AWARD OF MEDALS

The Eighty-seventh Annual Award of Medals was held on Monday, July 7, 1997, at 10:30 a.m., in the presence of His Majesty the Emperor.

The function was opened with an address by the President, in which he made a brief statement of each award.

The Medals and Prizes were presented to the following recipients:

Imperial Prize and Japan Academy Prize to:

Shigetada NAKANISHI
for "Studies on Molecular Mechanisms of Neurotransmission"

Japan Academy Prizes to:

Mitsuhiko TAKUMI
for *The World Great Crisis—The Process and Causes of the Crisis of 1929*

Taroh MATSUNO
for "Elucidation of Atmospheric Dynamics in the Stratosphere and Mesosphere"

Hideo YAMATERA
for "Invention of Yamatera's Rule of Spectroscopy of Metal Complexes and Studies on their Coordination Structures"

Mutsuo SEKIGUCHI
for "Studies on Mechanisms of DNA Repair and Maintenance of Genetic Information"

Kiyoshi HORIKAWA
for "Study on Nearshore Dynamics and Coastal Sediment Transport Mechanisms"

Nobuaki KUMAGAI
for "Basic Research on the Development of New Theories of Electromagnetic Waves and their Applications to Guided Wave Transmission"

Koichiro TSUNEWAKI
for "Comparative Gene and Plasmon Analyses in Wheat and its Related Genus *Aegilops*"

Shiro MIWA
for "Studies on Hereditary Hemolytic Anemia due to Red Cell Enzymopathies"

After this, congratulatory addresses were given by the Prime Minister and the Minister of Education, Science, Sports and Culture.

The function was closed at noon.

The outlines of the recipients' works appear in the following pages.

Imperial Prize and Japan Academy Prize to:

Shigetada NAKANISHI
Professor,
Kyoto University Faculty of Medicine

for "Studies on Molecular Mechanisms of Neurotransmission"

Outline of the Work:

Synaptic transmission mediated by a variety of neurotransmitters and their receptors is a fundamental mechanism that underlies brain function. It is thus a central theme to explore what mechanisms are involved in synaptic transmission and how such mechanisms control brain function. Dr. Shigetada Nakanishi has been thoroughly working on the regulatory mechanisms of neurotransmission and has made the following great contributions:

1. Substance P belongs to the tachykinin peptide family and acts as a neurotransmitter in pain generation. Dr. Nakanishi molecularly elucidated the structure and gene organization of the substance P precursor and revealed that the substance P precursor contains an additional novel tachykinin peptide, termed substance K. He chemically synthesized substance K and indicated that this peptide has an agonist profile and response different from those of substance P, leading to an important conclusion that the mammalian tachykinin system forms a peptide family and possesses multiple receptors specific to individual tachykinin peptides. He also demonstrated that the substance K production is regulated by tissue-specific alternative RNA splicing, thus establishing another important concept that splicing regulation is crucial in determining the specificity of the neuropeptide production and thus changing the phenotype of specific groups of neurons. Dr. Nakanishi also elucidated the precursor protein and its gene structure of the third tachykinin peptide, neuromedin K, and indicated that the two tacykinin precursor genes of substance P/substance K and neuromedin K have evolved from a common ancestor gene.

2. Elucidation of the molecular entity of neurotransmitter receptors was indispensable for understanding neurotransmission mechanisms in brain function. Dr. Nakanishi developed a new molecular cloning strategy that enabled isolation of membrane receptors and ion channels by combining electrophysiology and recombinant DNA techniques. Using this strategy, Dr. Nakanishi succeeded in molecular cloning of the substance K receptor. This was the first indication of the molecular entity of the peptide receptor and has provided the first evidence that the peptide receptor belongs to the G protein-coupled receptor family. He then reported a comprehensive analysis of the three tachykinin receptors in terms of signal transduction, ligand-binding specificity, ligand-binding domains, gene regulation and gene organizations. His cloning methodology has also been widely used in many laboratories for the molecular characterization of dozens of other receptors and ion channels, including his own work regarding neurotensin receptor and endothelin receptor.

3. Glutamate receptors mediate most excitatory neurotransmission in the brain and play a central role in many integrative brain functions such as memory, learning, neuronal development and neuronal cell survival and cell death. Glutamate receptors are categorized into NMDA receptors, AMPA/kainate receptors and metabotropic receptors (mGluRs). Dr. Nakanishi reported the first cloning of the NMDA receptor that is essential for integrative brain function and the mGluR that had not been well characterized at that time. Molecular extension by his group as well as other groups then indicated that both NMDA receptors and mGluRs exist as multiple subunits

and subtypes which differ in many properties of the receptor functions including agonist selectivity, signal transduction mechanisms, expression patterns, etc. Dr. Nakanishi's study has thus provided fundamental knowledge of the molecular diversity of the key receptors responsible for excitation of neuronal cells and integrative brain function.

