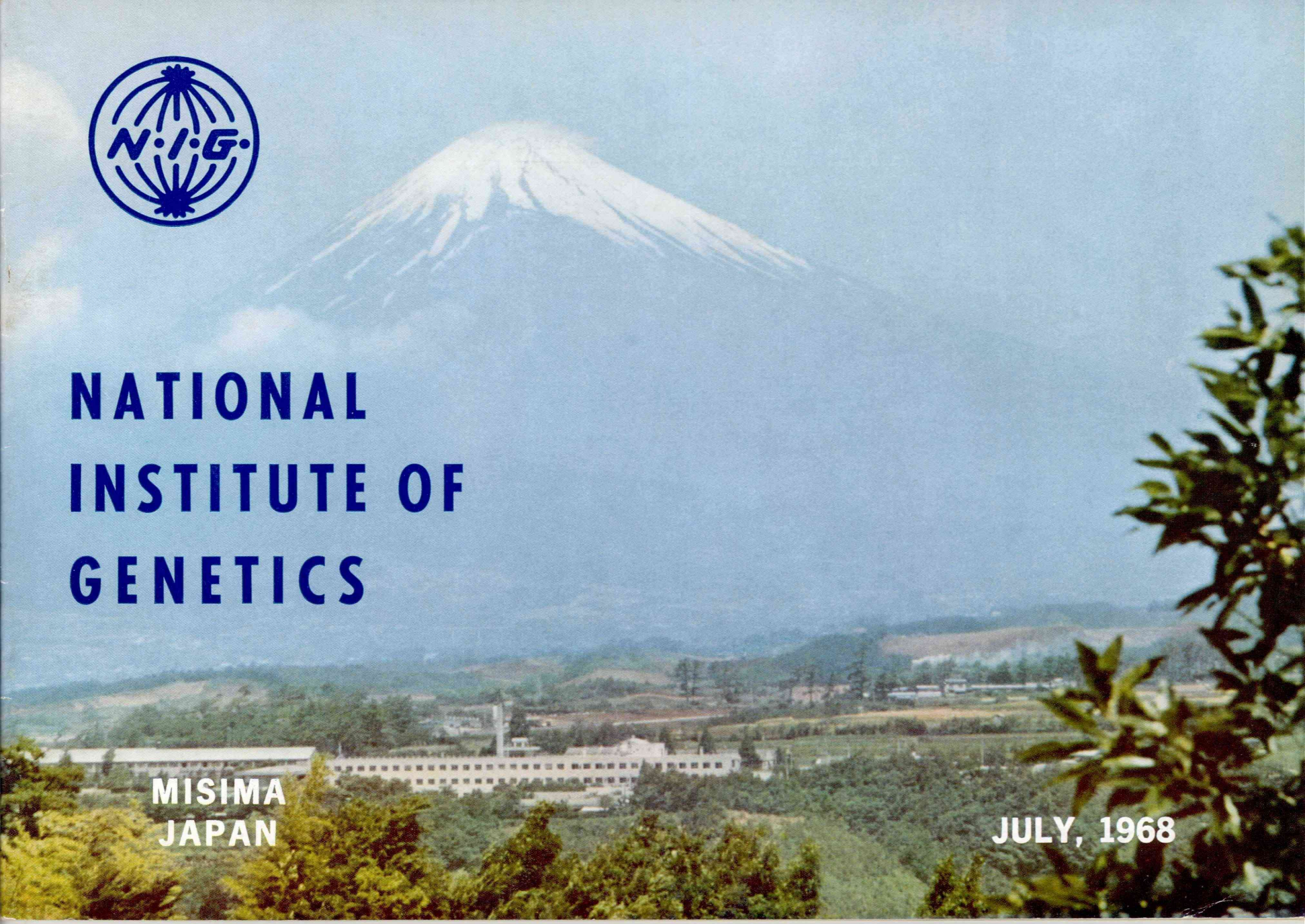
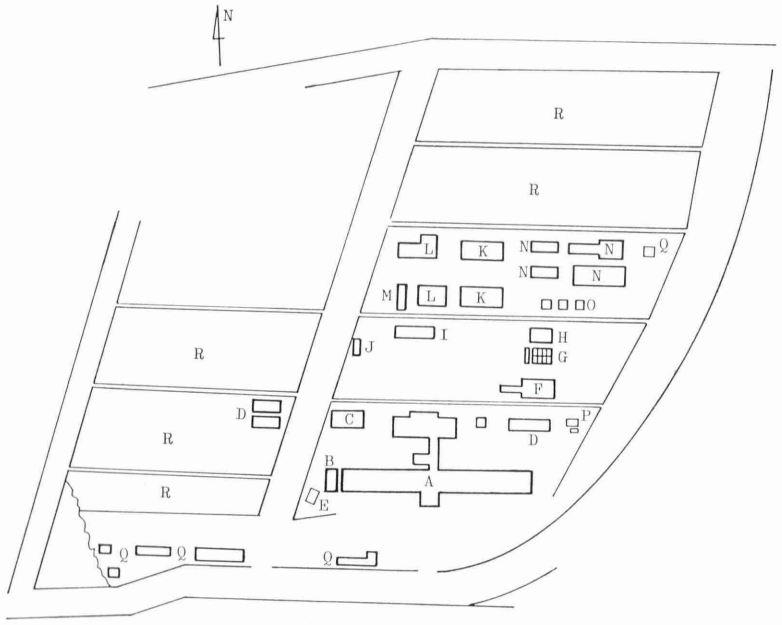


NATIONAL INSTITUTE OF GENETICS

MISIMA
JAPAN

JULY, 1968



Campus of the Institute

A	Main Building	J	Field Workroom
B	Auditorium	K	Mousery
C	Radio-isotope Laboratory	L	Silkworm Laboratory
D	Glasshouse	M	Barn
E	Air-conditioned Greenhouse	N	Poultry House
F	Isolation Greenhouse	O	Colony Houses
G	Short-day Paddy Field	P	γ-Greenhouse
H	Rice Laboratory	Q	Residences
I	Mulberry Greenhouse	R	Experimental Fields

CONTENTS

FRONT COVER
Distant view of the National Institute of genetics

Daigoro Moriwaki, Director,
succeeded Dr. Hitoshi Kihara,
the second director, in 1969

NATIONAL INSTITUTE OF GENETICS
JAPAN

Hitoshi Kihara, Director

The idea was to create a central institute which would carry out studies in genetics and various related fields. For the first director Dr. Kan OGUMA, Emeritus Professor of Hokkaido University was elected. In October of 1949 the Institute was established in its today's main campus, in Yata, a suburb of Misima at the center of the Fuji-Hakone-Izu National Park. The present director, Dr. Hitoshi KIHARA was appointed in 1955.

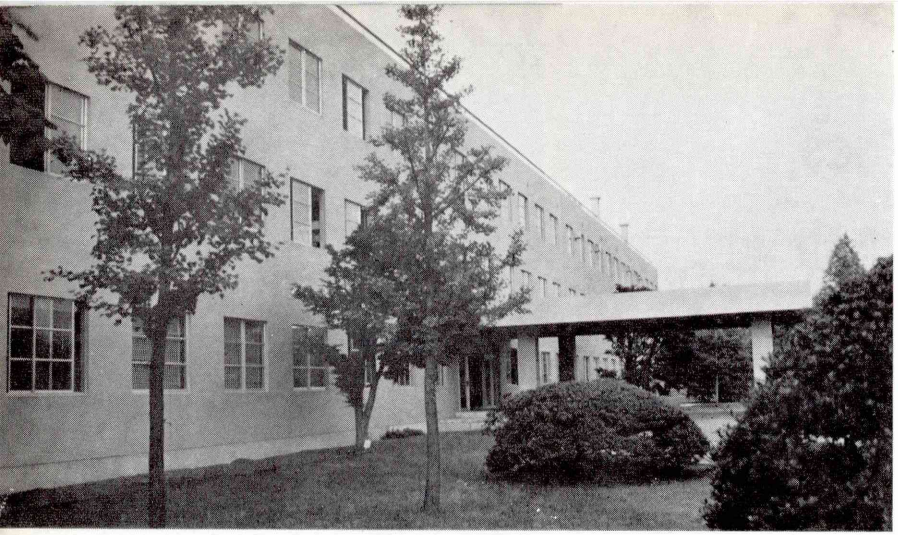
In March, 1968, the main building was completed in which 74 research members, 48 assistants and 20 administrative members are working. The research activities of the Institute cover various fields of morphological genetics, cytogenetics, physiological genetics, biochemical genetics, applied genetics, induced mutation studies, human genetics, microbial genetics and population genetics.

The Institute was honored by the visit of His Majesty the Emperor in November, 1954 and in April, 1965. Our Emperor, a distinguished biologist himself, has inspected our laboratories, listened to our recent progress and encouraged our staff.

A number of our members have been awarded prizes by Japanese and foreign genetic and other scientific societies.

Our library is not rich but we are proud of having the collection of reprints and books of the late Dr. GOLDSCHMIDT. The number of our published papers reached to 810 until the end of 1967. In addition to research activities, we have organized several international symposia and a genetic course for students of Southeastern Asia.

The present guide book provides the general outline of the Institute, its history, organization, equipments, staff members, research activities and collections of stocks.



Main building.

LOCATION AND CAMPUS

The National Institute of Genetics is located in a suburb of the city of Misima in Sizuoka Prefecture, about a hundred kilometers west of Tokyo. It takes two hours by express train, but one hour by super express since 1969, from Tokyo Station to Misima Station, and ten minutes by car from Misima Station to the Institute. Misima in feudal days was famous as a post town at the entrance to the Hakone passage on the Tôkaidô Highway. Nowadays it is noted for the springs and brooks which are fed by the melting snow of Mt. Fuji. Within a few kilometers from the town are several hotspring resorts: Nagaoka, Kona, Ôhito, Syuzenzi, Hatake, etc. The prosperous hotspring city of Atami can be reached in twenty minutes by train through the Tanna Tunnel, and Lake Ashi within one hour by bus. In fact, Misima is located at the center of the Fuji-Hakone-Izu National Park which is one of the most beautiful spots in the country, with beautiful Mt. Fuji in the background of the city. The countryside is known for various kinds of vegetables of good quality, and for the abundance of dairy products.

The campus of the Institute is part of a small foothill on the western slope of the Hakone Range. It has an area of 90,688 m^2; 17,417 m^2 are covered by buildings, 161 ares are occupied by roads and yards, and 300 ares by experimental fields. The Institute also has a separate piece of land of 51 ares in the neighborhood of the main campus. It is used as nursery for rare varieties of cultivated plants, and is at the same time the site of residences. It also includes a paddy field for experimental purposes.

HISTORY

The National Institute of Genetics was officially organized on June 1, 1949. Previous to this, the demand for a national institute devoted to the study of genetics had been expressed by Japanese geneticists on various occasions. It has been taken for granted from the beginning that such an institute should be an independent one, instead of being a part of a university or other institution. It had also been agreed upon, in view of the extensive field covered by genetics and the intricate relation between this branch of science and many others, that the institute should be designed on a fairly large scale. The first formal announcement of such demands was expressed in a resolution unanimously passed at the Thirteenth General Meeting of the Genetics Society of Japan held in August 1940 in Seoul. A little later, a special committee for the study of genetics was organized within the Japan Society for the Promotion of Science. Many senior geneticists of our country became members of this committee which paved the way for the establishment of a national center for the study of genetics in Japan. In addition, a foundation for the promotion of theoretical and applied genetics, "The Genetics Research Institution", was organized in May, 1947. Practically, the same group of geneticists have joined also this foundation and have cooperated in its research activities.

This foundation became the forerunner of the National Institute of Genetics.

In July 1948, the bill for the establishment of a national institute of genetics was presented to the Diet by the Government, and passed. The formal start of the Institute was made on June 1, 1949, under the Government Law No. 146. On the same day, the office of the Institute was opened in the Ministry of Education with Mr. K. KENNOKI, Director of the Higher Education and Science Bureau, as the Acting Director. A council responsible for setting up the basic principles of the organization and functions of the Institute was formed on the same day. At its first meeting held on July 30, 1949, the council nominated Dr. Kan OGUMA, Emeritus Professor of Hokkaido University, as the Director of the Institute. He was officially appointed to this office on August 10, 1949. Within a few months the rest of the staff was chosen, and by the middle of 1950, nearly all of the members had been appointed.

The whole Institute moved into the present main campus in Misima on October 29, 1949.

Dr. Kan OGUMA resigned from the directorship October 1, 1955, and Dr. Hitoshi KIHARA was appointed on the same day to replace him.

At the start, the Institute had three Research Departments, for Morphological Genetics, Cytological Genetics and Physiological Genetics. To these were gradually added six departments; for Biochemical Genetics in 1953, Applied Genetics in 1954, Mutational Genetics (presently Department of Induced Mutation) in 1955, Human Genetics in 1960, Microbial Genetics in 1962 and Population Genetics in 1964. The number of regular members of the staff increased from 16 at the beginning to the present 65 (July 1968). This number does not include the Administrative Department and the part-time staff and associates in the Research Departments. The annual expenditure steadily increased from ¥14,759,000 for 1950 to ¥175,493,000 for 1967. The equipment of the Institute has been in the meantime a great deal improved and enlarged. An active development of research work was launched in all departments and soon a considerable number of reports bore the evidence of a vigorous progress. To this auspicious development the interest and assistance of the authorities of the National and Prefectural Governments have largely contributed.

A relief of Kan Oguma, the first director.

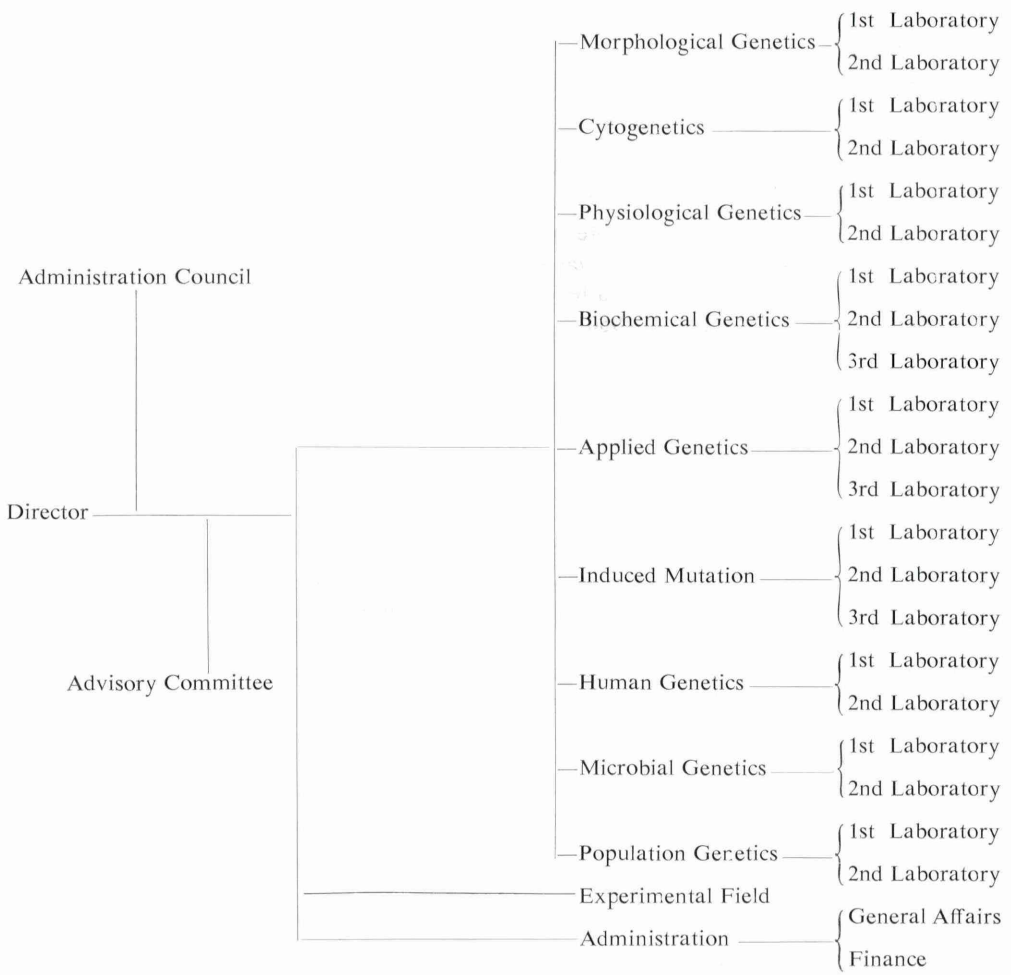
In a short time the Institute has become the center of our country's genetic research. A great part of national and international symposia and meetings are organized here and geneticists from all parts of Japan are here gathering, reporting on their results and exchanging views.

