

## AWARD OF MEDALS

The Eighty-eighth Annual Award of Medals was held on Monday, June 22, 1998, at 10:30 a.m., in the presence of Their Majesties the Emperor and Empress.

The function was opened with an address by the President, in which he made a brief statement of each award. This year, the sixth presentation of the Duke of Edinburgh Prize for the Japan Academy also took place at the same time.

The Medals and Prizes were presented to the following recipients:

**Imperial Prize and Japan Academy Prize to:**

Toshio YANAGIDA

for "Direct Manipulation and Observation of Molecular Machines of Biological Movements"

**Japan Academy Prizes to:**

Seizo SEKINE

for *Transcendancy and Symbols in the Old Testament: Genealogy of Hermeneutical Experiences*

Takane SUGIHARA

for *The System of the International Court of Justice*

Norio KAIFU

for "Research on Interstellar Matter"

Yasutaka IHARA

for "Studies in Arithmetic"

Norio ISE

for "Study of Microscopic Structures in Homogeneous Dispersions"

Hideaki YAMADA and Teruhiko BEPPU

for "Basic Studies for Development and Application of Microbial Functions"

Shoshichi NOJIMA

for "Structure and Metabolism of Membrane Phospholipids—with Special Emphasis on *Escherichia coli* Phospholipases"

Kazuo SASAKI

for "Studies on Integrative Functions of the Central Nervous System"

**Duke of Edinburgh Prize to:**

Tatuo KIRA

for "Contributions to the Development of Quantitative Plant Ecology and the Conservation of Natural Environments"

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

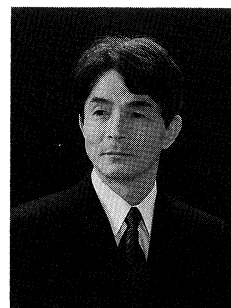
The function was closed at noon.

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

***Imperial Prize and Japan Academy Prize to:***

Toshio YANAGIDA  
Professor, Graduate School of Medicine,  
Osaka University

for "Direct Manipulation and Observation of  
Molecular Machines of Biological Movements"

***Outline of the Work:***

Muscle contraction is caused by the sliding movements of thin filaments composed of actin molecules among thick filaments composed of myosin molecules, coupled with hydrolysis of ATP molecules on myosin. The most popular idea on the mechanism of force generation for sliding was rotation of the head of myosin molecule bound on actin filament. The one-to-one correspondence was supposed between the rotation of myosin head and the hydrolysis of ATP.

In 1985, Toshio Yanagida performed simultaneous measurements of the sliding velocity of actin filaments and the rate of ATP hydrolysis using a bundle of thick and thin filaments isolated from a muscle fiber, and found that the sliding distance of actin filament induced by hydrolysis of one ATP molecule on myosin is much longer than the size of the myosin head. This finding raised a serious, never recognized, question on the coupling between the chemical reaction and the mechanical event during sliding.

It is difficult to clarify the chemo-mechanical coupling mechanism by experiments on solutions or fibers which contain a huge number of protein molecules. Professor Yanagida attempted to experimentally define the minimum structural units, molecular machines, necessary and sufficient for sliding, and to directly observe their behaviors during working. For this purpose, he developed various new techniques to see, catch, and manipulate single protein filaments and single protein molecules in water, and to measure in milliseconds their movements of nanometers and forces of piconewtons.

First, he made visible single actin filaments of several nanometers in diameter under an optical microscope by labelling them with fluorescent dye molecules. He showed that thermal bending movements of actin filaments are activated by interaction with free myosin heads hydrolyzing ATP. After this experiment, actin filaments were found to undergo sliding movements, upon addition of ATP, on myosin heads which were fixed on a glass plate. Yanagida attached the end of an actin filament to a thin glass needle, put the filament on fixed myosin heads, and measured the sliding force from the bending of the needle. This experiment done in 1988 was the first step of direct manipulation of single protein filaments to measure both their movement and force. He, then, constructed a new apparatus for precise measurements of the position of the tip of needle and determined the sliding force per myosin molecule and the on-off time of force generation. Using the same method of manipulation, he also measured the elastic moduli of stretching, bending, and twisting of single actin filaments.

