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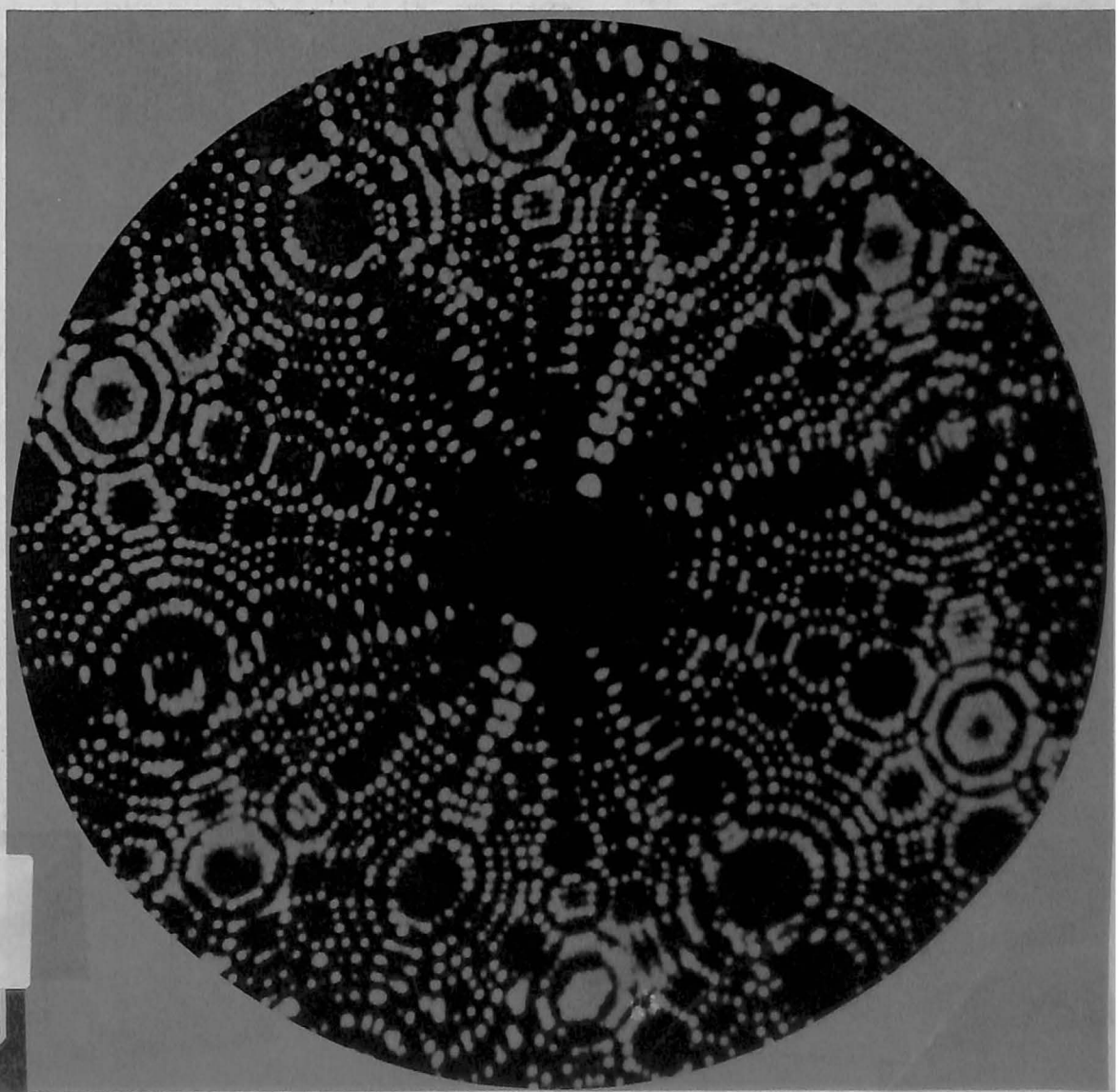

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Science policy and organization of research in Japan

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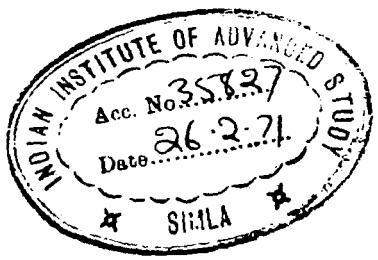

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PREFACE

The Unesco series *Science policy studies and documents* forms part of a programme " to collect, analyse and disseminate information concerning the organization of scientific research in Member States and the policies of Member States in this respect ", authorized by resolution 2.1131 b. adopted by the General Conference of Unesco at its eleventh session in 1960 and confirmed by similar resolutions at each subsequent session.

This series aims at making available to those responsible for scientific research and development throughout the world factual information concerning the science policies of various Member States of the Organization as well as normative studies of a general character.

The country studies are carried out by the governmental authorities responsible for policy making in the field of science in the Member States concerned.

The selection of the countries in which studies on the national scientific policy are undertaken is made in accordance with the following criteria: the originality of the methods used in the planning and execution of the national science policy, the extent of the practical experience acquired in such fields and the level of economic and social development attained. The geographical coverage of the studies published in the series is also taken into account.

The normative studies cover planning of science policy, organization and administration of scientific and technological research and other questions relating to science policy.

The series also includes reports of international meetings on science policy convened by Unesco.

As a general rule, the country studies are published in one language only, either English or French, whereas the normative studies and the reports of meetings are published in both languages.

The present study of national science policy in Japan was prepared under a contract between Unesco and the Japanese National Commission for Unesco, signed in December 1964. The Commission entrusted the execution of the study to the Science and Technology Agency, and a small group of officers of the Agency's Planning Bureau was designated to carry out the work, with Mr. Ryoshiro Tsuji, Chief of the Investigation Section, as co-ordinator.

The general plan of the study is as follows:

Part One presents the historical background of the development of scientific and technological activities in Japan.

Part Two describes the current administrative organization of scientific activities.

Part Three deals with funding and expenditure on research.

Part Four discusses the provision of manpower for scientific and technological activities.

Part Five deals with the main objectives and programmes of policy for science and technology.

Part Six sketches briefly the economic and social background against which the scientific and technological activities have to be viewed.

Relevant charts and tables are included at the end of the respective Parts.

Opinions expressed in the study are the sole responsibility of the authors, and do not necessarily coincide with the views of Unesco.

[redacted]

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This report presents a statement of the situation of scientific and technological research in Japan. It is divided into six parts which give the historical background, the present organization of the main bodies responsible for research, the financing of research including some analysis of the distribution of the funds, the use and availability of personnel in science and engineering, the major objectives of the science policy of the country, and an outline of the socio-economic background to the study, respectively.

The report is accompanied by various charts and tables to support the text and provide supplementary information. The most important sources of information on the subject, and the list of Acts of the Government concerning the administration of science and technology are appended.

One problem in the presentation of the information concerns definition of terms. In Japan, as elsewhere, usage has caused differences to appear compared with other countries. Rectifying this for the simplification of comparison is not easy as the terms involve published figures which group matters (such as type of personnel and expenditure) in a different way from other countries, and separation is not always possible. To facilitate reading the report some definitions are given here in the introduction; others appear as appropriate in the text.

DEFINITIONS

'*Industry*' includes private enterprises with a capital of more than 1 million yen and public corporations engaged in agriculture, forestry, fisheries, mining, manufacturing, transportation and communication, and electricity, gas and water services.

'*Research Institutes*' includes all institutes under governmental, public or private management which carry out research related to the natural sciences, technology and social sciences.

'*Higher Education*' includes the faculties of universities, colleges, their attached laboratories, junior colleges, technical colleges (since 1963), and the national training institutes for engineering teachers.

The faculty is the unit used for discussion, not the university. All these organizations may be supported by the national government, local government or private funds.

'*Special public corporations*' ("Special juridical persons", or "corporate juridical person") are bodies created by a special law for a specific purpose by the national government. They may fall under the heading of Industry or Research Institutes, and they may be only partly financed by the Government.

'*Research Personnel*' includes all those serving in a research laboratory or institute (public or private). They are subdivided into: (a) '*Researchers*', who have taken a 4-year university course, or have qualifications equivalent thereto and who have completed 2 years research, and are engaged on research with their own themes; (b) '*Assistant research workers*': persons engaged in research activities assisting researchers according to their directions; (c) '*Technical assistants*': persons, other than researchers and assistant research workers, who are engaged in testing and inspection for researches, or constructing mechanisms, tools and equipment for researches as well as pilot manufacturing; (d) '*Clerks etc*': personnel engaged in clerical work, accounting, etc., as well as labourers, guards, servants, drivers, janitors, etc., auxiliary to research activities.

Part one

HISTORICAL BACKGROUND TO THE DEVELOPMENT OF SCIENCE POLICY AND RESEARCH ORGANIZATION

BEFORE WORLD WAR II

The history of Western science and technology in Japan began with the introduction of a gun in 1543. But about the middle of the 17th century, the Tokugawa Shogunate (the title of the government of that time) closed the door to foreign countries. This situation lasted for about two and a half centuries, till the Meiji restoration (1867). During this period, Western civilization was still being imported, though only through contacts with the Netherlands; but because of the inhibiting effect of the prevailing feudal system of society, it could not be developed. The modernization of Japan started with the Meiji restoration. The Meiji government decided that Japan must catch up with the West and exerted every effort to make Japan a modern state politically, administratively, educationally and industrially. Japan is now the only highly industrialized country in Asia.

Promotion of Science and Technology by the Government

During the latter part of the Tokugawa period, the feudal government established a research institute for "foreign" sciences (1853), where astronomy, geology, physics, mathematics and chemistry were taught in addition to Western languages, and a Western medical institute (1861). Science instruction was also given at the Numazu Military and Nagasaki Naval Schools (at the latter, by the Dutch officers).

Between 1851 and 1857 the Government and the clans built reverberatory and blast furnaces and iron mills; and in 1867 a cotton mill was imported from the United Kingdom.

The Meiji government sent abroad 661 students (including literature students) from 1875 to 1911. Thus, many of the people who built the foundations of modern science in Japan gained their initial experience from studying abroad.

The early years of the Meiji period saw the establishment of the railway and telegraph services, the dockyards at Hyogo and Nagasaki, the Shinagawa Glass Plant, the Fukagawa Cement Mill, the Tomioka Spinning mill and the Akabane Manufacturing Plant; and the exploitation of the mines at Sado, Ikuno, Niike and Kamaishi.

The Government ministries responsible for the promotion of science and technology, at the beginning of the Meiji period, were as follows:

(a) the Ministry of Education, established in 1871, was responsible for the educational system and basic research in the country;

(b) the Ministry of Finance, established in 1869, was originally responsible for the administration of industry. Within its structure, the offices concerned with science and technology were the Bureau of Arms Manufacturing, the Section of International Trade and the Section of Mining;

(c) the Ministry of Home Affairs (originally the short-lived Ministry of National Wealth), was established in 1873. It was responsible for the bureaux of Industry, Postal Service, Civil Engineering, Geography and Survey, of which the first was the most important. It was divided, in 1877, into the Bureaux of Commerce and of Agriculture which were the centres of the industrial policy of the Government until the Ministry of Agriculture and Commerce was set up. The Ministry was also responsible for medical science;

(d) the Ministry of Technology, as the centre of the "Rich country, strong arms" and "Promotion of Industry" policy was set up in 1870 and abolished in 1885. During these years, the Ministry established the railway and telegraph services, managed Government plants and mines and built up the foundation for the introduction of modern science and technology. It also administered the University of Technology;

(e) the Ministry of Agriculture and Commerce was established in 1881 and was the centre of the industrial administration of Japan; it had affiliated research institutions and devoted its

efforts to the promotion of science and technology. The Ministry was divided into the Ministries of Agriculture and Forestry, and of Commerce and Industry in 1925;

(f) During the middle part of the Meiji period, the Ministry of Railways (including ships) and the Ministry of Communications were also concerned with technology in their own fields.

Universities

The leading educational institution for the training of modern scientists and engineers is the Tokyo (Imperial) University, established in 1877 by the amalgamation of the Tokyo Kaisei School and the Tokyo Medical School. The University originally consisted of four faculties, namely: law, natural sciences, literature and medicine.

Initially, between 1868 and 1889, many foreign instructors were recruited from America, Germany, the United Kingdom, France and Holland, to teach science. In 1877, the Science Faculty of Tokyo University had 5 departments with 15 professors, of whom 12 were foreigners. By 1887, more than half the graduates were from these departments of science.

In 1871 the Ministry of Technology established a school of technology with the help of British instructors. It became the University of Technology in 1877 and was amalgamated with Tokyo University as the faculty of technology in 1886. In 1890 the faculty of agriculture was added.

Further national universities were established in Kyoto (1897), Kyushu (1903), Hokkaido (1907), Tohoku (1911), Osaka (1931) and Nagoya (1939). The Tokyo College of Technology was built in 1929. By 1932, the number of national, public and private universities was 47.

The responsibility for training in the scientific and technological field, as well as for fundamental research, was taken mainly by these universities, especially by the national universities.

Research Institutes

Research institutes in our country which played a leading role in the development of science and technology, especially the latter, down to World War II were mainly the national research institutes attached to each Ministry. This situation had its origin at the beginning of the Meiji period, in the policy for promoting industry and making research and development in science and technology entirely dependent on the initiative of the Government. These institutes were established to lead and improve industrial technology; they were attached to each Ministry to achieve its administrative objects, and the scope of the research was decided by each Ministry.

The national research institutes established in the early Meiji period were Agricultural Experiment Stations, the Forestry Experiment Station, the Geological Survey Institute, the Central Meteorological Observatory, the Electro-Technical Laboratory, the International Latitude Observatory, the Brewing Laboratory , the Research Institute of the Printing Bureau, the National Research Laboratory of Metrology, the Government Chemical Industrial Research Institute, Tokyo, the Railway Technical Research Laboratory, the Tokyo Astronomical Observatory and the Institute for Infectious Diseases (the latter two attached to Tokyo University).

Of the private research institutes, the most noteworthy was the Physical and Chemical Research Institute, established in 1917. This institute was very active over the next 30 years; it contributed substantially to progress in the fields of physics, chemistry and technology and produced a large number of distinguished scientists.

Learned Societies

(a) *The Imperial Academy*: In 1879 the Ministry of Education established the Tokyo Academy, modelled on the academies of European countries, particularly those of England and France. The Government referred to the Academy the function of deliberation at the highest level of culture. The Imperial Academy, which was established in 1906, absorbed the Tokyo Academy and became a member of the International Association of Academies. The Imperial Academy consisted of two departments (literature and social sciences, and physical and applied sciences), each with 30 members. The major activities of the Academy were prize-awarding, aid and encouragement of scientific research, and publication of original research.

(b) *The Science and Research Council*: Following the formation of the International Research Council in 1917, the Science and Research Council was established in Japan in 1919 to participate in its work. The Council maintained a close relation with the Imperial Academy and worked for the liaison, consolidation and furtherance of scientific research activities.

(c) *The Japan Society for the Promotion of Science*: This foundation was established by Resolution of the Diet in 1932, with the aid of the Emperor's fund. In addition, it receives donations from non-official sources and a Government subsidy. The Society makes grants to researchers or research groups and assists in the establishment of research institutes.

(d) *Others*: The oldest society in the field of science and technology is the Mathematical Society of

Japan, which was established in 1874. The Chemical Society of Japan and the Zoological Society of Japan were established in 1878. According to the 1960 survey there are 304 learned societies in the field of science and technology, of which 60% were established before World War II.

AFTER WORLD WAR II

After World War II, science policy and the administrative structure for scientific and technological activities underwent modification.

For several years after the War, activities in science and technological research in Japan were virtually suspended.

After the occupation, the American Forces banned research on atomic energy, armaments and aeronautics and dismantled Japan's cyclotron.

The Science and Research Council was abolished in 1948 and replaced by the Science Council of Japan and the Scientific and Technological Administration Council which was responsible for co-ordination among the various Ministries concerned.

In 1951, the peace treaty was signed, and in 1954 research in atomic physics and development of atomic energy were resumed.

From about 1952, a movement to establish an institute for the combined administration of scientific and technological affairs had been promoted by the Diet and industrial circles. As a result, the Science and Technology Agency was established in 1956. In the same year, the Atomic Energy Commission was established.

Since about 1955, the importance of science and technology in the economy of the country has been widely recognized and the Government and private enterprise have built new universities, faculties and research institutes. In the administrative structure, such organizations as the Council for Science and Technology, and the various Committees and Councils for atomic energy, aeronautics, space research and so on have been established to promote the policies for science and technology.

Universities

After the War, the educational system of Japan was reformed. The alternative schedules for higher education are: 4 years' university or 2 or 3 years' junior college following 12 years of primary and secondary schooling; or (since 1962) 5 years' technical college following 9 years of primary and junior high school.

In 1949, when the educational reform started, there were 180 universities - 70 national, 18 public and 92 private; but by 1964 the number had increased to 291 - 72 national, 34 public and 185 private. These include 54 national, 21 public and 52 private universities having faculties of science and technology.

The number of science and technological faculties was 102 national, 18 public and 52 private, totalling 172 in 1949, but they had increased to 263 in 1963 (130 national, 29 public and 104 private).

Although the universities in Japan are numerous, most of them have been raised to their present status by the educational reforms, and they are inferior in equipment to those established before the War.

Before the educational reforms the major task of the postgraduate courses was to educate scientific researchers and teaching staff of the university; but since the reforms higher vocational training has been introduced particularly for medicals, lawyers and engineers.

The number of universities having postgraduate courses is 35 national, 16 public and 65 private. No university consists of postgraduate courses only.

Research Institutes

(a) *In Universities*: To deal with the pressure of basic research work of national importance which has to be carried out in the universities when instructors can be freed from their teaching duties, research institutes have been attached to the universities. In 1963, the number of such institutes was 107, 66 in the national universities (9 social science), 6 in the public universities (3 social science) and 35 in the private universities (21 social science). Of these, 10 deal with space research, aeronautics, atomic physics, oceanography and fundamental physics. They are used jointly by researchers from the national, public and private universities.

(b) *National Research Institutes*: The national research institutes are attached to a Ministry or Agency and have played a leading role in the promotion of science and technology in the industrial economy. Because of the rapid postwar progress of science and technology and the remarkable achievements of research institutes under private enterprise, the task of the national research institutes has changed. Their purpose now is to undertake research in: fundamental science, except in the fields of atomic energy and space; matters of public welfare such as public health and the prevention of disasters; technology which is basically common to all industries; the atmosphere, geology and the oceans; and matters requiring international co-operation for the common good. In 1964, the national research institutes numbered about 80, of which some 39 dealt with science and

technology, 30 with agriculture, forestry and fisheries and 11 with medicine and pharmacy. The research institutes are listed under each Ministry in Part II.

(c) *Research institutes of the Special Public Corporation*[1]: There are a number of these, including the Institute of Physical and Chemical Research, the Japanese Atomic Energy Research Institute, the Institute of Agricultural Machinery, and the Japanese Sugar Beet Promotion Association.

Learned Societies and Related Institutions

The Academy of Japan was founded as the successor to the Imperial Academy. It was absorbed by the Science Council of Japan in 1948, but was separated again and placed under the Ministry of Education. It consists of up to 150 members, and it had 15 associated foreign members in 1963. It awards the Imperial and Academy Prizes and publishes the *Bulletin* and *Proceedings* of the Academy of Japan.

The Japan Society for the Promotion of Science was reorganized in 1950 and conducts the following business, mainly financed by Government subsidies: management of joint committees of researchers from academic and industrial circles on applied sciences; assisting researchers participating in a joint research to be carried on in a university to which they do not belong; publication of research results; management of the affairs of the U.S. – Japan Committee on Scientific Co-operation.

The Japanese Science and Technology Advancement Foundation was established in 1960 by the co-operation of Government, academic and other non-official circles to encourage research activities in non-official circles in Japan, to promote the training of scientific and technical personnel and to disseminate science and technology. The Foundation established the Science and Technology Hall in 1964 and also a television studio exclusively for science and technology.

The Japan Information Centre for Science and Technology was established in 1957 as the central organization for scientific and technological information in Japan (see Part II).

The total number of learned societies in 1960 was 633; of these, 304 were concerned with natural sciences, 117 medicine, 92 with technology, 59 with physical sciences and 32 with agriculture.

1. See also Part II, X.

Part II

ADMINISTRATIVE ORGANIZATION OF SCIENCE AND TECHNOLOGY

INTRODUCTION

The administration of science and technology in Japan is carried out by the ministries, agencies, advisory organs and special public corporations. The liaison between these organizations on policy making, enforcement, co-ordination and budget formulation operates as follows:

Policy making for Science and Technology

The policy of Japan for science and technology can be considered on two levels. The first concerns specific policy related to a given field such as manufacturing, construction, etc.

These problems are dealt with by the appropriate Ministry. Each Ministry has technical advisory organs and formulates the science policy necessary for its administrative work based on the advice of these advisory organs. Research necessary for its work is performed by the national research institutes attached to it. There are now about 80 such national research institutes.

The second level concerns fundamental and overall policy and the policy for the fields that cut across several Ministries' boundaries or that have special national importance, such as atomic energy, space research, radiation problems and marine science. These policies are considered by the advisory organs established in the Prime Minister's Office.

The important organizations for making fundamental policy are the Council for Science and Technology and the Science and Technology Agency. The Council for Science and Technology, on being consulted by the Prime Minister, deliberates and drafts fundamental measures, with the assistance of the Science and Technology Agency, for a consolidated long-range programme. The Council, through its committees and sub-committees (see Chart II.3a) obtains the views of those interested in research, such as the national research institutes, universities and private organizations; for views on scientific research, it relies particularly on the Science Council of Japan.

The policies outlined by the Council are reported to the Prime Minister who through the ministers concerned, ensures the execution of the decisions by each Government agency or department. The practical measures to implement the policies in a given field are drafted by each Government agency concerned, with the help of the advisory organs attached to it.

Implementation and Co-ordination of Science and Technology Policies

This is effected by each competent Government agency in the following way:

(a) Research by the institutes attached to the agency is almost always technological in nature, and falls into three main classes as follows:

Problems which private enterprises cannot, or will not, attack, on account of their non-profitability, size or uncertainty of success. These are allocated to the research institutes attached to the ministries concerned and to agencies such as the Science and Technology Agency;

Problems concerning national health, are the specific responsibility of research institutes and hospitals under the control of the Ministry of Health and Welfare and the Ministry of Labour (industrial safety);

Technical problems facing government-operated enterprises are the responsibility of research institutes under the ministries concerned and the special public corporations.

(b) Support of technological research carried out by public research institutes and private enterprise by subventions or research contracts. The Science and Technology Agency, and the appropriate ministries, are responsible for such support.

(c) Overall co-ordination of the programme outlined in (a) and (b) above is the responsibility of the Science and Technology Agency, which is particularly concerned with the avoidance of unnecessary duplication in any programmes involving integrated research.

(d) Building up and improvement of the technological basis of industry, through technical training, promotional activities, dissemination of knowledge and standardization. This is the responsibility of the ministries concerned and the Science and Technology Agency.
(e) Promotion of research in basic science: Basic research in Japan is carried out mainly by the universities, and is the responsibility of the Ministry of Education, which manages the national universities and provides the private universities with subsidies for the purchase of research equipment.

Budget Formulation for Science and Technology

Each Government agency estimates its expenditure and, separately, asks for an appropriation from the Ministry of Finance. This ministry compounds the requests of each ministry and fixes the budget, which then goes to the Diet for approval. On the decision of the latter, funds are distributed by each Government agency.

The Science and Technology Agency co-ordinates the budget for integrated research (see above), excluding the universities. The budget for atomic energy is appropriated as a block grant by the Science and Technology Agency and is distributed by the Atomic Energy Commission among the Government agencies concerned.

Uncommitted research funds are the Special Research Promotion and Co-ordination Fund appropriated by the Science and Technology Agency and the Science Research Fund appropriated by the Ministry of Education. The former is disbursed to the national and private organizations in need. The latter is disbursed for research under the universities, the higher professional schools, the Ministry of Education and the special public corporations.

COUNCIL FOR SCIENCE AND TECHNOLOGY [1]

This council is an advisory body to the Prime Minister at the highest level of policy making, being established in the Prime Minister's Office. It consists of a Chairman (the Prime Minister) and ten members (Ministers of Finance and Education, Directors-General of Economic Planning Agency and Science and Technology Agency, Chairman of Science Council of Japan and five men of learning and experience appointed by the Prime Minister and approved by the Diet). The Chairman may invite any other Minister to be present at the meeting, and may appoint specialist members, as and when necessary.

The Council is concerned with the establishment of fundamental policies and goals for long-term overall research, with steering policy decisions in particularly important fields, and with the inquiries directed to the Science Council of Japan and the resultant reports and recommendations.

The plenary meetings, which are attended by the Chairman and members are held four times a year with, if necessary, additional extraordinary meetings. Decisions of the plenary meeting, as a rule, require the unanimous consent of all members present. There are five sub-committees, each under the chairmanship of a member of the Council. Sub-committee meetings are held when necessary.

The First Sub-committee deliberates on the improvement of the fundamental laws, the long range promotion programmes and the various organizations for science and technology, and on matters for which other sub-committees are not responsible. It is composed of 6 members and 20 specialist members.

The Second Sub-committee deliberates on the expansion of research activities, long range research goals and steering policies for particularly important research. It is composed of 6 members and 30 specialist members.

The Third Sub-committee deliberates on the policy for the training of personnel and the improvement of conditions for researchers. It is composed of 6 members and 20 specialist members.

The Fourth Sub-committee deliberates on exchange of information, international co-operation and dissemination of scientific knowledge. It is composed of 6 members and 25 specialist members.

The Liaison Sub-committee for the Science Council of Japan deliberates on important matters directed as inquiries to the Science Council of Japan and the subsequent reports or recommendations provided by the latter. It is composed of members appointed by the Chairman and the Secretary-General of the Cabinet, the Deputy Director-General of the Prime Minister's Office, Under-Secretaries of the Ministries of Finance and Education, representatives of the Economic Planning and Science and Technology Agencies and up to 9 persons recommended by the Science Council of Japan.

The steering committee deliberates on matters concerning the management of the Council for Science and Technology, and is presided over by the Director-General of the Science and Technology Agency. The staff committee appointed by the Prime Minister from the administrative personnel of the Government agencies concerned, is presided over by the Director of the Planning Bureau of the Science and Technology Agency and is responsible for keeping the papers and general affairs of the Council in order.