At present, in the view of progressing specialization, the Institute still lacks several representative departments of the new branches of genetics, such as molecular genetics, fine genetic structure, and biophysical genetics. Also, most of the existing departments need to be enlarged and their research staff increased.

Hallway of the main building.

ORGANIZATION AND STAFF

ORGANIZATION



STAFF

Director

Hitoshi KIHARA, D. Sci., M. J. A., Emeritus Professor of Kyoto University

Members

Department of Morphological Genetics

Yataro TAZIMA, D. Agr. (Head)

1st Lab. Yataro TAZIMA, D. Agr. (Head)
Akio MURAKAMI, D. Agr.

2nd Lab. Yukiaki KURODA, D. Sci. (Head)
Kiyoshi MINATO, M. Sci.

Department of Cytogenetics

Tosihide H. YOSIDA, D. Sci. (Head)

1st Lab. Tosihide H. YOSIDA, D. Sci. (Head)
Hirotami T. IMAI, D. Sci.

2nd Lab. Kazuo MORIWAKI, D. Sci. (Head)
Yoshiaki YONEDA, D. Sci.

Department of Physiological Genetics

Chozo OSHIMA, D. Sci. (Head)

1st Lab. Chozo OSHIMA, D. Sci. (Head)
Takao K. WATANABE, M. Sci.

2nd Lab. Hitoshi KIHARA, D. Sci (Head)
Sadao SAKAMOTO, D. Agr.

Department of Biochemical Genetics

Mitsuo TSUJITA, Dr. Agr. (Head)

1st Lab. Saburo NAWA, D. Sci (Head)
Masa-aki YAMADA

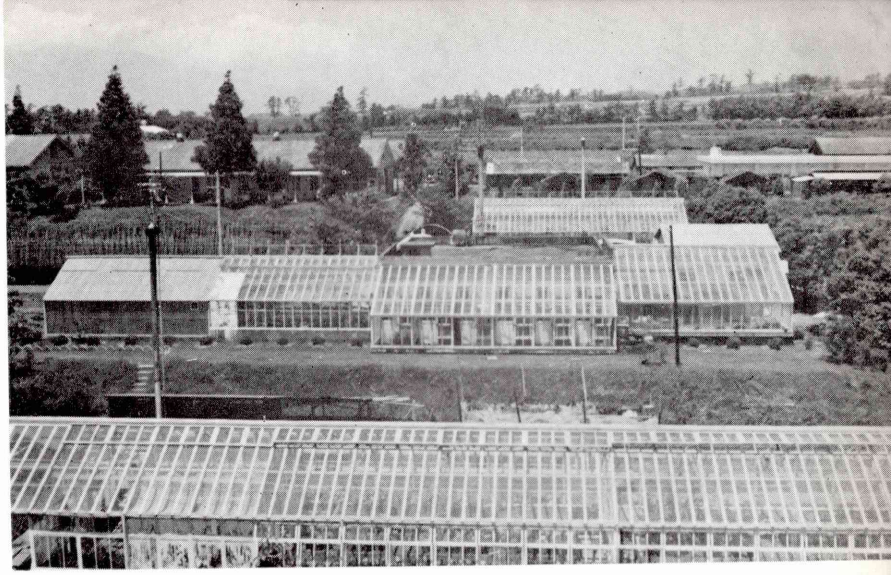
2nd Lab. Yoshito OGAWA, D. Med. (Head)
Toru ENDO, D. Agr.

3rd Lab. Mitsuo TSUJITA, D. Agr. (Head)
Susumu SAKURAI

Department of Applied Genetics

Kan-Ichi SAKAI, D. Agr. (Head)

1st Lab. Kan-Ichi SAKAI, D. Agr. (Head)
Takatada KAWAHARA, D. Agr.
Tohru FUJISHIMA, D. Agr.



Northern part of the campus.

2nd Lab. Shin-ya IYAMA, D. Agr. (Head)
Akira MIYAZAWA

3rd Lab. Hiko-Ichi OKA, D. Agr. (Head)
Hiroko MORISHIMA, D. Agr.

Department of Induced Mutation

Tsuneo KADA, D. Sci. (Head)

1st Lab. Kiyoshi TUTIKAWA (Acting Head)

2nd Lab. Tsuneo KADA, D. Sci. (Head)
Tarô FUJII, D. Agr.

3rd Lab. Tsuneo KADA, D. Sci. (Head)
Etsuo AMANO, M. Agr.
Yoshito SADAIE, M. Eng.

Department of Human Genetics

Ei MATSUNAGA, D. Med., D. Sci. (Head)

1st Lab. Ei MATSUNAGA, D. Med., D. Sci. (Head)

Tomotaka SHINODA
Ei MATSUDA

2nd Lab. Ei MATSUNAGA, D. Med., D. Sci. (Head)
Yasumoto KIKUCHI, D. Sci.
Hidetsune OISHI, D. Sci.

Department of Microbial Genetics

Tetsuo IINO, Ph. D., D. Sci. (Head)

1st Lab. Tetsuo IINO, Ph. D., D. Sci. (Head)
Masatoshi ENOMOTO, D. Sci.

2nd Lab. Tetsuo IINO, Ph. D., D. Sci (Head)
Hideho SUZUKI, D. Sci.
Jun-ichi ISHIDZU, M. Sci.

Department of Population Genetics

Motoo KIMURA, Ph. D., D. Sci. (Head)

1st Lab. Motoo KIMURA, Ph. D., D. Sci. (Head)
Takeo MARUYAMA, Ph. D.

2nd Lab. Motoo KIMURA, Ph. D., D. Sci. (Head)
Norikazu YASUDA, Ph. D.

Department of Administration

Toru OYAUCHI (Head)

General Affairs Section
Yoshiichi ANDO (Head)
Tatsuji TAKEDA (Assistant Head)
Akio SEKINE

Finance Section
Shigeo KATO (Head)
Shigeru TSURUMI, Asakichi MANO

Other Members

Research Associates	27
Assistants	4
Laboratory Technicians	36
Field Laborers	8
Clerks and Typists	12
Librarians	2
Chauffeurs	2
Janitors, etc.	4

Honorary Members

Yoshinari KUWADA, D. Sci., M. J. A., Emeritus Professor of Kyoto University
Kan OGUMA, D. Agr., Ex-Director, Emeritus Professor of Hokkaido University
Yoshimaro TANAKA, D. Agr., D. Sci., M. J. A., Emeritus Professor of Kyushu University
Taku KOMAI, D. Sci., M. J. A., Emeritus Professor of Kyoto University
Flora A. LILIENFELD, Ph. D.

BUILDINGS AND EQUIPMENTS

BUILDINGS

Building	Floor area (m^2)
Main building (three-storied)	4,763
Adjoining building and library (two-storied)	862
Mousery (two buildings)	563
Sericultural laboratories (two buildings)	488
Radio-isotope laboratory	535
Phytotrons (three)	606
γ-Greenhouse and operation room	89
Glasshouses	531
Poultry house	627
Auditorium	465
Barn	165
Field workroom	105
Transformer substation	90
Garage and storage house	93
Boiler room	97
Residences	2,192

EQUIPMENTS

Library

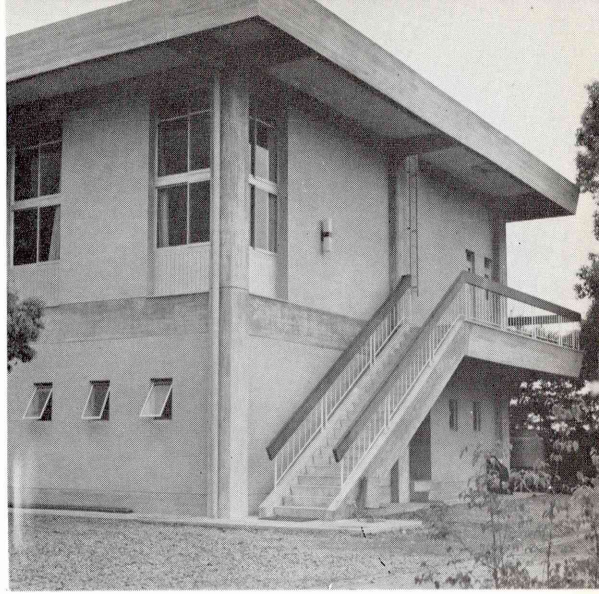
Among the valuable collections in the library, one may mention the whole GOLDSCHMIDT Library and KUWADA Library.

Since the start of the Institute in 1949 under the post-war circumstances, it was difficult to supply back-numbers even of the most important periodicals. GOLDSCHMIDT Library and KUWADA Library made up some extent for this deficiency. The library of Richard GOLDSCHMIDT was received in 1951, and he continued to send us his newly acquired reprints, periodicals and books until his death in 1958. The whole set, consisting of 36,270 reprints and about 780 books, is kept under the name of the "GOLDSCHMIDT Library". KUWADA Library was donated to this Institute by Dr. Y. KUWADA, Emeritus Professor of Kyoto University. It comprises about 482 books and 5,800 reprints. A donation of Sizuoka Prefecture made the erection of the building possible.

In the meanwhile the library received a financial support amounting to $10,000 from the Rockefeller Foundation and a donation of ¥150,000 from Dr. C. AUERBACH, Institute of Animal Genetics, Edinburgh University.

Patronaged by the good will of all those concerned, the library has been steadily expanding with purchases of new books and current as well as back numbers of periodicals and the arrival of quite a number of reprints through exchange.

The library, at present, possesses 6,582 books, receiving 340 volumes of periodicals every year.



Auditorium.

Radio-isotope Laboratory

Radiation Sources

(1) X-rays
Generator; KXC-18 (Toshiba)
Specification; 200 kVp, 25mA

(2) γ-rays
(a) ^{137}Cs source
Source intensity; 6,000 Ci (May, 1962, half life : 30.0 y)
Energy; 0.66 MeV.
Available dose rate; 230R/hr to 55,000R/hr (continuous)
(b) ^{60}Co source
Source intensity; 50 Ci (Sept., 1964, half life; 5.26 y)
Average energy; 1.25 MeV.
(c) ^{137}Cs source in green house
Source intensity; 40 Ci (March, 1964)
Available dose rate; 3R/hr to 0.2R/hr

(3) Neutrons
Generator; NT-200-2 (Toshiba)
Specification; 200 kVp, lmA
Energy; 14.1 MeV $\langle ^3H(d, n)^4He \rangle$
Neutron output; 1×10^{10} n/sec

(4) Ultraviolet
Light source; Super high pressure mercury lamp
Monochrometer; 1200 grooves/mm
Cat. No. 33-86-45-49 (Bausch and Lomb)
Available intensity; 16 ergs/mm^2/sec (25×25 mm area, 250 mμ, 100W lamp)

Dosimeter

Victoreen gamma-meter, model-570 (Victoreen)
Condenser chamber; 2.5R, 25R, 100R and 250R

Radcon (Victoreen)
Ionization chamber; 1/100, 1/10, 1, 10 and 100
Range; 0—100R/min

Glass dosimeter, Model 2 (Toshiba)

Fricke dosimeter
Reader; Photoelectric spectrophotometer, model QR-50 (Shimazu)

Dynacon electrometer, model 600 (Nuclear Chicago)
(For precise measurement of small ion currents.)
Specification; 10^{-16}A

Survey meters
Ionization chamber type; SBI-52101B (Toshiba)
GM type; RGS-B3 (Toshiba)
Pocketable GM type; TRM-1B5 (Kelch)
Alarm monitor; model SBI-52301 (Toshiba)

Isotope laboratory.

Radiation counters
GM counters; Window: 1.5 mg/cm²
Scalers: PW 4035 (Philips)
DS 10 (Aloka)

Single channel pulse height analyzer
Spectrogammeometer Model-1 (Radiation Counter Lab.)
Analyzing energies; 0.05–10 MeV

UV dosimeter
Germicidal light meter; GI-1 (Toshiba)
Monochrome UV dosimetry set
Detector: Bi-Ag 16 junction thermopile (Eppley)
Sensitivity: 0.274 microvolt per μV/μW/cm²
Reader: Micro-voltmeter AM2001A (Ohkura)
Range: 0–10μV to 0—5,000 mV
Recorder: LER-12A (Yokogawa)

Electron Microscope and Biochemical Laboratory

Electron microscope
Maker: Japan Electron Optics Laboratory Co., Ltd.
Model: JEM-T6
Resolving power better than 20Å
Direct magnification 500 to 30,000×
Accelerating voltage 60 kV

Vacuum evaporator
Maker: Japan Electron Optics Laboratory Co., Ltd.
Model: JEE-4B

Ultracentrifuge
Maker: Specialized Instruments Corporation, Belmont, Calif.
Model: Spinco L type

Automatic amino acid analyser
Maker: Hitachi Ltd.
Model: KLA-3 type

Recording spectrophotometer
Maker: Hitachi Ltd.
Model: EPS-3 type

Photo-electric spectrophotometer

Maker: Shimadzu

Model: QR–50 type

Refrigerated centrifuge

Maker: Tominaga Maker: Kubota

Model: S–62 type Model: KR–6P

Consent temperature rooms

A set of six rooms, regulated at 0°, 5°, 10°, 15°, 20° and 25°C, are used for various experiments requiring such temperatures.

Laboratories of Microbial Genetics

Main laboratory: In the main laboratory experiments in microbial genetics and biochemical analyses are carried out. Here, incubators, autoclaves, refrigerators, fraction collectors, electrophoretic apparatus, spectrophotometers and sonicators are available.

Rabbit-raising house: A circular house of steel-frames and concrete, accomodation for 25 rabbits. Rabbits raised in this house are used for immunization.

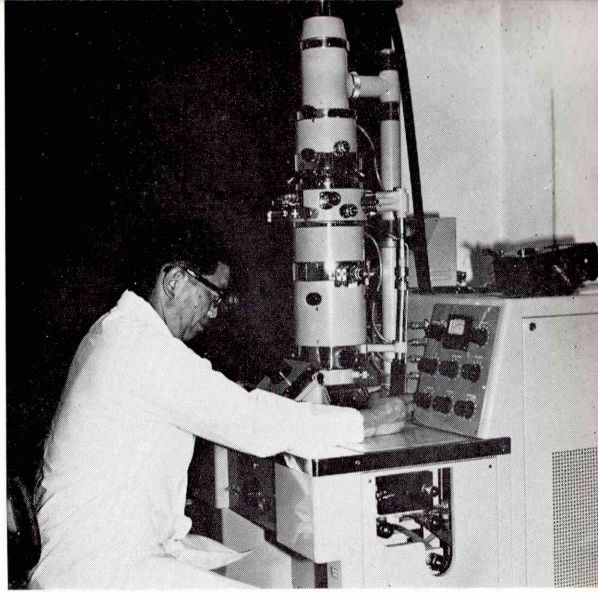
Inoculation rooms: Four rooms in which bacterial inoculation and other works under aseptic conditions are performed. They are associated with the main laboratory. Temperature and humidity of the rooms are controlled.

Stock culture room: About 3,000 mutant stock cultures of *Enterobacteria* are maintained. Temperature of the room is automatically regulated.

Room for analytical ultracentrifugation: A Spinco-E type ultracentrifugator is equipped with accesories.