In the next step, Yanagida with his colleagues designed an optical microscopic system using the evanescent light for imaging single molecules. In 1995, he succeeded in the direct observation of single myosin heads fluorescently labelled and single fluorescent ATP-analogue molecules bound to myosin, and followed the binding of ATP-analogue to myosin and its dissociation after hydrolysis.

Since then, his research has proceeded to manipulate single actin filaments and single myosin heads, construct from them unit molecular machines for sliding, measure the force and movement generated, and simultaneously

detect the hydrolysis of ATP. His experimental results have shown that myosin heads step on several actin molecules along the actin filament during or after hydrolysis of one ATP molecule and no definite one-to-one correspondence exists between the specific step of the hydrolysis reaction and the force generation. Thus, he has proved that the influx-efflux coupling in this molecular machine is not tight but loose.

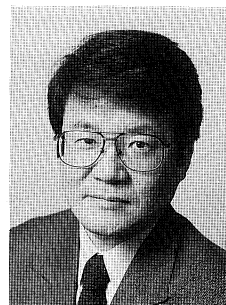
In parallel to the above research, Yanagida's group has carried out similar experiments on the other molecular machine of sliding, namely, the combination of kinesin molecules and microtubules. Sliding of single kinesin molecules on microtubules was directly observed and the coupling between the ATP hydrolysis on kinesin and the force generation was analysed.

Over these ten years, Prof. Yanagida's work has always been a source of great surprise to researchers in this field and has attracted their enthusiastic attention. He has opened a new way of research on molecular machines in living cells and created a new trend of direct manipulation and observation of molecular machines and protein molecules. Finally, he has demonstrated that molecular machines of biological movements have a loose coupling mechanism. His recent work has been highly appreciated not only in the realm of biology but also in related fields of physics and chemistry.

***Japan Academy Prize to:***

Seizo SEKINE  
Professor, University of Tokyo, Graduate School of  
Humanities and Sociology

*for Transcendancy and Symbols in the Old Testa-  
ment: Genealogy of Hermeneutical Experiences*



***Outline of the Work:***

Based on the hermeneutical experiences of the author, this book attempts to reveal the actuality of hidden transcendancy through interpretation of polysemous symbols in the Old Testament. It contains coherently organized arguments, including the author's previously published articles and Old Testament commentaries, in the following order. In Chapter 1, the author examines the roots of Old Testament ethics as seen in the Ten Commandments. In Chapter 2, he considers aspects of nihilism and the overcoming of nihilism, already apparent in the Old Testament (Ecclesiastes) in Coheleth. Discussions of the historical descriptions of adultery and murder committed by King David, as well as the poems in 2 Samuel 12 and Psalms 51 which reveal David's feelings after these deeds follow in Chapter 3. In Chapter 4, the author uses the Adam myth in the Book of Genesis to examine a God who forgives even human immorality and recognizes the autonomy of human beings.

The final chapter of the work examines the editorial processes in second Isaiah through a comparison of the usages of the perfect and imperfect forms of Hebrew verbs. The author argues that second Isaiah was a righteous servant of God who was waiting for the coming of the Messiah, though he suffered great misery and died disdained by his countrymen. He continues that, after second Isaiah's death, however, it occurred to his disciple that his master was himself a Messiah. According to this new interpretation, the disciple edited and revised the text of the poems left by his master. The author interprets that the identification of second Isaiah, the redeemer, with the

Messiah himself resolves the contradiction between the God of Justice and the God of Love. This argument is based on the contrasting usages of perfect verb forms, which express the miserable death of second Isaiah, the redeemer, and imperfect forms, which express the glorious elevation of second Isaiah in the fourth of the "Suffering Servant" poems (Ec. 52:13–53:12).

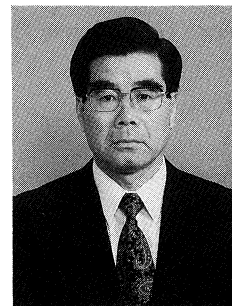
The author develops his argument upon a solid organizational structure. His approach is characterized, first, by an exacting scrupulousness in the reading of the Hebrew text. When passages present difficulties in Hebrew usage, he uses concordances to exhaustively research all existing examples in the Old Testament before deciding upon the appropriate interpretation. Second, the author's methods are marked by their radical reexamination of the theories and opinions of his scholarly predecessors in Japan and other countries. When proper interpretation of an issue eludes him, he states straightforwardly that the issue is yet unresolved. This rigorous scientific posture is commended. Thirdly, he is highly conscientious of methodology when interpreting symbols in the Old Testament text. While taking much from Tillich and Ricoeur, he also does much to substantiate their theories through his hermeneutical practices. Finally, though all researchers have inevitable biases, these biases can be softened and overcome through the process of hermeneutical experience in pursuit of new horizons of understanding. Borrowing Gadamer's words, the author refers to this process as a "fusion of horizons." The concrete processes and practical reporting embodied in this work make it an actualization of that "fusion of horizons".