1. See Chart II-3 a.

SCIENCE COUNCIL OF JAPAN [1]

The Science Council of Japan was established in 1949 as a representative organization of Japanese scientists, and was placed under the aegis of the Prime Minister. Its duties are as follows:

To deliberate on important matters relating to science, to assist in their realization, to maintain liaison among researchers in various fields and to promote efficiency in research activities.

To make recommendation to the government on the following:

(a) Promotion of science and development of technology.
(b) Better utilization of research results.
(c) Training of scientific researchers.
(d) Science in government administration.
(e) Permeation of science into industry and national life.
(f) Other matters designed to promote the objectives of the Science Council.

To act as consultant to the government on the following:

(a) Budgetary allocation of subventions for scientific research and the promotion of science.
(b) Budgetary principles for laboratories and experimental stations under the control of the government, research contracts, etc.
(c) Important measures requiring consideration by specialized scientists.
(d) Other matters as deemed appropriate.

The Science Council consists of seven departments dealing respectively with the following discipline:

First Department - Literature, Philosophy, Pedagogy, Psychology, Sociology, History;
Second Department - Jurisprudence, Politics;
Third Department - Economics, Commercial Science, Management;
Fourth Department - Natural Sciences;
Fifth Department - Technology;
Sixth Department - Agriculture;
Seventh Department - Medicine, Dentistry, Pharmacology;

Each department has 30 members, corresponding to a total Council membership of 210. The members are elected from among scientists having appropriate qualifications, for a term of 3 years. The chairman and 2 vice-chairmen are elected by the members.

The Council has a number of standing committees and *ad hoc* committees dealing with specific topics and 60 national committees to maintain contact with researchers throughout the country.

These committees do most of the work of the Council and their activities are reported at the general meetings which are held twice a year.

The Council is the body through which Japan adheres to the International Council of Scientific Unions; it sends representatives to academic conferences abroad, holds international conferences, symposia and scientific lecture meetings, and issues publications.

SCIENCE AND TECHNOLOGY AGENCY [2]

This Agency was established in 1956, under the Prime Minister's Office, to co-ordinate scientific and technological activities, to link the administrations concerned in each Ministry and Agency and to enhance the contribution of science and technology in the development of the national economy (excluding social sciences and university research).

The detailed duties of the Agency are:

(a) Planning and promoting activities relating to science and technology, through the Council for Science and Technology, the Atomic Energy Commission and other Councils.
(b) Co-ordination of the activities and research budgets of the government agencies concerned.
(c) Conducting research common to separate Ministries and Agencies in its attached research institutes, and putting expensive research facilities and equipment to common use to avoid unnecessary and wasteful duplication.
(d) Subsidizing co-operative interdisciplinary research and fundamental research projects.
(e) Subsidizing research and formulating regulations in new fields which require immediate development, e.g. in nuclear energy and space research.
(f) Establishing policy for the utilization of resources and co-ordinating the programmes of the Government agencies concerned.
(g) Unifying practices in each Ministry and Agency as regards the laws for consulting engineers, promotion of inventions, etc.
(h) Supervising the special public corporations under the control of the Agency. (Japan Atomic Energy Research Institute, Institute of Physical and Chemical Research, Atomic Fuel Corporation, Japan Nuclear Ship Development Agency, Japan Information Centre of Science and Technology, and Research Development Corporation of Japan).

The Agency includes the following 6 Bureaux:

(a) The Director-General's Secretariat, is concerned with general planning.
(b) The Planning Bureau drafts plans in furtherance of the fundamental policy (excluding that related to the atomic energy) in close collaboration with the Council for Science and Technology, provides overall co-ordination of the Government agencies concerned, investigates and analyses the trend of science and technology in and out of the country and compiles statistics.
(c) The Research Co-ordination Bureau is concerned with:

Co-ordination of budgeting by the Government agencies concerned.

1. See Chart II-4.
2. See Chart II-2.

Applying measures for ensuring efficiency in important interdisciplinary research.

Utilizing the Special Research Promotion and Co-ordination Fund.

Subsidizing interdisciplinary and fundamental research.

Furtherance of space research applications.

(d) The Promotion Bureau co-ordinates matters concerned with international co-operation, promotes information activities, encourages inventions and designs of practical utility and furthers their implementation, renders services concerning consulting engineers, and supervises the laboratories attached to the Agency and the special public corporations under the control of the Agency.

(e) The Atomic Energy Bureau plans for, reports on, and steers the fundamental policies concerning the application of atomic energy and manages the affairs of the Atomic Energy Commission. It provides co-ordination between the Government agencies concerned in budgeting, regulation of nuclear reactors and fuels, compensation for losses and elimination of hazards. It is also responsible for supervising the laboratories and special public corporations under its control, and for conducting the business of the Radiation Council (which is attached to the Prime Minister's Office).

(f) The Resources Bureau acts as the secretariat for the Resources Council (see Chart II-1), which is responsible for:

The general policy for utilization of resources.

Investigation and analysis of the trend, inside and outside the country, concerning utilization of resources.

Compilation of statistics on resources.

Utilization of resources not under the control of other Government agencies.

The Agency has five advisory bodies, namely, the Consulting Engineers Council, the National Aeronautics Council, the Electronics Council, the Inventions Promotion Council and the Resources Council, which, on consultation by the Director-General, present recommendations and reports. Each body consists of members appointed by the Prime Minister from among the administrative personnel of the Government agencies concerned and men of learning and experience.

The Agency has attached to it the following laboratories:

(a) The National Aerospace Laboratory undertakes applied research on supersonics, jet engines, rockets, control of aeroplanes, aeromedical psychology and aero-measurements.

(b) The National Research Institute for Metals conducts fundamental research on refining, analysing and processing metals.

(c) The National Research Centre for Disaster Prevention acts as the steering centre for disaster prevention and undertakes research on the prevention of damage from wind and flood, seashore sand drifting, land-slides and earthquakes.

(d) The National Centre for Space Development is the executive body for space development, and undertakes research on the design of rockets and artificial satellites, their trial production and launching.

(e) The National Institute of Radiological Sciences conducts research on sicknesses due to radiation, their prevention, diagnosis and cure, on the medical applications of radiation, and the training of experts in the radiological sciences.

OTHER AGENCIES AND ADVISORY ORGANS ATTACHED TO THE PRIME MINISTER'S OFFICE

The National Police Agency is under the control of the national Public Safety Commission and is responsible for the Scientific Police Research Institute, whose major subjects of study are the scientific investigation and examination of criminal evidence, etc., the prevention of delinquency and crime, and the prevention of traffic accidents (including the examination of the character of drivers).

The Hokkaido Development Agency is responsible for steering the fundamental policy relating to the development of resources in Hokkaido. The Civil Engineering Research Institute is attached to the Agency and carries out research on roads, bridges, rivers, ports, land-improvement, civil-engineering materials, soil properties and geology specific to Hokkaido.

The Defence Agency has the duty of controlling and managing the defence force. Besides the Director-General's Secretariat, there are six internal bureaux, of which the Equipment Bureau is responsible for scientific research, and in this Bureau the technical co-ordinator deals with the business relating to the Technical Research and Development Institute, and the five attached research centres where such duties as technical research, designing, pilot production and experiment on the equipment of the national defence force, and other scientific investigations and research necessary for the defence force are performed.

The Atomic Energy Commission (see Chart II-3b) was established in 1956 to implement the Government's policies relating to research, development and application of nuclear energy in Japan.

The "Atomic Energy Basic Law" provides that all activity in the nuclear energy field shall be only for peaceful purposes, and the establishment of a commission as the parent body for the nuclear energy administration is regarded as most suited for embodiment of the principle mentioned above.

The duty of this Commission is to deliberate on the following matters and report to the Prime Minister, who is legally bound to give due consideration to the recommendations.

(a) Policy relating to the application of nuclear energy.
(b) Overall co-ordination of the work of the Government agencies concerned, including estimation of expenditure and distribution of funds.
(c) Regulations relating to nuclear fuel and atomic piles.
(d) Fundamental problems in the elimination of hazards associated with nuclear energy.
(e) Subsidizing research on the applications of nuclear energy.
(f) Training researchers and engineers (excluding teaching and research at universities).
(g) Collection of information and compilation of statistics.
(h) Fundamental problems in connection with preventive measures against radioactive fall-out.
(i) Other important matters relating to nuclear energy.

The Commission is authorized to make recommendations on these points to the chiefs of the Government agencies concerned, through the Prime Minister.

The Commission consists of a chairman (the Director-General of the Science and Technology Agency) and six members who are appointed by the Prime Minister upon approval of the Diet. It has 12 committees composed of 30 examiners and about 140 specialist members (men of learning and experience appointed by the Prime Minister).

A board of 25 councillors is appointed by the Prime Minister from among men of learning and experience, and the administrative personnel of the Government agencies concerned. Problems which concern the Commission and require specialist opinion are referred to this Board.

Meetings of the Commission are held, once a week as a rule, and additionally as occasion demands.

The Atomic Energy Bureau of the Science and Technology Agency is responsible for the general affairs of the Commission.

The Radiation Council was established in 1958 to investigate and report its views after consultation with the chiefs of the government agencies concerned, on

(a) Technical standards relating to the elimination of radiation hazards.
(b) Methods of measurement of the quantity of natural radiation and that produced by the nuclear explosion

The Council consists of 30 members appointed by the Prime Minister from among the administrative personnel of the Government agencies concerned and men of learning and experience. The Council is authorized to appoint specialist members as required.

The Space Activities Council was established in 1960 for the purpose of establishing the national policies on space to meet the challenge of the phenomenal achievement and advances of other nations in space exploration.

The Council is authorized, on consultation by the Prime Minister, to report on important matters concerning developments in outer space exploration and allied topics, in science and technology. The Council consists of 30 members appointed by the Prime Minister from among the administrative personnel of the Government agencies concerned and men of learning and experience.

The Council for Marine Science was established in 1962 in order to rationalize the development, utilization and conservation of the resources of the ocean, which have increased in importance in recent years. On consultation by the Prime Minister, it reports its views on these matters.

The Council consists of 20 members appointed by the Prime Minister from among the administrative personnel of the Government agencies concerned and men of learning and experience. The Council is authorized to appoint specialist members.

MINISTRY OF EDUCATION

The responsibilities of the Ministry of Education in science and education at the higher education level include the approval for, planning of, and assistance to universities and similar institutes, maintenance of standards, preparation of the budgets of the national universities, subsidizing other higher education institutes, training and licensing teachers, subsidizing research, science information and promotion, encouragement of students, selection of candidates for overseas study, assistance to foreign students, honouring persons of merit in education, science and culture, and the study of education in other countries.

The Ministry maintains a liaison with the Science Council of Japan and other scientific groups.

An outline of the structure of the Ministry is shown in Chart II-1. It has a secretariat and 6 bureaux, of which the Higher Education and Science Bureau deals with most of the responsibilities listed above.

The organizations which come under the Ministry and are concerned with science and technology are as follows.

(a) *The Japanese National Commission for Unesco* has been established to advise, plan, and provide liaison for the activities of Unesco in Japan. It consists of up to 60 members.
(b) *The National Science Museum* is located in Tokyo, and undertakes research on natural history and science, collects and maintains reference materials for the public, and serves as an office for public guidance and liaison for studies on natural history.

(c) *The International Latitude Observatory* was established in 1899 in Mizusawa City, Iwate Prefecture, to determine latitude and conduct astronomical and geophysical research and observations. It has 46 officials.

(d) *The Institute of Statistical Mathematics* was established in 1944 and its responsibilities, apart from research, include the training of statistical experts. It has a staff of 74.

(e) *The National Research Institute for Genetics* was established in 1949 for the purpose of conducting overall research on genetics and its application, and guiding and promoting such research. It has a staff of 93.

(f) *The Academy of Japan*
(see Part One, Section II-3).

The advisory bodies to the Minister of Education concemed with science in higher education are as follows.

(a) *The Central Council for Education* examines the systems for education, science and culture and presents its recommendations to the Minister.

(b) *The Science Encouragement Council* has 6 subcommittees which watch over the structure, and facilities for research, the distribution of subsidies, the dissemination of scientific information, the collection and preservation of scientific materials (samples, experimental animals etc.), the production of films, and the preparation of the catalogue of the bibliography of science. It presents recommendations to the Minister.

(c) *The Private University Research Facilities Council* considers national subsidies for research facilities in private universities and presents recommendations on important matters to the Minister.

(d) *The Science Education Council* considers matters relating to science education and presents its recommendations on important points to the Minister.

MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY

This Ministry is responsible for the promotion of international trade, the production of export goods, production and research on mining and industrial goods, improvement of marketing and sales and matters concerning industrial proprietorship. It is concerned with experiments and research relating to mining and industrial technology, the establishment of industrial standards for weights and measures, and the dissemination of results.

The major bodies associated with this Ministry and concerned with science and technology are as follows:

(a) *The Agency for Industrial Science and Technology* (see Chart II-5)

This is concerned with research, analysis, appraisal, certification, technical surveys and information in mining and industrial technology; establishment of industrial standards (including weights and measures); the geological survey; aid to research on industrialization; and reporting, liaison and co-ordination of the science and technology programme of the Ministry. The Agency has two divisions, namely, General Affairs and Standards, 13 laboratories and 3 attached bodies.

The National Research Laboratory of Metrology was established in 1903 for research and technical information on weights and measures technology, establishment of standards, custody of prototypes and certification and examination of instruments. It has a staff of 383.

The Government Mechanical Laboratory was established in 1937 for research, analysis, certification, technical information and surveys in relation to the mechanical industry. It has a staff of 357.

The Fermentation Research Institute was established in 1940 for research, technical instruction and surveys concerning the alcohol and fermentation industry. It has a staff of 62.

The Textile Research Institute was founded in 1918 for research, analysis, certification, technical information and surveys relating to the textile industry. It has a staff of 149.

The Electro-Technical Laboratory was established in 1921 for research, technical information and surveys relating to electricity; establishment of standards for units of electricity, light, sound, radiation and radio-active substances; custody of prototypes and examination and certification of instruments. In 1964, the Certification Division was separated off, and the regular staff was reduced from 1,206 to 805.

Other research institutes and laboratories under the control of the agency are: four Government Industrial Research Institutes, at Tokyo, Osaka, Nagoya and Kyushu, which conduct researches on chemicals, ceramics, machinery, etc.; the Government Industry Development Laboratory at Hokkaido, the Geological Survey, the Industrial Arts Institute for industrial art, design and packaging; and the Resources Research Institute for mine safety, mine products, and fuels. These institutes and laboratories, in collaboration with other national research institutes and academic and industrial organizations, select research subjects as a basis for the establishment of standards, public safety, consumer protection, conservation of lands and resources, implementation of the national science policy, and identification of new fields of research of potential national interest.

Advice on subjects such as orientation of research, regional policy for strengthening technology, etc. is provided to the AIST by the Industrial Structure Conference, a body comprising some 40 members broadly representing Government departments, industry and the universities.

(b) *The Patent Agency*

This was established to encourage inventions and contributions to industrial development by protecting and applying inventions, and registering patents, designs of practical utility and trade marks. The Agency includes divisions for General Affairs and Examinations and Judgement, and two attached bodies, namely, the Library and the Industrial Property Training Institute.

(c) *Other Councils*

These were established as advisory bodies to the Ministry to increase efficiency in the various programmes and organizations concerned. They are composed of members appointed by the Minister from among the administrative personnel of the Government agencies concerned and men of learning and experience. Among these councils, special mention may be made of the Industrial Structure Investigation Council, which advises on major policy matters.

MINISTRY OF AGRICULTURE AND FORESTRY

This Ministry is responsible for research in agriculture, forestry, livestock and fisheries, and for the dissemination of results in those fields.

The Ministry has a Secretariat and 6 internal Bureaux (including Agricultural Economics and Administration, Livestock, Raw Silk and Horticulture) and 3 external Agencies (Food, Forestry and Fisheries).

The central organization for the research institutes attached to the Ministry is the Secretariat of Agriculture, Forestry and Fisheries and its Research Council.

The Agriculture, Forestry and Fisheries Research Council (see Chart II-6)

This consists of a chairman and 6 members appointed by the Minister from among men of learning or the official staff of the Ministry.

The duties of the Council are: to plan for and report on the fundamental programme for research, to co-ordinate the work of the research institutes and supervise their management, to investigate research progress, to raise standards of research personnel, and to subsidize research in Tokyo, Hokkaido and the Prefectures (i.e. municipalities) with the aid of the Secretariat. A number of laboratories, experiment stations, seed farms, conditioning houses, inspection offices, quarantine offices and livestock breeding farms are attached to the Ministry. The more important ones are shown in Chart II-6.

OTHER GOVERNMENT AGENCIES

The Ministry of Health and Welfare is responsible for improvement and promotion of social welfare, social security and public health. It has a number of attached research institutes, namely, the National Institute of Public Health, the National Institute of Mental Health, the National Institute of Nutrition, the National Institute of Health, the National Institute for Leprosy Research, the National Institute of Hygienic Sciences, the Institute of Hospital Administration, the Institute of Population Problems and the National Cancer Centre. In addition, the Ministry has under its charge the 85 national hospitals and 179 sanatoria in the country.

The Counsellor for Scientific and Technical Affairs in the Minister's Secretariat is responsible for the co-ordination of all the research conducted by the attached institutes.

The Ministry of Transport is responsible, along with its other duties, for ship engineering and safety, and meteorology. The Minister is advised by the Steering Committee of Science and Technology and the Steering Committee of Atomic Energy, which are responsible for the overall co-ordination of relevant research activities. The Shipbuilding Technical Council considers matters relating to improvements in shipbuilding technology, and research is carried out by the Ship Technical Research Institute and the Port and Harbour Technical Research Institute.

The Meteorological Agency is one of the external bodies of the Ministry and has attached to it the Meteorological Research Institute, the High Altitude Observatory, the Earthquake Observatory, the Terrestrial Magnetism Observatory, the Meteorological College, and the Meteorological Instrument Plant.

The Ministry of Posts and Telecommunications is advised on radio technology by the Radio Technical Council and research is carried out by the Radio Research Laboratory.

The Ministry of Labour is responsible for research into accidents and industrial health, which is carried out at the Industrial Safety Research Institute and the National Institute of Industrial Health.

The Ministry of Construction is responsible for the development and conservation of national lands, including roads, city planning, building construction, river conservancy, construction of dams, and erosion control projects. The relevant research bodies are the Geographical Survey Agency, the Public Works Research Institute and the Building Research Institute.

The Ministry of Autonomy (Home Affairs) is responsible for local government bodies and their liaison with the Central Government and with one another. It is also responsible for fire defence, through the Fire Defence Agency (which also covers floods and earthquakes). Research is carried out by the Fire Research Institute.

The Ministry of Foreign Affairs includes the United Nations Bureau, in which there is a science section concerned with international atomic energy organizations, Unesco, and co-ordination of and participation in international scientific conferences.

The Ministry of Finance includes the Research Institute of Brewing of the Tax Administration Agency.

SPECIAL PUBLIC CORPORATIONS

The *Japanese National Railways System* comes under the Minister of Transportation ; research is carried out by the Railway Technical Research Institute.

The Nippon Telegraph and Telephone Public Corporation is under the control of the Minister of Posts and Telecommunications. Research is carried out by the Telecommunications Laboratory.

The Japanese Monopoly Corporation is under the supervision of the Minister of Finance ; the Central Research Institute attached to the Corporation conducts research on machines and tools for tobacco manufacturing.

The Institute of Physical and Chemical Research (see Part One) was originally established before the war and was revived in 1958 ; it has 47 laboratories dealing with problems in physics, technology and agriculture. It undertakes general and special research and carries out projects under contract for public or private bodies. The special research concerns matters of national priority including important fundamental research, feasibility research (pilot research works for industrial utilization), special research on cosmic rays, and efficiency research on atomic energy.

The Japan Atomic Energy Research Institute was established in 1956 as the central organization for research, development and utilization of atomic energy. It comes under the supervision of the Science and Technology Agency, and its research covers a wide range including nuclear fuel, material for atomic piles, production of isotopes, nuclear physics, solid physics, radiation chemistry, development of locally made power plants, and education and training in atomic energy.

The Japan Information Centre for Science and Technology was established to contribute to the development of science and technology by collecting, storing, and retrieving information from domestic and foreign sources. The Centre also publishes "current awareness" bulletins on science and technology, foreign patents and contents lists, a chemical handbook, and an index of Japanese patents, and provides other services including reprints, translations and related surveys.

The Research Development Corporation of Japan was established in 1961 to encourage technological developments for the promotion of industry. It investigates and selects subjects for technological development, makes development contracts with private enterprises and disseminates information on new technology.

The Japan Nuclear Ship Development Agency was established in 1963 to develop a nuclear ship, as an application of atomic energy to the progress of shipbuilding and marine transportation. This Agency deals with the design, construction and navigation of the nuclear ship, the special training of the seamen, the necessary research and the dissemination of the results.

The Atomic Fuel Corporation undertakes the development and exploitation of nuclear fuel materials, mining experiments, ore-washing experiments and refining.

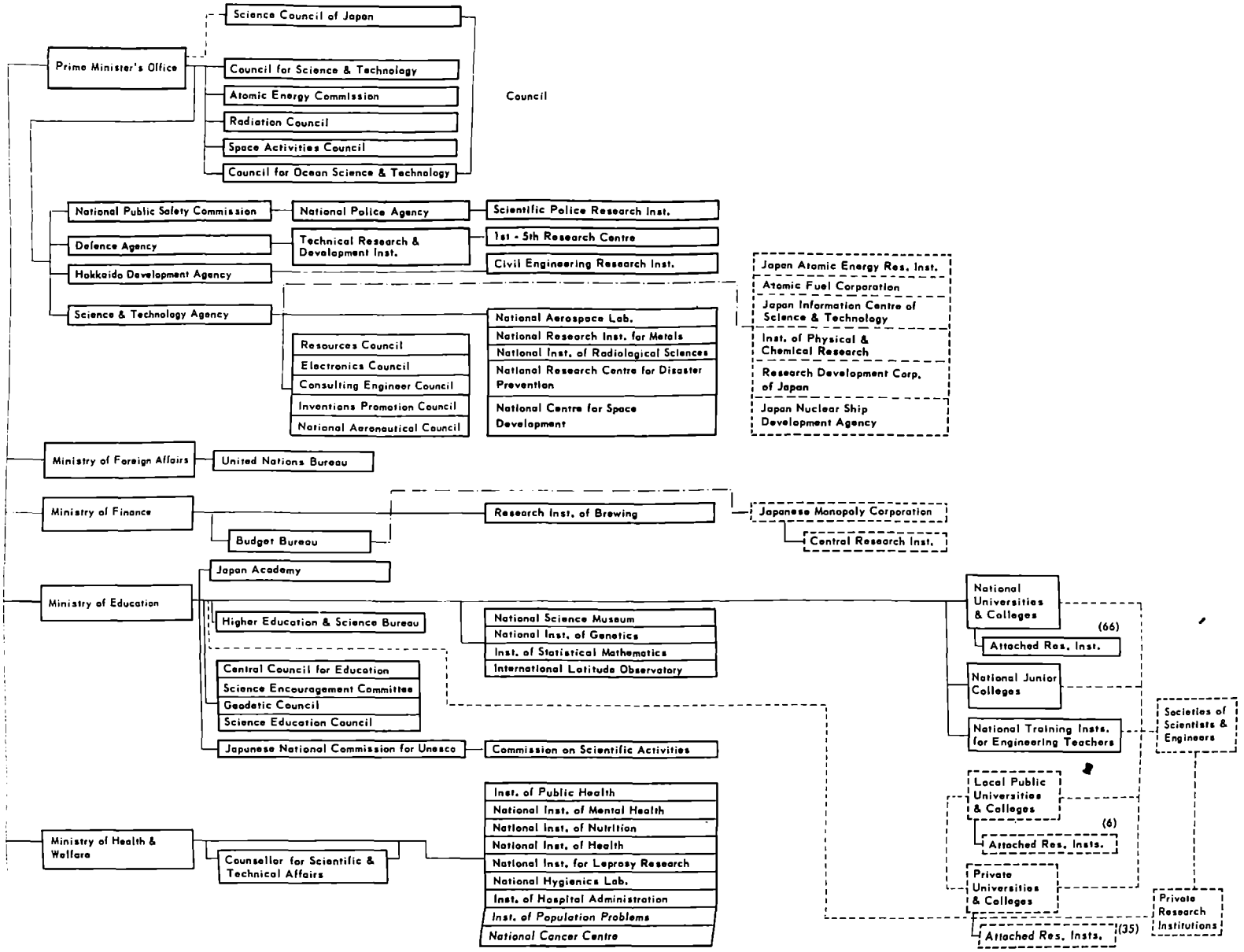
The Research Laboratory of the International Telegraph and Telephone Co., Ltd.

The NHK Technical Research Laboratory is attached to the Japan Broadcasting Corporation.

The Institute of Agricultural Machinery (1962) and *The Japan Beet Sugar Promotion Association (1959)* are supervised by the Ministry of Agriculture and Forestry.

