudalism," in McCormac, Gavan and Sugimoto Yoshio (eds.), *The Japanese Trajectory: Modernization and Beyond*, pp. 235-263. Cambridge: Cambridge University Press.
- Bartholomew, James R. 1974. "An Annotated Bibliography of English Language Works on the Social History of Modern Japanese Science," in Nakayama Shigeru (ed.), *Science and Society in Modern Japan: Selected Historical Sources*, pp. 312-325. Cambridge, MA: MIT Press.
- Bartholomew, James R. 1982. "Science, Bureaucracy, and Freedom in Meiji and Taishō Japan" in Najita, Tetsuo and J. Victor Koschmann (eds.), *Conflict in Modern Japanese History: The Neglected Tradition*, pp. 295-341. Princeton, NJ: Princeton University.
- Bartholomew, James R. 1989. *The Formation of Science in Japan*. New Haven, CT: Yale University Press.
- Beasley, W. G. 1989. *The Rise of Modern Japan*. New York: St. Martin's Press.
- Beasley, W. G. 1981. "The Iwakura Mission in Britain, 1872," *History Today*, 31:29-33.
- Beauchamp, Edward R. 1983. "Foreign Employees of the Meiji Period," in *Encyclopedia of Japan*, Vol. II:310-311. Tokyo: Kōdansha International, Ltd.
- Benedict, Ruth. 1967. *Kiku to Katana [The Chrysanthemum and the Sword]*. Tokyo: Shakai Shiso-sha.
- Bijker, Wiebe E.; Thomas P. Hughes; and Trevor Pinch. 1990. *The Social Construction of Technological Systems*. Cambridge, MA: The MIT Press.
- Bowen, Roger W. 1980. *Rebellion and Democracy in Meiji Japan: A Study of Commoners in the Popular Rights Movement*. Berkeley, CA: University of California.

- Burks, Ardath W. 1983. "Introduction" in Clark L. Beck and Ardath W. Burks (eds.), *Aspects of Meiji Modernization: The Japan Helpers and the Helped*, pp. 1-10. Rutgers, NJ: The State University of New Jersey.
- Burks, Ardath W. 1985a. "Japan's Outreach: The *Ryugakusei*," in Ardath W. Burks (ed.) *The Modernizers: Overseas Students, Foreign Employees, and Meiji Japan*, pp. 145-160. Boulder, CO: Westview Press.
- Burks, Ardath W. 1985b. "The West's Inreach: The *Oyatoi Gaikokujin*," in Ardath W. Burks (ed.) *The Modernizers: Overseas Students, Foreign Employees, and Meiji Japan*, pp. 187-206. Boulder, CO: Westview Press.
- Busch, Lawrence, and Caroline Sachs. 1981. "The Agricultural Sciences and the Modern World System," in Lawrence Busch (ed.). *Science and Agricultural Development*, pp. 131-156. Totoway, NJ: Allanheld, Osmun & Co.
- Busch, Lawrence, and William B. Lacy. 1983. *Science, Agriculture, and the Politics of Research*. Boulder, CO: Westview Press.
- Busch, Lawrence, William B. Lacy, Jeffrey Burkhardt, and Laura R. Lacy. 1991. *Plants, Power and Profit: Social, Economic, and Ethical Consequences of the New Biotechnologies*. Cambridge, MA: Basil Blackwell, Inc.
- Chūō Kōron. 1976. "Taidan: 'Ishin-go' o Ikani Toraeruka. Takana Akira and Satō Seisaburō, " *Rekishi to Jinbutsu*, 58, pp. 32-46.
- Chūō Kōron. 1979. "Seijika no Risōzō: Ōkubo Toshimichi. Ōkubo Toshiaki, Satō Seisaburō, and Mōri Toshihiko," *Rekishi to Jinbutsu*, 86:32-49.
- Clarke, Adele E. 1990. "A Social Worlds Research Adventure," in Cozzens, Susan E. and Thomas F. Gieryn (eds.). *Theories of Science in Society*, pp. 15-42. Bloomington and Indianapolis, IN:Indiana University Press.