The coherent organization of this work and its numerous original findings offer a significant contribution to the field of Old Testament studies. The value of this work, however, is not limited to the fruits of his research on the Old Testament. The precise philological and hermeneutical methodology employed by the author in this work and the openness he gives it from a scientific prospective make this work a significant resource for scholars in all areas of the humanities.

***Japan Academy Prize to:***

Takane SUGIHARA  
Professor, Kyoto University,  
Graduate School of Law

for *The System of the International  
Court of Justice*



***Outline of the Work:***

Professor Sugihara, the author of the present work, has published a number of remarkable articles and books, especially on international adjudication. This book marks an important milestone in his research activities hitherto pursued in this field.

The International Court of Justice, the successor to the Permanent Court of International Justice which was established in 1921, deals with cases of international disputes submitted by States and decides them in accordance with international law (contentious functions). The Court is also empowered to give advisory opinions on legal questions upon request by the organs of the United Nations and the Specialized Agencies (advisory functions). Through exercising these functions, it has made a notable contribution not only to the peaceful settlement of

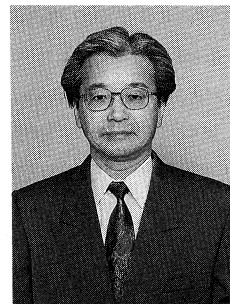
international disputes but also to the development of international law. The present work makes a comprehensive and systematic examination of the entire set of mechanisms under which the court exercises its judicial functions.

In fourteen chapters, the author organized his book in a clear and logical fashion. After having surveyed the historical development of international adjudication from the era of ancient Greece to modern times in the first chapter, a detailed account of the historical background underlying the establishment of the Court is given in Chapter 2. Then, questions of composition and organization of the Court, including those of the election and status of judges, and the Court's chamber system are examined in detail in Chapters 3 and 4 respectively. Chapter 5 addresses matters on standing before the Court or qualification to be a party to a case, and Chapter 6 moves to consider general concepts and categories of the jurisdiction of the Court in contentious cases. With regard to the latter question, particular examinations are made, in Chapter 7, of the compulsory jurisdiction of the Court that has been introduced under the optional clause system, so as to shed light upon its legal and practical functions. Chapter 8 deals with rules of procedure in written and oral proceedings on the merits phase as well as law of evidence. Thereafter, several kinds of incidental procedures to which resort has often been had during proceedings are dwelt upon in the subsequent three chapters; namely, the procedure for preliminary objections, the procedure for interim measures of protection, and the procedure for intervention by third States. The function and legal force of judgments rendered by the Court and the nature and role of the individual opinions of judges are examined in Chapter 12, and this is followed, in Chapter 13, by considerations of two other kinds of incidental procedures which operate in the post-judgment phase; namely, procedures for interpretation and revision of a judgment. The final chapter devotes itself to the advisory functions of the Court, analysing its legal character and various roles in the framework of international organizations.

As this outline shows, the book provides systematic and comprehensive observations, from a juristic point of view, on the whole system of the International Court of Justice. The author has, for this purpose, analysed a vast amount of judicial decisions and individual opinions, including those of the Permanent Court of International Justice. This corroborative and positivistic approach taken by the author serves to make his exposition objective and persuasive. At the same time, the author has been able to draw out many fresh issues, which have scarcely been discussed in academic papers, from the Court's jurisprudence. This research carried out by the author, being pioneer work in this field of study in Japan, has contributed to promoting a common perception of the judicial functions of the Court. For these reasons, the work merits great attention.