4. Dr. Nakanishi extended functional characterization of diverse members of the glutamate receptor family and elucidated that different glutamate receptors play distinct and key roles in brain function. He revealed that metabotropic glutamate receptor mGluR6 in the retina is responsible for visual responses to light stimulus and is indispensable for segregating light and dark stimuli in visual signal processing. He also demonstrated that mGluR2 in the olfactory bulb contributes to discrimination of olfactory stimulation and plays an important role in olfactory memory formation. These studies have demonstrated not only the specialized functions of different glutamate receptors but also the molecular mechanisms involving sensory information processing and memory formation in brain function.

In conclusion, Dr. Shigetada Nakanishi has greatly contributed to our understanding of the molecular mechanisms underlying neurotransmission and brain function and has provided great impacts and invaluable direction in neuroscience, molecular biology, physiology and many other fields.

Japan Academy Prize to:

Mitsuhiko TAKUMI
Professor, Faculty of Economics,
Rissho University;
Emeritus Professor, University of Tokyo

for *The World Great Crisis—The Process and Causes of the Crisis of 1929*

Outline of the Work:

This book treats of the World Great Crisis comprehensively, which began with the great crash in the New York stock market in autumn 1929 and raged throughout European countries and even in Japan during the thirties, with the analysis and the explication of the whole process of its outbreak, its effects and its aggravation in the U.S. mainly, but in Britain and Germany as well.

There have been a large number of studies on this theme both in Japan and abroad, among which this book has the following three distinctions:

1. The author, Professor Takumi, energetically accumulates data and statistics not only of the U.S. but also of Britain, Germany and other countries, and making free use of those, analyzes the business trends on the historical basis. At the same time, he theorizes their causes adopting various studies in the past with a critical attitude.

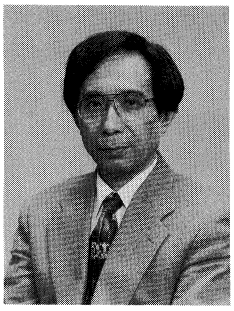
2. In contrast to the existing studies which tend to be limited to the analysis of the phases of the Crisis in each country or in each field of economy, this book throws light on the entire process in which the Crisis was aggravated and turned out to be a worldwide one, as it treats the conditions of the U.S. mainly, without neglecting its reciprocal relations with the Western countries. It elucidates at the same time the collapse of Pax Britannica

through World War I and the advent of unstable world economy with two focuses, Britain and America, and its vital influence on the Crisis.

3. The author carefully examines many crisis theories in the past, and sets up his original one, which he applies with a certain success in analyzing the historical process and, at the same time, investigating the validity of his own theory.

In these three points this book can be said to have given a comprehensive survey of past studies on the subject and to have made an important contribution to the development of further studies, which adequately deserves the prize of the Japan Academy.

Japan Academy Prize to:



Taroh MATSUNO
Professor, Graduate School of
Environmental Earth Science,
Hokkaido University

for "Elucidation of Atmospheric Dynamics
in the Stratosphere and Mesosphere"

Outline of the Work:

The stratosphere and mesosphere which are now called "middle atmosphere" are part of the atmosphere in a height range from about 10 km to 90 km. In the 1950's exploration of this part of the atmosphere became active in accord with the initiation of operational cruise of jet aircrafts in the lowest part of the stratosphere and also stimulated by the beginning of the space exploration. Many new and interesting atmospheric phenomena which are more or less different in nature from those so far known were discovered one after another. Among them are stratospheric sudden warmings, the quasi-biennial oscillation of the equatorial stratospheric winds (QBO) and the cool summer and warm winter in the upper mesosphere and the lower thermosphere. Prof. Matsuno has contributed decisively to solving these puzzling problems.

The stratospheric sudden warming was discovered in 1952 by Professor Scherhag. Occasionally in mid-winter the temperature of the stratosphere in the north polar region rises suddenly; a temperature rise of 40°C or larger occurs in a week. At the same time the polar vortex encircling the cold polar region collapses. The mechanism of this dramatic phenomenon had not been understood for a long time after its discovery. In this 1971 paper Prof. Matsuno proposed a dynamical model of the sudden warming which explains many aspects of the phenomenon consistently. In the Northern Hemispher the polar vortex in the stratosphere is distorted by planetary-scale Rossby waves propagating from the troposphere which are generated by continental-scale topography and by land-sea thermal contrast. When the waves invade into the stratosphere they bring westward angular momentum there which results in weakening of the polar vortex. When the vortex weakens it cannot sustain the meriodional pressure gradient and a poleward mass flow is generated which, in turn, forces an upward motion above and a downward motion below in the polar region. Adiabatic compression due to the downward motion causes large temperature rise recognized as sudden warming. The mechanism was demonstrated by use of a numerical model which was successful to reproduce major features of the real phenomenon.