CHART II-1 ADMINISTRATIVE STRUCTURE FOR SCIENCE AND TECHNOLOGY (1965)

Chart II-1. Administrative Structure for Science and Technology (1965)



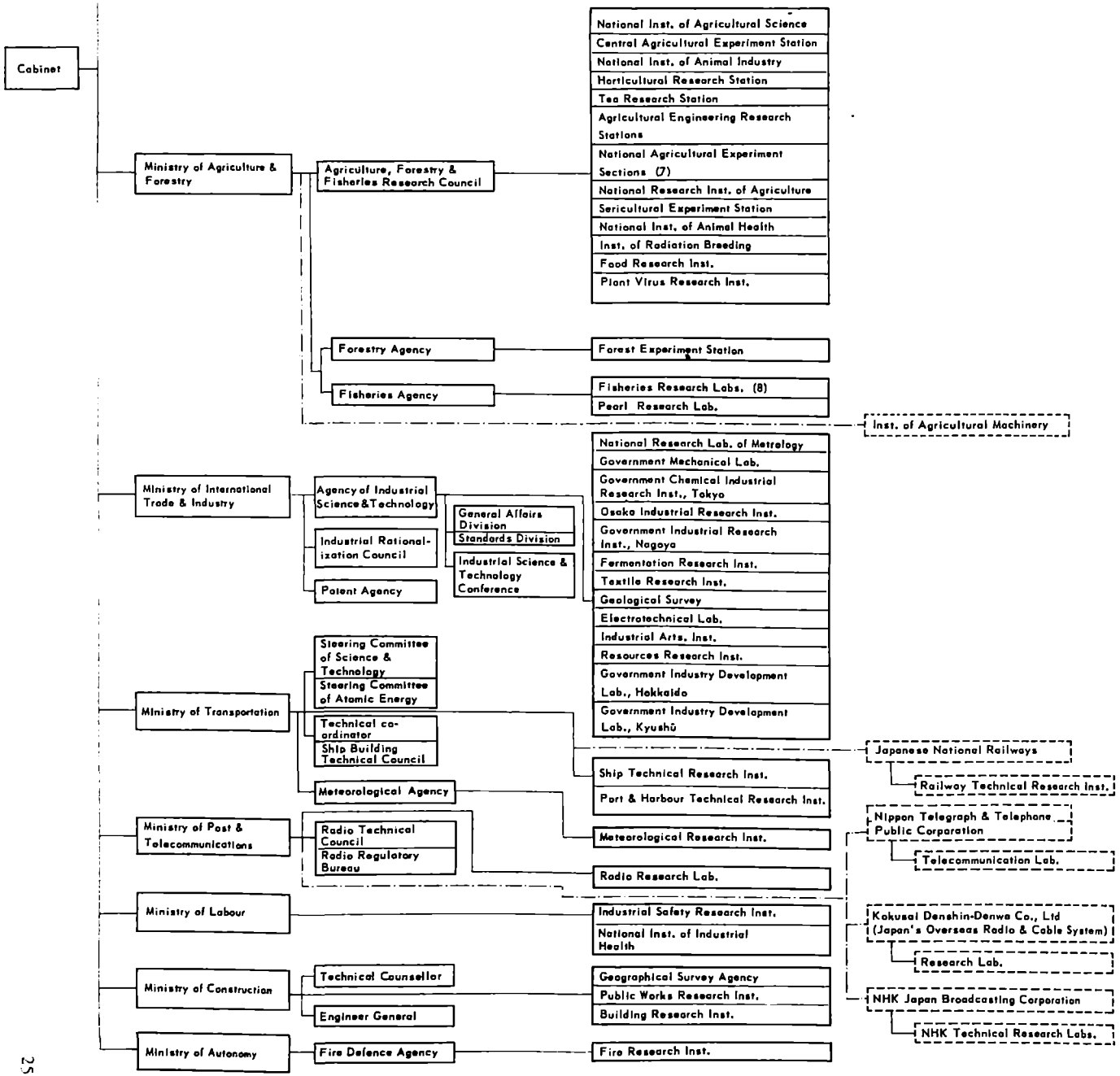
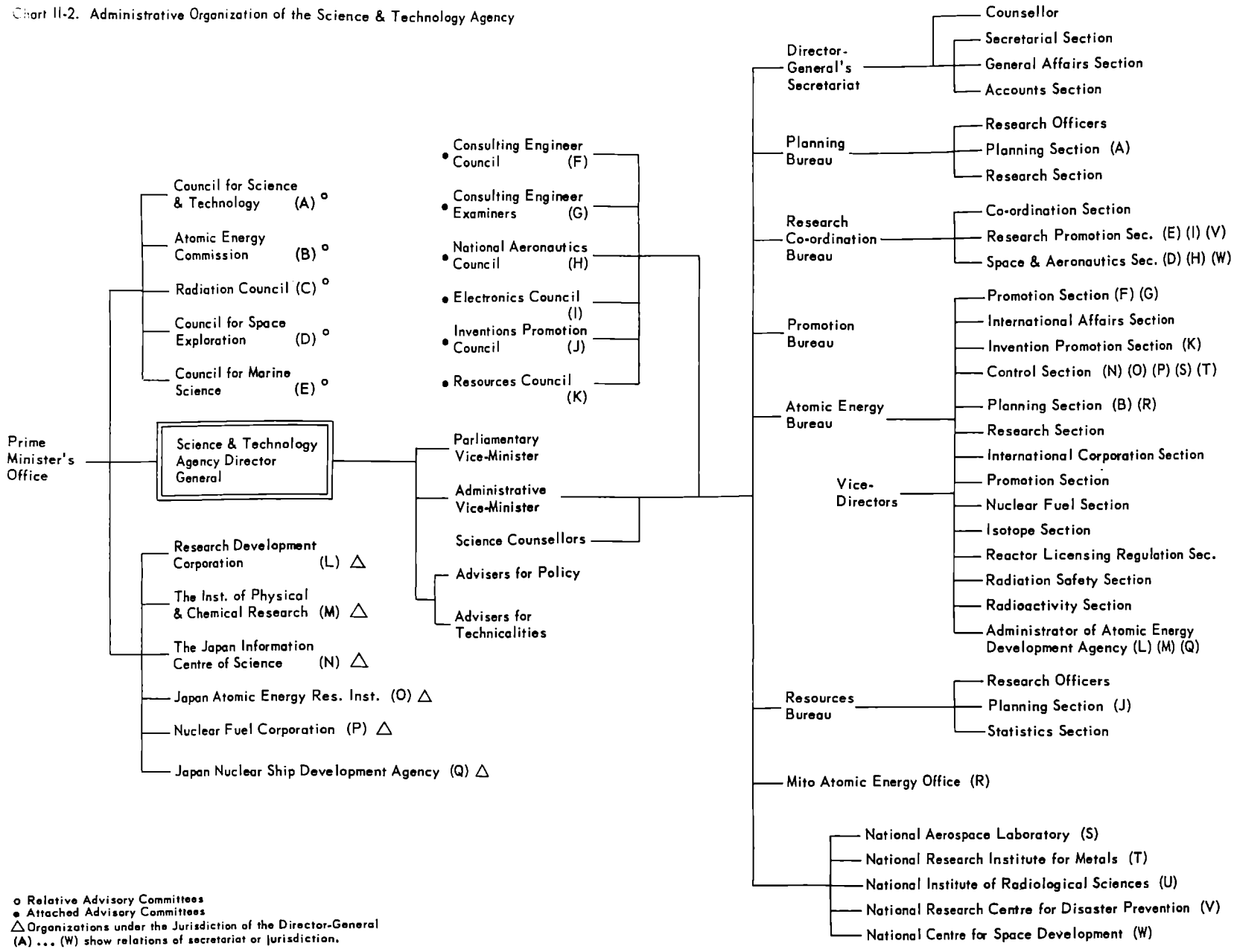

Cabinet
Ministry of Agriculture & Forestry
Agriculture, Forestry & Fisheries Research Council
National Inst. of Agricultural Science
Central Agricultural Experiment Station
National Inst. of Animal Industry
Horticultural Research Station
Tea Research Station
Agricultural Engineering Research Stations
National Agricultural Experiment Sections (7)
National Research Inst. of Agriculture
Sericultural Experiment Station
National Inst. of Animal Health
Inst. of Radiation Breeding
Food Research Inst.
Plant Virus Research Inst.
Forestry Agency
Forest Experiment Station
Fisheries Agency
Fisheries Research Labs. (8)
Pearl Research Lab.
Inst. of Agricultural Machinery
Ministry of International Trade & Industry
Agency of Industrial Science&Technology
General Affairs Division
Standards Division
Industrial Science & Technology Conference
Industrial Rationalization Council
Patent Agency
National Research Lab. of Metrology
Government Mechanical Lab.
Government Chemical Industrial Research Inst., Tokyo
Osaka Industrial Research Inst.
Government Industrial Research Inst., Nagoya
Fermentation Research Inst.
Textile Research Inst.
Geological Survey
Electrotechnical Lab.
Industrial Arts. Inst.
Resources Research Inst.
Government Industry Development Lab., Hokkaido
Government Industry Development Lab., Kyushū
Ministry of Transportation
Steering Committee of Science & Technology
Steering Committee of Atomic Energy
Technical coordinator
Ship Building Technical Council
Japanese National Railways
Railway Technical Research Inst.
Ship Technical Research Inst.
Port & Harbour Technical Research Inst.
Meteorological Agency
Meteorological Research Inst.
Ministry of Post & Telecommunications
Radio Technical Council
Radio Regulatory Bureau
Nippon Telegraph & Telephone Public Corporation
Telecommunication Lab.
Radio Research Lab.
Ministry of Labour
Industrial Safety Research Inst.
National Inst. of Industrial Health
Kokusai Denshin-Denwa Co., Ltd (Japan's Overseas Radio & Cable System)
Research Lab.
Ministry of Construction
Technical Counsellor
Engineer General
Geographical Survey Agency
Public Works Research Inst.
Building Research Inst.
NHK Japan Broadcasting Corporation
NHK Technical Research Labs.
Ministry of Autonomy
Fire Defence Agency
Fire Research Inst.

Chart II-2. Administrative Organization of the Science & Technology Agency



o Relative Advisory Committees
• Attached Advisory Committees
△ Organizations under the Jurisdiction of the Director-General
(A) ... (W) show relations of secretariat or jurisdiction.

Chart II-3a. Structure of the Council for Science & Technology

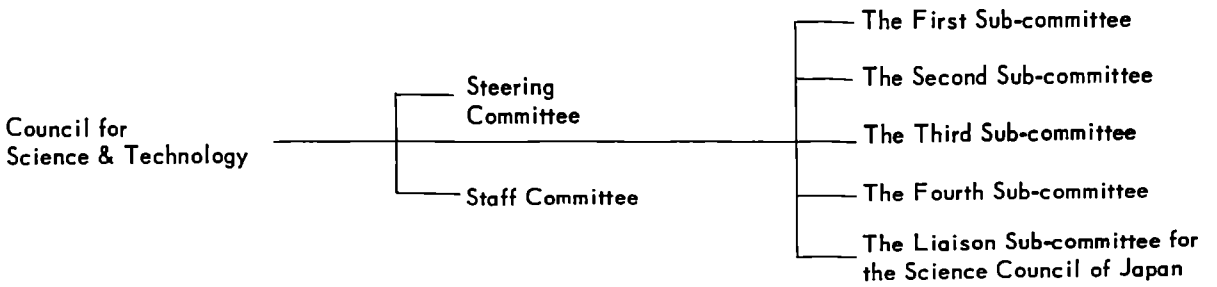


Chart II-3b. Structure of the Atomic Energy Commission

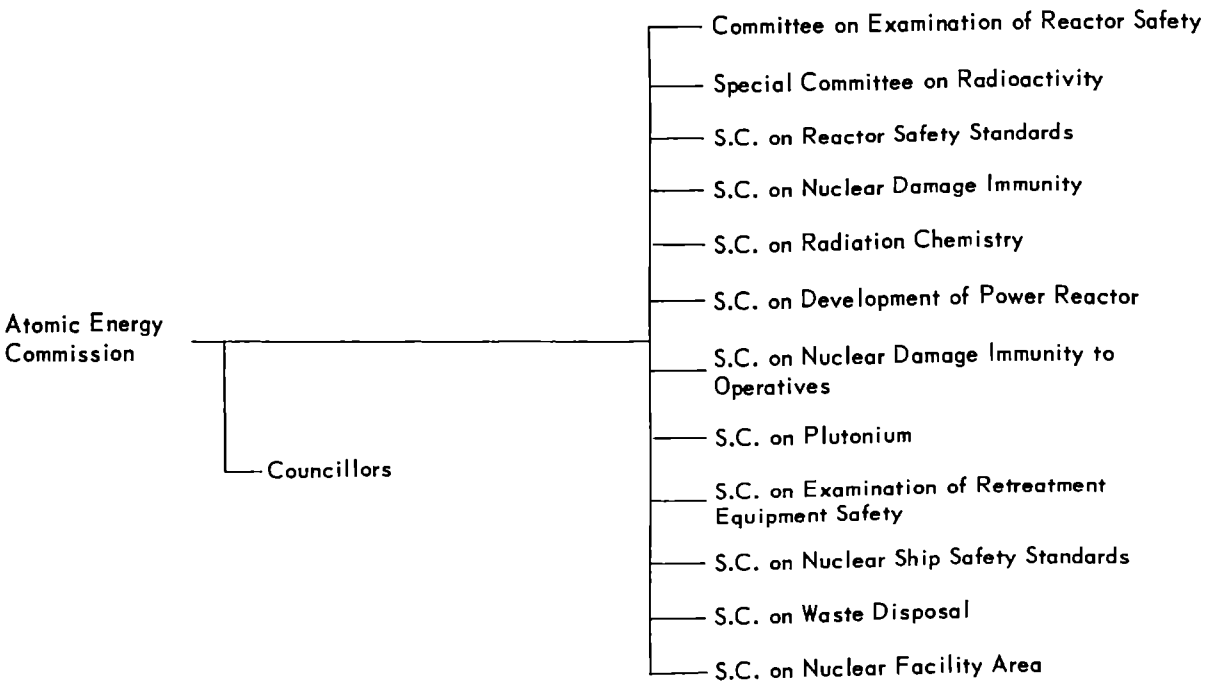


Chart II-4. Structure of the Science Council of Japan

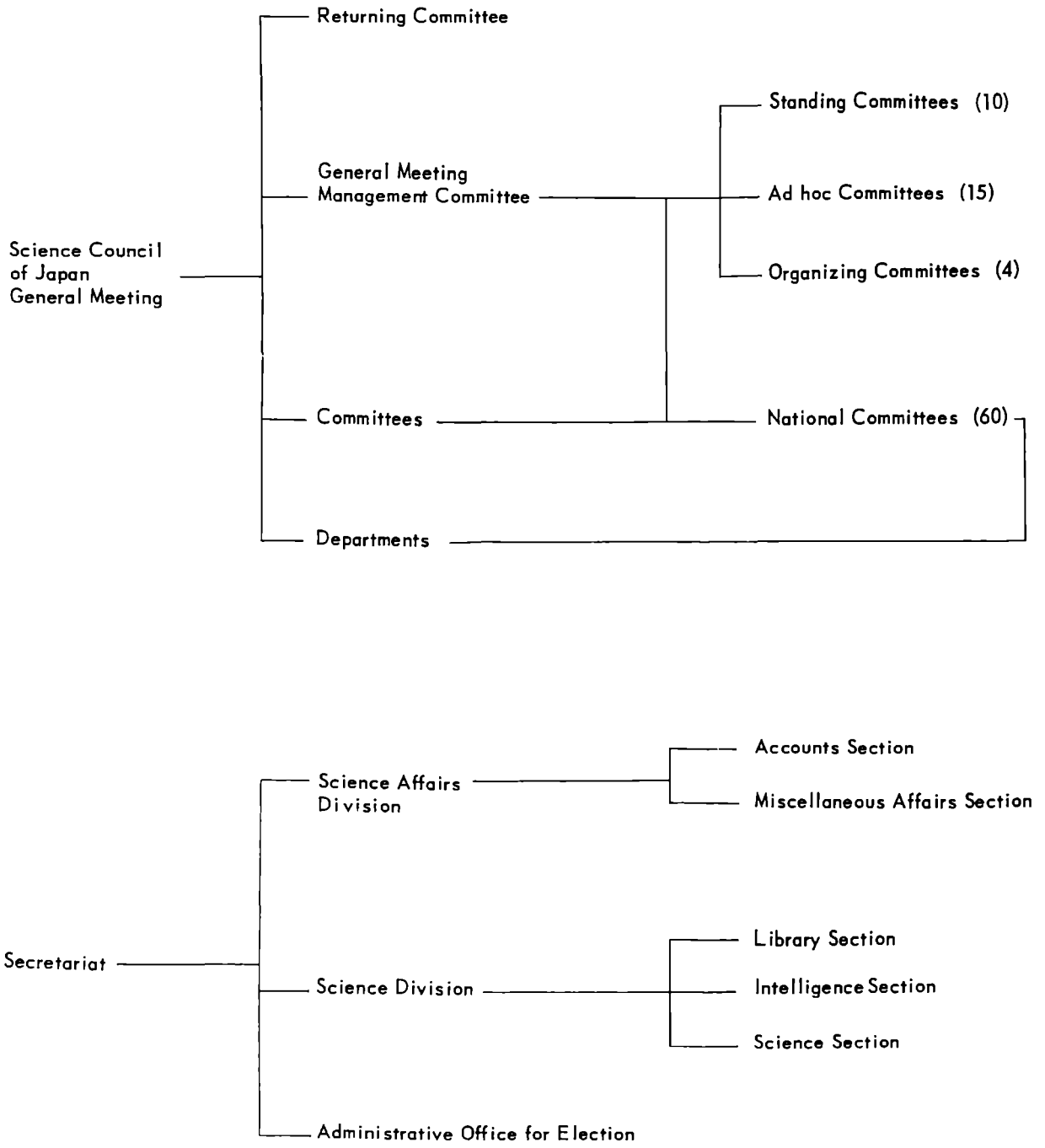


Chart II-5. Administrative Organization of Agency of Industrial Science and Technology

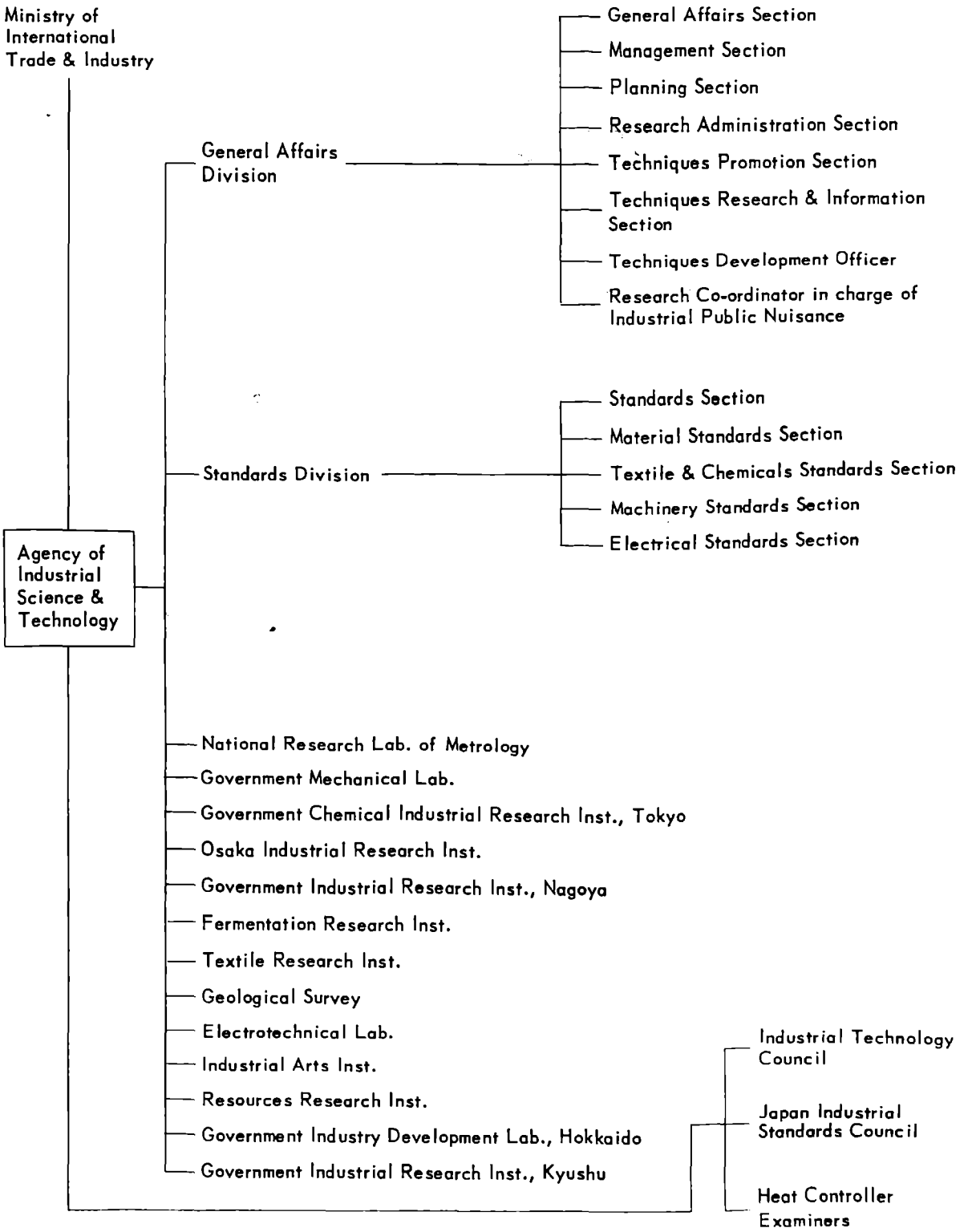
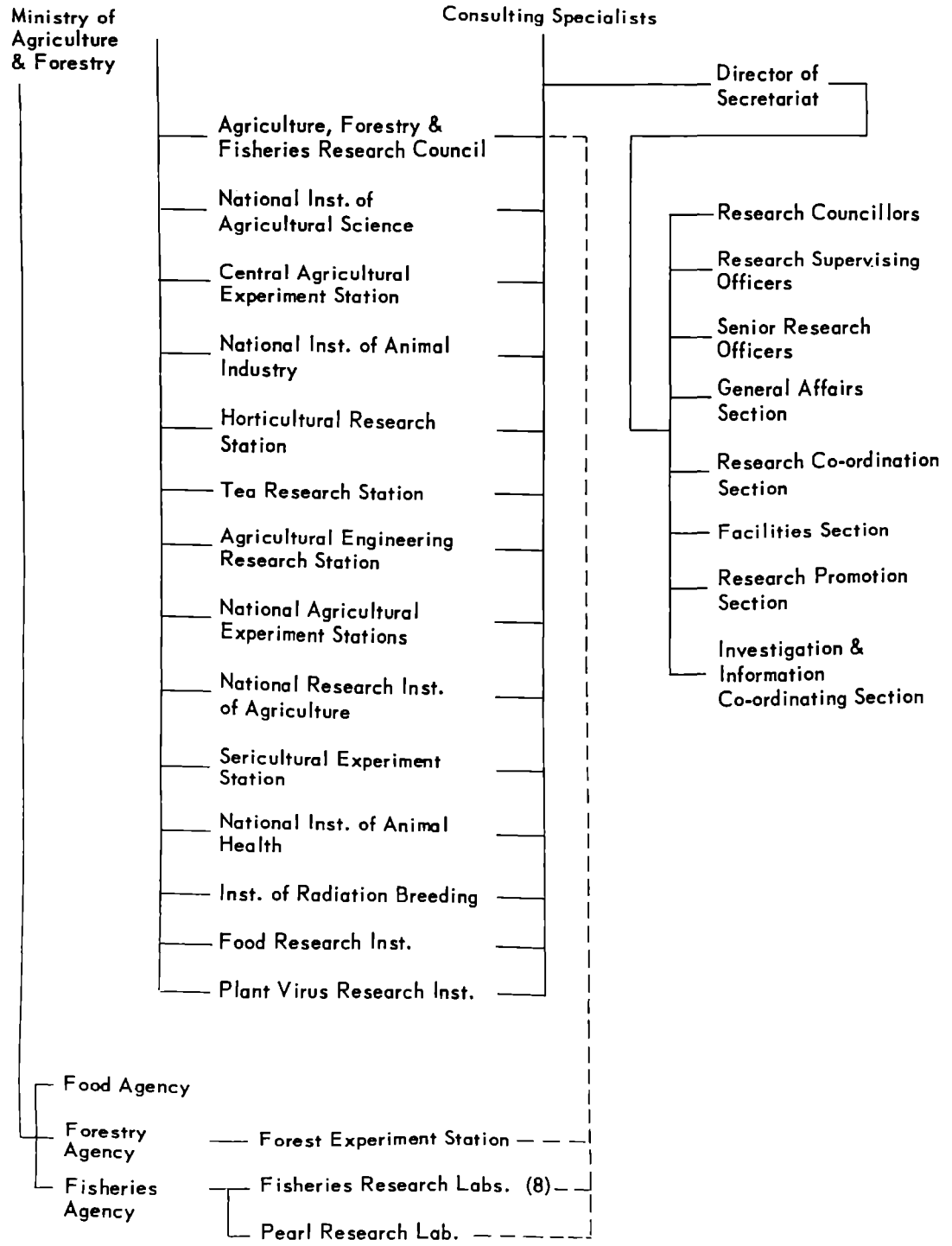


Chart II-6. Administrative Organization of Agriculture, Forestry and Fisheries Research Council



Part III

FUNDING AND EXPENDITURE ON RESEARCH

Research expenditure is given in the "Statistical Survey of Research" published annually, since 1953, by the Bureau of Statistics of the Prime Minister's Office. Until 1958 these statistics covered only the major research institutes, but they are now comprehensive. Actual expenditure and original budgets do not always agree. Figures quoted below are based on actual expenditure except when the national institutes' budgets are noted.

COMPOSITION AND TREND OF RESEARCH EXPENDITURE

Expenditure of the Nation as a Whole

For some time after World War II, there was a considerable shortage of research funds, but with the subsequent rapid economic growth of the country in the middle and later nineteen-fifties research work was greatly increased and expenditure on research rose markedly.

In 1953, it was only 47 billion yen ($130 million) but by 1965 it had reached 426 billion yen ($1,180 million), almost a ninefold increase.

The trend of research expenditure from 1961 to 1965 is shown in the following table:

	Billion yen	$ Million	Percentage of G.N.P.
1961	245	681	1.27
1962	281	781	1.33
1963	321	892	1.30
1964	382	1 061	1.34
1965	426	1 180	1.36

Important characteristic features of research expenditure in Japan are:

(a) About 70% of the total research expenditure is accounted for by private companies and almost all of this amount is provided by the private companies themselves.

(b) Research expenditure for defence is low compared with other countries. In 1965 it was only 4 billion yen ($11 million) or about 1% of the total research expenditure (See Table III-6).

A breakdown in terms of items of research expenditure is shown in Table III-1. This shows that since 1961, personnel expenses have increased more rapidly than equipment costs. Table III-2 shows that the rate of increase in the annual expenditure per researcher was lower in the most recent years than in those immediately preceding 1961; however, there are substantial variations as between different scientific activities (e.g. agriculture, medicine, physics) and different economic and social sectors (e.g. public and private, universities and research organizations). In spite of the increases, the figure is still much lower than in other advanced countries.