***Japan Academy Prize to:***

Norio KAIFU  
Professor and Director, Subaru Telescope, Hawaii  
Facility, National Astronomical Observatory of Japan



for "Research on Interstellar Matter"

***Outline of the Work:***

Interstellar space is almost empty in the sense that it contains only one hydrogen atom per cubic centimeter on average. However, there are places which contain more than a thousand times denser interstellar matter such as the Orion nebula. They are classified as dark nebulae, where many protostars are forming. Since neither the temperature of interstellar matter nor of protostars is high, they do not emit visible light but rather infrared and millimeter wavelength radiation.

Dr. Kaifu has studied such dense interstellar matter and protostars surrounded by protoplanetary clouds in dark nebulae by making detailed spectroscopic observations of them using millimeter wavelength radio. He has elucidated new aspects of star-forming processes and discovered new kinds of interstellar molecules.

Early on, Dr. Kaifu joined the radio astronomy group of the Tokyo Astronomical Observatory. With K. Akabane and M. Morimoto as its leaders, the group was at the time engaged in constructing a 6-meter diameter radio telescope for millimeter wavelength radio. In this construction process, his main role was to develop an acoustic-optical radiospectrometer. He carried out this task very successfully, as he and his colleagues would discover an interstellar methylamin in 1974 using his spectrometer connected to the 6-meter telescope. Later, during his stay at the U.S. National Radio Astronomy Observatory, he identified a line observed in the Orion A nebula as a maser emission of SiO molecules, and clarified its association with a late-type star. It was the second interstellar maser source discovered in the universe.

When the project to construct the 45-meter telescope for millimeter wavelength was implemented, he worked to develop a very stable acoustic-optical spectrometer with high dispersion through the use of a TeO<sub>2</sub> crystal. Again, he succeeded as in 1981 the spectrometer could cover a very wide-range of frequencies and has as many as 16,000 channels. In fact, it was a very powerful instrument with capacities that far exceed any international standard, and still has better performance than any other radiospectrometer in the world. His success provided much stimulus to radio astronomers around the world.

The first object that he and his colleagues observed through the 45-meter telescope in 1984 was L1551 IRS-5, which was known to contain a protostar with a bipolar flow. What they discovered was a rotating gas disk around the protostar from which the bipolar flow generates in a perpendicular direction. Subsequently, such disks have been found in many other protostar systems, making his discovery a key factor in explaining how planetary systems are created around protostars. We know now that almost every star has a planetary system.

Together with H. Suzuki and others, Dr. Kaifu also concentrated his efforts on identifying new interstellar molecule lines taking advantage of the high-resolution spectrometer and of the strong input power from the 45-meter telescope. The interstellar molecules his group has discovered include CCCO, C<sub>6</sub>H, CCS, CCCS, C<sub>3</sub>H of ring type, CH<sub>2</sub>CN, C<sub>4</sub>Si, CCO, H<sub>2</sub>CCCC, HCCNC, HNCCC, and HC<sub>3</sub>NH<sup>+</sup>. These constitute about half of the new molecules identified during this period. He also organized a group of young scientists to research how such

interstellar molecules are formed in the universe.

Due to the merits of his scientific achievements, he has been invited to deliver presentations on star forming regions and interstellar molecules at several international meetings.

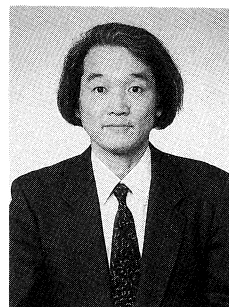
In summary, Dr. Kaifu is one of the pioneers in the field of millimeter radio astronomy and has contributed very much to the development of this field. In fact, international scientific activities on interstellar matter have both increased and advanced markedly since he entered the field at its yet premature stage.

He was awarded the Nishina Memorial Prize in 1987 and selected as an Associate of the Royal Astronomical Society (London) in 1995. He is now serving as a vice-president of the International Astronomical Union.

***Japan Academy Prize to:***

Yasutaka IHARA  
Professor, Research Institute for  
Mathematical Sciences, Kyoto University

for “Studies in Arithmetic”



***Outline of the Work:***

Arithmetic or the theory of numbers is one of the oldest branches of mathematics, whose primary object is the natural numbers 1, 2, 3, . . . . The realm of numbers has been enlarged, however, along with the development of mathematics, and the field of arithmetic continues to be advanced everyday. One of the most important contributions to this field in this century has been the work of Teiji Takagi, who established the class field theory in 1920. Since then, the activities of the Japanese school of arithmetic have attracted the attention of the world's mathematic community. Dr. Ihara has been a central figure of this school since the 1960s.