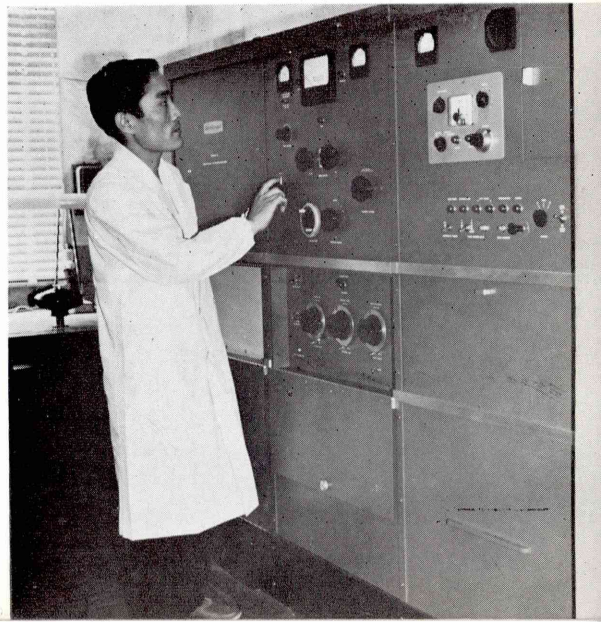
Drosophila Laboratory

Two laboratories (36 m^2), which are air conditioned at 25±2°C and two culture rooms, measuring one 9 m^2 and the other 27 m^2, with inside temperatures kept strictly at 18°C and 25°C are available to several researchers. In a kitchen (36 m^2), used vials and bottles are sterilized in a dry heat sterilizer and cleaned by a washing machine.



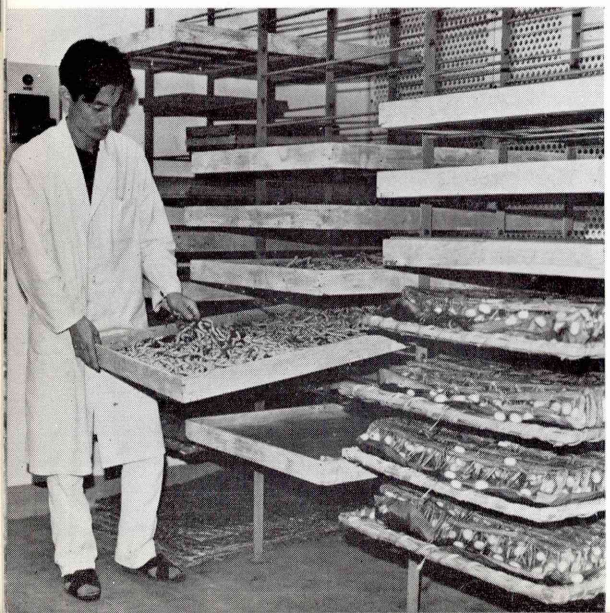
Electron microscope, Model JEM-T6, Japan Electron Optics Laboratory Co., Ltd.

Ultracentrifugator, Spinco-E type.



Drosophila laboratory.

Silkworm laboratory.



The culture medium (corn meal, sugar, agar and yeast) is cooked and poured into vials by a dispensing machine.

About one hundred and thirty useful mutant strains and seventy wild type strains collected from many places in Japan and foreign countries have been maintained for over ten years in the cool culture room (18°C) and about one hundred lethal strains, isolated from natural populations, have been gradually added every year since 1963. Several natural populations collected from Kofu and Katsunuma locality in Yamanashi Prefecture have been maintained in separate population cages kept in the culture room (25°C).

Insectarium

For the culture of silkworms, wild silkworms and other insects, an insectary is available with a floor space of 267.8 m², to which a mulberry field of 95 ares and an oak field of 2 ares are attached. About 120 mutant strains of the silkworm are reared and maintained in this building.

Special Silkworm Laboratory

With the purpose of studying the genetic effect of radiation a special silkworm laboratory was completed in March 1960. The laboratory, with a floor space of 218.6 m², has two rooms for silkworm rearing, a γ-room, a control rearing room, two refrigerated rooms for egg preservation and growth regulation, a working room and a machine room.

The γ-room is equipped with a rotating irradiation rack with a 3c ^{60}Co source, which permits continuous irradiation of growing silkworms while they are feeding. Both γ- and control rearing rooms are regulated automatically at a constant temperature and humidity of 25° ± 1°C and 75% ± 5%, respectively.

The laboratory is designed so as to make possible the performance of silkworm experiments from artificial hatching to egg collection.

A greenhouse of 97 m² floor space and an underground storage for mulberry leaves are attached.

First Mousery

Completed in December 1953. The mousery measures 290 m² in floor area, containing three rooms for mice, one for Norway rats, one for house rats (*Rattus rattus*), one for golden hamster and another one for Chinese hamster, Jangalian hamster and wild mice collected in Japan. It has also cage washing room, storage room and a population breeding room. It has a heating system consisting of a circulation gas-boiler and radiators, also a special ventilation device. Metal cages are arranged on shelves on hanging and movable racks. About 7,000 animals belonging to inbred and mutant mouse strains, inbred rat strains, and other laboratory animals (see p. 31 in this book) are kept in the building. The strains are distributed on demand to medical and biological institutes all over the country.

Second Mousery

The second mousery was built in 1958 in order to study genetic effects of radiation in mice. The total area of 272.7 m² includes five rooms in which the animals are kept, a research laboratory, an office, a kitchen, a washery and two rooms for air-accomodation. Each animal room is maintained at approximately 25°C by means of three package-type air-conditioning equipments in a relative humidity of 50% throughout the year.

Rice Laboratory

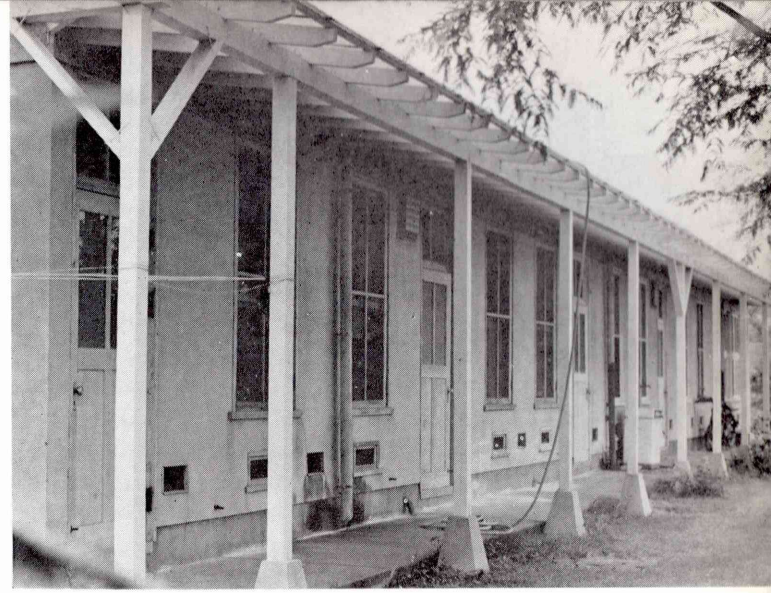
The rice laboratory was built for studies on "the origin of cultivated rice" under a grant of The Rockefeller Foundation.

The greenhouse, roughly air-conditioned, has two glassrooms (each 45 m²) and a laboratory. The temperatures are kept at about 28°C in day time and 20°C at night.

Besides the greenhouse, there are five concrete beds (each 2.6×3.5m) with an automatic short-day equipment. These are useful for genetic studies of rice, though the space available is limited.

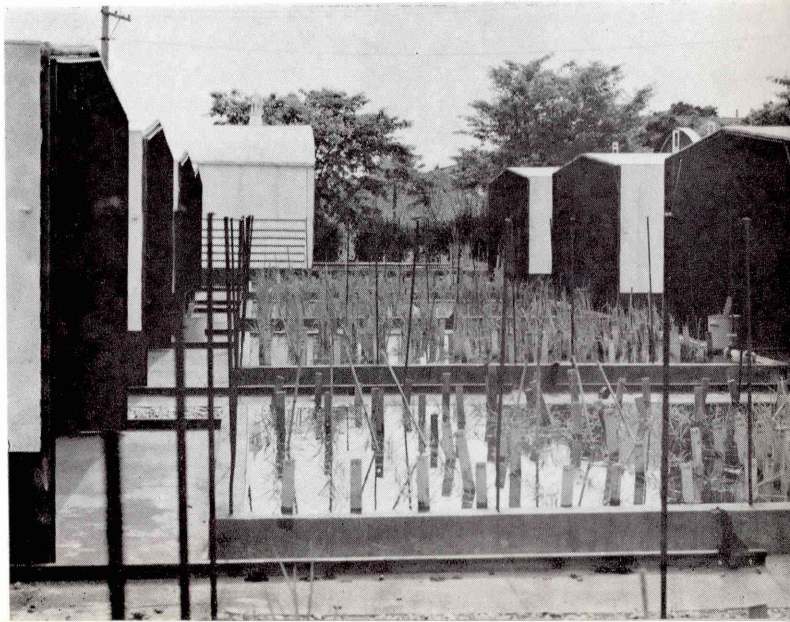
Isolation Greenhouse

The isolation greenhouse was built in 1957. Its surface measures 341 m² in floor area. It was built of concrete or concrete blocks. In the greenhouse, six air-conditioned small isolating glasshouses are



First mousery.

Short-day paddy field. Each field is specially equipped with a dark chamber whose opening and closing are automatically controlled.



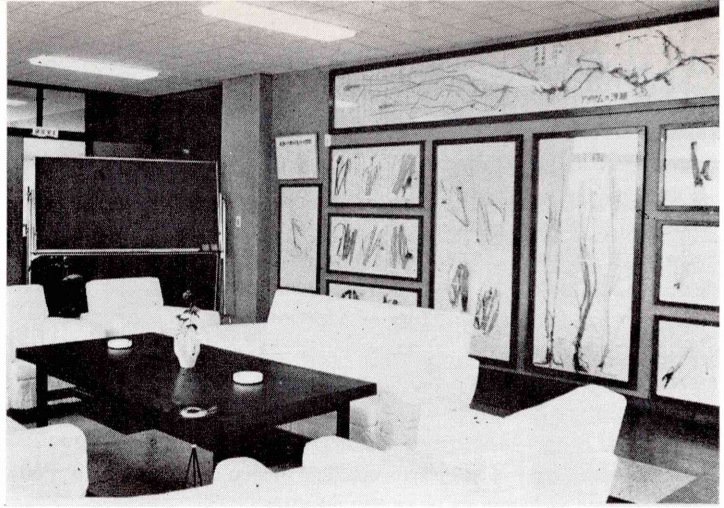
constructed for the isolation of plants which are cross- or self-pollinate. It has also a temperature-controlled glasshouse (45 m²), an air-conditioned glasshouse (45 m²), three air-conditioned darkrooms (each 10 m²) with artificial light, a low-temperature darkroom (10 m²) and a screened compartment (45 m²), besides two machinery rooms and a working (preparation) room.

Air-conditioned Greenhouse

The air-conditioned greenhouse was constructed in 1952-53 with the support of the Research Fund of the Ministry of Education. The greenhouse (87.5 m² in floor dimensions) comprises two glasshouses (each 13.2 m²) with turn-tables and two darkrooms (each 3.3 m²) where temperature and air humidity are automatically controlled, besides the machinery room, boiler room and a conventional greenhouse (36.3 m²) heated only for plant propagation.

The glasshouses and darkrooms have a temperature range from 18° to 30°C. The temperature is lowered by 5°–10°C each night at 16:00, under the control of a time switch, and kept low until 8:00 of next morning. The relative humidity is more than 60%.

Poultry house.



Herbarium.

Glasshouse

A glasshouse without heating, primarily for keeping tobacco strains and used also for other purposes.

Seed Storage Rooms

Two storage rooms, each being 4.2×3 m in floor area, have been constructed especially for seed storage. Different systems are adopted in each room for the regulation of storage conditions. In one room, temperature is kept at 0°±1°C, while humidity is not controlled. In the other room, both temperature and humidity are regulated, at 12°±1°C and 45%±5%, respectively. The principal factor for assuring longevity of stored seeds is low temperature in the former room, and a combination of lowered humidity and relatively low temperature in the latter.

Rice Herbarium

The rice herbarium (233 m²) was founded in 1965 under a grant from the Rockefeller Foundation in connection with the studies on "the origin of cultivated rice" sponsored by the Foundation. The herbarium contains 1,516 specimens covering 32 species.

In the harbarium also the following specimens of the tribe Triticeae are kept: *Triticum* (23 species), *Aegilops* (27), *Agropyron* (27), *Elymus* (6), *Hordeum* (23), *Secale* (4), other genera (8) and various hybrids totaling 1,623 specimens.

RESEARCH ACTIVITIES

MORPHOLOGICAL GENETICS

This department was started in 1949 as the First Department of this Institute. Comprising three laboratories, the department covered genetic studies of various organisms such as wheat, sugar beet, silkworm, poultry, mouse and man. With the expansion of the Institute, often reorganization of the laboratories was taking. Since 1961 the main activity of this department was directed to the genetic researches in silkworm, a traditional experimental animal in this country.

At present the department comprises two laboratories:

First Laboratory: Silkworm genetics

Second Laboratory: Cellular differentiation

The department is well equipped for genetical studies of the silkworm, having an air-conditioned rearing house, a refrigerating room, a mulberry field, a greenhouse and ordinary laboratories. Facilities are available for investigations in cell and tissue culture.

First Laboratory

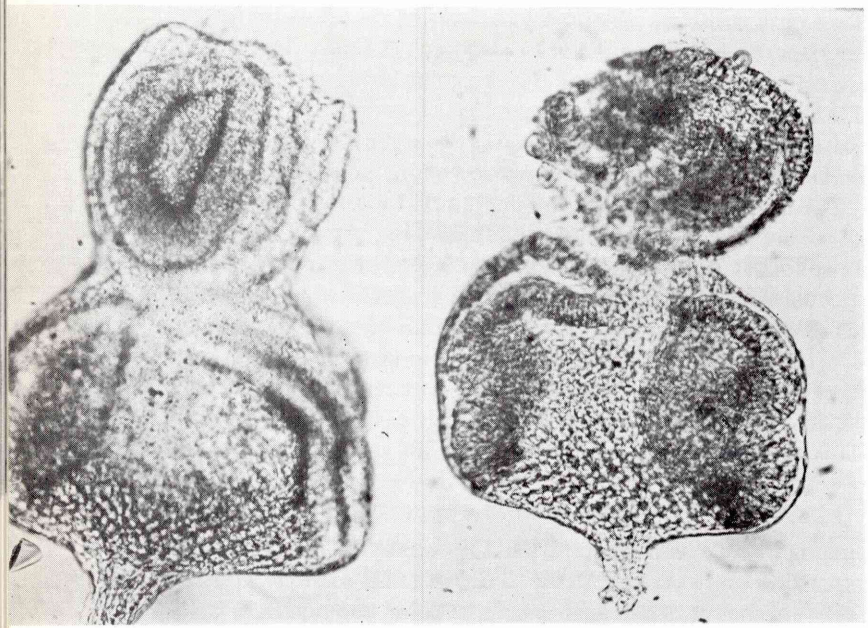
1. Silkworm genetics: Encouraged by sericultural industry silkworm genetics has achieved a great progress in Japan. More than 260 hereditary traits have been thus far analyzed and 20 linkage groups among the 28 have hitherto been established. The remaining eight are already represented each by a single marker gene. Although a number of research works on silkworm genetics have been conducted not only in this laboratory but also in many other laboratories in Japan, most of the results have been published in Japanese so that the details have scarcely become known outside this country. In order to give a general account of silkworm genetics, Y. TAZIMA published in 1964 an English monograph, " The Genetics of the Silkworm ", Logos Press, London. In this book he emphasized that although the silkworm may lack the special suitability of *Drosophila* for formal genetics or of *Neurospora* for biochemical studies, it is an ideal organism for the study of physiological and developmental problems.