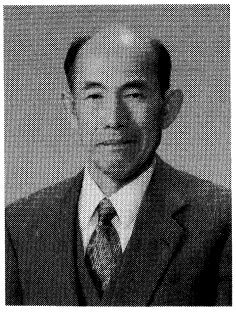
Another important contribution of Prof. Matsuno is the foundation of wave dynamics in the equatorial area. In his 1966 paper treating dynamics of atmosphere and ocean in the equatorial regions, he predicted two types of waves which had not been known by that time: Eastward moving Kelvin wave and westward moving mixed Rossby-gravity wave. These new waves were found in the real stratosphere soon after the prediction and later it became recognized that they play decisive roles in the dynamics of QBO as presented by Professors Lindzen and Holton.

In addition to this application Prof. Matsuno's theory on equatorial waves and thermal excitation of them founded the basis upon which many succeeding works treating El Nino and other phenomena in the equatorial atmosphere and oceans rest.

Prof. Matsuno also made a contribution to solving a puzzling problem that the temperature around the mesopause level (70~90 km) is low in summer and high in winter. In his 1982 paper, Prof. Matsuno had definitely shown that small-scale internal gravity waves generated in the troposphere and propagating upward into the mesosphere indeed cause adiabatic cooling in the summer hemisphere and warming in the winter hemisphere via the induction of the meridional and vertical motions which are forced by the drag force exerted by internal gravity waves in the opposite direction of the prevailing zonal winds.

In conclusion it may be said that Prof. Matsuno's works on many phenomena in the stratosphere and mesosphere form a substantial part of the current understanding of the dynamics of this part of the atmosphere.

Japan Academy Prize to:



Hideo YAMATERA
Emeritus Professor, Nagoya University

for "Invention of Yamatera's Rule of Spectroscopy of Metal Complexes and Studies on their Coordination Structures"

Outline of the Work:

Absorption spectra of transition metal complexes have been extensively studied since 1911 when Yuji Shibata published the first paper of his studies on the absorption spectra of cobalt complexes. Until early 1950's, the absorption spectra of transition metal complexes were related to the crystal field, the electrostatic field of the ligands.

On the basis of experimental findings, Hideo Yamatera thought that the covalency of the coordinate bond should also contribute to the metal-ligand interaction, and used the molecular orbital theory to explain the origin of the absorption spectra of cobalt complexes (1956). Then as an extension of this idea, he proposed a new molecular orbital based perturbation model to apply it to a series of complexes containing two kinds of ligands. In this model, the angular part of the overlap of wave functions is calculated by using rigorous fuctions and the radial part of the interaction is represented by a parameter characteristic of the ligand and the metal ion. This model is simple and practical, so that it can predict the shift and splitting of the absorption bands in the visible region on replacement of ligands of metal complexes (1958). The spectrochemical series (1938–1958), an empirical rule derived by Ryutaro

Tsuchida from extensive experiments, can be explained as the order of parameter values of Yamatera's model. The model can also be used in predicting the wavelengths of the absorption bands, explaining the dichroism of absorption spectra of crystalline complex salts, and deducing the geometrical structure of complexes from their absorption spectra. Thus the model gave a rule on the relationship between the absorption spectrum and the structure of complexes. The rule was named Yamatera's rule and gained a worldwide appreciation.

Yamatera extended his research to the strong absorption bands appearing in the ultraviolet. He noted in particular the $[Co(NH_3)_5X]^{2+}$-type complexes (X=Cl, Br, I) whose absorption spectra show different features depending on the X ligand. He thought that the ultraviolet absorption bands are caused by charge transfer from the X ligand to the central Co^{3+} ion and explained the difference in the spectrum as caused by the different strength of the spin-orbit interaction in X (1960). This is also a significant achievement in the study of absorption spectra of metal complexes.

In 1965, Danish scientists Schäffer and Jørgensen proposed the angular overlap model as a model to replace the traditional model based on the crystal field theory. Schäffer stated in a plenary lecture at an international conference (1969) that the angular overlap model had been first proposed by Yamatera for application to six coordinated orthoaxial chromophores. As Schäffer said, the angular overlap model is actually a generalization of Yamatera's model.

Yamatera also made a theoretical study on the reaction rate of metal complexes (1968). Although the rate of ligand substitution reactions of metal complexes in solution had been studied by Taube and by Basolo and Pearson, some inconsistency remained between theory and experiments. Yamatera introduced the idea of the angular overlap model to the reaction intermediates and used ligand field activation energy in place of crystal field activation energy used by Basolo and Pearson. Application of the new model to series of ions, $[M(H_2O)_6]^{2+}$ and $[M(CN)_6]^{3-}$, well represented experimental results.

Yamatera continued studies on the angular overlap model in collaboration with Schäffer, and published a joint paper (1991).