Research Expenditure by Principal Sectors

In the Bureau of Statistics "Statistical Survey", the principal sectors ("performers") are "Industries", "Research institutes" and "Higher education". The latter two are further subdivided into Government, local government and private institutes; and three disciplines; natural sciences and engineering, agriculture and medicine. This structure is shown in Chart III-1.

Chart III-2 shows the trend of actual research expenditure for each of the principal sectors, and Chart III-3 shows their relative proportions, for the period 1953-1965.

Until 1955, industry accounted for about half of the total research expenditure, but by 1958 the proportion had risen to about two-thirds, and the figure has remained at about this level.

Table III-3 shows details of the items of research expenditure for individual sectors, for the year 1965.

Personnel expenses are proportionally highest for "Higher education", namely 50 per cent. The proportion of personnel expenses in "Industry" is 40 per cent, the lowest of the 3 sectors.

Broadly speaking, the types of research conducted in the three major sectors are: basic research in the "Higher education" sector; applied research in the "Research Institutes" sector; and development in the "Industry" sector. From this it would appear that the proportion of expenditure on basic research in Japan is quite high, but it must be remembered that the "Higher education" figures include educational activities of the staff.

The annual expenditure per researcher for the different sectors in 1965 was: "Industries", 3.87 million yen ($10,700); "Research Institutes", 3.42 million yen ($9,500); and "Higher education", 2.41 million yen ($6,700). These differences would be greater if personnel expenses were not taken into account. The funds available to researchers after deduction of expenses for equipment and personnel are: "Industries", 1.40 million yen ($3,900); "Research Institutes", 940,000 yen ($2,600); and "Higher education", 390,000 yen ($1,100), respectively. The low figure for "Higher education" is noticeable, and an increased allocation for this item is planned.

Source of Research Funds

In the "Survey" the sources of research funds are given as the national and local governments, and private and foreign sources. Tables III-4/5 show that the contribution from private sources is much larger than that of the Government. One explanation for this is the low expenditure on national defence. In terms of scientific fields, private sources provide the bulk of finance for the physical sciences and engineering, whereas agriculture and medicine are mainly supported by the Government. In the field of agriculture, the Government provides as much as 95 per cent of the funds, largely because agricultural enterprises are on a small scale and the Government undertakes most of the research activities. In the field of medicine, the share of the Government is 71 per cent, for similar reasons.

Research Expenditure in the National Budget

The national budget for scientific and technological activities (See Tables III-6 and III-7) is conventionally called "Research Related Expenditure". This is divided into "Research Promotion Expenditure" and "Other Research Expenditure".

The former is one of the sub-items of the General Account of the Governmental budget, and includes (i) expenses of the national research institutes, (ii) subsidies, contracts and grants, (iii) administrative costs and capital investment related to scientific and technological activities and (iv) expenditure related to atomic energy.

"Other Research Expenditure" is the sum of the expenditures for scientific and technological activities included in other items of the General Account and the Special Account. This includes (i) expenditures related to national universities and the attached laboratories, (ii) research expenditure in the Defence Agency, (iii) expenditures for survey and observation in the Meteorological Agency, the Geographical Survey Agency, etc., and (iv) research expenditures in national hospitals and the National Cancer Research Institute. The inclusion in the budget of general administrative expenses related to research activities accounts for the higher figures compared with those in the "Survey", viz. Research Related Expenditure is 108 billion yen ($300 million), against the "Survey" (17 billion yen ($215 million) in 1964.

Tables III-6 and III-7 show the trend of State expenditure on scientific and technological research. The absolute amount of the research budget (i.e. Research Related Expenditure) is on the increase; as a percentage of total State expenditure it was 3.0 per cent in 1963; 3.2 per cent is 1964 and 1965 and 3.3 per cent in 1966. This rate of increase is however lower than in a number of advanced countries[1]. The share of Research Promotion Expenditure was highest (at about 1.6 per cent) in 1958, and fell to about 1.3 per cent in 1963 and 1964 and again to about 1.2 in 1965 and 1966. The distribution of the research budgets for 1963, 1964 and 1965 among various Government agencies is shown in Table III-8. The budgets of the Ministries of Education, Agriculture and Forestry, and International Trade and Industry, and the Science and Technology Agency together account for 88 per cent of the total research budget for 1965.

Subsidies to and contracts for research financed by the Government are very low, at about 12 billion yen ($34 million) in 1966, compared with the research funds of "Industry". Until 1954, however, the research expenditure of "Industry" was low, and subsidies and contract funds then played a role in priming the research activities in private enterprises. Research funds for the national universities were 44.3 billion yen ($123 million) for 1963, 54.1 billion yen ($150 million) for 1964, 62.6 billion yen ($172 million) for 1965 and 75.1 billion yen ($209 million) for 1966. The actual expenditure according to the "Survey" was 51.3 billion yen ($142 million) in 1964.

1. In the 1967-68 national budget, the appropriations for R & D in science and technology amount to about $455 million; this represents a 14.6% increase over the previous year, and accounts for about 3.3% of the budget total, roughly the same proportion as in the previous year.

The budget for participation in international research activities is quite small so far, but is expected to rise considerably.

RESEARCH EXPENDITURE OF RESEARCH INSTITUTES

The proportion of national research funds expended in these institutes is between 16 and 19 per cent every year. For the year 1965 it was 16 per cent, 68.4 billion yen ($190 million), an increase of 13 per cent compared with the previous year.

The number of research institutes, particularly private ones, is continually increasing. There were 834 in 1964, of which 557 are publicly managed and 83 are national in status.

Table III-9 gives details of research expenditure by type of establishment and field of science. It shows that physical sciences and engineering predominate in Government and private establishments, while agriculture predominates in local government. As can be seen from Table III-3, where the expenditure for 1965 is shown distributed by items, some 47 per cent of the budget of the research institutes is accounted for by the personnel item; and this percentage was about the same in 1964. The percentage spent on equipment also remained fairly steady. Examining the proportion of personnel expenses for different types of establishment, the figure for public (local government) institutes is particularly high, at 59 per cent for 1964; this is explained by the large number of agricultural institutes. On grouping the institutes in five classes according to numbers of personnel (from 1 to 100), research expenditure is found to be almost evenly distributed between the classes.

The annual research expenditure per researcher is on the increase. For 1964, the figure for private institutes was 6.63 million yen ($19,000), for the Government 3.34 million yen ($9,300), and for local government 2.34 million yen ($6,500). By field of research, the figures were: physical sciences and engineering 3.98 million yen ($11,000), medicine 2.96 million yen ($8,200) and agriculture 2.34 million yen ($6,500).

RESEARCH EXPENDITURE IN HIGHER EDUCATION

Research expenditure in the universities remains comparatively low, and although for 1965 it was 105 billion yen ($292 million), 21 per cent of the national research total, it must be remembered that this figure includes an uncertain amount more properly attributable to education. Up to 1960 the expenditure increased by about 10 per cent per year, but then the rate of increase rose sharply to over 30 per cent for 1961 and 36 per cent for 1965. This resulted from the increase in numbers of scientists and engineers, the establishment of new postgraduate courses, faculties and curricula and the creation of technical colleges. Nearly 75 per cent of the research funds are contributed by Government and local government sources.

The number of units of "Higher education" related to natural sciences, medicine and technology was 418 in 1964 (250 faculties, 67 attached laboratories, 46 technical colleges, 46 junior colleges, 9 others); 245 supported by the Government, 41 by local government and 132 by private funds. In 1964, 81 per cent of the total was spent on the university faculties, and 13 per cent on the attached laboratories. The expenditure, by type of establishing authority, was 67 per cent by the Government, 26 per cent by private sources and 7 per cent by local government. The expenditure by field of science was 59 per cent for physical sciences and engineering, 29 per cent for medicine and 12 per cent for agriculture.

In terms of items of research expenditure (see Table III-3), personnel expenses accounted for 50% in 1965, the highest of the three major sectors. Moreover, the trend shows a gradual decline of the percentage of personnel expenses, from 64% in 1959. On the other hand, the percentage of equipment investment had increased by 32% in 1965.

Expenditure per researcher in 1965 was 1.67 million yen ($4,650) in the university faculties, 3.67 million yen ($10,200) in the attached laboratories and 1.05 million yen ($2,900) in the junior colleges. The expenditure other than personnel expenses and equipment investment, which is considered as the portion available for use in accordance with the researcher's own ideas, was 260,000 yen ($720) in the university faculties, 650,000 yen ($1,800) in the attached laboratories and 110,000 yen ($305) in the junior colleges.

By type of establishing authority, these expenditures per researcher were 2.12 million yen ($5,900) by the Government, 1.90 million yen ($5,300) by private sources and 1.34 million yen ($3,700) by local government. By field of research these expenditures were with 2.50 million yen ($6,950) on engineering, 2.46 million yen ($6,850) on natural sciences, 2.20 million yen ($6,100) on agriculture, and 1.32 million yen ($3,700) on medicine. One explanation of the extraordinarily low figure for medicine is that many students in the intern course are counted as researchers.

With the need for more fundamental research, the other principal sectors are asking for more co-operation from "Higher education", which will no doubt bring about an increase in the research expenditure in this sector.

RESEARCH EXPENDITURE IN INDUSTRY

Composition and Trend of Research Expenditure

Up to 1955, the expenditure on research in industry was not large; the subsequent large increase in expenditure coincided with the rapid economic growth in Japan over the last 10 years, and undoubtedly contributed to it.

The research expenditure in the "Industry" sector can be closely correlated with the general market condition and follows the general business cycle; for example, the coefficient of correlation with the mining and industrial production index is 0.993 for the period 1959 to 1963. The Statistical Survey on Research in "Industry" (except the service industries) for 1963, covered 93,117 companies and public corporations, of which about 10,000 companies were conductive research and development.

The annual increase in research expenditure for industry including investment, was over 30 per cent for 1959 to 1961, but dropped to 10 per cent for 1962 and rose again to 16 per cent for 1965. It is considered unlikely to reach 30 per cent again.

For the years 1959 to 1961, personnel expenses and equipment investment each amounted to about one-third of the total, raw and processed materials and other expenses making up the rest. Since 1962, equipment investment has dropped to about a quarter and personnel expenses have risen to about two-fifths of the total.

The annual increase in current expenditure alone was 27 per cent for 1960, 31 per cent for 1961, 22 per cent for 1962, 20 per cent for 1963, 18 per cent for 1964 and 3.5 per cent for 1965. The increase in the personnel expenses is largely caused by the increase in personnel and the raising of pay standards. The decrease in equipment investment since 1961 is largely due to the completion of the purchase of land and buildings in the earlier years.

Analysis of Research Expenditure by Industries

While the overall percentage of companies conducting research is estimated to be about 11 per cent, this figure of course varies from industry to industry, being 14 per cent in manufacturing industry overall (54 per cent in the chemical industry and 35 per cent in electrical machinery), 2 per cent in the construction industry and 7 per cent in public utilities. Manufacturing industry accounts for 96 per cent of the total number of companies conducting research, and of these 18 per cent are concerned with chemical products, 17 per cent with food processing, 12 per cent with electrical machinery, and 11 per cent with textile products (1963 figures).

As regards research expenditure by industry, manufacturing companies account for over 90 per cent of the total. The other industries such as agriculture, etc., depend on Government research. Heavy and chemical industries accounted for 67 per cent of the research expenditure in 1959, and 71 per cent by 1963. Personnel expenses are lower than the average (39 per cent, 1963) for industry in chemical products, the installation industry, non-ferrous metals and products, electrical machinery, transportation equipment, communications, broadcasting, and gas and water. The industries in which the personnel expenses are over 50 per cent are agriculture, forestry, fisheries, textile products, publishing and printing, lumber and wood products. Equipment investment (average 25 per cent, 1963) amounts to 39 per cent in non-ferrous metals and products, 33 per cent in communication and broadcasting, 31 per cent in electricity, gas and water, and 30 per cent in food and construction. Of these industries, some have large investments in land and buildings.

The annual expenditure per researcher in 1964 averaged 4.00 million yen ($11,100). For some individual sectors the figures were as follows: transport 6.22 million yen ($17,300); transportation equipment 6.85 million yen ($19,000); iron and steel products 6.05 million yen ($16,800); chemical products 4.45 million yen ($12,400); electrical machinery 3.71 million yen ($10,300); timber and wood products 2.74 million yen ($7,600); and agriculture, forestry and fisheries 2.99 million yen ($8,300).

Analysis of Research Expenditure in Terms of Capital or Size of Undertakings

Of companies with a capital of over 10 billion yen ($28 million), 94 per cent were conducting research in 1964. In the lowest capital range, one million yen ($2,800) to 10 million yen ($28,000), only 5 per cent were doing research. Companies with a capital of more than one billion yen ($2.8 million) accounted for 64 per cent of the total research expenditure of industry in 1960, 72 per cent in 1963 and 78 per cent in 1964.

Personnel expenses in 1964 constituted 35 per cent of the total expenditure for the companies with a capital of over 10 billion yen ($28 million) and 57 per cent for those with a capital of 1 million yen ($2,800) to 10 million yen ($28,000).

The proportion of personnel expenses is thus much higher in the smaller enterprises; moreover it tends to fluctuate rapidly. On the other hand, the proportion of equipment investment is higher in the larger enterprises.

The annual expenditure per researcher increases with the amount of capital, being 5.7 million yen ($15,800) in companies with a capital of over 10 billion yen ($28 million), 5.85 million yen ($16,200) in certain public corporations, 4.38 million yen ($12,200) in companies with a capital of one billion yen ($2.8 million) to 10 billion yen ($28 million),

2.68 million yen ($7,500) with a capital of 100 million yen ($280,000) to one billion yen ($2.8 million) and 2.53 million yen ($7,000) with a capital lower than 100 million yen ($280,000) in 1964.

The average annual expenditure per researcher in industry is 4.07 million yen ($11,700). (1964 figures).

Trend of Research Expenditure as percentage of Gross Sales

Table III-10 shows both disbursement (total research expenditure including investment) and current research expenditure as percentages of gross sales of (a) companies conducting reserach, and (b) all companies. The proportion of current research expenditure to gross sales is rising but that of total research expenditure is static since 1961. Although only about 11 per cent of all companies are engaged in research, these are the companies with the greatest gross sales, and the sales of the others do not affect the figures to any marked extent.

For 1964 the proportion of current expenditure to gross sales in the companies conducting research and development averages 0.9 per cent. Looking at different industries in detail, the figure for electrical machinery is 2.3 per cent, for chemical products 1.9 per cent, for precision machinery 1.1 per cent, and for general machinery 1.1 per cent. By contrast, the figure for non-manufacturing companies is low: for construction 0.2 per cent, for agriculture, forestry and fisheries 0.1 per cent.

On examining the variation of this proportion with the amount of capital, the percentage is found to be highest, at 1.2 per cent, for companies with a capital less than 10 million yen ($28,000). This indicates that some science-minded small enterprises take a bold line as regards conducting research. In the higher capital stratum, the corresponding percentage is 0.8 - 1.0 per cent. The proportion of research expenditure to gross sales in the "Industry" sector in Japan is much lower than that in the U.S.A. (1 per cent compared with 4 per cent). However, this is partly due to the absence of spending on defence.

Table III-1. Research Expenditure, Breakdown by Items

Item		Years						
		1959	1960	1961	1962	1963	1964	1965
Total expenditure	in billions of yen	149	184	245	281	321	382	426
	in millions of U.S. dollars	414	512	681	781	892	1 060	1 180
Personnel expenses	in billions of yen	58	67	90	111	136	165	193
	in millions of U.S. dollars	162	187	250	309	378	468	536
Cost of materials and supplies consumed	in billions of yen	22	32	40	48	54	65	72
	in millions of U.S. dollars	61	89	112	132	150	180	200
Other costs	in billions of yen	25	22	29	36	42	50	55
	in millions of U.S. dollars	69	61	81	100	118	139	146
Capital expenditures	in billions of yen	44	63	86	86	89	102	106
	in millions of U.S. dollars	122	175	238	240	246	283	295

Source: Statistical survey of researches

Table III-2. Total Expenditure of the Country on Scientific and Technological Research

Item	Years					
	1960	1961	1962	1963	1964	1965
1. Total expenditure, billions of yen	184	245	281	321	382	426
2. Total expenditure billions of U.S. dollars	0.51	0.68	0.78	0.89	1.06	1.18
3. Total expenditure percentage of national income	1.42	1.59	1.63	1.61	1.69	1.70
4. Total expenditure percentage of Gross National Product at market prices	1.15	1.27	1.33	1.30	1.34	1.36
5. Research expenditure per researcher ($=\frac{\text{Total research expenditure}}{\text{the number of researchers}}$)						
(a) Yen	2 130 000	2 700 000	2 660 000	2 800 000	3 250 000	3 300 000
(b) U.S. dollars	5 900	7 500	7 400	7 800	9 000	9 200

Source: Statistical survey of researches, 1964 and Economy Handbook 1965.

Table III-3. Research Expenditures, by Sector and by Items, 1965

Item		Main sectors			
		Total	Industry	Research Institutes	Higher Education
Total expenditure	in billions of yen	426	252	68	105
	in millions of U.S. dollars	1 180	700	189	292
Personnel expenses	in billions of yen	193	109	32	52
	in millions of U.S. dollars	536	303	89	144
Cost of materials and supplies consumed	in billions of yen	92	52	8	11
	in millions of U.S. dollars	200	144	22	31
Other costs	in billions of yen	55	39	10	6
	in millions of U.S. dollars	153	110	28	17
Capital expenditures	in billions of yen	106	52	18	36
	in millions of U.S. dollars	295	144	50	100

Source: Statistical survey of researches, 1966

Table III-4. Source and Allocation of Funds for Scientific and Technological Research, by Main Sectors

(dollars and yen in millions to nearest million)

Years		SOURCE OF FUNDS			ALLOCATION OF FUNDS			
		Government *	Industry	Higher Education	Government	Industry	Higher Education	Others
1960-61	yen	46 709	137 500	224	21 568	124 374	30 637	7 854
	dollars	130	382	1	60	346	85	22
	%	26	74	0	12	67	17	4
1961-62	yen	63 457	181 484	275	30 209	163 868	41 454	9 704
	dollars	176	504	1	84	455	115	27
	%	26	74	0	12	67	17	4
1962-63	yen	78 466	202 340	385	35 650	179 423	54 132	11 988
	dollars	217	562	1	99	498	150	33
	%	27	72	0	13	64	19	4
1963-64	yen	89 123	231 635	371	39 313	207 294	62 661	11 861
	dollars	248	644	1	109	575	175	33
	%	28	72	0	12	65	19	4

* Includes local Government and foreign sources.

Source : Statistical survey of researches

Table III-5. Source of Funds for Research, by Fields of Science, 1963

		Source of funds			
		Total all sources	Public	Private	Foreign
Total, all fields	in billions[1] of yen	321	89	232	0.5
	in millions of U.S. dollars	892	247	643	1
Physical sciences and engineering	in billions of yen	273	49	224	-
	in millions of U.S. dollars	757	135	621	-
Agriculture	in billions of yen	25	24	1	-
	in millions of U.S. dollars	69	65	3	-
Medical sciences	in billions of yen	24	17	7	0.5
	in millions of U.S. dollars	66	47	19	1

Source: Statistical survey of researches

(1) 1 billion = 1000 million (U.S. usage)

Table III-6. State Expenditures on Scientific and Technological Research

Item	Years							
	1959	1960	1961	1962	1963	1964	1965	1966
1. Research related expenditure by the State								
(a) in billions of yen	43.6	51.0	62.9	74.9	90.6	108.7	120.6	143.1
(b) in millions of U.S. dollars	121	142	175	208	252	300	335	398
(c) as % of total State budget	2.9	2.9	3.0	2.9	3.0	3.2	3.2	3.3
(d) as % of total expenditure of the country on research	(29)	(28)	(26)	(27)	(28)	(28)	(28)	(-)
2. State expenditure on defence research (intra- and extra-mural)								
(a) as % of total expenditure of the country on research	(1.5)	(1.4)	(1.1)	(1.1)	(0.9)	(0.9)	(0.9)	(-)
(b) as % of total State expenditure on research	4.8	5.1	4.1	3.6	3.3	3.0	3.3	3.4
3. State expenditure on research (civil and defence) in respect of higher education as a percentage of total State expenditure on research.	40	41	44	48	50	58	60	59
4. State expenditure on research (civil and defence) in respect of industry as a percentage of total State expenditure on research	1.3	1.1	1.1	1.0	0.9	0.8	0.8	-

Source: Budget book and statistical survey of researches.

Table III-7. State Expenditure on Research, 1955-1965

	1955		1956		1957		1958		1959		1960		1961		1962		1963		1964		1965	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
A. Research promotion expenditure																						
1. General account																						
Research organizations	5 782	16 1	6 697	18 6	8 547	23 7	9 633	26 8	10 984	30 5	12 748	35 4	15 201	42 2	17 290	48 0	19 867	55 2	23 005	63 9	25 112	69 8
Subsidy and contract	2 245	6 2	2 204	6 1	2 317	6 4	2 544	7 1	2 669	7 4	3 105	8 6	3 850	10 7	4 359	12 1	4 826	13 4	5 199	14 4	5 848	16 2
Administration	333	0 9	471	1 3	608	1 7	869	2 4	1 125	3 1	1 432	4 0	1 934	5 4	2 553	7 1	3 013	8 4	3 552	9 9	4 260	11 8
Atomic energy	200	0 6	1 391	3 9	5 910	16 4	7 649	21 3	7 338	20 4	7 613	21 1	7 544	20 9	7 876	21 9	9 356	25 9	10 465	29 1	11 685	32 5
Subtotal	8 559	23 8	10 763	29 9	17 332	48 2	20 740	57 6	22 116	61 4	24 898	69 1	28 529	79 2	32 078	89 1	37 062	102 9	42 221	117 3	46 906	130 3
B. Other research expenditure																						
1. General account																						
Defence, observation, survey	1 741	4 8	2 168	6 0	1 904	5 3	2 315	6 4	2 609	7 2	3 068	8 5	3 853	10 7	4 282	11 9	4 828	13 4	5 192	14 4	5 896	16 4
Special aid	221	0 6	187	0 5	221	0 6	517	1 4	782	2 2	1 227	3 4	1 812	5 0	2 198	6 1	2 642	7 3	2 980	8 3	3 626	10 1
National universities, research institutes	10 941	30 4	12 019	33 4	13 401	37 2	14 740	41 0	17 274	48 0	20 918	58 1	26 827	74 5	34 491	95 8	44 292	123 0	54 114	150 3	66 740	185 4
Science Council, International organizations	96	0 3	113	0 3	109	0 3	116	0 3	149	0 4	142	0 4	168	0 5	190	0 5	190	0 5	204	0 6	245	0 7
Antarctic, miscellaneous	195	0 5	1 235	3 4	1 069	3 0	876	2 4	447	1 2	430	1 2	475	1 3	428	1 2	289	0.8	2 364	6 6	2.471	6 9
Subtotal	13 194	36 6	15 722	43 6	16 694	46 4	18 564	51 5	21 261	59 0	25 785	71 6	33 135	92 0	41 589	115 5	52 241	145 0	64 854	180 2	78 978	219 5
2. Special account																						
Research in national hospitals, cancer research, printing research, miscellaneous	186	0 5	234	0 6	209	0 6	211	0 6	257	0 7	313	0 9	1 283	3 6	1 231	3 4	1 292	3 6	1 396	3 9	1 578	4 4
C. Gross research expenditure	21 939	60 9	26 719	74 2	34 235	95 1	39 515	109 8	43 634	121 2	50 996	141 7	62 947	174 9	74 898	208 0	90 595	251 7	108 471	301 3	127 462	354 1
D. Social Sciences less Humanities	249	0 7	258	0 7	280	0 7	287	0 8	322	0 9	417	1 2	502	1 4	597	1 7	651	1 8	866	2 4	952	2 6
E. Research related expenditure	21 690	60 2	26 461	73 5	33 955	94 4	39 228	109 0	43 312	120 3	50 579	140 5	62 445	173 5	74 301	206 3	89 944	249 9	107 605	298 9	126 510	351 5

Source: Office of the Prime Minister, Science and Technology Agency. Planning Bureau. 1965

Notes: (1) Data as of 3 August 1965. Figures for 1965 subject to revision.
(2) (a) Rounded to nearest million yen
(b) U.S. dollars millions

Table III-8. Research Budgets, by Ministry

(yen = in billions of Japanese Yen)
(dollars = in millions of U.S. Dollars)

Ministry	1963		1964		1965		1966	
	yen	dollars	yen	dollars	yen	dollars	yen	dollars
Prime Minister's Office	16.9	47	18.3	51	21.4	60	26.0	72
Defence Agency	3.0	8	3.3	9	4.0	11	4.8	13
Science & Technology Agency	13.3	37	14.6	41	16.8	47	20.5	52
Others	0.6	2	0.4	1	0.6	2	0.7	2
Ministry of Finance	1.7	5	2.1	6	0.2	1	0.2	1
Ministry of Education	50.8	141	63.1	175	72.3	201	84.9	236
Ministry of Health & Welfare	2.5	7	3.1	9	3.2	9	3.4	9
Ministry of Agriculture & Forestry	8.3	23	9.4	26	10.2	28	11.4	31
Ministry of International Trade & Industry	6.7	19	7.9	22	8.3	23	11.3	31
Ministry of Transportation	1.0	3	1.6	4	1.8	5	1.8	5
Ministry of Construction	1.6	4	1.8	5	2.0	6	2.2	6
Others	1.2	3	1.4	4	0.6	4	1.9	5
Total	90.6	252	108.7	302	120.6	336	143.1	398

Data: Ministry of Finance

Table III-9. Research Expenditures in the "Research Institutes", 1964
(not including Social Sciences)

Field of research		Research institute			
		Total	Government	Local government	Private non-profit
Total	in billions of yen	60.6	25.7	21.6	13.3
	in millions of U.S. dollars	168	73	60	37
Physical sciences & Engineering	in billions of yen	33.8	16.9	6.1	10.8
	in millions of U.S. dollars	94	47	17	30
Agriculture	in billions of yen	21.0	6.4	13.8	0.8
	in millions of U.S. dollars	58	18	38	2
Medical sciences	in billions of yen	5.8	2.4	1.7	1.7
	in millions of U.S. dollars	16	7	5	5

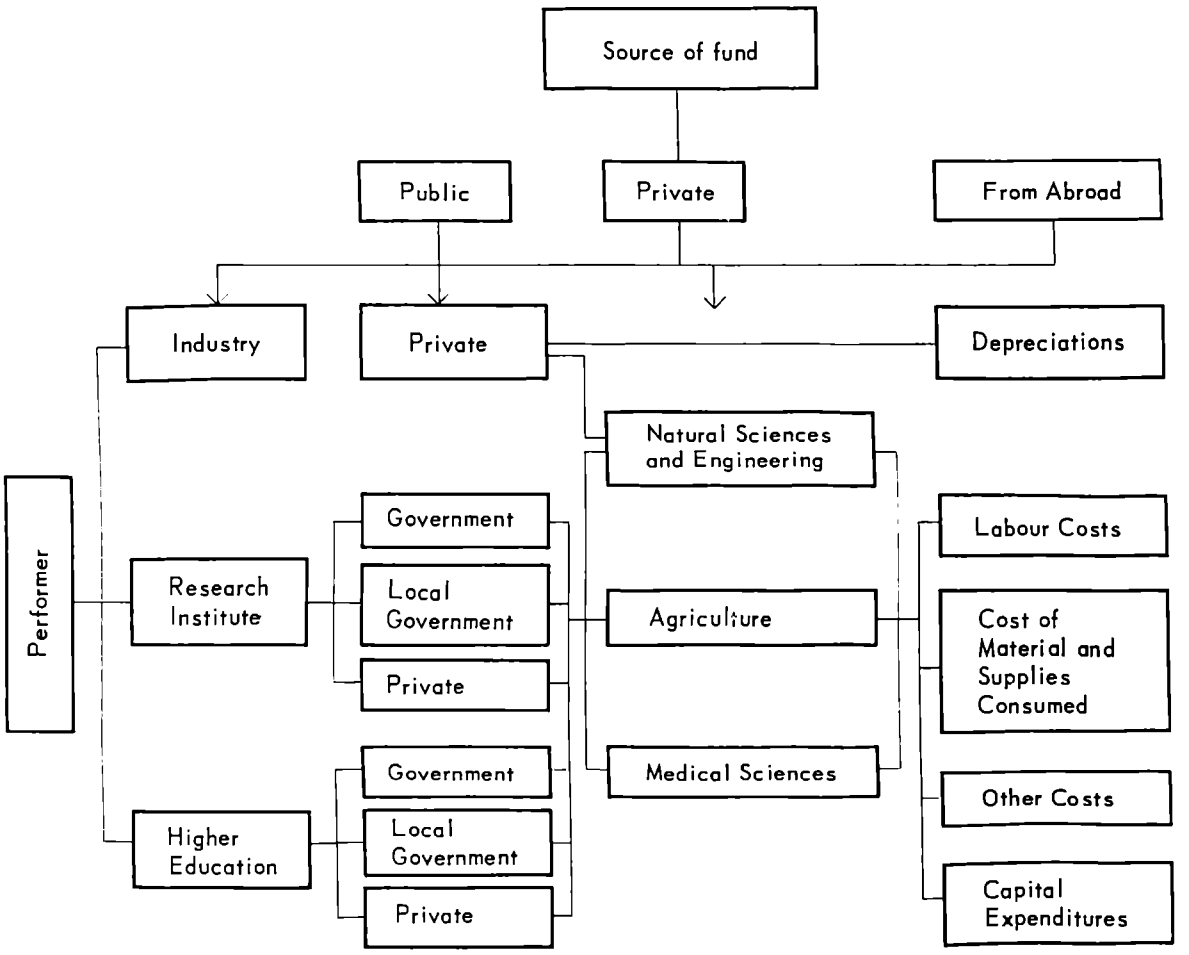
Source: Statistical survey of researches.