2. Radiation genetics: Egg color mutants of the silkworm furnish excellent opportunities for mutation detection. TAZIMA developed a simple specific loci method, using the egg color genes as markers and studied in detail the changes in mutability of germ cells at various stages of gametogenesis for both sexes. Since then the research has been direcled to the dose-rate effect on mutation induction at gonial stage. The most interesting was the finding that the dose-rate effect is reversed within a week after hatching of the larva. After experimenting with split-dose irradiation and cell kinetic studies, the cause of this phenomenon was attributed to a kind of cell synchronization effect. Another problem being tackled is the mechanism of repair in mutation process. The existence of this process was demonstrated by split-dose irradiation to spermatids. The investigations are being carried out with the use of several different radiosensitivity strains, established after many years of experimental work.

Second Laboratory

The main project of this laboratory has been the study of the phenotypic expression on the cellular level. Growth and differentiation of insect cells in chemically defined media, cellular interaction in cytodifferentiation and carcinogenesis of avian and mammalian cells, and effects of radiation on histogenesis and organogenesis of embryonic cells are here studied by the technique of tissue culture.

1. *In vitro* cultivation of insect cells: *In vitro* cultivation of embryonic cells and single cells from various imaginal discs of *Drosophila melanogaster* larvae is carried out. Since 1955 many attempts have been made by Y. KURODA to culture the imaginal discs, melanotic tumors, and blood cells of *D. melanogaster* in a chemically defined medium. Differential growth and differentiation of imaginal discs from various mutant strains and effects of ecdysone and some chemical substances added to the culture midium have been investigated. K. MINATO joined the laboratory in 1967 to work with KURODA. Recently it was found that the differentiation of ommatidia of the eye-antennal discs was much accelerated by addition of some ecdysone analogues of plant origin into the medium. Differences in histoformative aggregation patterns of dissociated single cells were also found among



Eye-antennal discs of *Drosophila melanogaster* cultured in a chemically defined medium containing ecdysterone (*left*) and inckosterone (*right*).

various imaginal discs from different mutant strains. Establishment of cell lines having some distinct genetic markers and isolation of clones from a variety of tissues or organs by colony formation are carried out.

2. Characteristic histoformative activity of tumor cells in culture: Characteristic property of tumor cells in histogenesis is investigated by KURODA in rotation cultures of cell suspensions of dissociated tumor and normal cells. A marked increase in aggregate-forming activity has been found in the process of neoplastic transformation of Rous sarcoma-infected chick cells and mouse mammary gland cells. The relationship between the aggregation pattern and chromosome number in carcinogenesis is also investigated. It was found the hypotetraploid mouse plasma tumor cells showed an increase in aggregate-forming activity and proliferationg activity (also malignancy) in comparison with diploid mouse plasma tumor cells. Selective sorting-out property of tumor cells for specific types of normal cells was found in co-aggregates of HeLa cells or mouse plasma tumor cells with a variety of chick normal cells.

These investigations on the characteristic property of tumor cells of cellular adhesiveness may provide a clue for elucidating the mechanism by which neoplastic transformation takes place in normal cells and they also may elucidate the relationship between neoplastic transformation and cellular differentiation.

3. Differentiation of histoformative activity of cells in culture: Differentiation of histoformative activity of embryonic cells is investigated by KURODA in rotation cultures of dissociated chick and mouse embryonic cells. Cell-free supernatants with histoformative activity have been obtained from cultures of embryonic chick liver and heart cells. These supernatants had a tissue- or organ-specific activity and a difference was found in amino acid composition of proteins contained in supernatants from different organs.

Effects of X-irradiation on histoformative activity of embryonic cells is investigated. It has been found that low doses of X-ray produced an increase in histoformative activity of embryonic chick and quail liver and heart cells and that high doses of X-ray causes a decrease in histoformative activity of the cells.

The control mechanism by which the cell-free materials with histoformative activity may differentially be produced in cells of varius organs and tissues is under investigation.

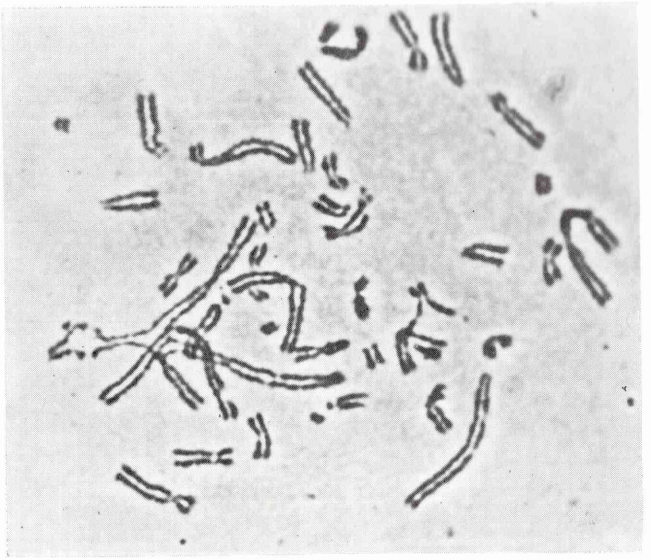
CYTOGENETICS

In this department genetical studies of animals and plants are carried out at cell and chromosome level. In the First Laboratory, the cells are mainly studied from morphological view point, and in the second laboratory, from biochemical view point. Main parts of these studies are carried in collaboration of the above two laboratories. Results obtained in the laboratories are as follows:

First Laboratory

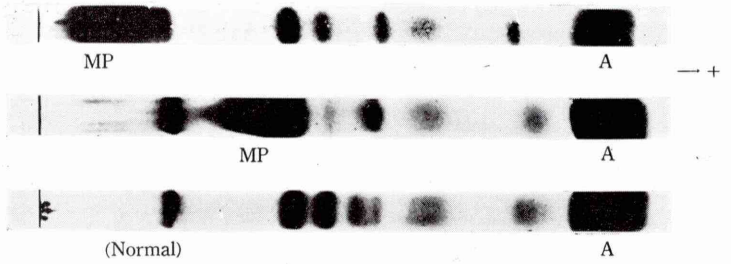
1. Karyological studies of tumors: Chromosomes of tumors in mice, rats and hamsters, which were developed spontaneously or by treatment with chemicals are studied by T. H. YOSIDA and H. T. IMAI to elucidate the relation between chromosomal alteration and tumor development. Many mammalian tumors thus developed had altered karyotypes from those of normal somatic cells, and they were changeable spontaneously or by treatment with chemicals. Various studies strongly suggest that chromosomal alteration is a causative process in creating more vigorous malignant cell types by sequential events of mutation and selection. Relation between gene expression and chromosome alteration was studied with mouse plasma cell tumors. In most of them polyploidization was observed as a common phenomenon. From the results of serial transplantations of the tumors produced in this laboratory to mice, it was concluded that plasma cell tumors can develop from cells with diploid karyotypes, but are changeable to near-tetraploid ones after two or three transplant generations. It was observed that polyploidization occurs by the union of two nuclei of binucleate cells which appear before the development of polyploid cells. Studies on gene expression of these tumor cells are carried out in the Second Laboratory.

2. Chromosomal polymorphism of rats: Chromosomal polymorphism in black rats, *Rattus rattus* and Norway rats, *Rattus noruvegicus*, was studied by YOSIDA. In the former the largest No. 1 chromosomes and in the latter No. 3 chromosomes are polymorphic by consisting of telocentric homomorphic pair (T/T), a subtelocentric homomorphic pair (S/S) and a telocentric and subtelocentric heteromorphic pair (T/S). Frequency of rats with the three chromosome types was surveyed in natural population in Japan and Korea. Frequencies of animals with T/T, T/S and S/S pair in 344 rats (*R. rattus*) collected in various localities in Japan and Korea were 79.1, 18.8 and 2.1% respectively. In the laboratory all animals with the three chromosome types could be bred, and from several matings between animals with different chromosomal types, it was found that in all crosses more animals with T/S pair were usually obtained than expected from the segregation ratio. From the above investigations, it is suggested that hybrid vigour may be involved in this animal in maintaining the S-chromosome.

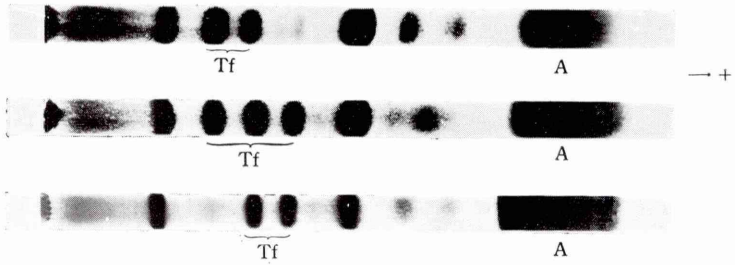


Chromosome abnormalities of Yoshida sarcoma cell induced by treatment with a carcinogenic agent, 4NQO.

3. Establishment and maintenance of laboratory animals and their genetical studies: Another important subject dealt by YOSIDA and his research associates is the establishment and maintenance of inbred strains and mutant stocks of laboratory mammals. (see p. 31). Some mouse strains, such as SMA, DM, DD/MS and D103, and rat strains,



Myeloma protein bands on starch gel electrophoresis of plasma cell tumor-bearing mouse serum.
A: albumin. MP: myeloma protein.



Serum transferrin polymorphism in black rat, *Rattus rattus*.
A: albumin. Tf: transferrin.

such as Wistar, NIG-1, and YOS, were established in this laboratory. Several inbred lines of the house rat (*Rattus rattus*), and golden hamster (*Mesocoritus aurattus*) have been established. Other experimental animals, such as Chinese hamster (*Cricetulus griseus*), and Djungarian hamster (*Phodopus sungows*) are also bred. The genetics of new mutants of mice, *i.e.* falter and postaxial polydactly found in this laboratory were also studied.

Second Laboratory

1. Biochemical studies on gene expression mechanisms in mammalian cells: The mechanism of gene expression in mammalian cells is studied by K. MORIWAKI in connection with the regulation of gene action according to polyploidization of tumor cells. A basic question in these studies is whether the duplicated genes in the polyploid cells can be fully expressed or not. To solve this problem, a mouse plasma cell tumor which can synthesize a specific gamma globulin at a higher rate was employed. Both diploid and tetraploid lines derived from the same original tumor have been maintained in this laboratory. Experimental results obtained so far indicate that the rates of total protein and gamma globulin syntheses in tumor cells did not show a parallel increase with the duplication of chromosome number, suggesting that the gene action concerning those protein syntheses is somewhat depressed following tetraploidization.

2. Studies on serum protein polymorphism in the rat (MORIWAKI): Electrophoretic survey by starch gel of serum protein polymorphism in natural population of *Rattus rattus* in Japan has revealed three types of transferrin variants, R-, N-, and RN-type. No marked difference in the frequencies of these types was observed among five localities; Sizuoka Pref., Gunma Pref., Niigata Pref., Tottori Pref. and Okinoerabu Island. Their average frequencies were 70.3% of R type, 26.4% of RN type and 4.3% of N type. Distribution of transferrin phenotypes in progenies obtained from laboratory crosses among R-, RN- and N-type is consistent with the hypothesis that two transferrin types, R and N, may be controlled by two codominant alleles at a single locus.

3. Studies on morphogenetic mechanisms in higher plants: Analysis of stem and other parts of Japanese morning glory (*Pharbitis nil*) revealed the presence of auxin protectors (or indole-acetate oxidase inhibitors), the distribution of which suggested their regulatory role in stem elongation and tissue maturation. These protectors, together with auxin destroying enzyme in intact plants and also in callus tissues *in vitro* of various mutants are studied by Y. YONEDA in relation to morphogenetic differentiation and growth. The effort is also directed to preservation of various mutants of Japanese morning glory and investigation of their morphological characters, with the intention of pursuing morphogenetic mechanisms in higher plants. The plant is one of the most important materials for genetic study in this country. About 220 genes have been analyzed and 146 genes are arranged in 10 linkage groups. At least 40 mutant strains as well as about 200 horticultural varieties are propagated in the Institute.

PHYSIOLOGICAL GENETICS

First Laboratory

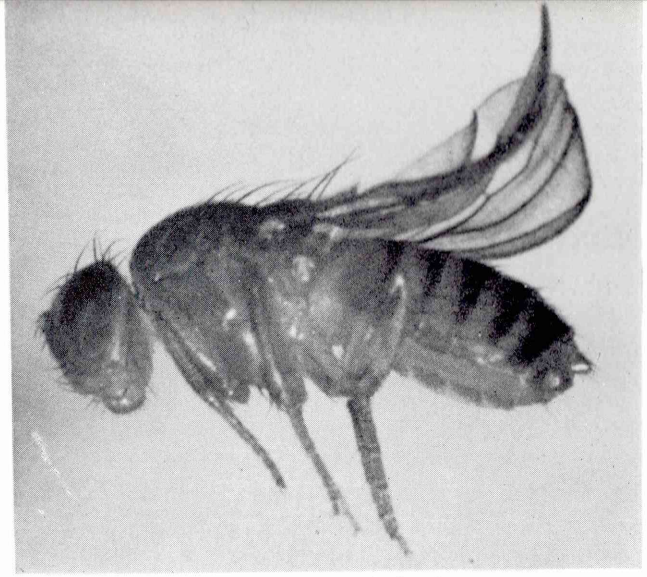
A sample of individuals from a natural population of *Drosophila* usually shows little variability in visible traits. On the contrary, autosomes carrying recessive deleterious genes such as lethal, semilethal and sterile genes were observed to be concealed in fairly high frequency in a natural population, when viabilities of homozygous flies for each autosome could be estimated by a specialized genetic technique (*Curly Plum* method).

Those deleterious chromosomes have been isolated from large or small natural populations of *Drosophila melanogaster* every autumn since 1959, and allelism tests were performed between lethal genes extracted from the same sample and also between new and old ones extracted in successive years. From the results, it could be confirmed that some lethal genes have persisted for a long time in large natural populations distributed over a wide area ($3 \times 15\,km^2$). As to the mechanisms of persistence, a linkage relationship was assumed from experiments under constant temperature (25°C) between such lethal genes and an adaptive gene complex, a heterotic inversion, or a segregation distorter gene.

On the other hand, the viability of heterozygous flies for deleterious genes was estimated and compared with that of normal flies under fluctuating temperature (20–30°C) in an INSECTORON equipped with a Recording Temperature Program Controller, and the difference between these two mean viabilities was found to be more reduced than in constant 25°C environment.

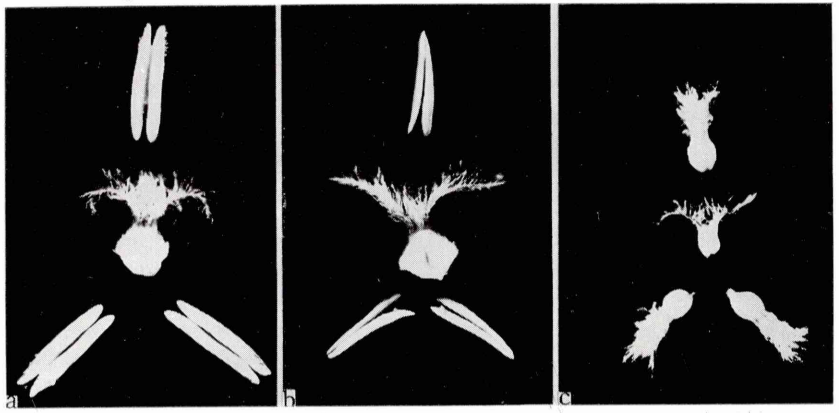
Second Laboratory

The main research problem of this laboratory is the analysis of the mechanisms involved in the origin and differentiation of higher plants, such as wheat and other plants of the tribe Triticeae. For this purpose, a considerable variety of materials collected from almost all over the world are maintained. Not only genetic, karyotypic and comparative gene analyses, but also physiological, morphological and



***Curly Plum* fly, *Drosophila melanogaster*.**

Stamens and pistils of normal and nucleus substitution lines of wheat. a: *Triticum vulgare* var. *erythrospermum* (normal). b: *T. v. e.* with *Aegilops caudata* cytoplasm (male sterile). c: *T. durum* var. *reichenbachii* with *Ae. caudata* cytoplasm (pistillody).



anatomical studies have been carried out in order to elucidate the genetic basis of the origin and differentiation of species.