- Cozzens, Susan E. and Thomas F. Gieryn (eds.). 1990. *Theories of Science in Society*. Bloomington and Indianapolis, IN:Indiana University Press.
- Duus, Peter. 1976. *The Rise of Modern Japan*, pp. 55-104. Boston, MA: Houghton Mifflin Company.
- Ebina, Kenzō. 1991. *Sapporo Nōgakkō: Nippon Kindai Seishin no Genryū*. Tokyo: Shin Hyōron-sha.
- Feyerabend, Paul. 1975. *Against Method*. London: New Left Books.
- Feyerabend, Paul. 1978. *Science in a Free Society*. London: New Left Books.

- Francks, Penelope. 1984. *Technology and Agricultural Development in Pre-War Japan*. New Haven, CT: Yale University Press.
- Fujita, Fumiko. 1983. "An Encounter Between the United States and Japan: The Case of Horace C. Capron," *Journal of Tsudajuku Daigaku*, 15:213-242.
- Fukutake, Tadashi. 1978. *Rural Society in Japan*. Tokyo: University of Tokyo Press.
- Fukutake, Tadashi. 1981. *The Japanese Social Structure*. Tokyo: University of Tokyo Press.
- Fuller, Steve. 1988. *Social Epistemology*. Bloomington, IN: Indiana University Press.
- Furushima, Toshio and Saitō Yukio. 1979. "Nōgaku no Tanshō," in *Nihon Nōgyō Hattatsu-shi IX*:13-83 Tokyo: Chūō Kōron-sha.
- Haga, Toru. 1978. "Iwakura Shisetsu-dan no Pari," *Rekishi to Jinbutsu*, 77:164-172.
- Hagendijk, Rob. 1990. "Structuration Theory, Constructivism, and Scientific Change," in Cozzens, Susan E. and Thomas F. Gieryn (eds.). *Theories of Science in Society*, pp. 43-65. Bloomington and Indianapolis, IN:Indiana University Press.
- Hashimoto, Mitsuru. 1982. "The Social Background of Peasant Uprising in Tokugawa Japan" in Tetsuo Najita and J. Victor Koschmann (ed.) *Conflict in Modern Japanese History: the Neglected Tradition*, pp. 145-161. Princeton, NJ: Princeton University.
- Hasumi, Otohiko. 1965. "The Impact of Science and Technology on Traditional Society in Japan," *Journal of World History*, 9(2):363-379.
- Hayami, Yūjirō. 1975. *A Century of Agricultural Growth in Japan: Its Relevance to Asian Development*. Minneapolis, MN: University of Minnesota Press.
- Hayami, Yūjirō. 1988. *Japanese Agriculture Under Siege: The Political Economy of Agricultural Policies*. New York: St. Martin's Press.
- Hayami, Yūjirō and Vernon W. Ruttan. 1971. *Agricultural Development: An International Perspective*. Baltimore, MD: Johns Hopkins University Press.
- Hayashi, Motoi. 1964. "Hōreki -- Tenmei-ki no Shakai Jyōsei" in *Iwanami Kōza, Nippon no Rekishi* 12:103-154. Tokyo: Iwanami Shoten.
- Hessen, Borris M. 1968. "The Social and Economic Roots of Newton's 'Principia,'" in George Basalla (ed.), *The Rise of Modern Science*:

- External or Internal Factors?*, pp. 31-38. Lexington, MA: Raytheon Education Company.
- Higuchi, Kiyoyuki. 1986. *Shizen to Nihonjin: Nihonjin no Rekishi Vol. 4*. Tokyo: Kōdansha Bunko.
- Hiroshige, Tetsu. 1965. "The Role of the Government in the Development of Science," *Journal of World History*, 9(2):320-339.
- Hunter, Janet E. 1984. *Concise Dictionary of Modern Japanese History*. Berkely, CA: University of California Press.
- Iinuma, Jirō. 1981. *Nihon Nōgyō no Sai Hakken*. Japan: NHK Books.
- Inoue, Harumaru. 1979a. "Zenshi Bakuhanjidai no Gaikatsu," in *Nihon Nōgyō Hattatsu Shi*, Vol. 1:7-52. Tokyo: Chūō Kōronsha.