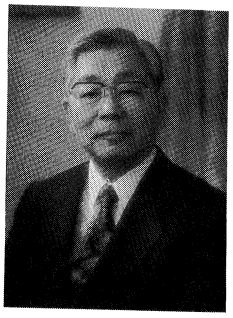
Yamatera's model has been cited in many papers and also described in textbooks. Yamatera's research ranges widely and extends to various branches such as theoretical and experimental studies of ion association in solution and the study of the electronic state of metal complexes by means of X-ray photoelectron spectroscopy and molecular orbital calculation.

Yamatera's work in coordination chemistry is pioneering and original. So it is highly appreciated by both domestic and foreign scientists. Yamatera was awarded a Prize of the Chemical Society of Japan in 1982.

Japan Academy Prize to:

Mutsuo SEKIGUCHI
Professor, Fukuoka Dental College;
Emeritus Professor, Kyushu University

for "Studies on Mechanisms of DNA Repair and Maintenance of Genetic Information"



Outline of the Work:

Maintenance of genetic information is of the utmost importance. Once the DNA sequence is altered, it is fixed as a mutation. In higher organisms, a specific type of mutation in the somatic cell may cause cancer and, if mutation occurs in a germ line, it may cause inherited disease. It is also true that mutation plays an important role in the evolution of organisms. A wide variety of organisms have evolved from a single primitive life, as achieved by a huge number of cycles of mutation and selection. Indeed, mutation can be regarded as the driving force of evolution.

To consolidate these two aspects, organisms are equipped with mechanisms to keep in check the frequency of mutation. Organisms possess elaborate mechanisms to execute accurate DNA replication and to repair DNA damage incurred by intracellular and environmental factors. Dr. Sekiguchi has resolved these mechanisms using genetic and biochemical approaches.

Dr. Sekiguchi first examined how DNA damage produced by ultraviolet light is recognized and repaired within cells. He found that a specific DNA repair enzyme is induced in cells infected with a certain virus and that virus mutants with high sensitivity to ultraviolet light lack such potential. The enzyme was purified to physical homogeneity and the mode of action elucidated. This paved the way toward investigations of mechanisms of DNA repair, at the molecular level.

Dr. Sekiguchi then directed attention to mechanisms that cells use to repair various DNA lesions. As the target, he selected DNA damage caused by alkylating agents, since these are potent mutagens and carcinogens and some internally formed substances (metabolites) have the capacity for alkylation. He isolated numerous mutants sensitive to alkylating agents, cloned the genes responsible and identified the gene products. He characterized enzymes, each of which acts on a specific alkylated base(s) in DNA. He also found that one of the enzymes, methyltransferase, accepts methyl groups from damaged DNA to its own molecule and that the methylated form of the enzyme then acts as a regulator for transcription, thereby inducing formation of large amounts of self and related enzymes.

To elucidate mechanisms controlling spontaneous mutation, Dr. Sekiguchi used the same strategy and fundamental pathways were revealed. He obtained evidence that DNA polymerase itself plays an important role in maintaining the fidelity of DNA synthesis, by showing that defects in genes encoding its subunits led to a high frequency of spontaneous mutation. He also demonstrated that oxidation of guanine in nucleotide substrates and DNA causes mutation and that cells possess specific enzymes to counteract this type of damage.

Dr. Sekiguchi extended studies to mammalian cells and cloned several genes involved in DNA repair, replication and cell proliferation. Some of these genes are linked to induction of cancer and this knowledge made feasible approaches to a better understanding of events related to cancer and genetic disorders. All this research in basic biology has had a strong impact in various fields, including medical science.

Japan Academy Prize to:

Kiyoshi HORIKAWA
President, Saitama University;
Emeritus Professor, University of Tokyo

for "Study on Nearshore Dynamics and Coastal Sediment Transport Mechanisms"

Outline of the Work:

Typhoon No. 13 in 1953 produced severe storm surge damage along the coastline of Ise Bay. This event induced strong motivation for researchers and engineers in Japan to initiate scientific study on the subjects related to coastal problems. This was just about the time when Dr. Horikawa initiated his research work in the field of coastal engineering.

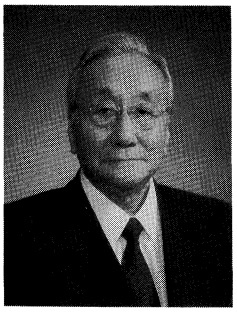
His representative research subject is the study on nearshore dynamics and coastal sediment transport mechanisms. The aim of this reseach is to clarify the mechanism of nearshore phenomena such as shallow water waves, including breaking and broken waves, nearshore currents, and coastal sediment transport induced by waves and currents. Based on the results of the above fundamental studies, simulation models to predict beach evolution were developed for practical use.