1. Study on wheat: H. KIHARA, S. SAKAMOTO, and Y. OHTA are responsible for this work. Nucleus substitution is the main concern. The purpose of the work is to examine the effects of alien cytoplasm on the expression of genes. For this purpose, various nuclei of wheat were introduced into nine different alien cytoplasms of related species, resulting in as many as 70 substitution lines. Among them, the effects of three cytoplasms has been studied extensively, namely, cytoplasms of *Aegilops caudata*, *Ae. ovata* and *Triticum timopheevi*.

The results speak for close interrelation between speciation and cytoplasmic differentiation. These investigations were carried out primarily from the theoretical standpoint. However, in their course several effective systems of male sterility and fertility restoration have been found. This has opened a new field for wheat breeding, namely, hybrid wheat breeding.

Nucleus substitution and restoration study between *Aegilops caudata* var. *typica* and var. *polyathera* has revealed a new nucleus-cytoplasm relationship.

2. Study in the tribe Triticeae; S. SAKAMOTO is carrying out this work. At present extensive experimental and taxonomical studies of interspecific and intergeneric hybrids are in progress.

BIOCHEMICAL GENETICS

First Laboratory

The main program of research which is now being carried on by S. NAWA and M. YAMADA in this laboratory is to study the genetic effects of external DNA in higher organisms. As to genetic activity of DNA, it was conclusively demonstrated by the phenomenon of bacterial transformation. If the phenomenon is established to occur in multicellular organisms, it will become useful for understanding of the specific genetic behavior of DNA in higher differentiated organisms. Several years ago, an encouraging result for somatic transformation was obtained in experiments with the moth *Ephestia*. In these experiments wing scales of wild type pigmentation were produced by injection of wild type DNA into mutant larvae homozygous for a recessive gene. The procedure is so sensitive that it was possible to detect a rare mutational event at a frequency of 10^{-4}–10^{-5}. A procedure has been devised to extract adequate DNA preparations of higher molecules. Since it is not certain in these experiments that the DNA-induced phenotypic changes in somatic cells would be transmitted to their offspring, studies of hereditary nature of these changes are carried out. For this purpose, insects are favorable materials to detect a rare event in thousands of individuals. In *Ephestia* and *Bombyx*, a positive evidence was obtained in favor of transmission of genetic transformation into offspring, although the process of the establishment of transformation is complex. It was also found in *Ephestia* that donor DNA penetrated into the recipient cells without degradation. Further investigations of this important problem are going on.

Second Laboratory

Under OGAWA's leadership, the main research project of this laboratory was directed to biochemical studies on the differentiation of animal embryos. In order to examine the differentiation mechanism of skeletal muscle tissue, a series of experiments were carried out, by

means of immunochemical and electrophoretic techniques, on the synthesis of contractile proteins, actin and myosin, in early embryonal stages or regenerating tissue of *Triturus pyrrhogaster* (BOIE) applying some chemicals and X-ray irradiation.

Currently, biochemical and genetic investiagations of human serum proteins are carried out. Paraalbumin, antitrypsin and lipoprotein in the serum of the Japanese population are studied by two-dimensional electrophoretic technique originated by OGAWA, using cellulose acetate and polyacrylamide as supporting media.

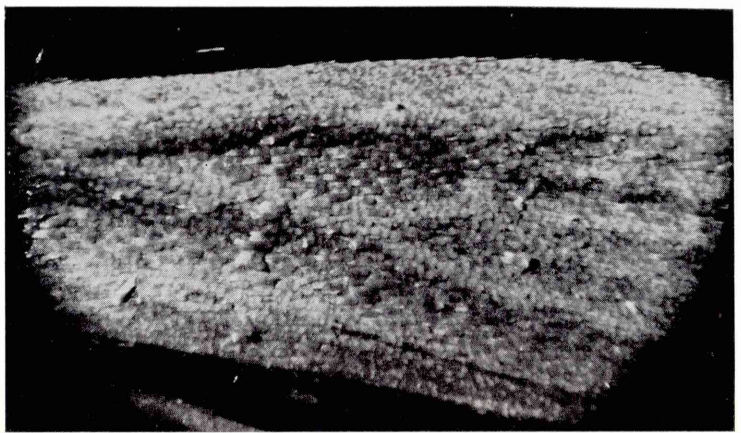
T. ENDO together with Y. YONEDA of the Department of Cytogenetics are working on biochemical genetics of mutant strains of the Japanese morning glory, *Pharbitis nil*. Their main interest is the biological role of several isozymes, especially per-oxidase and indoleacetate oxidase, in relation to morphogenesis of the plants. Differentiation of callus from tissues of various mutants in media containing different kinds of hormones as well as growth regulators are zymographically studied.

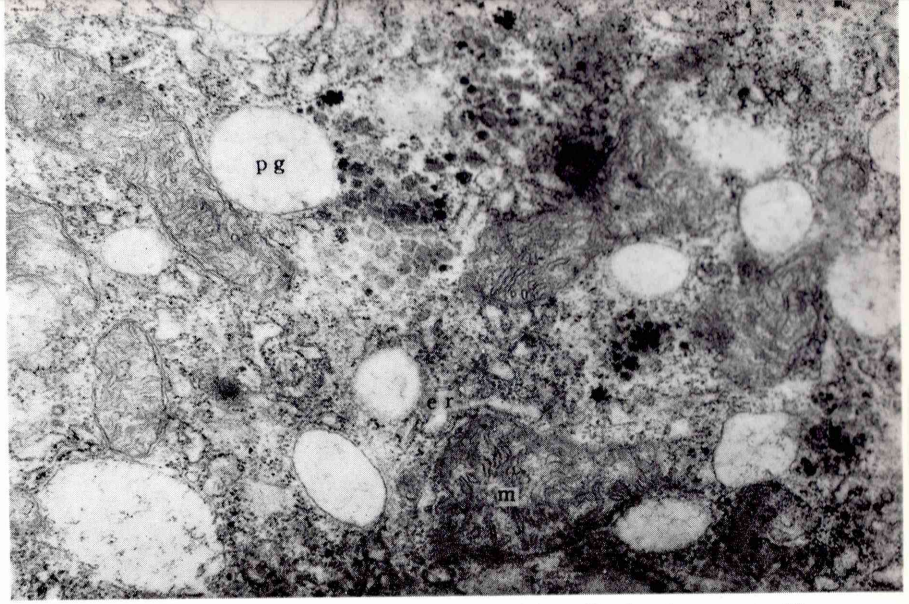
Third Laboratory

Since S. SAKURAI became a staff member of this laboratory in 1963, M. TSUJITA in collaboration with him has carried on genetic and biochemical studies of the membrane systems which participate in cellular differentiation. They employ normal and mutant silkworm (*Bombyx mori*) strains as materials: It was found that a large amount of pteridine granules (chromogranules) is produced in larval skin cells of normal silkworm strains by special differentiation of endoplasmic reticulum according to the cellular function. Structure, chemical composition and development of the granules, protein synthesizing ability of granules (by incorporation experiments of several ^{14}C amino acids), and genetic variation in their shape, size and amount per cell were studied. It was reported that the granules consist of vesicular membranes and their contents, *i.e.* secretion products.

The membrane itself consists of a homogeneous single protein (membrane unit protein). Futhermore, reconstitution of granule vesicles (surrounded by membrane) from their solubilized subunits was confirmed. Repeating particles which are considered to be the subunits constituting the vesicular membrane are now being studied. Thus, the present interest is in the mechanisms of the differentiation of pteridine granules from endoplasmic reticulum and gene control mechanism of the molecular structure of the granule membrane.

A wild type scale detected on a mutant wing of *Ephestia* which had been injected with wild type DNA at larval stage.





Electronmicrograph of a part of larval skin cell of *w-b* mutant silkworm. er: endoplasmic reticulm. m: mitochndria with peripheral double membrane and with inner tubular structure membranes. pg: pteridine granules surrounded by monolayer membrane.

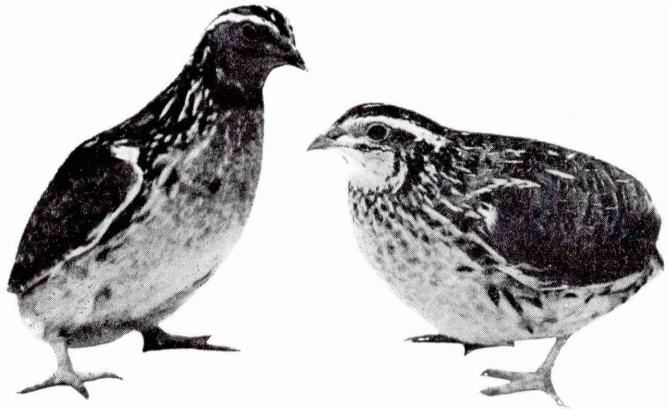
APPLIED GENETICS

First Laboratory

Main projects being pursued and some of the results obtained so far are as follows:

1. Inbreeding experiments in Japanese quail: It is found in the experiment conducted by the staffs in the laboratory that the bird is very sensitive to inbreeding and it appears hardly possible to obtain strains inbred for more than four generations. An establishment of inbred lines, however, is anxiously desired and further effort is being made toward the goal.

2. Multidirectional selection experiment for body size and shank length in Japanese quail: Since body size or weight and shank length are genetically positively correlated with each other, the selection for larger body size and longer shank or that for smaller body size and shorter shank has been apparently effective whereas the selection for one and against the other was less effective. An investigation is carried out by T. INOUE and K. I. SAKAI to find whether changes in body size or those in the balance between body size and shank length are accompanied by any decrease in fitness.



Japanese quail; male (*left*) and female (*right*).

Spikelet of *Oryza perennis*, Asian form.

3. Genetic investigations in wild strains of Japanese quail: The main interest at present with the bird is in detecting morphological and physiological differences, if any, between wild and domestic birds. Some experiments are under progress by T. KAWAHARA.

4. Selection for egg shape in a White Leghorn flock: It has been concluded as the result of the experiment conducted by KAWAHARA that the selection was effective for increasing the width of egg but less effective for increasing its length. It has also been elucidated that the selection induced an increase in the amount of egg albumin without any visible change in the quantity of yolk.

Second Laboratory

The main projects in this laboratory are as follows:

1. Theoretical studies on breeding techniques of plants and animals: Present problems being pursued by SAKAI and others are 1) estimation of genetic parameters in forest trees without raising the progeny, by taking clusters of different sizes comprising trees growing in close proximity, and 2) method of subflock selection for improving combining ability in poultry.

2. Detection of clonal progeny in a natural forest of *Cryptomeria japonica*: This investigation is carried out by the staffs in the laboratory to estimate genetic parameters or to find out the involved genetic potentiality. The method of detecting clonal progeny is based on the use of an identity index which is constructed on the basis of several more or less qualitative characters. Details of this study will be published before long.

3. Competition and migration in plants or animals: The problems investigated at present by SAKAI, S. IYAMA and T. NARISE are to ascertain the ecological-genetic aspects of competition in forest trees, on one hand, and to inquire into biological mechanisms of emigration of *Drosophila* flies in intergenotypic competition, on the other hand.

4. Developmental genetics of plant organs: Materials are tobacco and rice, and approaches are made by S. NARISE and S. HIGUCHI from the standpoints of genetic and biochemical correlations among different organs.

Third Laboratory

H. I. OKA and H. MORISHIMA are working with problems related to the origin of cultivated rice. The present main research objects are: 1) species relationship between *Oryza sativa* and *O. glaberrima*, 2) genetic control of developmental pattern, 3) breeding of isogenic lines with different sterility genes, which will be used for gene analysis of F_1 and F_2 sterilities. 4) isolating mechanisms, and 5) natural selection experiments with hybrid populations of wild rice species. The last one is being conducted in cooperation with the International Rice Research Institute and the Botany Institute of Academia Sinica. Studies on many other subjects were made along the same line and their results have been already published. In general, the research activity of this laboratory aims at evolutionary genetics in rice.

INDUCED MUTATION

First Laboratory

1. Genetic effects of radiation in mice: The main experiments by K. TUTIKAWA are 1) determination of RBE of fast neutrons for the induction of dominant lethal mutations in spermatozoa, 2) observations of the induction rate of recessive mutations at six specific loci or visible dominant mutations at any locus, and 3) estimation of frequencies of dominant mutations affecting the skeleton in first-generation descendants from males irradiated with fast neutrons and X-rays. Results to date suggest that 14.1 MeV neutrons are about 1.8 times as effective as acute X-rays for the induction of dominant lethal mutations. Furthermore, genetic tests for several diverging phenotypes assumed to be mutants are now in progress.

2. Strain differences in mice regarding the response to radiation and teratogenic agents: A distinct difference was shown among the strains in response of peripheral leucocyte number to whole body X-irradiation. The evidence indicates that the radiation response shown by the amount of leucocytes three days after exposure is genetically controlled and is possibly determined by a small number of genetic factors. The magnitude of heritability of the response to irradiation is roughly estimated as 0.809 in the F_2 generation. The experiments with ethylurethane as a teratogen suggest that factors controlling the response to produce malformations among embryos following maternal treatment with ethylurethane may not be cytoplasmically transmitted, and might involve an interaction of fetal and maternal genotypes.

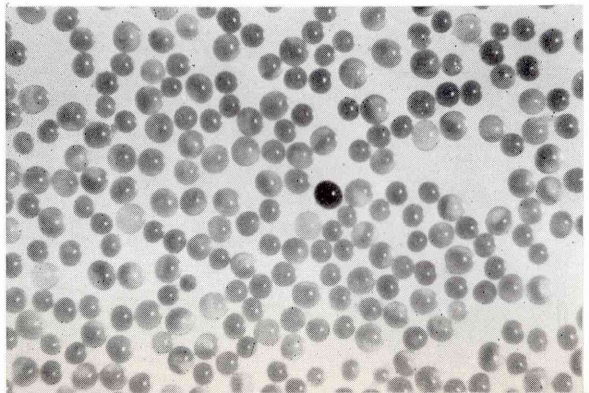
Second Laboratory

1. Comparison of killing and mutagenic efficiencies in plants treated with various types of radiation: Comparisons of radiation effects with different types of radiation have been carried out by T. FUJII in this laboratory for about 10 years with rice, wheat, maize and *Arabidopsis* seeds, using thermal neutrons of Japan Research Reactor No. 1 and Kyoto University Reactor, fission neutrons in Oak Ridge National Laboratory as well as heavy ions by HILAC in California. A 14 MeV neutron generator was recently established in this institute for the

promotion of these studies. Observations in higher plants indicated high RBE values around 20, i.e. two- to tenfold higher than those in animals and microorganisms. Also differences in RBE values at various ploidy levels were ascertained. The most severe radiation effect was observed by *C*-ion exposure of *Arabidopsis* seeds; the value was estimated as 35 in inducing somatic mutations. The RBE value might be the highest in that LET range, namely around 200 keV/μ.

2. Modification of radiation damage caused by dose rate or environmental conditions: With dormant seeds or growing plants of wheat and rice, the dose-rate effect is being studied by FUJII using ^{60}Co γ-ray irradiator and a γ-greenhouse in this institute, aud a γ-field of the Institute of Radiation Breeding. The recovery of radiation damage under chronic conditions and the does-rate dependency of mutation frequencies have been generally observed. In experiments with heterozygotic maize and chrysanthemum, a positive relationship between somatic mutation and dose-rate effect was observed. Recently, studies on modifications of radiation damage by environmental conditions with high LET radiations were started. Protection by nitrogen gas against thermal neutron induced damage was not observed in the seedling growth of wheat, while it was marked after X- or γ-irradiation. On the other hand, the killing efficiency in steeped *Arabidopsis* seeds was higher than that in dry seeds in thermal and fast neutron exposures as with X- or γ-rays. However the difference in the former was rather smaller than in the latter.