- Inoue, Harumaru. 1979b. "Nōgyō ni Okuru Nihon-teki Kindai no Keisei," in *Nihon Nōgyō Hattatsu Shi*, Vol. 1:53-118. Tokyo: Chūō Kōronsha.
- Inoue, Harumaru. 1979c. "Nippon Shihonshugi no Kakuritsu to Nōgyō," in *Nihon Nōgyō Hattatsu Shi*, Vol. 4:7-115. Tokyo: Chūō Kōronsha.
- Inoue, Kiyoshi. 1963. *Nihon no Rekishi*. Tokyo: Iwanami Shoten.
- Inoue, Kiyoshi. 1968. *Meiji Ishin no Mikata*. Tokyo: Tōhata Shoten.
- Ishizuka, Hiromichi, and Katō, Kōsaburō. 1962. "Kindaishi Kenkyū Kaisetsu" in *Iwanami Kōza, Nippon no Rekishi 17*:315-351. Tokyo: Iwanami Shoten.
- Ishizuki, Minoru. 1972. *Kindai Nihon no Kaigai Ryūgakusei*. Kyoto: Mineruba Shobō.
- Ishizuki, Minoru. 1985. "Overseas Study by Japanese in the Early Meiji Period," in Ardath W. Burks (ed.), *The Modernizers: Overseas Students, Foreign Employees, and Meiji Japan*, pp. 161-186. Boulder, CO: Westview Press.
- Itagaki, Tetsuo. 1979. "Ōkubo Jinmyaku no Kenkyū," *Rekishi to Jinbutsu*, 86:102-109.
- Izumi, Saburō. 1984. *Meiji Yonen no Anbassadoru: Iwakura Shisetsudan Bunmei-kaika no Tabi*. Tokyo: Nippon Keizai Shinbun-sha.
- Jansen, Marius B. 1983. "The Meiji Modernizers," in Clark L. Beck and Ardath W. Burks (eds.), *Aspects of Meiji Modernization: The Japan Helpers and the Helped*, pp. 11-20. Rutgers, NJ: The State University of New Jersey.
- Japan FAO Association. 1959. *A Century of Technical Development in Japanese Agriculture*. Tokyo: Japan FAO Association.

- Jones, Hazel J. 1968. "The Formation of Meiji Government Policy toward the Employment of Foreigners," *Monumental Nipponica*, 23(1-2):9-30.
- Jones, Hazel J. 1974. "Bakumatsu Foreign Employees," *Monumental Nipponica*, 29(3):305-327.
- Jones, Hazel J. 1980. *Live Machines: Hired Foreigners and Meiji Japan*. Vancouver: University of British Columbia Press.
- Jones, Hazel J. 1985. "The Griffis Thesis and Meiji Policy Toward Hired Foreigners," in Ardath W. Burks (ed.), *The Modernizers: Overseas Students, Foreign Employees, and Meiji Japan*, pp. 219-253. Boulder, CO: Westview Press.
- Jussaume, Jr., Raymond A. 1991. *Japanese Part-time Farming: Evolution and Impacts*. Ames, IA: Iowa State Press.
- Kamatani, Chikayoshi. 1965. "The Role Played by the Industrial World," *Journal of World History*, 9(2):400-421.
- Kanai, Madoka; Sakai, Takahito; and Naramoto, Tatsuya 1964. "Kinseishi Kenkyū Kaisetsu" in *Iwanami Kōza, Nippon no Rekishi* 13:289-342. Tokyo: Iwanami Shoten.
- Kashiwa, Suketaka. 1964. *Nihon Nōgyō Gairon*. Tokyo: Yōkendō.
- Katayama, Seiichi. 1988. *Kindai Nihon no Nōgyō Kyōiku*. Tokyo: Kōryōsha.
- Kawano, Kenji. 1989. "The French Revolution and the Meiji Ishin", *International Social Science Journal*, 41(1):45-52.
- Kenkyūsha. 1968. *New School Japanese-English Dictionary*. Tokyo: Kenkyūsha.