In order to proceed with the reseach activities, he adopted in parallel the following three approaches, namely theoretical, experimental, and field investigations. As a first step, he treated the wave transformation in the nearshore area. As the second step, the quantitative prediction of nearshore currents was investigated by the combined procedure of field observations and numerical calculations. With the purpose of accumulating field data of nearshore currents, a balloon camera system was developed to be used in the field, and the system was employed intensively at numerous coasts in Japan under various conditions of sea state and beach topography. On the other hand, numerical calculations were actively done on the basis of governing equations under the wave conditions similar to in the field. A comparison was made between the calculated and observed spatial distributions of nearshore current velocities, and then the equations formed a closed system.

It has been widely recognized for many years that the coastal sediment transport phenomena were highly complicated to be treated analytically. He attacked this subject for more than thirty years from various stand points. The most remarkable achievement of his study can be classified into the following two parts. The first part is to determine the critical water depth for the incipient motion of bottom sediment particles due to waves. The above critical water depth is of importance to determine the outer boundary of the coastal sediment movement zone. By using the data obtained in a large scale oscillatory flow flume, it was verified that the proposed formula could be applicable to the field. The second part is for the quantitative prediction of sediment transport rates in various sediment movement modes, as well as in different directions (on—offshore and alongshore).

In order to propose a new plan of coastal utilization and also to prevent beach erosion caused by coastal structures such as breakwaters and seawalls, he proposed to select either one of the following simulation models of beach evolution. That is to say, the shoreline change model can be used for the case of a relatively long period and with large spatial scale. On the other hand, the three dimensional beach evolution model can be used for the case of a relatively short period and local beach evolution. These prediction models were verified by comparison with field or laboratory data respectvely. Since then these models have been widely used for the practical purposes.

Japan Academy Prize to:



Nobuaki KUMAGAI
Emeritus Professor, Osaka University

for "Basic Research on the Development of New Theories of Electromagnetic Waves and their Applications to Guided Wave Transmission"

Outline of the Work:

Dr. Nobuaki Kumagai has made significant achievements in trailblazing and pioneering research on basic theories of electromagnetic waves and a wide range of fields of applications which cover microwaves, millimeter waves and optical waves. He has played a leading role in the development of new theories of electromagnetic waves and establishing an important field of engineering now known as electromagnetic waves engineering.

Among his various achievements, a series of research on relativistic electromagnetic wave theory is regarded as the major one which has won a particularly high recognition in the world academic community. He is a world pioneer in research on relativistic electromagnetic wave theory, and discovered a number of peculiar electromagnetic phenomena which conventional theories of electromagnetic waves could not foresee. One such examples is a law of reflection and refraction of incident electromagnetic wave which enters from one medium into another. Under the conventional law, total reflection of incident electromagnetic wave is believed to occur only when the wave goes into a medium with small refractive index from a medium with large refractive index if the incident angle is larger than a particular critical angle. The conventional law states that no matter what the incident angle is, total reflection does not occur when the wave enters a medium with large refractive index from a medium with small refractive index. Dr. Kumagai proved that this law is valid only when both media are static. He proved that when one medium is moving in relation to the other, total reflection occurs even when the wave enters a medium with large refractive index from a medium with small refractive index within a certain range of incident angle. He also proved that even when the two media's refractive indexes are the same, total reflection occurs if the incident angle is within a certain range. He also found that the well known directivity characteristics of radiation power from dipole antenna and the directivity of antenna gain are observed only when the dipole antenna is static. He theoretically and quantitatively proved that when the dipole antenna is moving, the components of the directivity of radiation power and antenna gain in the direction of movement show an increase and a decrease in the opposite direction when the antenna moves faster. This includes the Doppler shift of the frequency of the receiving wave. Dr. Kumagai also found that when electromagnetic waves propagate through conductive moving media, wave amplification can occur under certain conditions. That is, the waves' amplitude increases as the waves propagate through the media. All these achievements were regarded as new views of academic significance which fundamentally revised or expanded conventional theories and common sense of electromagnetic waves.

In addition, Dr. Kumagai has contributed to the development of theories of electromagnetic waves by a number of outstanding achievements in his research of stationary and quasi-stationary systems. He has solved a problem of electromagnetic wave scattering by complex scatterers, analyzed electromagnetic waves' scattering and electromagnetic radiation in various electromagnetic wave systems, analyzed mode conversion and mode coupling phenomena, and has also developed a variety of useful techniques of electromagnetic field analysis.