A non-*waxy* pollen grain of maize (at the center stained dark by iodine) found among *waxy* pollen grains (stained lighter) of a hybrid between different *waxy* mutants.



Third Laboratory

1. Molecular mechanisms of spontaneous and induced mutagenesis in bacteria: Studies on bacterial mutagenesis provide the most fundamental knowledge on the primary events in mutation phenomena on the cellular level. Recent research activities have been focused on genetic factors by which the cellular mutability is controlled. Extensive analysis of these factors was carried out by T. KADA in biochemical mutants of *Escherichia coli* K12 by means of conjugation and transduction techniques. These studies indicate that the actual observable mutability regarding a specific marker is determined by the molecular nature of the original locus, pre-mutational suppressor codons and modification of suppression mechanisms involving *s*RNA and ribosomes as well as by the function of mutator genes. It was also shown that ultraviolet irradiation or lysogenization with a temperate phage λ could induce mutator actions. Implications of these observations are now under examination in relation to the basal mechanisms involved in spontaneous and radiation or chemical-induced mutations, repair of pre-mutational damages, virus-induced mutagenesis, and so on.

2. Fine structure analysis of the waxy locus in maize: Since pollen grains can be handled by hundreds of thousands and show the *waxy* character of starch, non-*waxy* (*Wx*) pollen grains may be obtained by means of intragenic recombinations in the F_1 hybrid between two different *wx* mutants. Preliminary examinations carried out by E. AMANO of more than 40 EMS (ethyl methanesulfonate) induced *wx* mutants revealed that most of them might be point mutations and those induced by radiations so far examined might involve deletions.

3. Mechanism of mutational lesion and photorecovery of ultraviolet-induced damage: Photoreactivaion in UV-induced mutational lesions is studied by AMANO in maize by specific loci method. UV-treated pollen grains which have several dominant genes (*Su*, C^I, *Sh*, *Wx*, etc.) with and without additional visible-light treatments, were dusted on the silks of the recessive stocks and the change in the frequency of mutations in those genes was scored. A clear photoreactivation effect was observed. Two types of mutation, whole and fractional, were observed and they showed a similar repairability.

Qualitative estimation of the photoreactivability of UV-damage was also tried using the linked endosperm genes on chromosome 9, *C sh bz* and *wx*. The UV irradiation caused phenotypic losses in more than one marker genes, expressed as completely mutated tissue or as B-F-B mosaic tissue, suggesting chromosome breakage rather than point mutation. The visible light treatment reduced this effect.

4. Chemical interferences of biological effects induced by radiations of different LETs: Ionizing radiations act directly on target molecules as well as indirectly by means of reactive chemical species produced from water. Certain chemicals can scavenge them and prevent harmful reactions from proceeding. Others can maintain the cellular physiology so that the repair process may proceed at the maximum rate. On the contrary, it is known that the presence of some chemical agents enhances the radiation effects. They might produce toxic substances either to react with cellular components or to inhibit the cellular repairing capacity. Observations have been made by KADA and Y. SADAIE with γ-irradiation on protective and sensitizing effects of acridine dyes on the DNA level. It was also found recently that alkali iodates are extremely efficient sensitizers on the cellular level. These observations are now being developed for radiation cases of different LETs.

5. Mutation induction by internal radiation: One of the main projects is to clarify the mechanisms of biological effects of internal radiation caused by internally located radioisotopes, such as incorporated ^{32}P or ingested ^{90}Sr. Since several years, the transmutation effects of incorporated ^{32}P on killing and inducing mutations have been studied by KADA and M. HAYASHI in microorganisms, plants and silkworm. Past studies carried out by S. KONDO, H. ISHIWA and M. IKENAGA indicated that, in the case of bacteria, the killing action of decay of ^{32}P is due neither to intracellular nor extracellular β-radiation but to the transmutation effect itself. The mutagenic action of ^{32}P is also due largely to the transmutated atom. Similar conclusions have been obtained in silkworm. Further studies are in progress to obtain detailed informations on the molecular nature of damages.

6. Genetic studies on radiation effects on cellular division mechanisms: Regulation of cell division might be one of most radio-sensitive biological functions. The radiation lethality is due to inhibition of cytokinesis in certain cells irradiated with very low doses of ultraviolet light or ionizing radiations. It has been found by KADA that highly frequency revertants from a threonineless strain of *Escherichia coli* K12 were very sensitive to radiation because of their tendency to form filamentous cells. Genetic analysis has indicated that the radiosensitivity was closely linked to a gene controlling suppressor actions. Implications of such a genetic character in cellular division mechanisms are under investigation.

HUMAN GENETICS

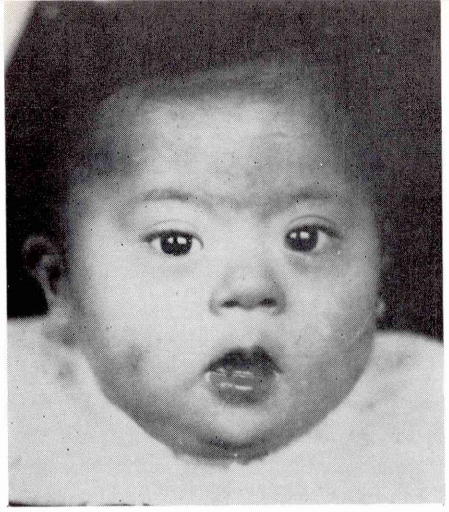
As it usually happens in the development of a science, human genetics has been acquiring wider and wider aspects during the last decade, and integration is now a serious problem for most of the workers in this field. A major concern of this department since its initiation in 1960 has been, therefore, a comparative study of the genetic composition, normal and abnormal, of the Japanese population in comparison with other ethnic groups. Its aim is to understand how the genetic composition is related to environmental factors, past and present, of physical, biological and cultural nature, and what kind of genetic consequences may be expected from rapid changes of various factors such as those affecting in recent times social, family and marriage patterns in this country.

While the formal organization of the department consists of two laboratories they are working in close cooperation on the topics outlined below. Besides, genetic counselling has been incorporated into the current activities as a service to the public.

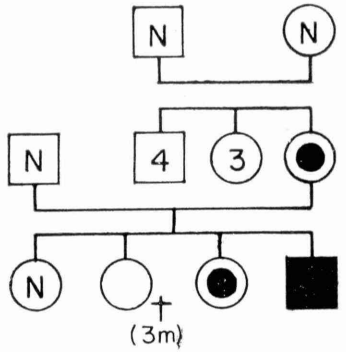
First Laboratory

1. Possible genetic consequences of family planning: Since the legalization of abortion by the Eugenic Protection Law in 1948, Japan has achieved an unprecedented drop in births during a short period, so that a pattern of small family size is now established not only in urban but also in rural areas. The purpose of this study carried out by E. MATSUNAGA is to evaluate the family planning programme on national scale, to estimate to what extent the abortions have been replaced by contraceptions as a means of limiting family size, and to inquire about possible eugenic as well as dysgenic effects of the present trend upon future generations.

2. Genetic variation in dermal ridge patterns: Dermatoglyphics can be used for various purposes related to human biology. The main purpose of this study is to elucidate the heritability of some traits in dermal ridge patterns and to test the intercorrelation between them. Prints of finger tips, palms, soles and toes are being cellected from family members. The anlysis is now going on by MATSUNAGA

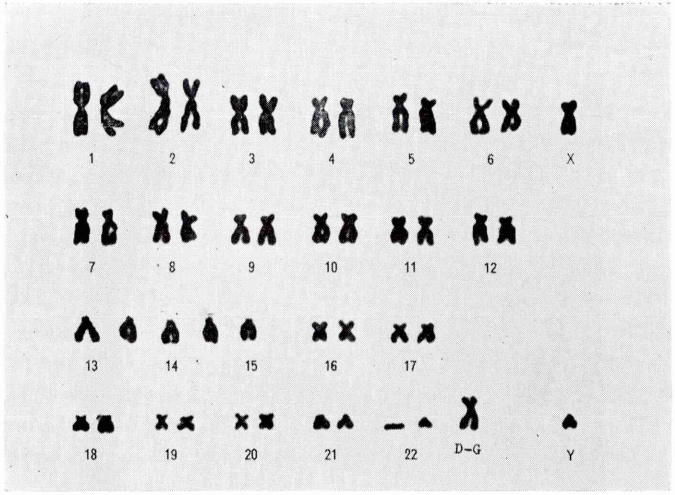


Six months old boy with Down's syndrome.

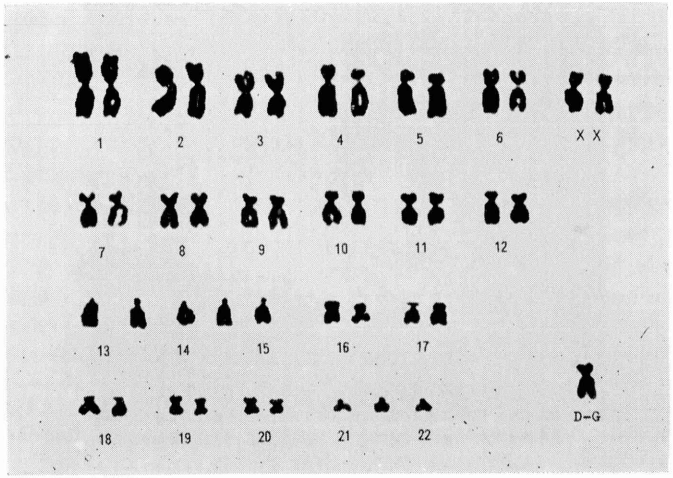


■: Down's syndrom with D-G translocation
⊙: D-G translocation carrier
N: Normal karyotype
③, 4: Number of sibs, not examined
†: Died

Pedigree of the family showing transmission of a D-G translocation.



Karyotype of a patient with Down's syndrome; an extra G chromosome translocated to one of D chromosomes.



Karyotype of the mother who is phenotypically normal but a carrier of D-G translocation.

and E. MATSUDA, and some results related to sexual variation in finger pattern size and pattern types have been obtained.

3. Studies in biochemical genetics: Biochemical polymorphisms in human serum proteins and blood enzymes are studied by T. SHINODA from the view points of both molecular and population genetics. Recently, SHINODA has determined, in collaboration with Professor Frank W. PUTNAM of Indiana University, Indiana, U. S. A., the complete amino acid sequence of a λ type Bence-Jones protein, including the assignment of the amide groups; he obtained some evidences supporting the view that the light chains of immunoglobulins have a variable amino-terminal half and an invariant carboxyl-terminal half that carries the genetic factors.

Second Laboratory

1. Chromosome studies in patients with congenital anomalies: In collaboration with several University Hospitals in Tokyo, a number of chromosome aberrations were analyzed by Y. KIKUCHI and H. OISHI in various types of congenital anomalies. In particular, more than 500 cases with Down's syndrome have been karyotyped, and it was shown that the relative proportions of G-trisomic and translocation types (D-G and G-G) are essentially the same as reported for Caucasians. Epidemiologic studies are going on to identify factors, both intrinsic and extrinsic, affecting chromosome mutations.

2. Autoradiographic studies of human chromosome replication: Autoradiographic techniques have been used by KIKUCHI and OISHI mainly for the study of DNA replication pattern of human chromosomes. This technique may be utilized also for chromosome identification. The major aim of this study is to analyze the replication pattern of sex chromosomes and autosomes in normal subjects as well as in patients with various chromosome abnormalities.

MICROBIAL GENETICS

First Laboratory

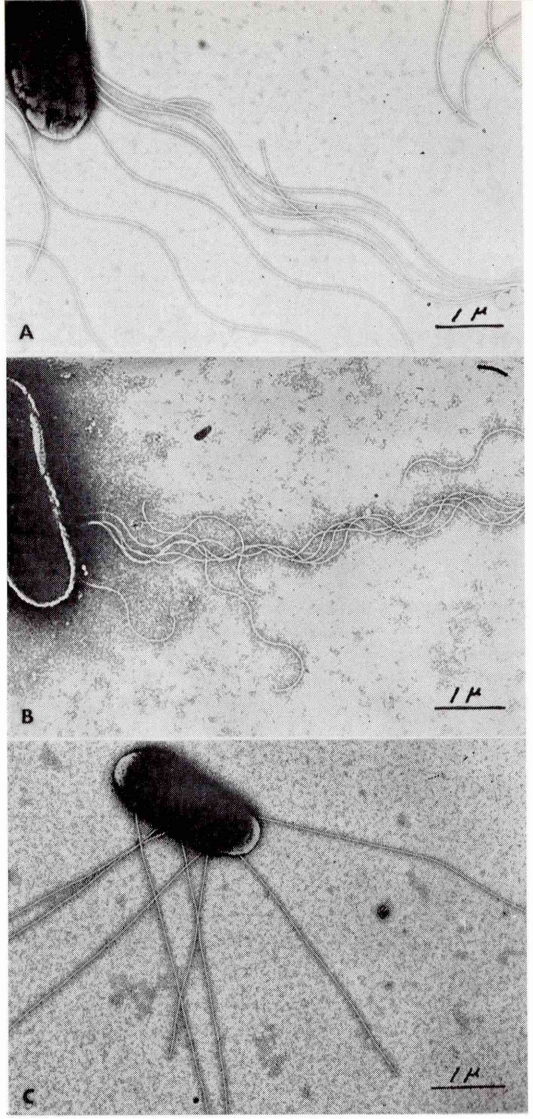
The major subject of researches in this laboratory is the genetics of *Salmonella* flagella. *Salmonella* flagella are excellently suited for genetic studies on synthesis of proteinaceous antigen and cytomorphogenesis.

In acid solution below pH 3.5, a bacterial flagellum dissociates into homogeneous protein monomers called "flagellin". Immunological studies of both flagella and their component flagellins have indicated that a flagellin molecule is the unit of flagellar antigen. Two flagellin loci, *H1* and *H2*, each of which is assumed to carry the whole genetic code for amino acid sequence of a flagellin, were disclosed by the studies of their genetic fine structure. It was demonstrated that a mutation in one of those genes produces an altered configuration of the corresponding flagellin, resulting in a change in antigen type, a modification of the flagellar shape or an alteration of the receptor site to motility phage.

For the production of flagella, several regulatory genes have been found to be involved, namely *fla*, *ah* and *vh* 2. A *fla*$^-$ mutation in any one of the *fla* genes causes loss or decrease of the ability to produce flagella. More than 100 *fla*$^-$ mutants so far examined were classified into, at least, eight complementation units. One of these *fla*$^-$ mutants was found to produce flagellins but fail to construct flagella from them. The remaining *fla*$^-$ mutants can not synthesize flagellin monomers. *ah* adjoins to each *H* gene, *ah 1* to *H1* and *ah 2* to *H2* respectively, and switches on or off the genetic activity of the latter. The function of *ah* is effective to the adjoining *H* gene only when it is in cis-position to *H*. *vh 2* regulates the stability of *H2* state. Regulatory mechanisms of those genes are under active investigation.

As regards flagellar morphogenesis, *in vitro* reconstitution of flagellar fibres from their component flagellin molecules is under study.

An efficient method to select paralyzed mutants of bacteria was invented. By genetic analysis, paralyzed mutants (*mot*$^-$) of *S. typhimurium* obtained by this method were classified into three cistrons and their chromosomal locations were mapped. Biochemical studies on the function of these cistrons are in progress.



Electron micrographs of flagellar shape mutants of *Salmonella typhimurium*. A: normal. B: curly. C: straight. Negatively stained by phosphotungstate.

Second Laboratory

Cellular regulatory mechanisms of gene action are studied genetically and biochemically with *Salmonella* in this laboratory.