Table III-10. Trend of Research Expenditure as percentage of Gross Sales

Item	Years						
	1959	1960	1961	1962	1963	1964	1965
Total research expenditure (including investment) as percentage of gross sales of companies conducting research	0.99	1.00	1.12	1.08	1.05	1.04	1.02
Current research expenditure as percentage of gross sales, of companies conducting research	0.76	0.76	0.85	0.90	0.91	0.92	0.95
Total research expenditure (including investment) as percentage of gross sales of all companies	0.71	0.68	0.73	0.66	0.70	0.66	-
Current research expenditure as percentage of gross sales of all companies	0.54	0.51	0.54	0.55	0.61	0.58	-

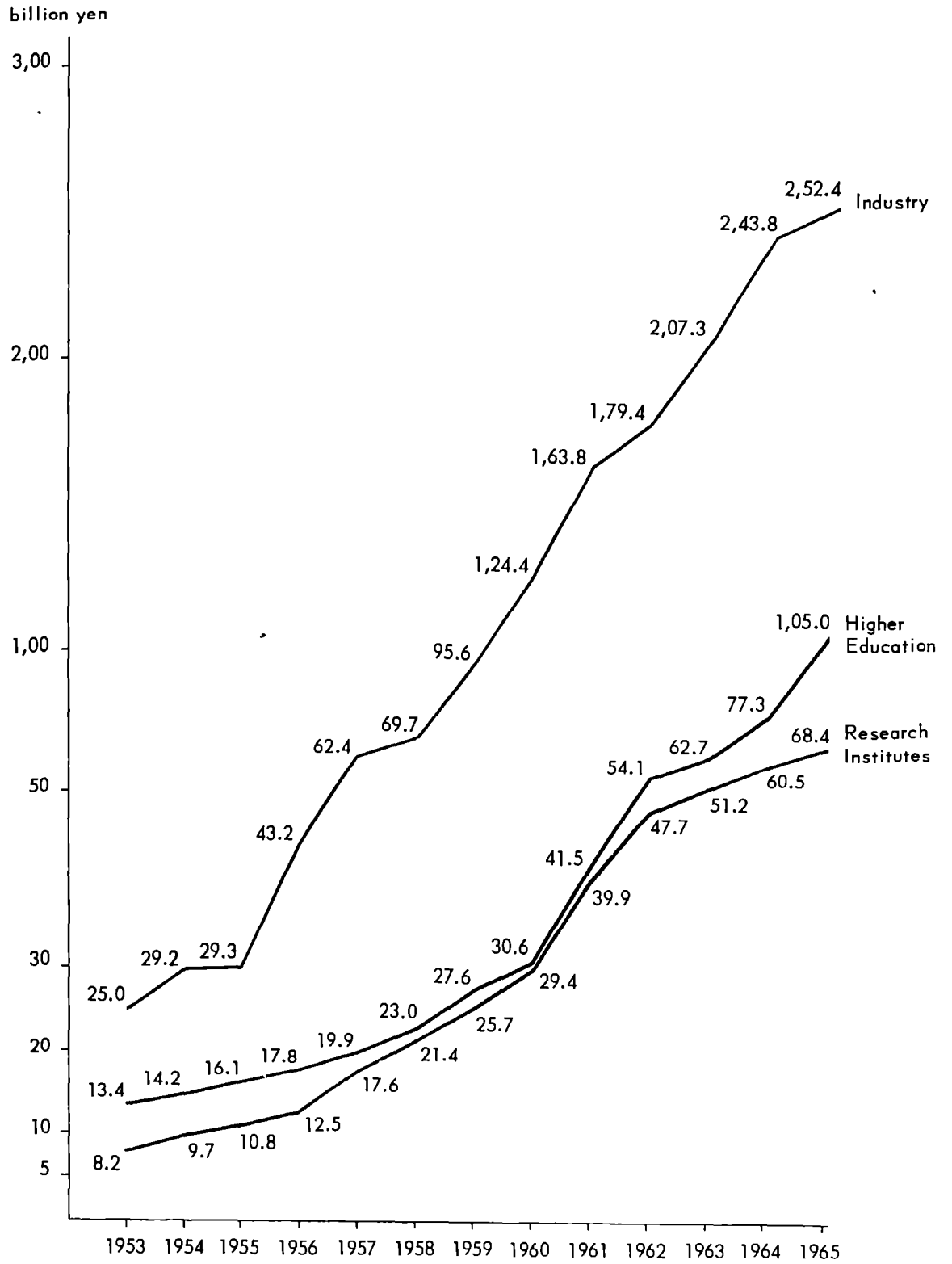
Source: Statistical survey of researches

Chart III-1. Basis for the Statistical Survey of Research Expenditure



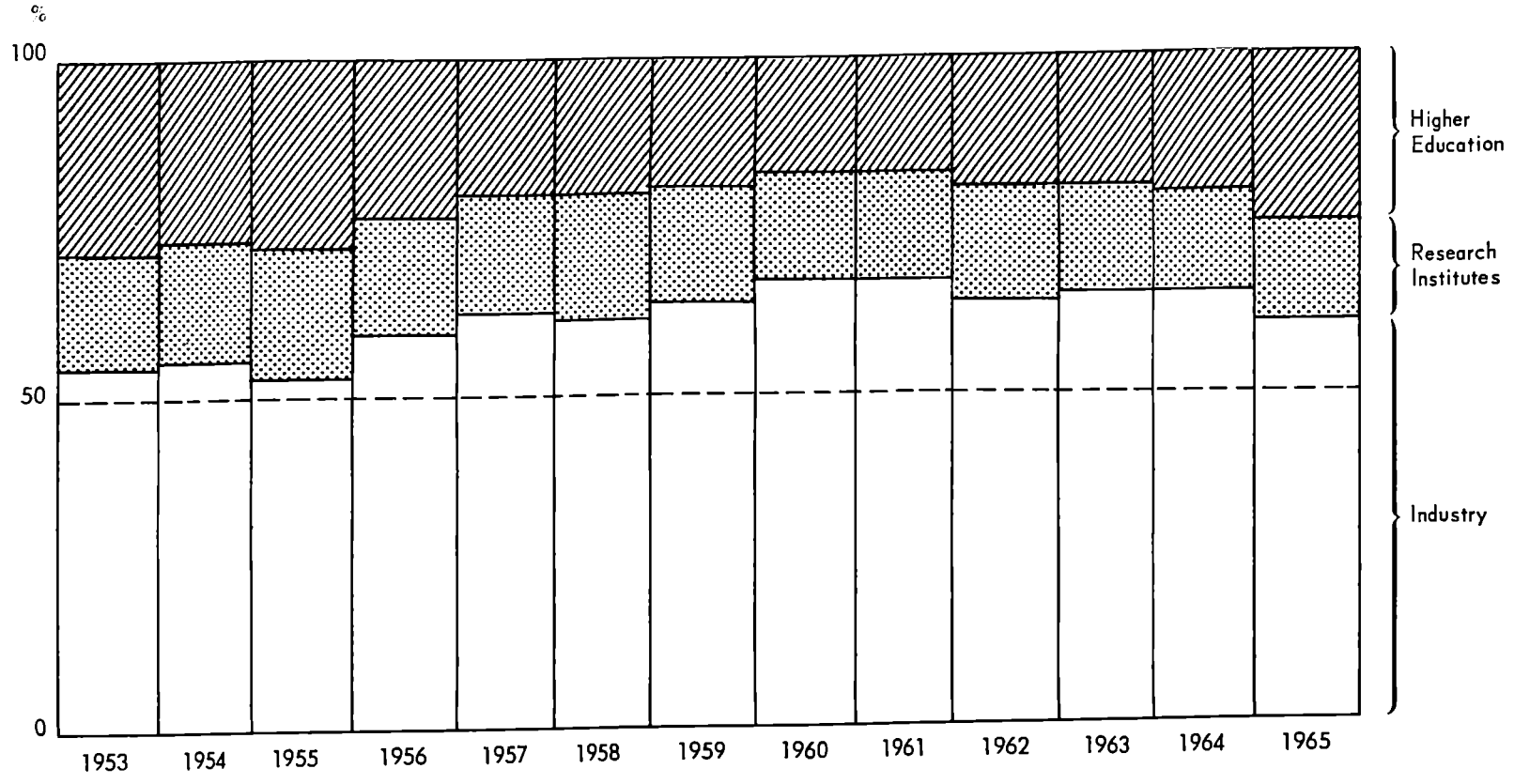
Source : Statistical Survey of Researches
Bureau of Statistics, Office of the Prime Minister, Japan

Chart III-2. Trend of Research Expenditure for Individual Sectors ("Performers")



Source: Statistical Survey of Researches

Chart III-3. Research Expenditure, Relative Proportions of Major Sectors



Source: Statistical Survey of Researches

Part IV

SCIENTIFIC AND TECHNOLOGICAL PERSONNEL

THE EDUCATIONAL SYSTEM

The new educational system in Japan (see Chart IV-1) involves compulsory education for 9 years, covering primary school (6 years) and junior high (secondary) school (3 years). This may be followed by senior high (secondary) school (a further 3 years) *or* by technical college (5 years). As the university now has 4-year courses only, the need for shorter courses for professional training of 2 or 3 years led in 1964 to the legal recognition of the " junior colleges ". The technical colleges were established in 1961 to meet the requirements for more engineers.

FINANCE FOR THE NATIONAL AND PUBLIC UNIVERSITIES

Education and research in these universities are largely financed by the Government, since tuition fees and other income meet only 5% of their expenses. Taking 1960 as 100 the expenses index for 1965 had risen to 344, the increase since 1961 being about 25% annually. (*Note*: the research expenses are given in Part III.)

Management expenses have risen from 33% of the total in 1949 to 46% in 1963. The index of the integrated school expenses per teacher is 180 for 1963, taking 1959 as 100. The expenses of the experimental chairs are 2,580 000 yen ($7,200), 4 times as much as those of the non-experimental chairs, which are 650,000 yen ($1,800). Expenses per student are 12,500 yen ($35) in the natural sciences and engineering and 5,500 yen ($15) in the humanities and social sciences.

THE FINANCING OF PRIVATE UNIVERSITIES

The private universities depend mainly on the tuition fees of the students for their finance. In order to secure the necessary funds, they therefore have to enrol many students. Compared with the national universities, the facilities per student are considerably inferior.

The number of students per year per teacher in the faculties of technology is 5.0 in the national universities, 3.9 in the public universities and 11.8 in the private universities. Nearly 70% of the students in higher education are in the private universities and the increase in recruitment of students in natural science and technological faculties largely depends on them.

The Government provides special subsidies to assist the private universities with the equipment expenses, etc. for the students' research activities. These amounted to 2,800 million yen ($7.8 million) in 1965 and 3,700 million yen ($10.3 million) in 1966.

TRENDS IN STUDENT ENROLMENTS

The number of university and college students in 1964 was about 1 million, i.e. 5.3 times as many as the average number over the years 1934 to 1936 and 2.5 times that in 1950. The number of women students in 1964 was 12.5 times the average number in 1934-1936 and 6 times that in 1950. Over the period 1954-1964, students taking natural science increased 2.3 times and those taking technology 2.5 times. The average increase for all faculties was 1.7 times. In the universities, the numbers of basic science and engineering students in 1964 were about 24,000 and 157,000 respectively, i.e. 2.9% and 19.2% respectively of the total number of students in all faculties (about 820,000). The numbers in other scientific faculties were: agriculture, about 35,000 (4.3% of the total); medicine, dentistry and pharmacy, about 33,000 (4.1%). Thus the total number of science and technology students at the universities (some 250,000) amounted to about 31% of the total for all faculties. (*Note*: These figures are set out in Table IV-2.)

Over the ten years from 1954 to 1964, the number

of women students in basic natural sciences increased 2.2 times, to 3,400, and those in technology increased 1.9 times, to 1,000.

In the junior colleges, domestic science attracts the highest percentage of students (about 39%), followed by literature, law and economics. In the private establishments, the percentage of those in domestic science is about 43%, this high figure may be explained by the large number of women students who take this subject, combining it for general culture with literature.

However, in the national junior colleges, the situation is different from that in the junior colleges as a whole; and students of the scientific, technical and agricultural faculties make up 53.7 per cent of the total.

Although the numbers of university students in natural sciences and technology have recently increased considerably, they are still not high enough, and enrolment of a further 170,000 is planned. While the appropriate subject distribution of these additional students has not yet been decided, an estimate has been made of the distribution between public and private universities, and this is expected to be in the proportion of 20,000 to 150,000. As far as the national universities are concerned,63% of the additional enrolments are to be in the natural science and technology departments.

EMPLOYMENT OF GRADUATES

For all university graduates employed in industry in 1963 the index was 170 compared with 1955; for natural science and technology graduates it was 206. In 1963, science and technology graduates constituted 43 per cent of all graduates employed in manufacturing industries, 47 per cent in the iron and steel industry, and 70 per cent in the construction industry. Of all graduates in science and technology, as many as 95 per cent are employed in industry. If it is assumed that the remainder enter postgraduate courses, this implies full employment of all science and technology graduates in industry, and a demand in excess of supply.

The index for the number of engineers employed in 1963 compared with 1955 was 297, this rate of increase being 50 per cent higher than that in non-technological occupations and double that for all graduates employed.

The ratio of engineers to all other graduate employees in industry increased from 13 per cent (8,951) in 1955 to 22 per cent (26,578) in 1963.

DISTRIBUTION OF SCIENTISTS AND ENGINEERS

The general idea of " scientists " and " engineers " in Japan is not always clear, since in addition to the academic training, the subsequent place and nature of work affect the categorization. In Japan, personnel are classified as researchers and engineers.

Distribution of Researchers (Tables IV-1, 4 and 5)

At 1 April 1965, the number of research personnel was about 323,000, including about 130,000 researchers. (These figures exclude the social sciences.) The distribution of research personnel among different types of employing organizations was roughly 56% in the industry, 29% in universities and 15% in research institutes; the corresponding distribution for researchers was 51% in industry, 34% in universities and 15% in research institutes.

The number of assistant research workers per researcher , in 1965, was 1.01 in industry, 0.39 in research institutes and 0.22 in the universities. The increase in the numbers of researchers is largely concentrated in highly technological industries such as electrical machinery, general machinery and chemical products. With the increase of public investment in civil engineering and construction there is a great increase in the number of researchers in these fields; and similarly in the field of livestock, veterinary activities and modernization of agriculture.

In industry, over 93 per cent of the research personnel and researchers are concentrated in the manufacturing industries, the chemical and electrical machinery industries each accounting for about 24% in 1966, with a large concentration in heavy industry generally. Research personnel and researchers are employed mainly in the large enterprises. Companies with a capital of over one billion yen ($2.8 million) employ about 60% of all research personnel and about 56% of all researchers in industry.

Distribution of Engineers

There is as yet no clear and generally agreed definition of the profession or qualification of an engineer in Japan. The following definitions have been used for specific purposes:

(a) The 1960 Census stated that " the engineer applies his specific and scientific knowledge and means to production activities and engages in scientific and technological professions such as planning, administration and research for production ", " excluding those engaged in research work which needs specific training in natural sciences or a knowledge equal thereto and practical experience in a university or similar institution ".

(b) The survey by the Ministry of Education in 1961 stated that " the engineer has a higher scientific knowledge and specific technique than university

and college graduates (natural science, technology, agriculture and medicine) and usually does not engage in production itself but in such engineering work as will assist production directly or indirectly".

Other surveys made by the Ministry of International Trade and Industry and the Science and Technology Agency, mention definitions based on academic career, standard of scientific and technological knowledge, and nature of the engineering profession.

In the 1960 Census the number of engineers was 333,630 and the number of scientific researchers was 32,370.

In the "survey on the structure of academic careers in the place of work" conducted by the Ministry of Education in 1959, those who graduated from the higher educational institutions and became engineers numbered 220,450 and researchers numbered 85,000[1]. When the numbers of engineers and researchers from the faculties of science and technology are compared they were 24 and 23% from the former, and 47 and 9% from the latter. In the same survey for 1963, engineers numbered 343,390 and researchers 106,840, corresponding to increases of 56 and 24% respectively compared with 1959. These figures may be compared with an 8% increase in all personnel and a 41% increase in higher education graduates. Employment figures for science and technology graduates in industry in 1963 show that 64% of graduates from technology faculties are engaged in manufacturing and 11.6% in service industries, while for graduates from science faculties the preponderance is reversed, the percentage being 28.4% and 57.6% respectively. Of the graduates from the faculties of agriculture in 1963, engineers numbered 26,640 and researchers 16,020 compared with 18,700 and 10,790 in 1959, showing increases of 42% and 48% respectively.

(c) From the results of the "survey on the distribution and duties of scientists and engineers" by the Science and Technology Agency in 1963, the proportion of graduates from higher educational institutions in science and technology to all personnel was about 5.1%. For individual industries this proportion was 19.8% in construction, 10.3% in petroleum and coal products, 6.0% in precision machines, 0.4% in rubber products, 1.2% in railway services, 2.0% in textile products, and 2.4% in mining.

USE OF AND CONDITIONS FOR SCIENTISTS AND ENGINEERS

The recent rapid progress of science and technology has increased the fields of activity and specialization of scientists and engineers and brought with it problems of organization and administration. This has resulted in the use of more such personnel in management. From the survey carried out by the Science and Technology Agency specialization has increased in such occupations as production control in automation, operation of auto-control machines in mass-production, supervision and conservation, industrial engineering, and operational research, and the sciences needed in such occupations are metrology, applied physics, electronics, mathematical engineering and management engineering. Moreover, the employment of such specialists in chemical engineering, applied physics and metrology is continually increasing, and the supply is unlikely to keep pace with the changing demand.

The shortage of scientists and engineers is aggravated by their improper allocation. The survey by the Science and Technology Agency in this respect revealed that 54% of the enterprises questioned answered that "the present situation is satisfactory"; 14% indicated "maldistribution", and 6% "too much decentralization". These figures indicate room for improvement. Deployment was found to be generally satisfactory in large enterprises, but deployment problems were reported from enterprises dealing with machinery, wood pulp, ceramics, railways, precision machines, textiles and transportation equipment. In the larger enterprises the problem seems to be one of quality rather than of quantity.

Scientists and engineers who considered themselves to be efficiently used accounted for 27%, and those who did not for 14%. Most of the latter were young, and engaged in sales and clerical work.

Generally pay conditions and the system of remuneration of scientists and engineers are not very satisfactory, particularly in the early days of the career. Pay is largely based on status and seniority, and there is insufficient recognition of talent. The recent shortage of personnel has helped to raise the levels of employment and pay, but the latter is still only 4% higher than that in clerical work. The initial pay for personnel with higher degrees, in 1957, was only 14% more than that of the ordinary graduate, but by 1964 the difference had risen to 20%.

The above cited survey by the Science and Technology Agency also provides some information regarding the promotion of scientific and technical personnel to higher-level posts. The proportion of engineers among the Supervisors (higher than Section Chief) is 21%, the proportion of technical personnel other than engineers at this level is 24%, which is not significantly different. Of the promotions to top-management, clerical staff gain 58% and technical staff 42% overall; in enterprises with a capital of over 10 billion yen the ratio is 54 : 46.

1. Otherwise unexplained discrepancies between the results of the different surveys are no doubt due to the absence of agreed definitions, noted above.

Recently a new staff system was introduced in industry. In 1963 the proportion of enterprises having adopted this system was 20% overall (39% among enterprises with a capital of over 10 billion yen) and the proportion of those contemplating its adoption was 15% (20% for the larger enterprises). The system is intended to encourage the higher knowledge and creativity essential for these enterprises.

The terms for employment in Government institutes are less attractive than for industry and this makes it difficult for the Government to secure the essential staff. The Council for Science and Technology has recommended special measures for improvement of this state of affairs. The need for improvement has also been stressed by the Temporary Administrative Investigation Council. The Science and Technology Agency sends proposals for the improvement in the terms of service of researchers in public service to the National Personnel Authority every year, and also considers plans on its own initiative for improving the system for public employees in scientific research. In January 1965 the Agency submitted an interim report which proposed that, in view of the special requirements, scientific research appointments should be based not on the present competitive senior examination for national and public employees but on a special non-competitive examination relevant to the special field of knowledge required.

Table IV-1. Number of Researchers and Research Personnel* (including non-regular) (not including Social Science)

		Total	Companies and public corporations	Research institutes			Universities and attached institutes
				National	Public	Private	
	**						
1959	R	52 077	-	-	-	-	-
	RP	161 046	-	-	-	-	-
1960	R	82 149	42 938	6 500	5 793	1 997	24 921
	RP	253 404	153 280	14 671	15 319	4 548	65 586
1961	R	89 707	43 666	6 590	6 345	2 409	30 697
	RP	228 212	134 171	15 208	14 746	5 160	58 927
1962	R	101 509	47 035	7 580	7 785	2 742	36 367
	RP	253 146	148 604	16 964	17 146	5 826	64 606
1963	R	117 567	54 909	8 025	8 930	3 935	41 768
	RP	284 281	166 654	17 394	19 690	7 798	72 745
1964	R	131 037	61 155	8 086	8 926	4 374	48 496
	RP	303 963	179 658	18 078	19 750	7 213	79 264
1965	R	137 607	60 982	8 379	9 633	4 702	53 911
	RP	323 800	186 214	18 708	22 153	9 554	87 171

* Research personnel includes researchers.
**R = Researchers.
RP = Research personnel.

Table IV-2. Number of Students in Colleges and Universities, by Scientific Disciplines

		Total, all disciplines	Natural sciences	Engineering	Agriculture	Medical science *	Total, scientific disciplines
1959	Universities	572 461	14 715	83 094	26 226	28 201	152 236
	Jun. coll.	74 022	185	8 166	1 266	-	9 617
1960	Universities	601 464	16 206	94 001	28 040	28 115	166 362
	Jun. coll.	81 528	199	9 200	1 353	-	10 752
1961	Universities	644 022	17 535	105 983	29 277	29 198	181 993
	Jun. coll.	91 245	120	10 635	1 492	-	12 247
1962	Universities	699 200	19 114	121 103	31 213	30 142	201 572
	Jun. coll.	105 182	132	12 419	1 589	-	14 140
	Tech. coll.	3 375	-	3 375	-	-	3 375
1963	Universities	762 749	21 537	140 961	33 286	31 658	227 442
	Jun. coll.	119 767	154	13 646	1 709	-	15 509
	Tech. coll.	8 560	-	8 560	-	-	8 560
1964	Universities	817 751	23 863	156 656	34 855	33 128	248 502
	Jun. coll.	125 566	160	4 203	1 722	-	16 085
	Tech. coll.	15 398	-	15 398	-	-	15 398

* Medical science includes pharmacology and dentistry.