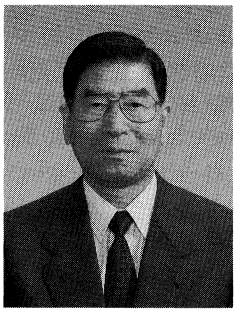
Dr. Kumagai has used these analysis techniques to do research on engineering applications of microwaves,

millimeter waves and optical waves, mainly in basic research on guided wave transmission, and has made remarkable achievements. His pioneering research on waveguide transmission system for millimeter waves in particular won an international recognition. He was among the first to study millimeter waves' application to high-capacity telecommunications which had been unexplored until then. This was significant at a time when the frequency of carrier waves was getting higher to deal with a surge in the volume of information to be transmitted. In order to realize the low-loss millimeter wave transmission, he conducted a series of pioneering research on multi-mode waveguide transmission systems which none of telecommunication engineers in the world had ever experienced. He identified the mechanism of a number of phenomena peculiar to multi-mode waveguide transmission systems, and also developed a variety of new waveguide components and devices for millimeter waves, and thus played a leading role in opening the way for low-loss waveguide transmission system for millimeter waves.

Dr. Kumagai has always been engaged in pioneering research on the fundamental electromagnetic wave theory and its engineering applications in extensive fields of electromagnetic waves ranging from microwaves, millimeter waves to optical waves, and through a variety of innovative and significant research, he has made an enormous academic and technological contributions to the development of modern electromagnetic wave theory and the establishment of an important area of technology now known as electromagnetic waves engineering.

Japan Academy Prize to:

Koichiro TSUNEWAKI
Professor, Faculty of Biotechnology,
Fukui Prefectural University;
Emeritus Professor, Kyoto University



for "Comparative Gene and Plasmon Analyses in Wheat and its Related Genus *Aegilops*"

Outline of the Work:

Dr. Koichiro Tsunewaki has contributed greatly to our understanding of the process of wheat evolution, in particular its origin and phylogenetic differentiation, using two methods; comparative gene and plasmon analyses of *Triticum* (wheat genus) and *Aegilops*. The term, plasmon refers to the entire genetic entity in the cytoplasm; the chloroplast and mitochondrial genomes inclusively.

1. Comparative gene analysis of wheat and its ancestral species

Since 1955, Dr. Tsunewaki has made comparative analyses of the genes in common wheat and its ancestors; the emmer and einkorn wheats and *Aegilops squarrosa*. First he collected a large number of strains of all four groups from different parts of their distribution areas. He then determined the gene loci that control the main morphological and physiological traits which the four groups have in common. He identified and designated about 50 gene loci, assigning them their chromosomal locations. Next, he selected about 20 of these loci for ease of allelic identification and surveyed the distribution of the different alleles in each locus in the different taxonomic and geographical populations of the four groups. The findings led to the following conclusions: (1) Common wheat has differentiated into two population types, Asian and Euro-American. (2) Of those types, the Asian population is the

original type in the common wheat phylogeny. (3) The birthplace of common wheat is in the northwestern Iran, in an area between the Caspian Sea coast and the Elbruz Mountains, not in Afghanistan or the Transcaucasus as suggested by previous workers.

2. Plasmon analysis of two related genera, *Triticum* and *Aegilops*

Since 1966, Dr. Tsunewaki has devoted himself to plasmon analysis and has succeeded in clarifying the entire picture of plasmon evolution in these genera. He has utilized the different modes of inheritance of the nuclear genome and plasmons; the biparental vs. the exclusively maternal mode. This contribution was made in two ways: (1) Classification of the *Triticum* and *Aegilops* plasmons through production of alloplasmic wheat lines: Dr. Tsunewaki selected a few strains from all the *Triticum* and *Aegilops* species (totally 46 strains) to be plasmon donors and 12 common wheats to be plasmon recipients. He crossed the plasmon donors as female to all 12 common wheats then repeatedly backcrossed the F_1 hybrids and their descendants, at least 10 times, with pollen from the same common wheats, thereby producing 552 alloplasmic wheat lines which had the restored wheat nuclear genotype in 99.95% or even higher purity. The term alloplasmic wheat refers to a line having an alien plasmon and wheat nuclear genotype. Dr. Tsunewaki investigated more than 20 characters of the alloplasmics and compared them to those of the respective normal, euplasmic lines. Some alloplasmics showed novel characteristics never found in euplasmic wheats: haploid parthenogenesis of the egg cell, germless seed formation, precocious seed germination, variegation, prolonged vegetative growth period, pollen sterility, and pistillody. Numerico-taxonomical analyses of the data obtained indicated that the 47 plasmons, including the common wheat plasmon, are classifiable in 15 major types plus 5 subtypes. Dr. Tsunewaki designated a plasmon name for each type, which names are now in worldwide use.

(2) Clarification of the phylogenetic relationships between different plasmons using restriction fragment length polymorphism (RFLP) analysis of organellar DNAs: Since 1975, RFLP analyses of chloroplast and mitochondrial DNAs have proved useful tools in phylogenetic studies of higher plants. Dr. Tsunewaki extracted both these organellar DNAs from fertile alloplasmics which had originated from the respective alloplasmon donors. He treated them with a large number of restriction endonucleases and compared the electrophoretic patterns of the digests. Using the similarity of the electrophoretic patterns, he estimated the genetic distances between the different plasmons for both the chloroplast and mitochondrial genomes, and on that basis constructed the first phylogenetic tree of the plasmon in *Triticum* and *Aegilops*.