- Kloppenburger, Jr., Jack. 1991. "Social Theory and the De/Reconstruction of Agricultural Science: Local Knowledge for an Alternative Agriculture," *Rural Sociology*, 56(4):519-548.
- Knorr-Cetina, Karin. 1981. *The Manufacture of Knowledge*. Oxford: Pergamon Press.
- Kōdansha International. 1983. *Encyclopedia of Japan*, Vol. II:241. Tokyo: Kōdansha International, Ltd.
- Kuhn, Thomas. 1970. *The Structure of Scientific Knowledge*. Chicago, IL: The University of Chicago Press.
- Kume, Kunitake. 1977 [1878]. *Tokumei Zenken Taishi Beiō Kairan Jikki*. Tokyo: Iwanami Bunko.
- Kurata, Jun. 1978. "Nōgyō Kyōiku no Seiritsu," in *Nihon Nōgyō Hattatsu Shi*, Vol. 3:477-617.

- Kwok, Danny Wynn Ye. 1965. *Scientism in Chinese Thought, 1900-1950*. New Haven, CT: Yale University Press.
- Kyoto Daigaku Bungakubu Kokushi Kenkyū Shitsu (ed.). 1958. *Nippon Kindaishi Jiten*. Tokyo: Tōyō Keizai Shinpō-sha.
- Latour, Bruno. 1987. *Science in Action*. Cambridge, MA: Harvard University Press.
- Maki, John M. 1983. "The Japan Helpers," in Clark L. Beck and Ardath W. Burks (eds.), *Aspects of Meiji Modernization: The Japan Helpers and the Helped*, pp. 21-39. Rutgers, NJ: The State University of New Jersey.
- Marshall, Byron K. 1982. "Growth and Conflict in Japanese Higher Education," in Najita, Tetsuo and J. Victor Koschmann (eds.), *Conflict in Modern Japanese History: The Neglected Tradition*, pp. 276-294. Princeton, NJ: Princeton University Press.
- Matsuhara, Hironori. 1967. *Kagaku: Meiji Hykunen-shi*. Tokyo: Kōdansha.
- Mayo, Marlene J. 1961. *The Iwakura Embassy and the Unequal Treaties, 1871-73* (Thesis). New York: Columbia University.
- Mayo, Marlene J. 1983. "Iwakura Mission," in *Encyclopedia of Japan, Vol. III*:358-360. Tokyo: Kōdansha International, Ltd.
- McLaren, W.W. (ed.) 1979 [1914]. *Japanese Government Documents*. Washington, D.C.: University Publications of America.
- Merton, Robert K. 1973. *The Sociology of Science: Theoretical and Empirical Investigations: Theoretical and Empirical Investigation*. Chicago, IL: The University of Chicago Press.
- Miyanaga, Takashi. 1989. *Bunkiyū Ninnen no Eoroppa Hōkoku*. Tokyo: Shinchō Sha.
- Miyoshi, Nobuhiro. 1982. *Nihon Nōgyō Kyōiku no Seiritsu*. Tokyo: Kazama Shobō.
- Moore, Richard H. 1990. *Japanese Agriculture: Patterns of Rural Development*. Boulder, CO: Westview Press.
- Murakami, Yōichiro. 1968. *Nihon Kindai Kagaku no Ayumi. Seiō to Nihon no Setten*. Tokyo: Sanseidō.
- Nakamura, Takeshi. 1965. "The Contribution of Foreigners," *Journal of World History*, 9(2):294-319.
- Nakamura, Yoshimi. 1952. "Wagakuni Bokuyō Jigyō no Senkusha Jyōnzu no Jisseki," *Nippon Rekishi*, 52(9):14-18.

- Nakamura, Yoshimi. 1955. "Meiji Shonen Oyatoi Gaijin no Sarari," *Nippon Rekishi*, 80(1):43-45.
- Nakane, Chie. 1970. *Japanese Society*. Berkeley, CA: University of California Press.
- Nakayama, Shigeru. 1965. "The Role Played by Universities in Scientific and Technological Development in Japan," *Journal of World History*, 9(2):340-362.