New mutants which suffer growth inhibition by arginine were isolated from wild type *S. typhimurium* strain LT 2. Main characteristics of these mutants are as follows: 1) their growth is specifically inhibited by arginine, 2) growth of more than half of them is also inhibited by uracil, 3) the critical point of arginine or uracil concentration high enough to supress the growth of these mutants lies between 10^{-5} M and 10^{-4} M, 4) the growth inhibition by arginine is specifically and immediately removed by addition of uracil to the concentration equivalent to or higher than that of arginine, and *vice versa*, 5) one of the mutants, *arg-s-1*, shows normal activity of ornithine transcarbamylase, aspartate transcarbamylase and carbamate kinase (or carbamyl phosphate synthetase), suggesting that it has no genetic block in the structural genes of these enzyme proteins, and 6) ornithine transcarbamylase of *arg-s-1* is normally repressed by arginine. From these observations, these mutants have most likely some genetic block in the cellular regulatory mechanism for synthesizing both arginine and uracil, probably in a regulator gene. To clarify cellular regulatory mechanisms of gene action, it would be most helpful to bring to light the fine structure of the regulator gene itself as well as to identify the repressor as a chemical substance. For this purpose, it is attempted to produce more such mutants as described above for their genetical and biochemical analyses.

On the other hand, it is never neglected to carry out investigations *in vitro* to find out the characteristics of the repressor itself. The establishment of a system for synthesizing a specific protein *in vitro*, and finding of an efficient method for detecting the synthesized protein are essential for biochemical approach to repressor. To start with, the flagellar antigen of *Salmonella* has been chosen as a specific protein, because this protein has heen genetically extensively studied in the First Laboratory of this department. Fractionation of flagellins by DEAE-cellulose or by antibody cellulose has been carried out, through which separation of flagellins with different antigenic specificities has been successful. Now it is tried to establish a system, which will allow the synthesis of those proteins *in vitro*.

POPULATION GENETICS

The department was launched in July 1964 with a single laboratory (the First Laboratory), and another one (the Second Laboratory) was added in April 1966. It is the ninth and at the moment the last research department added to the preexisting eight.

The purpose of this department is to investigate the laws which govern the genetic structure of natural populations. In the First Laboratory, the emphasis is placed on the investigation of the mechanism of evolution, while the main object of the Second Laboratory is to carry out mathematical and statistical analyses of the genetic structure of natural populations including those of man.

For those studies, it is hoped that the department will have in future the facility of an electronic computer.

First Laboratory

Here, problems relating to the mechanism of evolution are investigated from the standpoint of population genetics. The staff members of the laboratory, their previous and present activities are as follows:

M. KIMURA has been working on the mathematical theory of population genetics for the past 20 years, the first ten having been mainly devoted to the solution of problems dealing with the stochastic processes of the change of gene frequencies in populations.

His contributions include the finding of solutions for the processes of random genetic drift and for the probability of fixation of mutant genes in a finite population. The latter results have been used by Alan ROBERTSON in developing his theory of selection limits in animal and plant breeding. Also, KIMURA derived in 1956 the equations describing the change of chromosome frequencies under linkage and epistasis.

Later, in collaboration with J. F. CROW of the University of Wisconsin, he worked on problems relating to genetic loads, effective population number and maintenance of genetic variability in populations. He also worked on models of population structure.

More recently, he has worked, in collaboration with T. MARUYAMA, on such problems as mutational load with epistatic gene interaction

in fitness, substitutional load in a finite population and probability of gene fixation under inter- and intra-population selection. He is also working on the evolutionary rate at the molecular level.

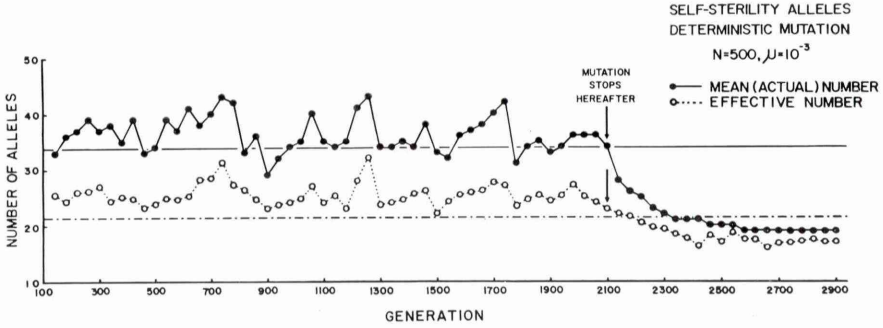
MARUYAMA joined the laboratory in 1966 to work with KIMURA Previously, he obtained a Ph. D. degree at the University of Wisconsin majoring in genetics under the direction of Dr. J. F. CROW. He also holds an M. S. degree in mathematics granted by the same university. The aim of his main research is to extend KIMURA's theoretical works, using more advanced mathematical treatments. He is also concerned with simulation studies with the help of a computer.

Second Laboratory

In 1966, the laboratory was opened for mathematical and statistical analyses of the genetic structure of natural populations, including those of man. N. YASUDA has been working in this field for several years. He holds a Ph. D. degree from the University of Hawaii. His career in human population genetics started in 1961 when he studied medical genetics at the University of Wisconsin. During 1962, his experience from a field study in Brazil induced him to extend Wahlund's principle to evaluate mating type frequencies in terms of gene frequencies and inbreeding coefficient. This model has been successfully applied to a population of Northeastern Brazil. He also studied the problem of isolation by distance, confirming that the inbreeding coefficient decreases with distance.

Since 1966, he has been investigating the distribution of matrimonial distance in Misima district, in order to obtain a basic information on the pattern of human migration. Such an information is necessary for evaluating the probability of consanguineous marriages and for estimating the inbreeding coefficient. A promising set of data have been accumulating which enable us to determine a mathematical form of the distribution. This study is still under progress.

His investigation on statistical methodology is directed at present to gene frequency estimation. In collaboration with KIMURA, he devised a simple method of obtaining the maximum likelihood estimates, based on the concept of gene counting.



An example of Monte Carlo experiments performed by using computer IBM 7090 to study the number of self-sterility alleles maintained in a small population consisting of 500 individuals in which one new mutant S allele is introduced in each generation.

STOCKS MAINTAINED

BACTERIA AND BACTERIOPHAGES

1) Bacteria

Salmonella typhimurium
- Strain LT2, LT7, TM2 etc.
- Auxotrophic mutants, c. 350 strains including auxotrophy for amino acids, purines, pyrimidines, or vitamins
- Mutants unable to utilize various sugars as energy source, c. 20 strains
- Resistant mutants to antibiotics (Sm, Cm, Tc, etc.), c. 50 strains
- Sensitive or resistant mutants to bacteriophages (P22, chi, etc.), c. 50 strains
- Non-flagellated mutants, c. 250 strains
- Paralyzed mutants, c. 100 strains
- Serotype mutants, c. 20 strains

Salmonella abortus-equi
- Strain NTC5727, SJ241 etc.
- Resistant mutants to antibiotics (Sm, Cm, Tc, etc.), c. 30 strains
- Sensitive or resistant mutants to bacteriophages (P22, chi, etc)., c. 30 strains
- Non-flagellated mutants, c. 100 strains
- Paralyzed mutants, c. 10 strains
- Serotype mutants, c. 130 strains

Salmonella abony
- CDC103, Hfr and F$^-$ strains
- Auxotrophic mutants for amino acids
- Sensitive or resistant mutants to antibiotics and bacteriophages

Salmonella serotypes C. 30 strains including *S. para B, S. paratyphi A, S. sendai, S. heidelberg,* etc.

Escherichia coli
- Strain K, B, S, Row
- Auxotrophic mutants for amino acids, purines, pyrimidines or vitamins
- Sensitive or resistant mutants to antibiotics or bacteriophages
- Hfr and F$^-$ strains

Serratia indica
Serratia plymuthicum
Serratia marcescens
- Color mutants
- Sensitive or resistant mutants to antibiotics or bacteriophages

Shigella boyd
Shigella sonnei
Shigella dysenteria
Shigella flexneri
- Sensitive or resistant mutants to antibiotics (Sm, Cm, Tc, etc.)

2) Bacteriophages

Salmonella: P22, chi
Escherichia: T1, T2, T3, T4, T5, T6, T7, Lambda
Serratia: Sigma

DROSOPHILA

1) Drosophila melanogaster = 994 strains, 12 cage populations

A) Wild type, 70 strains

a)	Strains Collected from different places in Japan	39
b)	Strains Collected from different places in foreign countries	27
c)	Isogenic strains	4

B) Mutant type, 126 strains

a)	Mutant genes on X chromosome	33
b)	Mutant genes on second chromosome	41
c)	Mutant genes on third chromosome	20
d)	Mutant genes on fourth chromosome	3
e)	Mutant genes on multi-chromosomes	29

C) Deleterious and normal second chromosomes, 798 strains

a)	Lethal chromosome	481
b)	Semilethal chromosome	81
c)	*Reduced bristle* gene	71
d)	SD (segregation distorter gene)	59
e)	SD sensitive chromosome	10

f) SD resistant chromosome 9
g) Normal chromosome 86

D) Cage population, 12 populations
a) Wild type 9
b) SD 3

2) ***Drosophila virilis***, 8 strains

A) Wild type, 3 strains

B) Mutant type, 5 strains

3) ***Drosophila pseudoobscura***, 30 strains

ST (standard chromosome) 9
AR (Arrowhead chromosome) 8
CH (Chiricahua chromosome) 6
PP (Pikes Peak chromosome) 7

4) **Other species**, 15 strains

Drosophila kikkawai 1
D. simulans 1
D. lutea 3
D. auraria 2
D. busckii 2
D. hydei 1
D. rufa 1
D. nigromaculata 1
D. immigrans 2
D. equinoxialis 1

Grand total=1047 strains and 12 populations

SILKWORMS

1) **Mutant strains**

Linkage group I	*od*; *od'*; *od e*; *os e*; *e od Vg*; *sch*
Linkage group II	*p*; p^+; p^M; p^S; p^{Sa}; $p^{Sa-2}Y$; *Gr*; Gr^{col}; *Y*; *oα*
Linkage group III	*Ze*; *lem*; lem^1; *d-lem*; *d-lem*^{1}; *d-lem*^{2}
Linkage group IV	*L*; S_{pc}; *L lem q oc*
Linkage group V	*pe*; *re*; *ok*; *oc*; *bw*
Linkage group VI	*E*; E^{Ca}; E^D; E^{El}; E^d; E^H; E^{Kp}; E^{Mc}; E^{Ms}; E^N; E^{Nc}; E^{Np}; E^{Ns}; $E^{Gd}E^{Nc}$; $E^{Kp}E^D$; $E^{Kp}E^H$; $E^{Nc}E$: $E^{Nc}E^H$; $E^{Np}E^D$; E^{Tc}; b_2, 6 strains of E^{Kp} mutant, and 5 strains of E^{El} mutant
Linkage group VII	*q*
Linkage group VIII	*ae*; *be*; $+^{ae}$; $+^{be}$; *st*
Linkage group IX	*I-a*
Linkage group X	w_1; w_2; w_3; w^{ol}; *fl*; b_3; *oew*; w^{ox}; *w-a*; *w-b*; *w-c*
Linkage group XI	*K*; *Bu*; *Np*; *bp*
Linkage group XII	*Ng*
Linkage group XIII	*ch*
Linkage group XIV	*odk*; *Nl*; Nl_1; Nl_2; *U*; *oa*; *Di*
Linkage group XV	*Se*
Linkage group XVI	*cts*
Linkage group XVII	*Bm*
Linkage group XIX	*elp*
Linkage group XX	*nb*
Others	*al*; *Gl*; *m-gr*; *Nd*; *rb*; *so*; *sp* Seihaku, Brown spot, Daizo, Sasa, Kojiki, Ascoli, Aojiku, Akajiku, Sekko, Kansen, Hiko, p 22, 2 hereditary mosaic mutants, 3 abnormal appetite mutants

2) **Strains with chromosome aberrations**

ZW II	$+^{od}\cdot\widehat{W\cdot+^{p}\cdot p^{Sa}}y/od$
Z 101	$+^{od}\cdot\widehat{W\cdot+^{p}\cdot p^{Sa}}/Z^{+}/Z^{od}$ (lethal female, 2 strains)
H 108	$\widehat{W\cdot+^{p}y\cdot p^{Sa}}y$
W-P 108	$\widehat{W\cdot+^{p}}y$ *oα*
K 7	$\widehat{W\cdot+^{p}}y$ *def* (3 strains)
M 3	$\widehat{W\cdot p^{M}}$ (4 strains)

Sex-limited Ze	$\widehat{W \cdot Ze}$
T-20	$\widehat{W \cdot +^{w2}}$ (4 strains)
T-re	$\widehat{W \cdot +^{re}}$
Dup	$+^{p}\widehat{y \cdot p^{Sa}}Y/py$ (2 strains)
Q 121	$+^{p}\widehat{y \cdot p^{Sa}}y/pY\ o\alpha/py\ o\alpha$ (2 strains)
C 32	$p^{Sa}\widehat{\cdot +}pY\ o\alpha$ (high crossover frequency between $+^{p}$ and Y, 2 strains)
GH 1	$\widehat{U \cdot E^{Kp}}$
GH 3	$\widehat{U \cdot E^{N}}$
GH 4	$\widehat{U \cdot E^{H}}$
GH 13	$\widehat{U \cdot Nc}$
Trisomic 2	$p^{S}/p^{M}/+^{p}$
Trisomic 6	$E^{H}E^{Kp}/+/+$; $E^{Nc}/E^{H}/+$; $E^{Nc}/E^{D}/+$
Trisomic 14	$+^{oa}/oa/Di$
Trisomic 112	$p^{Sa}y/pY/py$
black mottles	(2 strains)

Grand total 159 strains

Mousery.

EPHESTIA

1) **Wild type strain**
   NCR
2) **Single recessive mutant strains**
   b/b
   ml/ml
   a/a
3) **Double recessive mutant strains**
   a/a : *b/b*
   ml/ml : *b/b*

MICE, RATS AND OTHER LABORATORY ANIMALS

1) **Inbred strains of mice (*Mus musculus*)**
   A/HeMs, AKR/JaxMs, BALB/cJMs, BL/De, CFW/Ms, C57BL/6HeMs, C57BR/aJMs, C57L/HeMs, C58/LwMs, C3H/HeMs, C3HeB/De, DM/Ms, DD/Ms, D103/Ms, DBA/2, DBAf/Lw, RF/Ms, RFM, SL/Ms, SM/J, SWR/Ms, SWM/Ms

2) **Mutant stocks of mice**
   Linkage group I chinchilla (c^{ch}), extreme dilution (c^{e}), pink-eyed dilution (p)
   Linkege group II short ear (s^{e}), dilute (d), dilute lethal (d^{l})
   Linkage group III piebald (s), hairless (hr), rhino (hr^{rh}), Viable dominant spotting (W^{v}), luxate (lx)
   Linkage group V non-agouti (a), black and tan (a^{t}), Lethal yellow (A^{y})
   Linkage group VI Caracul (Ca)
   Linkage group VII Rex (Re), tipsy (ti)
   Linkage group VIII brown (b)
   Linkage group IX Brachyury (T), Fused (Fu)
   Linkage group XI obese (ob)
   Linkage group XII jerker (je)
   Linkage group XIII leaden (ln)
   Linkage group XIX dystrophia muscularis (dy)
   Mutants of unknown linkage group furless (fs), alopetia

periodica (*ap*), falter (*fa*), Post-axial polydactyly (P_O), dwarf (*dw*)

3) Inbred strains of rats (*Rattus norvegicus*)

ACI/N, Albany, Buffalo, Castle's Black, CW-1, Fischer, Long-Evans, Nagoya, NIG-III, YOS, Tailless-W, Wistar, Wistar-King-A, Wayne's pink-eyed yellow hooded.