Table IV-3. Number of First-year Students in Colleges and Universities, by Scientific Disciplines

		Total, all disciplines	Natural sciences	Engineering	Agriculture	Medicine	Total, scientific disciplines
1959	Universities	157 032	3 550	22 395	6 630	7 065	39 640
	Jun. coll.	37 889	80	3 663	650	–	4 393
1960	Universities	168 408	4 148	25 917	7 478	7 248	44 791
	Jun. coll.	42 471	74	4 436	756	–	5 266
1961	Universities	181 133	4 811	28 737	7 768	7 510	48 926
	Jun. coll.	47 240	41	5 071	802	–	5 914
1962	Universities	202 340	5 488	34 615	8 535	7 878	56 516
	Jun. coll.	55 930	74	6 209	906	–	7 189
	Tech. coll.	3 375	–	3 375	–	–	3 375
1963	Universities	217 439	6 034	40 376	8 892	8 381	63 683
	Jun. coll.	61 411	80	6 198	859	–	7 137
	Tech. coll.	5 117	–	5 117	–	–	5 117
1965	Universities	259 164	8 428	49 442	9 586	9 893	77 349
	Jun. coll.	80 940	116	7 059	1 085	–	8 260
	Tech. coll.	7 509	–	7 509	–	–	7 509

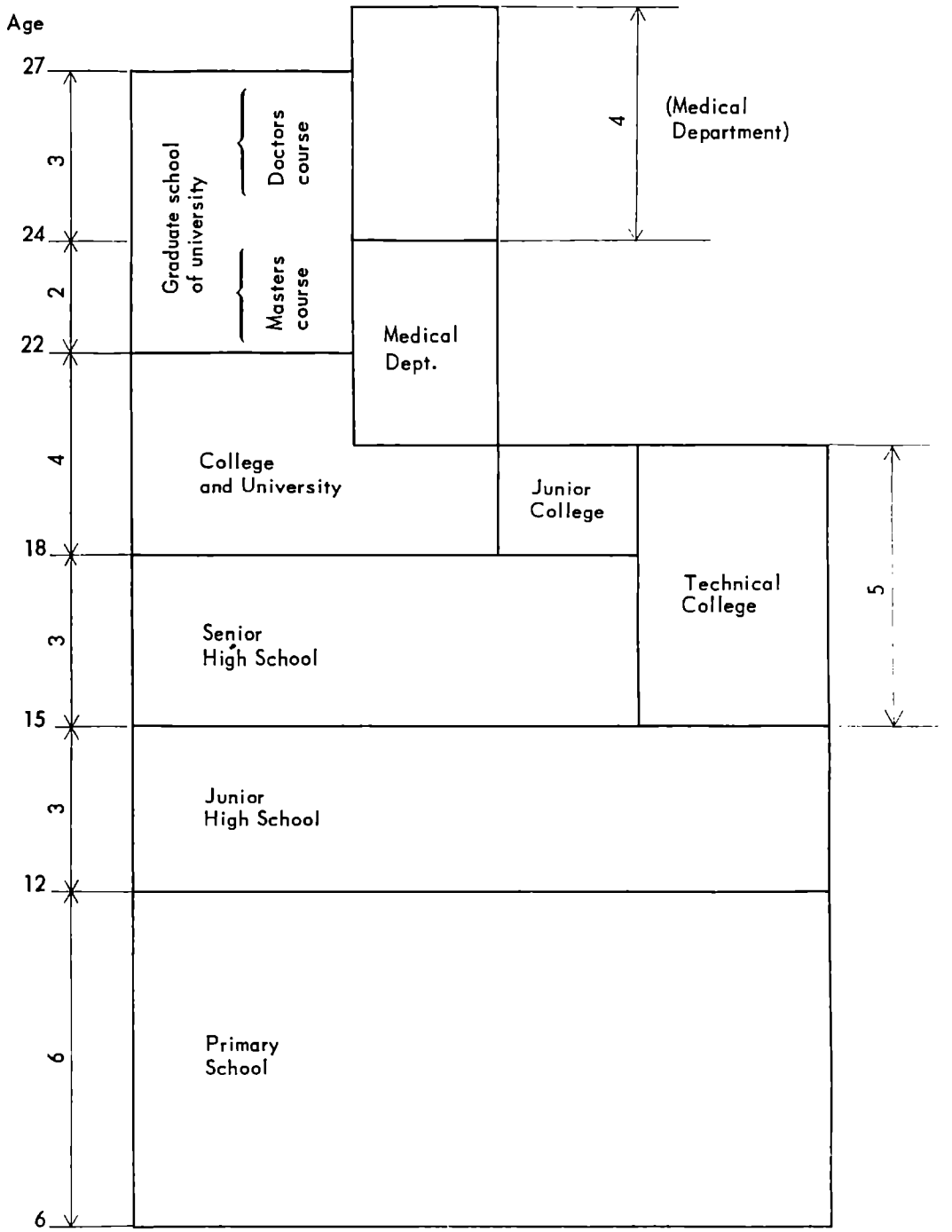
Table IV-4. Number of Researchers by Field of Science and by Type of Employing Organization, 1965

	Total	Companies and public corporations	Research institutes	Univ. and coll. and attached institutes
Total	148 838 (100)	58 997 (100)	21 145 (100)	68 696 (100)
Social science	31 242 (21.0)		1 679 (7.9)	29 563 (43.0)
Natural science and engineering	85 320 (57.3)	58 997 (100)	8 472 (40.1)	17 851 (26.0)
Agriculture	13 312 (9.0)		9 031 (42.7)	4 281 (6.2)
Medicine	18 964 (12.7)		1 963 (9.3)	17 001 (24.8)

Table IV-5. Number of Research Personnel by Field of Science and by Type of Employing Organization, 1965

	Total	Companies and public corporations	Research institutes	Univ. and coll. and attached institutes
Total	350 364 (100)	184 229 (100)	50 543 (100)	115 592 (100)
Social science	46 575 (13.3)		3 376 (6.7)	3 199 (37.4)
Natural science and engineering	236 372 (67.5)	184 229 (100)	20 391 (40.4)	31 752 (27.5)
Agriculture	29 478 (8.4)		21 950 (43.4)	7 528 (6.5)
Medicine	37 939 (10.8)		4 826 (9.5)	33 113 (28.6)

Chart IV-1. Diagram of Educational System



Part V

PRINCIPAL OBJECTIVES AND PROGRAMMES OF SCIENTIFIC AND TECHNOLOGICAL POLICY

OBJECTIVES AND PRINCIPLES OF THE SCIENTIFIC AND TECHNOLOGICAL POLICY

In Japan, science and technology are considered essential factors in the formation, development and welfare of a cultured nation.

The overall purpose of the national policy for science and technology is to provide a sound foundation for the development of science, to further technological research and its application to the needs of society, and to raise the level of science and technology. As a principle, the government recognizes the cultural value of science and the need to respect free activity in this field.

SCIENCE AND TECHNOLOGY PROMOTION POLICY IN RELATION TO ECONOMIC PLANNING

National Income-Doubling Plan

Since World War II, the economy of Japan has made spectacular progress, and to promote further development on a long range programme, the "Doubling Plan" was approved in December 1960.

The objectives of the plan were to double the gross national product as fast as possible, to attain full employment, and to raise living standards. Specific efforts were to be made towards the adjustment of differences of living and income standards between agricultural and non-agricultural industries, between large and small enterprises, between different regions, and between income levels, and to balance the development of the national economy and national life.

The target was to reach a GNP of 26 trillon[1] yen (at 1958 value) in ten years, with an initial growth rate of 9 per cent.

It was in the above context that the Council for Science and Technology presented its recommendations, in October 1960, on "the overall fundamental policy for the promotion of science and technology to aim at 10 years ahead". This included a number of statements of policy, established goals for science and technology, and suggested measures for their implementation. These were incorporated in the plan, which aims at a rapid levelling up of Japan's science and technology by correcting the present technological unbalance in industries, balancing research activities at each stage from fundamental to applied research and development, increasing co-ordination between education, research and production, improving information services and international exchange, disseminating knowledge to the public providing better training for more personnel, increasing the number of schools and courses for science and technology, modernizing research facilities and environments, furthering research and development, and improving the industrialization policy particularly in respect of agriculture and smaller enterprises.

With present trends, a shortage of 170,000 scientist and engineers and 440,000 technicians was forecast; and an appropriation for research investment of 300 billion[2] yen was estimated for 1970 (four times that for 1958). As a proportion of the national income, this figure represents an increase from 0.9 per cent in 1958 to 1.3 per cent by 1970. However, it is recommended that the proportion be increased nearer to 2 per cent (400 billion yen) to enable improvements in research to be made, particularly in respect of better pay and facilities for researchers at universities and in public service.

The plan assumes that private enterprise will continue to undertake research from the fundamental to the development stages as a part of its activity, and that universities and national institutes will be responsible for research which cannot be done by private enterprise.

The plan further suggests that the Government should use its funds extensively to promote industrialization, improve the patent system, give tax relief on inventions, research funds and donations, and depreciation costs. Finally, the plan recommends a fundamental law for science and technology.

1. 1 trillon = 1 million million (U.S. usage)
2. 1 billon = 1 thousand million (U.S. usage)

The Medium-Term Economic Plan

From the start of the national income-doubling plan the economy achieved extraordinary growth, but problems of labour supply soaring consumer prices, unbalanced productivity, and the backwardness in public welfare have become intensified and have created such instability that a revised "Medium-Term Economic Plan" was introduced in 1965.

The new target for expenditure on research is 620 billion yen in 1968 (280 billion yen for 1962), which exceeds the 1970 target of 2 per cent of the national income set up in the earlier plan.

It is considered that more effort should be directed towards original work in fundamental research and development to reduce the reliance on, and expense of, imported foreign technology; particularly since it is believed that Japan can now afford this effort in funds and labour.

It is stated that the appropriate functions of the Government in the field of science and technology are, first,sponsoring of fundamental research which cannot be pursued on a commercial basis; second, furtherance of research activities for public welfare directly concerned with the public safety, disaster prevention and medical science; third, furtherance of research and development in those sectors which are technologically bacward, such as agriculture, forestry, fisheries, and small and medium-sized enterprises; fourth, assistance to, and furtherance of, research and development of a long term or large-scale nature which is beyond the ability of private enterprise; fifth, training of researchers; sixth, supply of information and improvement of environment to encourage the research and development activities; and seventh, raising the Government's share of the total expenditure on research and development.

The measures in support of this are similar to those for the earlier plan, but they emphasize the need for coupling the advancement of science and technology with the economic growth, improving the quality of scientists and engineers, avoiding wasteful duplication of work and equipment, increasing research in public welfare, raising the level of technological work in agriculture, forestry and fisheries and the smaller enterprises, increasing subsidies to an effective level in private enterprise, assisting and encouraging research by tax relief, establishing research associations between private enterprises, improving co-operation between the various sections and establishments, public and private, speeding up information activities and the examination of patents, and improving the research environment.

THE FUNDAMENTAL LAW FOR SCIENCE AND TECHNOLOGY

In conjunction with the establishment of the medium-term economic plan, the Council for Science and Technology re-examined its recommendations on "overall fundamental policy for the promotion of science and technology to aim at 10 years ahead", both in respect of the present period and beyond. A Bill for the Science and Technology Law is to be submitted to the Diet, to clarify the responsibility of the Government on science and technology and to indicate the goals of the policy. The Bill will provide that matters of policy important to the nation as a whole will be dealt with collectively, particularly in respect of:

Furtherance of research and development relating to science and technology.

Improvement of research environments by renewal and expansion of equipment and facilities.

Improvement of the structural system for research activities.

Furtherance of the application of research results.

Security for researchers, research assistants, engineers and technicians, and improvement in conditions of service.

Smooth flow of information relating to science and technology.

Furtherance of dissemination to the public of information on science and technology.

Furtherance of international co-operation in the field of science and technology.

Other necessary matters concerning the higher levels of science and technology.

The implementation of these policies will be based on long-term fundamental plans, taking into consideration the views of the Science Council of Japan.

A change in the administrative structure and the establishment of a new Council for Science and Technology will take place after the enactment of the new Law, when the above-mentioned long-term programmes are to be reconsidered.

PROMOTION PLAN FOR SCIENCE AND TECHNOLOGY

As mentioned in Part Two above, the Council for Science and Technology makes recommendations to the Prime Minister on fundamental and overall policy.

The Council has made three important recommendations on Science Policy. The 1960 report on "The Promotion of Science and Technology in the Next Ten Years" was the first attempt to construct a national science policy and to summarize the various trends in the thinking of academic, business and administrative circles. In 1965, the Council felt the need to amend the contents of the above report, which had become inadequate to the existing situation;

and the revised promotion plan was formulated in 1966. The main features of this report are as follows:

Policy for Strengthening and Reorganizing Research Activities

First, it is necessary generally to strengthen research which involves all subject fields throughout research institutions.

Secondly, it is necessary to establish policies for the selection of organized research activities which require co-ordinated and systematic efforts from the viewpoint of well-balanced progress in related fields and also from the viewpoint of promoting researches in boundary regions, large-scale projects and international co-operative projects as well as setting up ways and means for promoting and conducting such researches. The Council selected 13 areas based on scientific requirements, 102 subjects based on social and economic requirements, and 6 international co-operative projects. These should be conducted through close co-operation among research workers concerned.

Thirdly, in order to promote the above researches more smoothly and efficiently, it is necessary to plan for the increase and the more flexible use of the research budget, to guarantee the free movement of research workers and to provide supporting facilities such as large-scale electronic computers.

It is also necessary to promote the establishment of research campuses, to secure improvement of research environments including Government research institutes in particular.

Moreover, it is necessary to set up a realistic target for research and development investment, and to make efforts to reach it. In an earlier report, it was clearly stated that gross national R & D investment should be about 2 per cent of national income in the very near future, but in 1964, about 5 years later, the R & D investment barely reached 1.75 per cent.

Bearing in mind the continuing tendency in Europe and the United States for the ratio of R & D investment to national income to increase, and bearing also in mind the introduction of new projects in the future, it will be safer to say that R & D investment in the very near future should be increased to 2.5 per cent of national income through combined governmental and civil efforts. While governmental R & D investment had steadily increased in recent years, the Government's share remains around 30 per cent, fairly low as compared with that in Europe and the United States, where it frequently exceeds 60 per cent, though it must be remenbered that defence-related expenditure is quite significant in these countries. When the increasing tendency of the Government's share in R & D is considered in relation to basic scientific research activities, those directly connected with the promotion of the nation's welfare, and super-large-scale R & D projects beyond the capacity of private enterprises, it is necessary to do everything possible, in the future, to increase governmental R & D appropriations as far as the country's finances can bear. It is estimated that the Government's share of R & D investment after 5 years will be 360 billion yen ($1 billion).

It is also necessary to arrange for tax exemption or alleviation in some form on R & D investment.

Policy for Training Scientists and Improving Pay Level of Research Workers

The earlier report pointed out that it was urgently necessary to adopt measures for increasing scientific manpower, particularly in expectation of growing demand. Accordingly, the enrolment of science and engineering students in institutions of higher education was substantially increased, resulting in a gradual mitigation of the shortage of scientific manpower as a whole. But further efforts to increase the ratio of science to non-science students are required.

As the training of creative scientists and engineers is the most important matter at present, when science and technology are highly sophisticated, improvement of the quality of scientists and engineers should be particularly stressed, and more efforts should be made for strengthening faculties, research budgets and research facilities of graduate schools and university departments.

Two earlier reports indicate the necessity for improving the pay level of university faculty members and government scientists. This improvement has been partly realized, but further steps are needed to make the pay level of university faculty members and government scientists higher than general government employees and to attain a proper pay structure, and to encourage a smooth exchange between the two categories of scientists.

Policy for Strengthening Scientific and Technical Information Activities

It has been estimated that the world's yearly production of scientific and technical papers was about 1 million in 1955, but this rose to about 2.5 million in 1965 and will probably continue to rise. For efficient operation it is necessary to organize a smooth flow of information, with a transfer structure including a co-ordinating information centre, specialized information centres, data centres, libraries and a clearing house mechanism to serve as an inquiry office for scientific information ; each of these institutions should be fully equipped. Moreover, it may be necessary to consider the mechanization of information handling for large volumes of information.

Policy for Strengthening International Co-operation in Science and Technology.

International co-operative research and scientific and technological assistance to developing countries should be considered as priority. Expansion of research fields and acceleration of research activities involve a growing necessity for international co-operation ; the Government is requested to consider active participation, according to priority, in projects proposed by international organizations in consideration of the mutual benefit to Japan and other countries concerned, and to encourage the holding of international conferences, symposia, and the like in Japan and attendance at them abroad.

Because of the high level of science and technology attained in Japan, many developing countries look to her for assistance in those fields. Hence consideration should be given to a structure which can provide a consultation service, conduct thorough investigations for requesting countries, strengthen research and development activities on behalf of those countries, train personnel qualified for co-operative works overseas, etc.

PROMOTION PLANS IN INDIVIDUAL MAIN FIELDS OF SCIENCE AND TECHNOLOGY

There are a number of councils which deliberate on promotion policies in their respective fields. The most important of these councils and their recommendations, are as follows:

Space Activities Council

" Fundamental Policy for Space Exploitation " (Recommended, May 1962)

" Targets of Important Exploitation in Space and Practical Measures to Attain them " (Recommended, February 1964).

Council for Ocean Science and Technology

" Important Researches and Surveys to Perform Immediately to Further Ocean Science and Technology " (Recommended, October 1961).

" Fundamental Policy for Furtherance of Ocean Science and Technology " (Recommended, June 1963 and September 1964).

National Aeronautical Council

" Targets of Research, Principles and Necessary Measures related to Super Altitude Flying " (Recommended, April 1958).

" Important Research Subjects and Research Facilities to be Improved Regarding Aeronautical Engineering under the Present Situation " (Recommended June 1958).

" Research Principles, Important Research Subjects and Research Facilities to Improve, Regarding Aeronautical Safety Measures " (Recommended, November 1958).

" Targets of Important Researches and Steering Measures to Attain them, Regarding Aeronautical Engineering " (Recommended, December 1961).

" Technical Problems and their Counter-Measures in the Effective Development of the Aeroplane for the Promotion of Aeronautical Engineering " (Discussed, January 1964, and the recommendation in preparation, 1967).

Electronics Council

" Long Term Programme for the Promotion of Electronics Engineering " (Recommended, September 1960).

" Important Researches and Steering Measures for Electronics Engineering " (Recommended, August 1959).

" Cooperative Measures for the Promotion of Electronics Engineering in Asiatic Regions " (Recommended, March 1963).

" Proposal on Promotion of Electronics Research in Japan " (Proposed, June 1964).

Atomic Energy Commission

" Long-Term Fundamental Programme for the Development and Utilization of Atomic Energy " (Decided, September 1956).

" Long-Term Programme for the Development of Atomic Reactors for Power Generation " (Decided, December 1957).

" Training of Personnel Regarding Atomic Energy " (Decided, November 1962).

" Fundamental Programme for the Development of Atomic Vessel No. 1 " (Decided, July 1963).

Resources Council

" Recommendation on Required Nutrition for Japanese " (Recommended, February 1959).

" Overall Survey of Ocean Resources " (Recommended, June 1960).

" Recommendation on Technical Development of Coal Utilization " (Recommended, July 1963).

" Recommendation on the Development of Super Critical Pressure Thermal Power Generation " (Recommended, January 1964).

Part VI

ECONOMIC AND SOCIAL BACKGROUND OF JAPAN

GOVERNMENT STRUCTURE

At the time of the administrative reform, about 100 years ago, Japan abolished its feudal system and started as a modern nation. The country was modelled on the patterns of politics, economy, society, culture and education of the advanced countries in Europe and America, and devoted its efforts towards modernization in every phase. By the middle 1930's, the level of the national economy and the national life had been raised and a degree of modernization had been achieved.

At the termination of World War II Japan was a defeated and devastated country.

After the War, the national effort was devoted to economic recovery and social democratization. A new Constitution was enacted in 1947, and Japan made a new start as a democratic constitutional monarchy.

The govemment organization is grouped into the legislative, the administrative and the judiciary – three separate organs (See Chart VI-1). For legislation, a bicameral system has been adopted consisting of the House of Representatives and the House of Councillors. In the administration, under the Diet Cabinet there are 13 Ministries and one Office. Besides the Board of Audit, which is apart from the Cabinet, the Cabinet Secretariat, the Legislative Bureau and the National Personnel Authority (which has considerable independence), are established under the direct control of the Cabinet. The judiciary consists of the Supreme Court and lower courts. In addition, there is a local govemment system, which comprises 1 To (Metropolitan authority of Tokyo), 1 Do (Hokkaido local authority), and 44 Prefectures.

LAND, POPULATION, AND NATURAL RESOURCES

Japan is made up of 4 large and many small islands on the north-west edge of the Pacific, between longitude 128° and 146° E and between latitude 26° and 46° N. The total area is 370,000 sq. km, of which Honshu, the centre of the Japan Islands occupies about 230,000 sq. km, Hokkaido 80,000 sq. km, Kyushu 40,000 sq. km, and Shikoku 20,000 sq. km. The distance from north to south is 2,000 km and the maximum width is 300 km. Climatically, Japan is situated in the temperate zone, under the influence of the monsoon. It has a high relative humidity, and the mean annual rainfall is 1600 mm. The climate is generally mild. These are numerous volcanoes, and the topography is generally hilly, with few plains. The proportion of cultivated land, pastures and meadows to the total land area is only 20 per cent, and forests occupy 68 per cent. The population in 1963 was nearly 96 million and, with 257 inhabitants per sq. km, the density is the third highest in the world.

The trend of population after World War II is shown in Table VI-3, Life expectancy during the Meiji and Taisho Periods was 40 years, but by 1962 it had reached 62 years for men and 71 years for women. Chart VI-7 shows the population increase of 10-15 per cent expected over the next 40 years; thereafter it is expected to remain static or decline slightly.

The natural resources of Japan are not abundant. Heavy rainfall and the hilly topography favour the use of hydro-electric power (See Table VI-4). The major ore reserves are indicated in Table VI-5. The industrial materials and fuel resources in Japan, apart from limestone, sulphide and zinc ores, are generally poor and of inferior quality and high price. For this reason the importation of materials and fuels from abroad is a main feature of the economy. For instance, nearly nine-thenths of the iron ore, one quarter of the scrap iron, one-third of the copper, all domestic needs of industrial salt, bauxite, and phosphate ore, one-third of the coal, and almost all requirements for oil have to be imported.

Although the forest covers so much of the total land area, and the resources are considerable, about

one-third of timber consumption is dependent upon imports. The growing stock of conifers and non-conifers is shown in Table VI-6.

Table VI-7 shows the reserves of the major energy resources and domestic production in 1963. Coal production accounts for nearly 60 per cent and hydroelectric power for 30 per cent of local production. The imports of coal and petroleum are expected to increase to 72.5 per cent of the requirements by 1980. The expected trend of the supply of primary energy by domestic production and imports is shown in Table VI-8.

The main exports are cotton and rayon textiles, ships, metals, canned fish, chemicals and a wide variety of manufactured goods including chinaware, toys, bicycles, and cameras.

THE NATIONAL ECONOMY

The 20-year period following World War II has seen the Japanese economy develop spectacularly.

The increase in the Gross National Product averaged 10 per cent per year from 1955 to 1965; this is unprecedented even by comparison with any other country of the world (See Table VI-1).

As a result of this high rate of economic growth, wages and profits increased, wage differences were reduced, the volume of capital increased, exports increased and the ceiling of the international balance of payments was raised.

Chart VI-2 shows the trend of incomes for labour and private enterprise income from 1955 to 1964. The labour income tripled and the enterprise income increased nearly 2.5 times. Taking into consideration the rise in commodity prices, real incomes rose about 2.5 times. In terms of per capita income Japan is close to Italy (See Chart VI-3). It was a feature of Japan in the past that wages varied with the size of the enterprise. However, as indicated in Table VI-2, there is a tendency for this divergence to disappear.

The rate of savings has been high in relation to the increase of income, and as a result, capital has increased rapidly. From the quinquennial surveys, it is estimated that the wealth of the nation in 1953 was 12 trillion 800 billion yen[1], and by 1963 it was 35 trillion 300 billion yen (See Chart VI-4). The amount of capital per employee has increased rapidly, as also shown in Chart VI-4, and is the main cause of rising labour productivity.

In exports Japan ranked eighth in the world in 1955, but as a result of the exports growth rate of 15.4 per cent per year, she had risen to the sixth place by 1963 (See Chart VI-5).

Despite this progress in exports and economic growth there is internal instability. In private enterprise, profits are declining and capital formation is difficult; and for the individual, the cost of living is increasing rapidly. The important problem for the national economy is to make growth and stability compatible with each other (See Tables VI-9 and 10).

PUBLIC FINANCE

The most important function of public finance in the postwar years in Japan was to provide funds for the fields of activity important for economic growth. Just after the War, the need was to reconstruct the war-damaged industries. For this purpose, a number of financial organizations linked to the central government were established, through which funds were allocated on a priority basis to such key industries as coal production, iron and steel manufacturing and power generation.

Next followed a period when priority was allocated to the expansion of social services, which were backward by comparison with the dynamic growth of private enterprise. The demand for capital for social services started with the national railway service and then extended to the roads and harbours. More recently, facilities have been demanded for housing, water supply and drainage (See Table VI-11).

The sources of finance in the postwar years, comprising ordinary revenue from taxes, income from social insurance dues, and surpluses from government enterprises, etc., are shown in Table VI-12.

INDUSTRY AND INTERNATIONAL TRADE

Rapid economic growth has followed the promotion of secondary industries based on demand and investment facilities.

The change in the industrial structure is shown by the fact that the proportion represented by the primary sector fell from 23.1 per cent in 1955 to 13.5 per cent in 1963, while that represented by the secondary sector (i.e. manufacturing) rose from 29.9 per cent to 39.0 per cent and that represented by the tertiary sector (i.e mainly services) from 47.4 to 49.0 (See also Tables VI-13 and VI-14).

EMPLOYMENT, WAGES AND PRICES

A rapid increase in the demand for labour has altered the employment situation considerably. The changed relationship between demand and supply occurred first for juvenile labour and then extended to all age groups. Until 1960, there were more high school

1. U.S. usage: a trillion = a million millions; a billion = a thousand millions.

graduates than jobs, but by 1964 there were approximately 4 jobs per graduate. This affected wages, which, particularly for young workers in the manufacturing industries, rose by over 10 per cent in 1960, and between 22 and 23 per cent in 1961 and 1962. The average annual percentage wage rise, which was only 5 to 6 per cent before 1961, has been 10 per cent since then. Increases of labour productivity and wages in the manufacturing industries are shown in Table VI-18.