- Nakayama, Shigeru (ed.). 1974. *Science and Society in Modern Japan: Selected Historical Sources*. Cambridge, MA: MIT Press.
- Najita, Tetsuo and J. Victor Koschmann (eds.) 1982. *Conflict in Modern Japanese History: The Neglected Tradition*. Princeton, NJ: Princeton University.
- Naramoto, Tatsuya. 1968. *Meiji Ishin Ron*. Tokyo: Tokuma Shoten.
- Needham, Joseph. 1954. *Science and Civilisation in China*. Cambridge, UK: Cambridge University Press.
- Nihon Nōgyō Hattatsu-shi Chōsa Iinkai (ed.). 1979. "Nōji Shikenjō no Setsuritsu Zengo," *Nihon Nōgyō Hattatsu-shi*, V:671-705. Tokyo: Chūō Kōrōn-sha.
- Nippon Steel Corporation (ed.). 1982. *Nippon: The Land and the People*. Tokyo: Gakuseisha.
- Ogura, Sōichi. 1979a. "Meiji Zenki Nōsei no Dōkō to Nōkai no Seiritsu," in *Nihon Nōgyō Hattatsu Shi*, Vol. 3:219-386. Tokyo: Chūō Kōronsha.
- Ogura, Sōichi. 1979b. "Nōsei Oyobi Nōkai -- Meiji Kōki/Taishō Shoki," in *Nihon Nōgyō Hattatsu Shi*, Vol. 5:309-415. Tokyo: Chūō Kōronsha.
- Ogura, Takekazu (ed.). 1970. *Agricultural Development in Modern Japan*. Tokyo: Fuji Publishing Co., Ltd.
- Ōkubo, Toshiaki (ed.). 1976. *Iwakura Shisetsu-dan no Kenkyū*. Tokyo: Munetaka Shobō.
- Ono, Takeo. 1941. *Gendai Bunmei-shi Vol. 9: Nōson-shi*. Tokyo: Tōyō Keizai Shinpōsha.
- Osatake, Takeki. 1989. *Bakumatsu Kengai Shisetsu Monogatari*. Tokyo: Kōdansha.
- Rosenstone, Robert A. 1980. "Learning from Those 'Imitative' Japanese: Another Side of the American Experience in the Midado's Empire," *American Historical Review*, 85(3):572-595.
- Ruttan, Vernon. 1982. *Agricultural Research Policy*. Minneapolis, MN: University of Minnesota Press.

- Saitō, Yukio. 1968. *Nihon Nōgaku Shi*. Tokyo: Taisei Shuppan.
- Science. 1992. "Women in Science," *Science*, 255(5050):1378.
- Shibahara, Takuji. 1962. "Hanbaku Shoseiryoku no Seikaku" in *Iwanami Kōza, Nippon no rekishi* 14:164-212. Tokyo: Iwanami Shoten.
- Shidō, Sadaaki, and Yabe Ichirō (eds.). 1990. *Kindai Nippon Sono Kagaku to Gijyutsu: Genten-eno Shōtai*. Tokyo: Kōgaku Shuppan.
- Shōgakkan (ed.). 1965. *Zusetsu Nihon Bunkashi Taikei Vols. 7-9*. Tokyo: Shōgakkan.
- Smith, Thomas C. 1959. *The Agrarian Origins of Modern Japan*. Stanford, CA: Stanford University Press.
- Takahashi, Kamekichi. 1969. *Nihon Kindai Keizai no Ikusei*. Tokyo: Jiji Tsūshinsha.
- Takayama, Teruo. 1981. *Nippon Nōgyō Kyōiku Shi*. Tokyo: Nōsan Gyosan Bunka Kyōkai.
- Tamura, Sadao. 1977. "Kido Takamichi no Yūutsu," *Rekishi to Jinbutsu*, 58:56-64.
- Tanaka, Akira. 1977. *Iwakura Shisetsu-dan*. Tokyo: Kōdansha Gendai Shinsho.
- Takahashi, Kamekichi. 1969. *Nihon Kindai Keizai no Ikusei: Kiseki teki Hattatsu no Kiban*. Tokyo: Jiji Tsūshinsha.