Integrating the results of the two investigations described above, Dr. Tsunewaki successfully identified the maternal and paternal parents of almost all the polyploid species that originated as hybrids between two parents with different nuclear genomes. Through these investigations, he was the first to prove that common wheat originated from emmer wheat as the female and *Ae. squarrosa* as the male parent, and that this emmer parent was produced from *Ae. speltoides* as the female and einkorn wheat as the male parent.

As described above, Dr. Tsunewaki has carried out many original and pioneering studies that have contributed to our knowledge of the origin and phylogenetic differentiation of wheat. For this work he was awarded the Japan Agricultural Science Prize from the Association of Japanese Agricultural Science Societies (1978), the Kihara Prize from the Genetics Society of Japan (1992), and the Purple Ribbon Medal from the Japanese Government (1995). He also has been elected an Honorary Member of the American Society of Agronomy (1990) and a Foreign Associate of the National Academy of Sciences, USA (1996).

Japan Academy Prize to:

Shiro MIWA
Director, Okinaka Memorial Institute
for Medical Research

for "Studies on Hereditary Hemolytic Anemia due to Red Cell Enzymopathies"

Outline of the Work:

In 1950's, causes of hereditary hemolytic anemia (HHA) remained largely unknown, except for few diseases such as hereditary spherocytosis which could be diagnosed by microscopic observation of red cell shape. In 1961, in collaboration with Drs. Valentine and Tanaka, Dr. Miwa discovered that deficiency of one of the red cell glycolytic enzymes, pyruvate kinase (PK), caused HHA. This discovery opened a new field in hematology called "red cell enzymopathies associated with HHA". He has since been working as a leading researcher in this field over 35 years. His studies were not only limited to PK deficiency but also to many other red cell enzymopathies.

1) Search for the patients and their care:

From the beginning, Dr. Miwa had made every effort to find out these rare patients. He kept good contact with many doctors in charge, patients and their families, helping them as a consultant or counselor and sometimes as a doctor in charge. As a result, his laboratory became a world leading laboratory with respect to the collection of most (fourteen) kinds of red cell enzymopathies associated with HHA as well as a large number of the patients.

2) PK deficiency; from phenotype to molecular genetics:

a) In 1979, Dr. Miwa issued "Recommended methods for the characterization of PK variants", working as chairman of the expert panel. This made possible to compare enzymatic properties of various PK variants characterized in different laboratories.

b) Molecular genetic studies of the patients: Through collaboration with other investigators, he cloned and sequenced human PK isozymes, M2(fetal- or proto-type), L(liver-type) and R(red cell-type) in 1988–1990, and mapped M gene which produces M1- and M2-type PKs on chromosome 15 as well as L gene which produces L- and R-type PKs on chromosome 1. He was the first in making molecular analysis of PK deficiency (1990).

Taking advantage of having many true homozygous (not compound heterozygous) patients, he analyzed structure-function relationship of PK mutants. He found that as compared with missense mutations which located close to the substrate binding site, those located in the allosteric activation site were phenotypically worse. An important finding was that mutations such as one base pair deletion and splicing mutation which produced truncated PK molecules were phenotypically very severe, and in addition, M2-type PK persisted in mature red cells while R-type PK could hardly be seen.

c) Switch of PK isozymes during red cell differentiation: Leukocyte and platelet PKs are known to be M2-type produced by M-gene, while red cell PK is R-type produced by L-gene. It is well known that there are multipotent hematopoietic stem cells in bone marrow. Hence, there must be an isozyme switch from M1- to R-type PK during the red cell differentiation process while no switch occurs in leukocyte and platelet maturation. In 1984–85, using fluorescent antibody technique, Dr. Miwa demonstrated that M2-type PK was seen in proerythroblasts, and R-type PK production increasingly occurred during the differentiation process, thereby accompanied by the reduction of M2-type PK. When K562 cells were induced by hemin, M2- to R-type PK switch occurred along with the

appearance of fetal hemoglobin (Hb F). As seen by PK electrophoretic studies, persistence of M2-type PK was seen in severe PK deficient patients. Precise mechanisms of this switch phenomenon remain to be analyzed in molecular level.

d) Discovery of murine PK deficiency: In 1995, Dr. Miwa had a chance to investigate anemic inbred CBA strain mouse, resulting in a discovery of murine PK deficiency. This is the first mouse of the red cell enzymopathy model whose genetic basis has been characterized at the molecular level. Like the most severe type human PK deficient patients, the mouse showed persistence of M2-type PK in the red cells. Probably, because of compensatory erythropoiesis by the huge spleen of the deficient mouse, the mouse shows less severe anemia as compared with the genotypically similar severe human PK deficiency, and thus, is able to survive to adulthood and is fertile. This discovery opened a way to use this animal for an experimental model of gene therapy for PK deficiency as well as for understanding the pathophysiology of this disorder.