The rapid inflation in the postwar years continued up to 1951, since when the situation has been gradually stabilized, with only slight fluctuations. The most noticeable phenomenon, recently, is the continuous rise in consumer prices despite relative stability in the wholesale prices. This is largely ascribed to wage increases in the services and non-productive sectors of industry (See Tables VI-15, 16, 17, 18 and Chart VI-6).

Table VI-1. Annual Economic Growth Rates of some Major Countries
(average increase from 1956 to 1962, as percentage)

	Japan (1)	Japan (2)	France	West Germany	Italy	England	U.S.A.
GNP	9.6	10.5	4.8	6.8	6.5	2.3	2.9
Gross investment	16.2	21.3	6.8	8.5	9.5	5.0	1.5
Personal consumption	6.6	7.0	7.0	7.2	5.5	2.7	3.1
Enterprise profit	15.4	17.0	4.4	7.8	-	0.7	0.4

(1) Averages for the period 1953-63 (real)

(2) Accumulation (reserves) + Corporation tax (nominal)

Table VI-2. Trend of Wage Differences between Small and Large Enterprises
(The figures in the table indicate, for various age groups, the ratio of average wages for males in small enterprises (30-99 workers) those in large enterprises (over 1000 workers), taking the latter as 100).

Age group	1954	1958	1961	1964	(1966)
Total, all age groups	63	62	71	82	
18	83	91	111	114	105
18- 19	84	87	96	108	102
20 - 24	82	93	98	108	105
25 - 29	76	80	91	104	102
30 - 34	73	74	76	88	92
35 - 39	68	70	72	77	78
40 - 49	62	62	63	71	72
50 - 59	57	55	57	62	
60 and over	91	87	92	101	

Source: Ministry of Labour : "Basic Survey of Wage Structure"

Table VI-3. Trend of Population Statistics

	Population	Births		Deaths		Natural increase	
		Absolute No.	Rate per 1,000	Absolute No.	Rate per 1,000	Absolute No.	Rate per 1,000
1947	78 101 473	2 678 792	34.3	1 138 238	14.6	1 540 554	19.7
1948	80 002 500	2 681 624	33.5	950 610	11.9	1 731 014	21.6
1949	81 772 600	2 696 638	33.0	945 444	11.6	1 751 194	21.4
1950	83 199 637	2 337 507	28.1	904 876	10.9	1 432 631	17.2
1951	84 573 000	2 137 689	25.3	838 998	9.9	1 298 691	15.4
1952	85 852 000	2 005 162	23.4	765 068	8.9	1 240 094	14.4
1953	87 033 000	1 868 040	21.5	772 547	8.9	1 095 493	12.6
1954	88 293 000	1 769 580	20.0	721 491	8.2	1 048 089	11.9
1955	89 275 529	1 730 692	19.4	693 523	7.8	1 037 169	11.6
1956	90 259 000	1 665 278	18.4	724 460	8.0	940 818	10.4
1957	91 088 000	1 566 713	17.2	752 445	8.3	814 268	8.9
1958	92 010 000	1 653 469	18.0	684 189	7.4	969 280	10.5
1959	92 971 000	1 626 088	17.5	689 959	7.4	936 129	10.1
1960	93 418 501	1 606 401	17.2	706 599	7.6	899 442	9.6
1961	94 285 000	1 589 372	16.9	695 644	7.4	893 728	9.5
1962	95 178 000	1 618 616	17.0	710 265	7.5	908 351	9.5
1963	96 156 000	- - -	17.3	- - -	7.0	- - -	10.3
1964	97 186 000	- - -	17.7	- - -	6.9	- - -	10.7
1965	98 276 000	- - -	18.5	- - -	7.1	- - -	11.4
1966	99 056 000	- - -	- - -	- - -	- -	- - -	- - -

Source: Dynamic statistics of population by the statistics & research section. Ministry of Health & Welfare.

Table VI-4. Water Power in Japan (Output figures in thousands of KW)

	Total			Developed			Undeveloped		
	No. of stations	Maximum output	General output	No. of stations	Maximum output	General output	No. of stations	Maximum output	General output
1910-1913 Survey	2 233	3 420	3 120	327	480	320	1 906	2 940	2 800
1918-1922 Survey	2 822	7 430	3 930	650	1 030	690	2 172	6 400	3 240
1937-1941 Survey	3 178	16 419	5 772	1 327	5 397	2 413	1 851	11 022	3 359
1951-1955 Survey	2 793	22 534	11 158	1 185	8 755	3 471	1 608	13 779	7 741
1956-1959 Survey	2 372	35 370	8 003	1 541	10 816	4 028	758	21 254	3 427
							(73)	(3 301)	(548)

Data: Public utilities bureau, Min. of International Trade & Industry.

Table VI-5. Main Mineral Reserves (as at 1 April 1963)

	Reserves			Actual Output	Refuse	Rough ores			No. of mines	Rough ore products (Actual: 1963)		
	Quantity	Quality	Content			Quantity	Quality	Content		Quantity	Quality	Content
	(1 000 t)	(%)	(1 000 t)	(%)	(%)	(1 000 t)	(%)	(1 000 t)		(1 000 t)	(%)	(1 000 t)
Gold	22 814	6.3 g/t	143 357 kg	77.0	20.1	21 990	5.2 g/t	114 489 kg	36	919	6.3 g/t	6 208 kg
Silver	134	596.0 g/t	79 753 kg	87.7	31.3	171	409.0 g/t	69 942 kg	3	943	74.0 g/t	69 912 kg
Copper	100 811	1.65	1 666	84.8	27.6	118 001	1.24	1 465	121	8 665	1.3	108
Lead	71 218	1.5	1 068	76.3	16.9	71 218	1.3	861	30	3 416	1.6	56
Zinc		5.9	4 216				5.0	3 277			5.3	180
Iron Sulphide	127 197	32.4	41 130	51.5	2.5	67 186	33.5	22 490	25	1 426	37.8	539
Mercury	976	0.21	2	78.2	10.5	854	0.22	2	8	71	0.3	0.2
Tin	2 056	0.88	18	79.3	24.9	2 171	0.68	15	3	9	2.4	0.2
Iron	44 644	39.6	17 693	82.5	10.4	41 107	36.0	14 793	37	3 411	26.8	916
Sand iron	306 757	12.4	38 073	65.9	16.1	240 973	10.9	26 376	81	9 681	12.7	1 230
Manganese	5 230	24.0	1 272	86.0	14.0	5 223	21.0	1 093	111	493	21.7	107
Manganese dioxide	126	66.0	84	82.0	10.0	114	60.0	69	47	9	65.2	6

Data: Statistics & research section, secretariat, Min. of International Trade & Industry.

Table VI-6. Forest Resources (Millions of cubic metres)

	Total Forest				Natural Forest Only			
	Area (1000 ha)	Accumulation			Area (1000 ha)	Accumulation		
		Total	Conifers	Deciduous		Total	Conifers	Deciduous
Total all owners	25,053	1,903	957	946	16,282	1,368	441	927
National forest	8,043	943	414	529	5 674	808	292	516
Public	2,846	184	84	99	1,904	121	25	96
Private	14,164	776	459	317	8,704	439	124	314

Data: Forest Agency, Min. of Agriculture.

Table VI-7. Domestic Energy Resources of Japan, 1963

	Reserves	1963 Production			
		Actual production	Energy equivalence factor	Coal equivalent (1000 t)	Percentage of total production
Total				78,291	100.0
Coal	20,246 (million t)	52,051 (thousand t)	0.89 t/t	46,325	59.2
Lignite	547 (million t)	914 (thousand t)	0.5 t/t	457	0.6
Petroleum	10 (million kl)	898 (thousand kl)	1.43 t/kl	1,284	1.6
Natural gas	3,650 (100 million m^2)	1,694 (million m^3)	1.14 t/ $10^3 m^3$	1,931	2.4
Water power	3,537 (10 thousand kW)	66,374 (million kWh)	0.35 t/ 10^3kWh	23,231	29.7
Woods for fuel	331 (million m^3)	14,063 (thousand m^3)	0.36 t/ m^3	5,063	6.5

Data: Resources Bureau, Science & Technology Agency.

Table VI-8. Expected Trend of Primary Energy Supplies (7 000 kcal/kg coal equivalent; 1 000t)

Energy source	Unit	1959		1970		1980		Proportion (%)		
		Actual	Equivalent	Actual	Equivalent	Actual	Equivalent	1959	1970	1980
Water power	1 000 kWh	616	36,950	919	55 140	1 059	63 540	27.6	19.5	14.0
Coal	1 000 t	56 751	50 636	84 640	81 278	102 440	100 858	37.8	28.7	22.2
Domestic	1 000 t	47 886	42 666	55 000	50 914	55 000	50 914	31.9	18.0	11.2
Imported	1 000 t	5 684	6 252	25 640	28 204	43 440	47 784	4.7	10.0	10.5
Lignite	1 000 t	1 445	723	400	200	400	200	0.5	0.1	-
Petroleum	1 000 kl	27 522	39 356	98 335	140 618	198 977	284 537	29.5	49.6	62.6
Crude, domestic	1 000 kl	482	689	1 500	2 145	2 000	2 860	0.5	0.8	0.6
Crude, imported	1 000 kl	24 997	35 746	89 976	128 665	183 630	262 591	26.8	45.4	57.8
Refined, imported	1 000 kl	2 043	2 921	6 859	9 808	13 347	19 086	2.2	3.4	4.2
Natural gas	millions of of m^3	684	780	2 053	2 340	2 530	2 884	0.6	0.8	0.6
Firewood and charcoal		-	5 284	-	3 650	-	2 670	4.0	1.3	0.6
Firewood	1 000 Koku	62 570	3 754	43 500	2 160	32 000	1 920			
Charcoal	1 000 t	1 530	1 530	1 040	1 040	750	750			
Nuclear fuel	t	-	-	(226)	(2 260)	(1 481 -1 112)	(14 810 -11 120)	-	(0.8)	(3.3 -2.5)
Total coal equivalent	1 000 t		133 729		283 226		454 689	100.0	100.0	100.0
As percentage of 1959 figure			100.0		211.8		340.0			
Imported energy as percentage of domestic			33.6		58.8		72.5			

Data: National Income Doubling Plan.

Table VI-9. Distribution of National Income (100 millions of yen)

Year	Total	Remuneration of employees			Unincorporated enterprises			Individuals' property income			Transfer from incorporated enterprises to individuals	Corporation tax	Incorporated enterprises reserves	Income from gov't enterprises and properties	Deduction debt interests of gov't and consumers
		Total	Wages and salaries	Others	Total	Agriculture, fisheries and forestry	Others	Rent	Interest	Dividends					
1951	43 112	19 987	18 027	1 960	18 920	10 013	8 907	488	575	491	57	2 391	368	19	146
1952	52 224	24 321	21 592	2 728	21 294	10 706	10 588	829	855	535	73	2 354	2 059	340	437
1953	58 517	29 093	25 801	3 292	21 752	10 993	10 759	1 176	1 213	686	88	2 407	2 320	333	551
1954	64 877	32 013	28 126	3 887	23 651	12 248	11 403	1 497	1 576	578	106	2 455	2 903	697	598
1955	71 818	35 059	30 706	4 353	27 230	14 431	12 799	1 742	2 143	895	119	2 368	2 376	572	685
1956	79 889	40 172	35 065	5 107	27 389	13 670	13 719	1 960	2 520	1 039	180	3 063	3 492	821	745
1957	91 346	44 874	38 807	6 067	28 827	14 361	14 466	2 332	3 038	1 292	164	4 295	5 892	1 450	816
1958	94 235	49 366	42 383	6 983	28 334	14 280	14 053	2 776	3 721	1 352	150	3 779	3 912	1 729	883
1959	107 498	55 241	47 222	8 019	30 260	15 023	15 237	3 542	4 727	1 596	202	4 910	6 261	1 671	912
1960	130 091	64 830	54 804	10 026	34 678	16 336	18 343	4 113	5 774	2 185	251	6 768	10 143	2 310	961
1961	154 139	77 936	65 974	11 962	39 206	17 983	21 223	4 895	7 082	2 775	293	8 461	11 429	3 167	1 102
1962	172 150	91 555	77 114	14 442	42 595	19 255	23 340	5 642	8 190	3 544	299	9 404	9 407	2 695	1 181
1963	199 808	106 975	89 541	17 433	48 576	20 470	28 106	6 616	8 719	3 953	363	10 308	11 009	3 711	1 421
1964	225 801	124 075	103 753	20 322	53 950	21 974	31 976	7 692	11 620	4 426	395	11 695	11 198	2 389	1 640
1965	250 668	143 331	119 389	23 941	58 050	24 412	33 639	8 941	13 877	4 625	444	11 600	9 710	2 055	1 967

Data: Economic Research Institute, Economic Planning Agency.

Table VI-10. Gross National Product and Gross National Expenditure (100 millions of yen)

Year	Total	G. N. P.					G. N. E.					
		N. I.	Depreciation etc.	Indirect enterprise tax	Grants (deduction)	Statistical inconsistency	Personal consumption	Govt's current purchase of goods and service	Capital formation	Increase of stock	Export, income from abroad	Import, (deduction)
1951	54 368	43 112	4 126	5 029	327	2 428	32 817	5 437	11 012	3 841	8 118	6 857
1952	62 368	52 224	4 869	6 038	585	△ 223	40 097	6 796	13 077	2 412	7 539	7 554
1953	73 437	58 517	6 411	6 973	767	2 303	47 594	8 171	16 823	2 070	3 091	9 312
1954	78 347	64 877	7 605	7 340	314	△ 1 162	51 678	8 567	16 348	1 455	8 741	8 442
1955	87 850	71 818	8 813	7 488	119	△ 150	55 530	9 026	17 937	4 460	10 335	9 439
1956	98 924	79 889	10 653	8 554	97	△ 76	60 061	9 454	24 560	6 090	12 349	13 599
1957	112 065	91 346	11 385	9 755	128	△ 294	65 691	10 410	30 974	5 900	13 485	14 396
1958	115 182	94 235	12 270	10 323	71	△ 1 576	70 238	11 104	30 314	1 860	13 265	11 599
1959	133 772	107 498	14 353	11 643	114	391	77 598	12 098	37 985	5 155	15 927	14 991
1960	160 469	130 091	17 387	14 099	355	△ 753	87 740	13 975	51 245	7 395	18 012	17 899
1961	193 077	154 139	22 091	17 017	659	489	101 996	16 256	67 853	10 537	19 048	22 614
1962	211 897	172 150	25 084	17 784	756	△ 2 364	117 766	19 312	72 560	2 190	21 743	21 674
1963	247 262	199 808	29 697	20 178	949	△ 1 440	136 150	23 203	81 013	10 552	24 396	28 052
1964	284 071	225 801	37 016	23 234	1 330	△ 649	155 103	26 847	92 234	9 490	30 878	30 480
1965	313 448	250 668	41 095	24 291	1 583	△ 1 022	175 340	30 861	97 842	5 287	36 824	32 706

Data: Economic Research Institute, Economic Planning Agency.

Table VI-11. Trend of Public Finance

(100 millions of yen)

	1952	1956	1960	1964
Property service purchasing	11 555	16 283	26 831	54 706
Capital formation	4 739	6 917	13 402	29 604
Current purchasing	6 816	9 366	13 429	25 103
Transfer expenditure	1 796	3 506	5 625	9 799
Investment and financing	1 924	1 739	3 186	7 049

Table VI-12. Public Finance (100 millions of yen)

Year	Current expenditures					Gov't's total	Current receipts							
	Gov't's current purchasing of property and service	Current grants	Transfer to individuals	Transfer to abroad	Gov't's current surplus		Tax (individual)	Tax (corporation)	Indirect enterprise tax	Responsibility to social insurance	Transfer from individuals	Transfer from abroad	Income from gov't's property and enterprises	(Deduction) Gov't's debt interest
1951	5 437	327	1 121	2	5 013	11 901	2 855	2 391	5 029	954	401	362	△ 19	73
1952	6 796	585	1 721	2	4 317	13 421	3 204	2 354	6 083	1 232	545	7	340	345
1953	8 171	767	2 052	6	3 894	14 890	3 492	2 407	6 973	1 419	697	0	333	433
1954	8 567	314	3 339	18	3 733	15 971	3 486	2 455	7 340	1 724	716	14	697	462
1955	9 026	119	3 471	94	3 642	16 353	3 671	2 368	7 488	1 972	767	31	572	516
1956	9 454	97	3 526	146	5 889	19 112	4 019	3 063	8 554	2 258	895	57	821	555
1957	10 410	128	3 843	301	7 501	22 183	3 568	4 295	9 755	2 603	1 086	26	1 450	599
1958	11 104	71	4 345	912	6 537	22 969	3 671	3 779	10 323	2 864	1 174	37	1 729	607
1959	12 098	114	4 994	274	8 673	26 153	3 919	3 910	11 643	3 289	1 330	3	1 671	612
1960	13 975	355	5 664	367	13 044	33 404	5 195	6 768	14 099	4 071	1 595	2	2 310	635
1961	16 256	659	6 786	317	17 663	41 680	6 610	8 461	17 017	5 136	1 930	24	3 167	665
1962	19 312	756	7 936	318	17 641	45 964	8 305	9 404	17 784	6 142	2 322	2	2 695	690
1963	23 203	949	9 687	287	19 369	53 493	10 007	10 308	20 148	7 574	2 565	2	3 711	821
1964	26 847	1 330	11 549	324	20 380	60 430	11 922	11 695	23 234	8 907	3 202	9	2 389	928
1965	30 861	1 583	13 832	366	19 580	66 222	14 112	11 600	24 291	11 460	3 799	6	2 055	1 102

Data : Economic Research Institute, Economic Planning Agency.

Table VI-13. Production Index of Mining and Manufacturing Industries

(1960 = 100)

Year	All industries	Public utilities	Mining and manufacturing industries					
			Total	Mining	Total	Iron & steel	Non-ferrous metals	Machinery
1957	67.9	70.0	67.9	95.4	66.9	60.8	56.5	57.6
1958	67.0	74.2	66.7	92.5	65.7	57.2	57.7	56.5
1959	80.3	85.1	80.1	91.6	79.6	76.3	75.5	72.6
1960	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961	119.3	116.2	119.4	107.0	119.9	126.1	119.7	129.0
1962	129.1	123.9	129.3	109.4	130.1	125.5	117.1	145.0
1963	142.1	137.8	142.3	107.7	143.7	140.4	132.9	159.5

Data: Analysis Section, Dept. of Statistics and Research, Ministry of International Trade & Industry.

Table VI-14. Trend of International Trade

(a) Exports, as percentages of 1960 figures.

Year	All exports	Foods	Textile products	Chemical products	Non-metal mineral products	Metal products	Machinery	Miscel-laneous
1950	22.4	18.7	35.1	7.1	22.6	35.9	9.5	14.0
1951	26.7	23.9	36.2	14.5	37.7	39.0	12.1	18.7
1952	28.1	34.3	30.7	16.4	37.8	53.1	13.1	20.9
1953	29.7	43.0	35.4	28.1	36.2	32.6	21.3	22.8
1954	39.2	43.2	51.6	35.7	43.7	47.7	23.4	30.1
1955	51.6	50.3	61.4	44.2	57.1	72.5	33.6	41.7
1956	62.2	68.3	70.7	48.4	48.4	73.8	63.8	52.4
1957	68.5	69.4	82.3	58.7	75.0	46.8	74.1	57.8
1958	72.4	91.1	77.6	71.6	71.5	67.6	68.2	67.0
1959	87.1	100.0	90.0	96.1	85.6	74.7	85.8	87.4
1960	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961	107.5	94.2	95.2	116.1	100.2	106.0	129.7	107.6
1962	127.9	117.4	105.3	166.0	103.5	154.1	150.7	120.1
1963	143.5	98.4	100.9	213.4	116.6	200.6	192.0	127.2

Data: Custom Bureau, Min. of Finance.

(b) Imports, as percentages of 1960 figures

Year	All imports	Foods		Textile materials	Others materials		Mineral ore, mineral chips	Mineral fuels	Chemical products	Machinery	Miscel-laneous
		Total	Cereals		Total	Rubber					
1950	19.5	43.7	67.7	38.2	20.5	26.9	3.8	7.2	12.5	2.3	3.4
1951	31.9	66.4	87.9	47.7	31.8	29.8	11.7	15.5	13.8	22.1	18.2
1952	34.8	81.1	102.9	51.2	26.6	31.3	17.3	20.5	14.8	32.2	15.6
1953	47.4	88.8	110.6	65.8	43.4	38.6	24.7	31.2	33.6	55.2	20.7
1954	48.6	98.8	136.8	58.8	47.2	36.2	27.3	31.9	32.1	55.5	19.6
1955	49.7	97.9	130.6	59.3	58.0	43.9	27.4	34.1	38.1	42.4	16.3
1956	62.2	89.7	113.0	83.9	60.5	55.2	51.2	42.9	53.1	54.5	53.2
1957	76.5	83.9	96.2	81.7	67.8	66.2	70.6	61.8	60.5	84.0	124.4
1958	64.7	89.0	104.8	72.9	65.3	66.1	38.7	54.2	59.4	86.3	44.5
1959	81.2	89.0	98.4	90.4	86.0	90.4	75.9	67.8	81.9	92.4	64.2
1960	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961	130.6	122.7	111.2	121.8	119.3	105.5	139.6	131.6	127.0	147.9	152.1
1962	129.0	137.8	123.4	96.0	128.0	110.3	109.2	149.7	122.3	186.5	120.9
1963	152.4	172.6	157.2	111.8	157.3	109.9	128.5	178.2	147.8	182.2	156.0

Data: Customs Bureau, Min. of Finance.

Table VI-15. Wholesale Price Index (1960 = 100)

Year	Average of all	Foods	Textile	Iron & Steel	Non-ferrous metals	Metal products	Machinery & equipments	Petroleum & coal products	Lamber & its products	Ceramic	Chemicals	Paper & pulp	Miscel-laneous	Special classification	
														Manu-factured	Non-manu-factured
1955	97.4	97.7	113.6	91.6	101.8	83.1	93.5	96.0	80.6	96.5	105.8	103.6	94.8	99.0	93.6
1956	101.7	95.4	114.8	119.3	126.0	101.3	98.7	101.9	84.1	93.1	110.4	102.8	94.0	104.5	96.2
1957	104.8	98.2	107.1	126.4	106.3	111.8	105.4	110.7	97.2	100.6	110.3	107.4	97.8	106.0	102.2
1958	97.9	97.5	97.9	99.3	91.0	95.7	101.6	104.2	94.3	98.9	102.6	98.0	92.2	98.0	97.5
1959	98.9	98.0	100.0	102.0	98.8	101.4	100.4	101.5	95.5	97.7	100.0	101.0	94.0	99.5	97.8
1960	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961	101.0	100.8	100.8	99.0	95.8	102.2	98.5	95.7	120.8	101.7	97.6	101.9	104.3	100.0	104.8
1962	99.3	101.0	98.3	91.2	92.3	99.0	97.1	92.5	121.7	107.7	94.2	100.9	106.3	98.0	104.5
1963	101.1	107.4	107.5	90.5	89.9	97.1	95.8	92.1	124.4	107.2	92.8	102.9	105.7	99.1	109.0
1964	101.3	106.8	104.4	91.3	99.5	99.8	94.9	91.3	125.8	107.1	94.1	107.3	105.7	99.1	110.0
1965	102.1	110.6	101.5	89.9	109.5	101.8	94.8	92.6	126.1	106.5	94.6	104.6	107.5	99.1	113.6

Data: Statistics Bureau, Japan National Bank.

Table VI-16. Consumer Price Index

Cities (in all) (1960 = 100)

Year	All	Foods			Housing	Light & heat	Clothes	Miscellaneous goods
		All	Cereals	Others				
1956	93.0	93.5	93.9	93.3	84.7	90.6	102.4	91.1
1957	95.9	96.9	98.0	96.3	89.5	98.6	102.8	92.5
1958	95.5	95.8	100.7	93.0	91.2	96.1	99.9	94.3
1959	96.5	96.3	100.0	94.3	94.7	94.9	97.9	97.3
1961	105.3	106.1	101.3	108.3	106.2	104.0	103.5	104.8
1962	112.5	114.7	103.4	119.5	111.3	106.1	109.5	112.1
1963	121.0	125.5	114.1	130.5	116.1	107.1	115.3	120.6
1964	125.6	128.8	117.4	133.8	122.2	107.6	119.2	128.0
1965	135.2	141.8	132.8	145.7	128.9	108.5	123.9	137.1

Data: Statistics Bureau, Prime Minister's Office.

Table VI-17. Ratio of Job Hunters to Vacancies

Year	Junior high school graduates	Senior high school graduates	Others
1955	0.91	1.38	4.58
1956	1.02	1.27	3.03
1957	0.85	0.94	2.54
1958	0.82	0.94	3.13
1959	0.83	0.90	2.28
1960	0.51	0.69	1.71
1961	0.31	0.49	1.35
1962	0.34	0.31	1.48
1963	0.38	0.31	1.43
1964	0.28	0.25	1.25

Data: Min. of Labour

Table VI-18. Trend of Labour Productivity and Wages Indexes in the Manufacturing Industries

Year	Wages		Productivity	
	% of 1960 figure	Annual increase	% of 1960 figure	Annual increase
1955	74.5	-	64.5	-
1956	81.4	9.3	73.4	13.8
1957	84.2	3.4	78.9	7.5
1958	86.2	2.4	78.6	-0.4
1959	92.6	7.4	88.5	12.6
1960	100.0	8.0	100.0	13.0
1961	111.6	11.6	110.2	10.2
1962	122.1	9.4	113.3	2.8
1963	134.7	10.3	124.0	9.4
1964	149.3	10.8	141.7	14.3
Average annual increase				
1958/1955		5.0		6.8
1961/1958		9.0		11.9
1964/1961		10.2		8.8

Data: Min. of Labour & Japan Productivity Agency.