- Teikoku Shoin (ed.). 1982. *Teikoku's Complete Atlas of Japan*. Tokyo: Teikoku Shoin Co., Ltd.
- Tokutomi, Sobō. 1991 [1933]. *Kenbei Shisetsu to Rō-Ei Taiketsuhen*. Tokyo: Kōdansha.
- Tonegawa, Yutaka. 1978. "Kaettekita Joshi-ryūgakusei no Saichi," *Chūō Kōron Rekishi to Jinbutsu*, 82:134-141.
- Toriumi, Yasushi. 1979. "Itō Hirobumi to Ōkuma Shigenobu," *Rekishi to Jinbutsu*, 86:50-59.
- Tōyama, Shigeki. 1962. "Kindaishi Gaisetsu" in *Iwanami Kōza, Nippon no Rekishi* 14:1-56. Tokyo: Iwanami Shoten.
- Tuge, Hideomi. 1961. *Historical Development of Science and Technology in Japan*. Tokyo: Kokusai Bunka Shinkōkai.
- Umetani, Noboru. 1969. *Oyatoi Gaikokujin*. Tokyo: Kashima Kenkūsho Shuppankai.

- Umetani, Noboru. 1971. "Foreign Nationals Employed in Japan during the Years of Modernization," *East Asian Cultural Studies*, 10(1-4), pp. 1-32.
- UNESCO Higashi Ajia Bunka Kenkyū Sentā. 1975. *Shiryo Oyatoi Gaikokujin*. Tokyo: Shōgakukan.
- Watanabe, Masao. 1985. "Science Across the Pacific: American-Japanese Scientific and Cultural Contacts in the Late Nineteenth Century," in Ardath W. Burks (ed.), *The Modernizers: Overseas Students, Foreign Employees, and Meiji Japan*, pp. 369-392. Boulder, CO: Westview Press.
- Watanabe, Masao. 1990 [1976]. *The Japanese and Western Science*. Philadelphia, PA: University of Pennsylvania Press.
- Watanabe, Minoru. 1951a. "Meiji Seifu no Ōka Seisaku to Gaijin Kyōshi (1)," *Nippon Rekishi*, 38(7):16-21.
- Watanabe, Minoru. 1951b. "Meiji Seifu no Ōka Seisaku to Gaijin Kyōshi (2)," *Nippon Rekishi*, 39(8):22-25.
- Watanabe, Minoru. 1953. "Yūgaku kara Ryūgaku e," *Nippon Rekishi*, 59:26-33.
- Watanabe, Minoru. 1965. "Japanese Students Abroad and the Acquisition of Scientific and Technical Knowledge," *Journal of World History*, 9(2):254-293.
- Yabuuti, Kiyoshi. 1965. "The Pre-history of Modern Science in Japan: The Importation of Western Science during the Tokugawa Period," *Journal of World History*, 9(2):208-232.
- Yagi, Haruo. 1964. "Nōson Kōgyō no Hatten to Manufacture", in *Iwanami Kōza, Nippon no Rekishi* 13:1-40. Tokyo: Iwanami Shoten.
- Yamada, Seitarō. 1933. "Meiji Ishi ni Okeru Nōgyōjō no Shohenkaku," *Nippon Shihonshugi Hattatsushi Kōza* I, 2(4). Tokyo: Iwanami Shoten.
- Yamazaki, Ryūzō. 1963. "Edo-kōki ni Okeru Nōson-keizai no Hatten to Nōmin-sō bunkai", in *Iwanami Kōza, Nippon no Rekishi* 12:331-374. Tokyo: Iwanami Shoten.
- Yano Tsuneta Memorial, The. 1984. *Nippon no Sugata*. Tokyo: Kokusei-sha.
- Yuasa, Mitsutomo. 1952. *Kagaku Gojūnen*. Tokyo: Jiji Tsūshin Sha.
- Yuasa, Mitsutomo. 1965. "The Scientific Revolution and the Age of Technology," *Journal of World History*, 9(2):187-207.

MICHIGAN STATE UNIV. LIBR



3129300899028