In summary, Dr. Miwa has greatly contributed to progress in clinical hematology and pathophysiology of the red cell. This achievement could be made as he was a clinical-minded researcher with the possession of an idea and the determination and patience to pursue it.

PROCEEDINGS AT THE 910TH GENERAL MEETING

The 910th General Meeting of the Academy was held on Thursday, June 12, 1997, at 1:00 p.m., Dr. Yoshio FUJITA, President, taking the chair. Ninety-five members were present, and the following communications were made:

Legal principles of the establishment of the Constitution of Japan . . . . . Nobuyoshi ASHIBE, M. J. A.
Education in mathematics and social sciences in Japan . . . . . Hirofumi UZAWA, M. J. A.
Molecular machines of sliding in living cells . . . . . Fumio OOSAWA, M. J. A.
Uniqueness of unibranched curve in $\mathbf{R}^2$ up to simple blowings up . . . . . Masanori KOBAYASHI and Tzee-Char KUO
On a relation among toric minimal models . . . . . Daisuke MATSUSHITA
On classification of elliptic fibrations with small number of singular fibres over a base of genus 0 and 1 . . . . . Khac Viet NGUYEN
Above three, communicated by Heisuke HIRONAKA, M. J. A.
New stishovite-like phase of silica formed by hydrostatic compression of cristobalite . . . . . Masaaki YAMAKATA and Takehiko YAGI
Communicated by Syun-iti AKIMOTO, M. J. A.
Characterization and distribution of IS*1164* that exists in the high molecular mass nitrile hydratase gene cluster of the industrial microbe *Rhodococcus rhodochrous* J1 . . . . . Michihiko KOBAYASHI, Hidenobu KOMEDA, Sakayu SHIMIZU, Hideaki YAMADA, and Teruhiko BEPPU
Communicated by Yasuyuki YAMADA, M. J. A.
Why is the Palau Treuch so deep? Deep-Sea treuch without plate convergence . . . . . Kazuo KOBAYASHI, Kantaro FUJIOKA, Toshiya FUJIWARA, Yo IWABUCHI, and Hiroshi KITAZATO
Communicated by Yoshibumi TOMODA, M. J. A.
Asymmetric total synthesis of Taxol . . . . . Teruaki MUKAIYAMA, M. J. A., Isamu SHIINA, Hayato IWADARE, Hiroki SAKHO, Yu-ichirou TANI, Masatoshi HASEGAWA, and Katuyuki SAITOH
SV theory of synchronous machine. Analysis of single phase grounding and short circuit between phases . . . . . Sakae YAMAMURA, M. J. A.
Quadratic forms and elliptic curves. IV . . . . . Takashi ONO
On the vanishing of Iwasawa invariants of certain cyclic extensions of $\mathbf{Q}$ with prime degree . . . . . Takashi FUKUDA
Above two, communicated by Shokichi IYANAGA, M. J. A.
Stationary solutions of the heat convection equations in exterior domains . . . . . Kazuo ŌEDA
Generalizations of coefficient estimates for certain classes of analytic functions . . . . . Engin HALILOGLU
Above two, communicated by Kiyosi ITÔ, M. J. A.
Model building study of complex structures using NMR chemical shift change information . . . . . Andreas HEGER, Junichi HIGO, and Haruki NAKAMURA
Communicated by Setsuro EBASHI, M. J. A.

After a recess during which the members present met in their respective Sections, the General Meeting was resumed for business transactions.

First, Dr. Keiichiro NAKAGAWA, M. J. A., paid a tribute of admiration to the late Dr. Yoshitaro WAKIMURA's meritorious services to academic circles.

Next, the Chairmen of both Sections made reports of the matters dealt with at the respective Sectional Meetings.

Then, the President reported that the Twenty-sixth meeting of the Japan Academy Public Lectures was opened to the public in the Aoba Memorial Hall, Sendai, at 2:30 p.m. on Saturday, May 24, 1997, with Dr. Masami ITO, M. J. A., and Dr. Wataru MORI, M. J. A., as speakers, whose respective subjects were:

"Flag Burning and Freedom of Expression: Symbolic Speech"
"Informed Consent in Medical Care".

After that, it was reported on the result of election of half the members of the Administrative Committee, which had taken place at the Sectional Meetings. The Committee members elected are: Tatsuro YAMAMOTO, Shigemitsu DANDO, Tsutomu OUCHI, Yoshihide KOZAI, Sakae YAMAMURA, Yoshiaki ISHIZUKA, Masao ITO.

The Meeting adjourned at 4:52 p.m.

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PROCEEDINGS OF THE JAPAN ACADEMY

SERIES A
MATHEMATICAL SCIENCES

CONTENTS

Papers Communicated:—