4) Other laboratory animals

Chinese hamster (*Cricetulus griseus*)
House rat (*Rattus rattus*)
Golden hamster (*Mesocricetus aurattus*)

RICE

O. abromeitiana PROD.	4
O. alta SWALLEN	5
O. australiensis DOMIN	2
O. brachyantha A. CHEV. et ROEHR.	12
O. breviligulata A. CHEV. et ROEHR.	45
O. coarctata ROXB.	3
O. eichingeri PETER	16
O. glaberrima STEUD.	400
O. grandiglumis PROD.	5
O. latifolia DESV.	26
O. longiglumis JANSEN	15
O. malampuzhaensis KRISH. et CHAND.	2
O. meyeriana BAILL.	27
O. minuta PRESL	42
O. officinalis WALL.	76
O. perennis MOENCH	340
O. perrieri A. CAMUS	1
O. punctata KOTSCHY	10
O. ridleyi HOOK.	6
O. sativa L.	3,404
O. subulata NEES	1
O. tisseranti A. CHEV.	1

WHEAT AND ITS RELATIVES

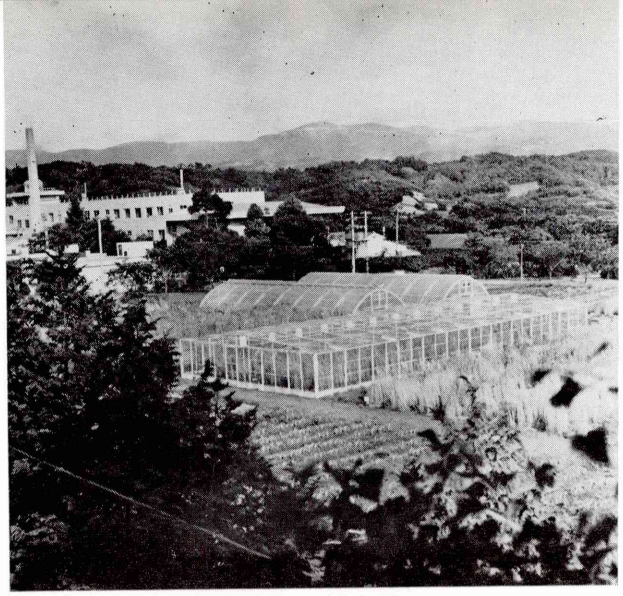
1) Wheat

A) Species collection

T. aegilopoides BAL.		3
T. monococcum L.		3
T. dicoccoides KÖRN.		3
T. araraticum JAKUBZ.		1
T. dicoccum SCHÜBL.		3
T. durum DESF.		5
T. orientale PERC.		1
T. persicum VAV.		3
T. polonicum L.		1
T. isphanicum HESLOT		1
T. pyramidale PERC.		1
T. turgidum L.		2
T. palaeocolchicum MEN.		2
T. timopheevi ZHUK.		14
T. aestivum L.		7
T. compactum HOST		2
T. macha DEC. et MEN.		14
T. spelta L.		94
T. sphaerococcum PERC.		2
T. vavilovii JAKUBZ.		1
T. zhukovskyi MEN.et ER.		1
Synthetic hexaploid wheat		6
Total	21 species	170 strains

B) Cultivated varieties of common wheat

Japanese local varieties	211
Chinese varieties	223
Tibetan varieties	19
Indian varieties	75
KUSE (Middle to Near East) vars.	241
American varieties	300
Australian varieties	84
Iberian varieties	231



Experimental fields.

Russian varieties	93
Greek varieties	20
Jugoslavian varieties	17
Scandinavian varieties	62
Italian varieties	78
South American varieties	46
Total	1,700 strains

2) ***Aegilops***

Ae. aucheri BOISS.	1
Ae. bicornis JAUB. et SP.	2
Ae. biuncialis VIS.	1
Ae. caudata L.	1
Ae. columnaris ZHUK.	2
Ae. comosa SIBTH. et SM.	2
Ae. crassa BOISS.	2
Ae. cylindrica HOST	3
Ae. heldreichii HOLZM.	1
Ae. kotschyi BOISS.	4
Ae. longissima SCHW. et MUSCH.	1
Ae. mutica BOISS.	1
Ae. ovata L.	6
Ae. sharonensis EIG	2
Ae. speltoides TAUSCH	2
Ae. squarrosa L.	6
Ae. triaristata WILLD.	7
Ae. triuncialis L.	6
Ae. turcomanica ROSH.	1
Ae. umbellulata ZHUK.	3
Ae. uniaristata VIS.	3
Ae. variabilis EIG	3
Ae. ventricosa TAUSCH	5
Total 23 species	68 strains

3) ***Agropyron***

Ag. campestre G. G.	3
Ag. caninum (L.) P. B.	3
Ag. ciliare (TRIN.) FRANCH.	11
Ag. cristatum (L.) GAERTN.	6
Ag. dasystachyum (HOOK.) SCRIBN.	1
Ag. desertorum (FISCH.) SCHULT.	4
Ag. elongatum (HOST) P. B.	11
Ag. humidorum OHWI et SAKAMOTO	8
Ag. intermedium (HOST) P. B.	8
Ag. junceum (L.) P. B.	7
Ag. littorale (HOST) DUM.	3
Ag. pectiniforme ROEM. et SCHULT.	2
Ag. repens (L.) P. B.	3
Ag. riparium SCRIBN. et SMITH	1
Ag. semicostatum NEES	1
Ag. sibiricum (WILLD.) P. B.	5
Ag. smithii RYDB.	3
Ag. spicatum (PURSH) SCRIBN. et SMITH	1
Ag. trachycaulum (LINK) MALTE	2
Ag. trichophorum (LINK) RICHT.	5
Ag. tsukushiense (HONDA) OHWI	19

	Ag. yezoense HONDA	4
	Total 22 species	111 strains
4)	***Aspere1la***	
	As. longe-aristata (HACK.) OHWI	2
5)	***Elymus***	
	El. canadensis L.	2
	El. dahuricus TURCZ.	2
	El. glaucus BUCKL.	1
	El. mollis TRIN.	1
	El. sibiricus L.	6
6)	***Sitanion***	
	St. hystrix (NUTT.) J. G. SMITH	1
7)	***Eremopyrum***	
	Er. buonapartis (SPRENG.) NEVSKI	9
	Er. orientale (L.) JAUB. et SPACH	1
	Er. triticeum (GAERTN.) NEVSKI	2
8)	***Henrardia***	
	Hn. persica HUBBARD	1
9)	***Heteranthelium***	
	Ht. piliferum HOCHST.	1
10)	***Taeniatherum***	
	Tn. asperum (SIMK.) NEVSKI	1
	Tn. crinitum (SCHREB.) NEVSKI	1

FLOWERING CHERRY TREE

Prunus apetala
P. apetala var. *pilosa*
P. incisa
P. incisa forma *Yamadai*
P. incisa var. *tomentosa*
P. incica var. *kinkiensis*
P. nipponica kurilensis
P. campanulata
P. sieboldii
P. yedoensis
P. Jamasakura
P. Jamasakura var. *chikusiensis*
P. sargentii
P. verecunda
P. subhirtella
P. subhirtella var. *pendula* forma *ascendens*
P. subhirtella forma *pendula*
P. Lannesiana var. *speciosa*
P. maximowiczii
P. ogawana

Cultivated varieties and hybrids 148

MORNING GLORY (PHARBITIS NIL)

a	white	*dl*	delicate
ac	acuminate	*dl*^{m}	delicate mutable
B	Blown	*dp*	duplicated
b	blown	*dw*	dwarf
br	brown	*dy*	dusky
bv	brimvein	*e*	extended
Bz	Blizzard	*ef*	early flowering
c	c-white	*Ex*	Expanded
ca	ca white	*f*	fasciated
ca^{i}	ivory	*fa*	fainted
cd	contorted	*fd*	faded
cm	crumpled	*fd*^{s}	smeary
cn	chestnut	*fe*	feathered
co	cordate	*fe*^{c}	creased
co^{H}	Hederacea	*ft*	faint
coa	cocoa	*g*	glabrous
cp	crepe	*Ob*	Globose
cr	cream	*h*	hair
cs	criss-crossed	*hs*	hard seed
ct	contracted	*hw*	half-white
cu	couple	*i*	intense
cy	cream yellow	*Ln*	Lined
dc	deep-crumpled	*lp*	lilliputian
dg	dragonfly	*lt*	light
di	dingy	*m*	maple
dk	duskish	*mp*	pine

Mutants of Japanese morning glory (*Pharbis nil*): *delicate willow* (upper left), *acuminate willow* (upper right), *willow* (lower left), and *acuminate* (lower right).

m^w	willow	*sf*	shaded off
mg	magenta	*Sl*	Stellate
Mr	Margined	*sp*	speckled
Mr-f	Margined fluctuated	*sph*	spheloid
p	pear	*sr*	side-reduced
p^p	pear-petaloid	*st*	striped
pg	pigmy	*su-Cy*	Cream yellow suppressor
pr	purple	*su-Mr*	Margined-suppressed
pt	petaloid	*su-tw*	tube color suppressor
py	polymorphic	*sz*	size
r	white	*tw*	tube-white
re	retracted	*v*	variegated
Ry	Rayed	*we*	weeping
s	star	*wr*	wrinkled
Sa	Striated	*y*	yellow
sc	semi-contracted	*y^{-m}*	yellow mutable

ORNAMENTAL PLANTS

1)	Camellia	*Camellia japonica* var. *hortensis*	83 cultivated varieties
		C. rusticana	5 cultivated varieties
2)	Plum	*Prunus mume*	19 cultivated varieties
3)	Maple	*Acer spp.*	34 cultivated varieties

PUBLICATIONS

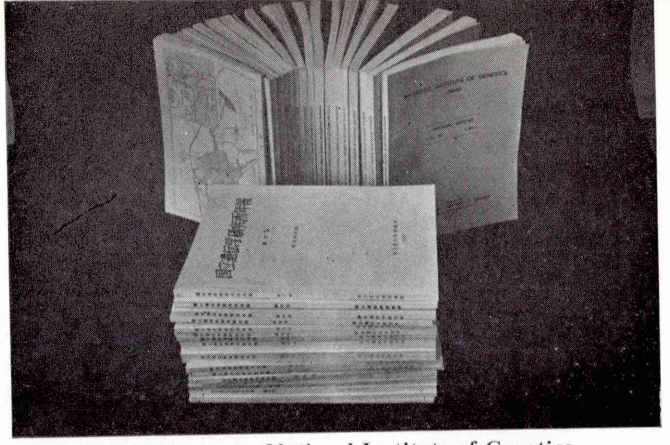
ANNUAL REPORTS

The Institute publishes the "Annual Reports" both in Japanese and English, and distributes them to institutions and individuals interested in the activities of the Institute. So far the following numbers of the English edition have been issued.

No.	Pages	Research items contained	Date of issue
1 (1949–50)	53	46	Nov. 1951
2 (1951)	70	54	Oct. 1952
3 (1952)	69	44	Oct. 1953
4 (1953)	69	47	Aug. 1954
5 (1954)	90	57	Sep. 1955
6 (1955)	102	76	Aug. 1956
7 (1956)	105	68	Aug. 1957
8 (1957)	115	76	Jul. 1958
9 (1958)	144	84	Sep. 1959
10 (1959)	162	109	Oct. 1960
11 (1960)	111	97	Oct. 1961
12 (1961)	128	101	Jun. 1962
13 (1962)	115	86	Aug. 1963
14 (1963)	139	111	Aug. 1964
15 (1964)	165	126	Nov. 1965
16 (1965)	139	111	Nov. 1966
17 (1966)	146	100	Jul. 1967

CONTRIBUTIONS TO SCIENTIFIC JOURNALS BY THE STAFF

Papers written by the staff members have been contributed to various scientific journals, both domestic and foreign. Up to date (December 1967), 810 "contributions" have been printed. The reprints of these papers are distributed regularly to biological institutions and individual geneticists.

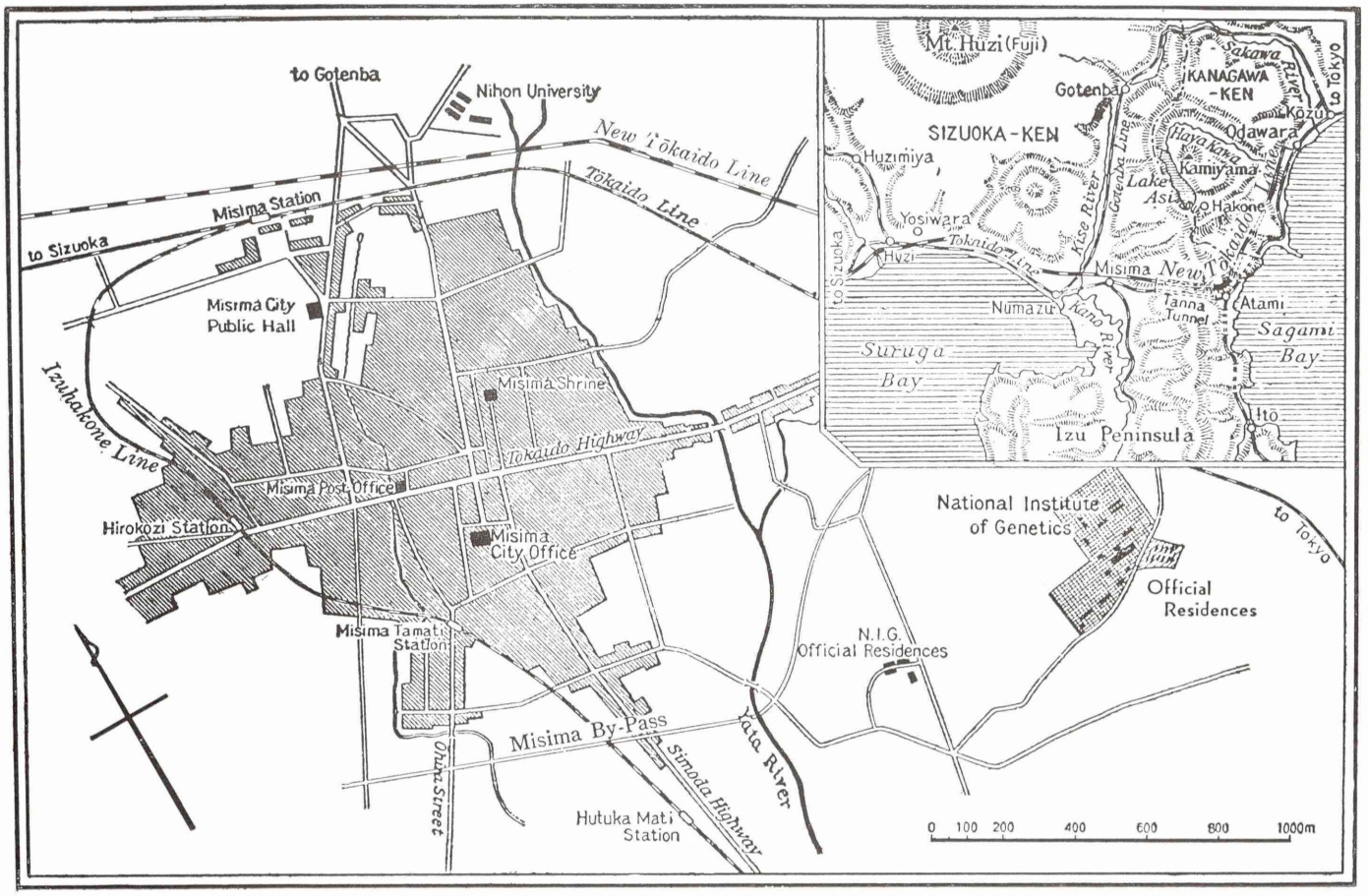


Annual Reports, National Institute of Genetics.

This issue was edited by T. H. YOSIDA and Y. KURODA, who express their sincere gratitude to Dr. F. A. LILIENFELD for her kindness in reading the original manuscripts.

BACK COVER

Aerial view of the National Institute of Genetics (Photographed by the Mainichi Press).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Yosiwara
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to Sizuoka
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Numazu
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Atami
Sagami Bay
Suruga Bay
Ito
Izu Peninsula