Chart VI-1. Constitutional System

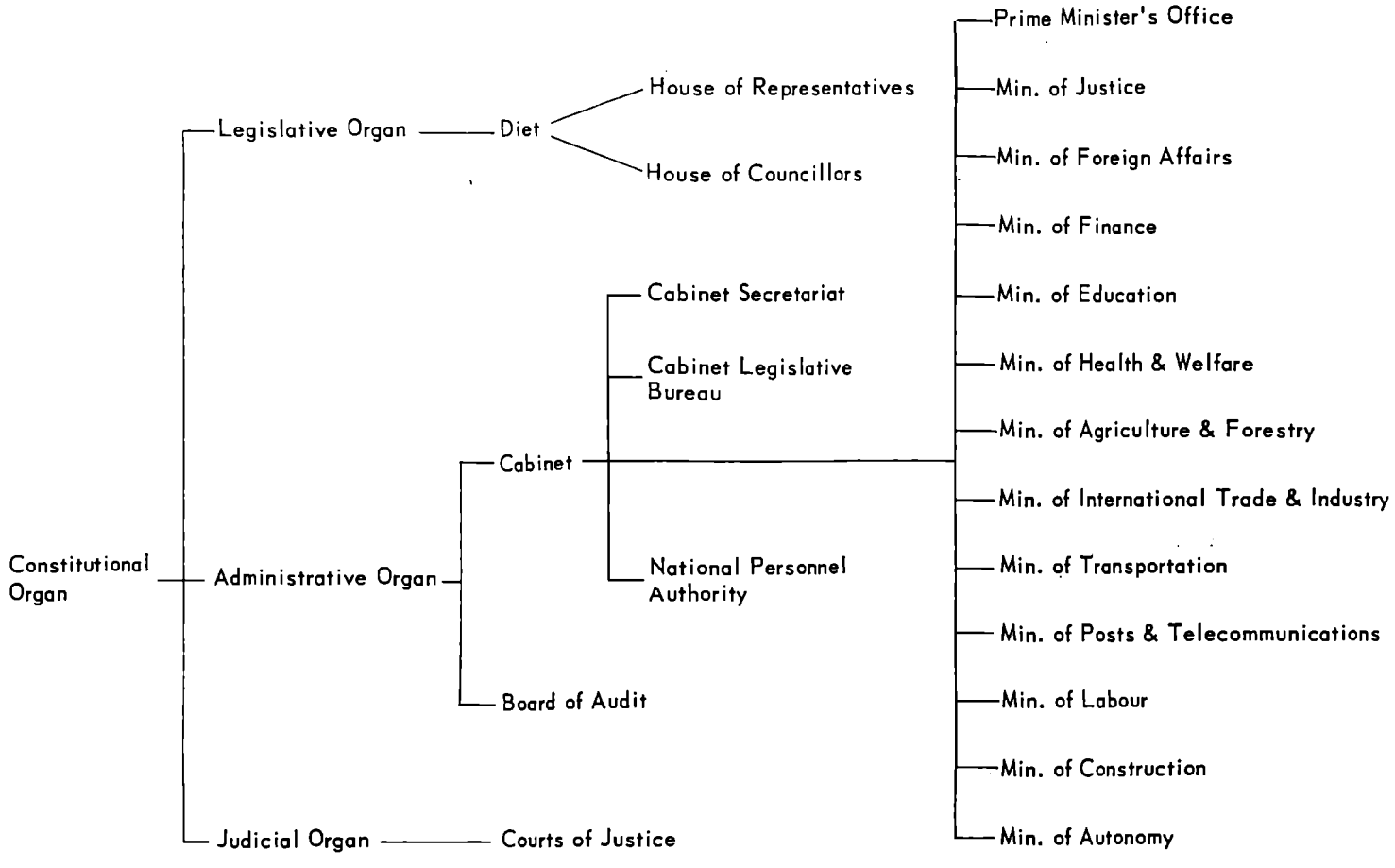
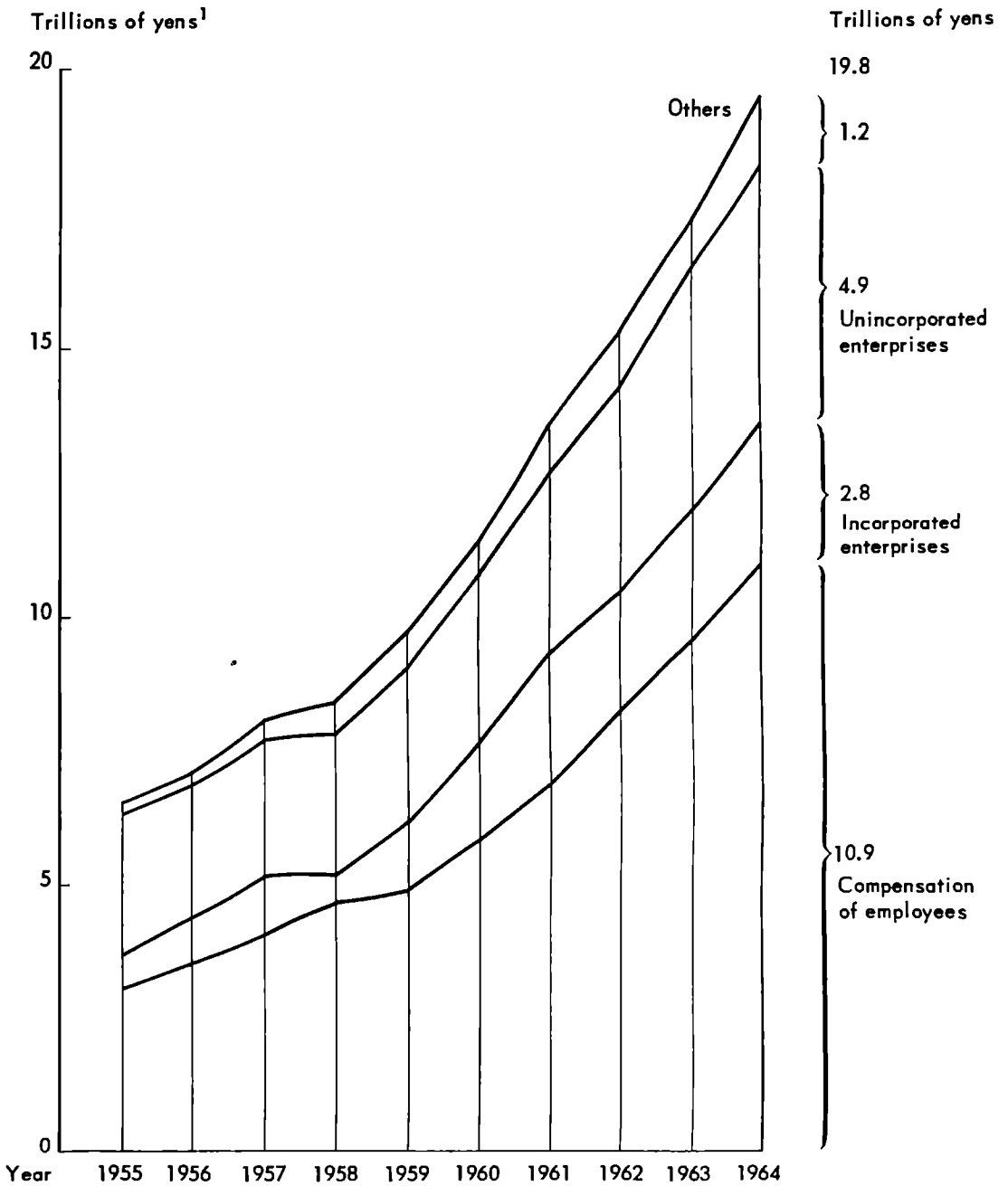


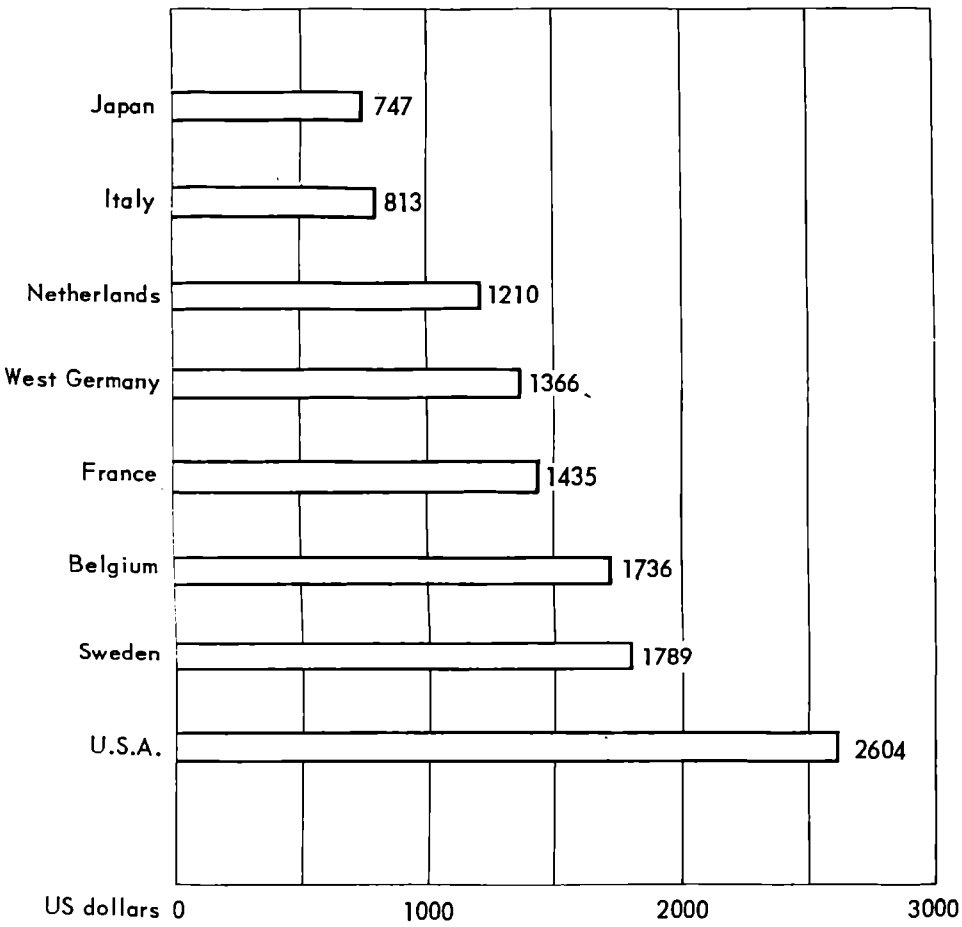
Chart VI-2. Trend in the Distribution of the National Income



Source: White Paper on National Economy

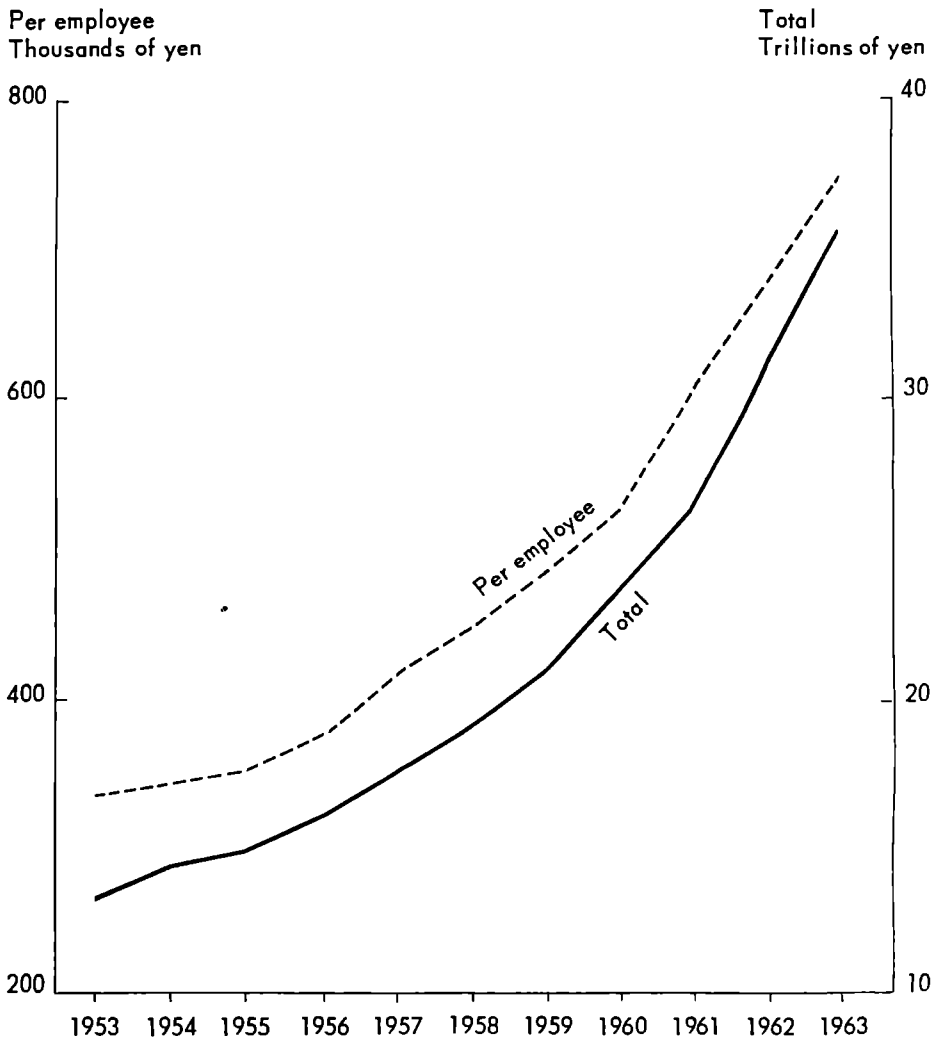
1. 1 trillion = 1 million million (U.S. usage)

Chart VI-3. National Income Per Capita (U.S. dollar figure adjusted for Equivalent Purchasing Power), 1963



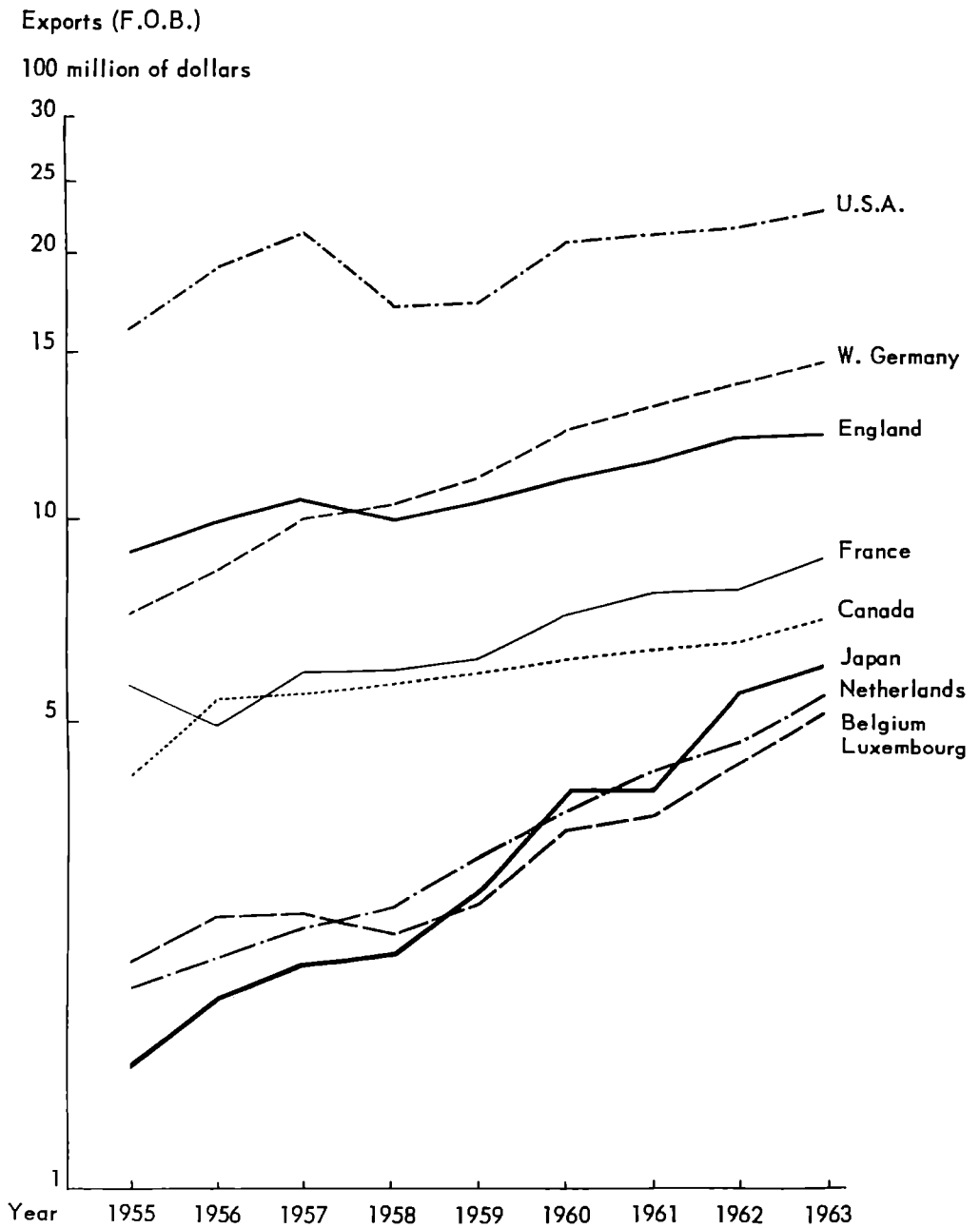
Source : White Paper on National Economy

Chart VI-4. Trend of National Wealth (exclusive of fixed assets)



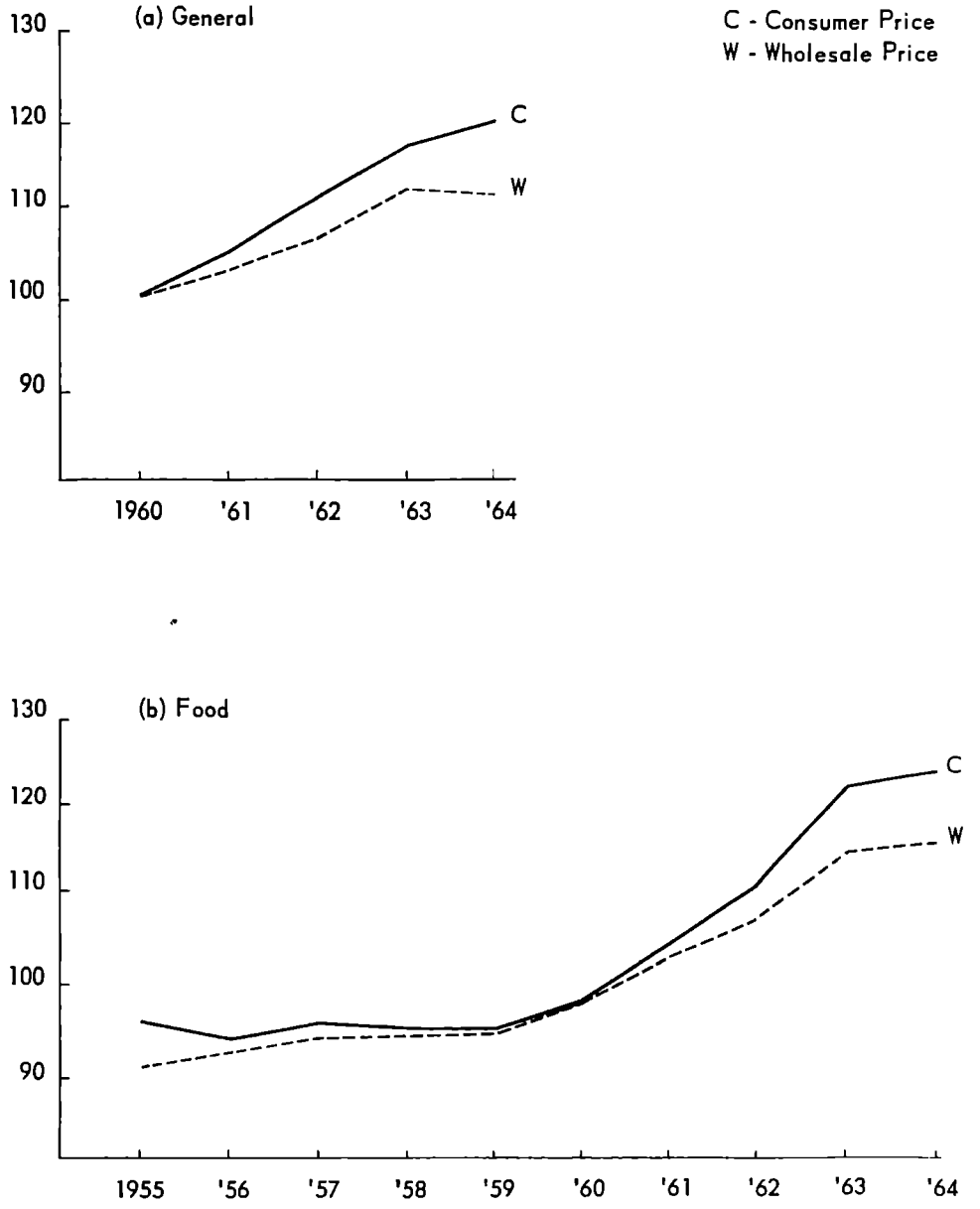
1. Balance of fixed assets in each year is based on the results of National Wealth Survey (1960) ± net investment (1960 value).
2. Total number of employees from Manpower Survey by Statistics Bureau.

Chart VI-5. Trend in Exports



Source : U.N. Statistical Yearbook

Chart VI-6. Trend in Wholesale Prices and Consumer Prices



Data: Statistics Bureau of Prime Minister's Office, Japan National Bank and Tokyo Wholesale Market.

Chart VI-7. Expected Trend of Population

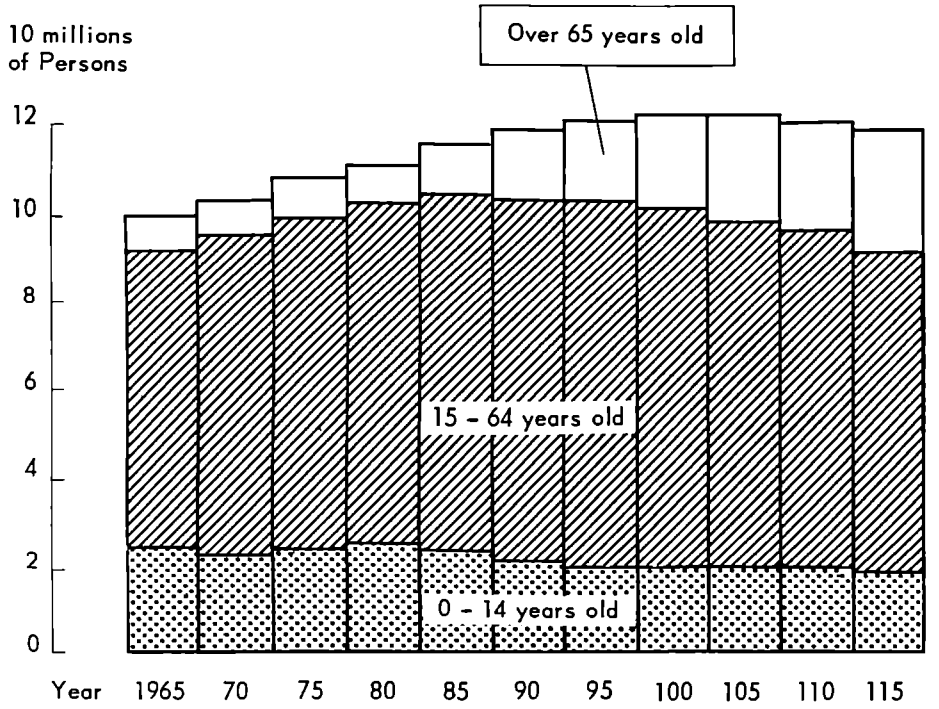
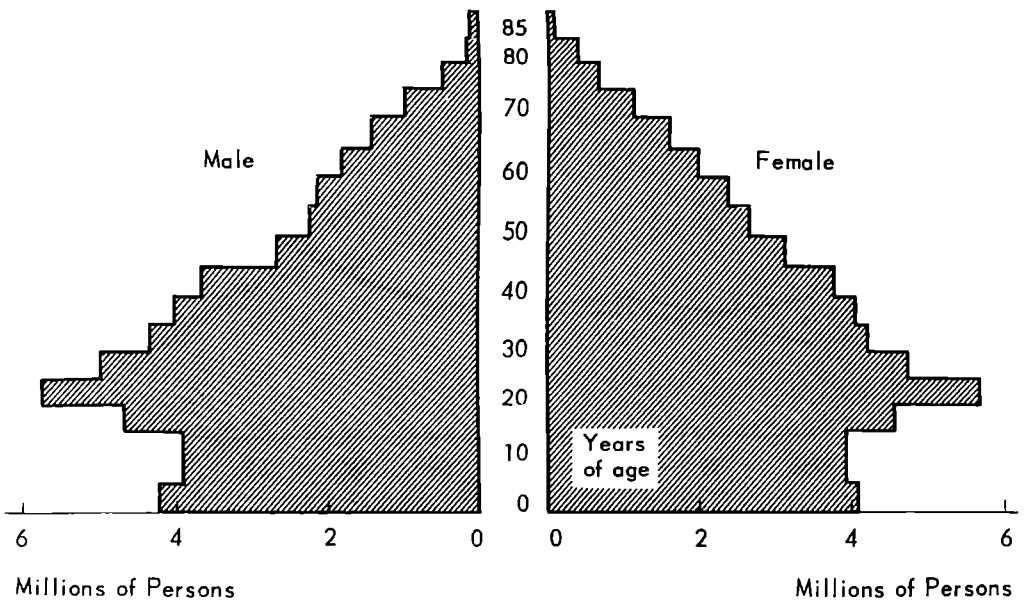
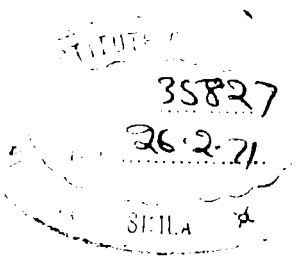


Chart VI-7a. Age Distribution of Population, 1965



(Estimated by the Population Research Institute)



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