The class field theory is the theory of Abelian extensions of algebraic number fields. After Takagi, it was supplemented by important contributions by E. Artin and C. Chevalley, from which resulted an elegant formulation of a main result of this theory as an isomorphism of the Galois group of the Abelian closure of any algebraic number field to the group of connected components of what Chevalley called the idele class group of the ground field.

Takagi left the important problem of generalizing this theory to non-Abelian Galois extensions of algebraic number fields. This problem is still far from being solved, though it has been discovered that one can establish analogues of the class field theory by changing the ground fields from algebraic number fields to other fields such as local fields or the algebraic function fields of one variable over finite fields. Concerning the latter fields, A. Weil succeeded around 1940 in proving an analogue of Riemann hypothesis, after giving a rigorous foundations to the algebraic geometry. In 1955, A. Selberg introduced a new kind of zeta-functions related to discrete subgroups of Lie groups, for which he proved also another analogue of Riemann hypothesis.

Takagi's problem of generalizing the class field theory to non-Abelian cases was challenged in around 1960 by G. Shimura, who succeeded in showing that in some special cases with function fields as ground fields an analogue of the class field theory for non-Abelian extensions can indeed be established. Dr. Ihara attempted to elucidate the mechanism of this work by Shimura utilizing the results of his predecessors including Weil and Selberg. In doing so,

he attained brilliant achievements, which he reported in his invited talk at the International Congress of Mathematicians in Nice in 1970.

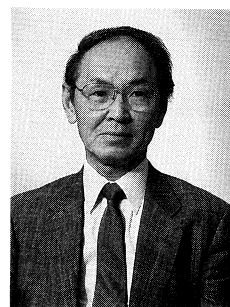
Since around 1980, Dr. Ihara's main interest has turned to the Galois group of the algebraic closure  $\overline{\mathbf{Q}}$  of the field  $\mathbf{Q}$  of rationals over  $\mathbf{Q}$ . The elucidation of the structure of this group  $G(\overline{\mathbf{Q}}/\mathbf{Q})$  can be regarded as an ultimate object of arithmetic. In 1979, G. V. Belyi showed that  $G(\overline{\mathbf{Q}}/\mathbf{Q})$  is isomorphic to a subgroup H of the outer automorphism group of a group which he denoted by  $\hat{\pi}(V)$ , where V is the algebraic variety  $\mathbf{P}^1 - \{0, 1, \infty\}$ ,  $\mathbf{P}^1$  being the projective line over the complex field  $\mathbf{C}$ . He noted the relation between this group H and the braid group of Artin, and derived deep arithmetical consequences. These results were reported by Dr. Ihara in his invited talk at the International Congress of Mathematicians in Kyoto in 1990.

The list of titles of his 43 papers from 1964 through 1997 shows that he has collaborated with a number of foreign and Japanese mathematicians. He maintains close relations with leading mathematicians in the field of arithmetic in Europe and America, and leads the Japanese school including the collaborators of his papers. Recently, three members of this group were awarded a prize from the Mathematical Society of Japan for having proven the validity of Grothendieck conjecture, which had been pending for more than ten years. Dr. Ihara, himself, received the society's prize in 1973.

***Japan Academy Prize to:***

Norio ISE  
Director, Central Laboratory, Rengo Co., Ltd.;  
Emeritus Professor, Kyoto University

for "Study of Microscopic Structures in  
Homogeneous Dispersions"



***Outline of the Work:***

Macromolecular chemistry and physics have become important elements in both pure and applied sciences. The main emphasis in their developmental stage had been placed on electrically uncharged polymers; particularly in the 1950/60s, less attention was given to ionic polymers such as nucleic acids and many proteins. It was in this setting that Dr. Ise started his systematic studies of ionic polymer solutions, measuring the mean activity coefficients of these solutions for the first time in 1963. Through this work, he found that solute macroions form unexpectedly, more or less ordered arrangements, though in solution. Through a small-angle X-ray scattering (SAXS) study in 1979, he discovered a single broad peak that corresponded to the ordered arrangements, and found the Bragg spacing between macroions ( $2D_{\text{exp}}$ ) to be smaller than the average spacing calculable from the concentration ( $2D_0$ ). This implied the existence of a "two-state structure" in macroscopically homogeneous solutions, in which localized ordered structures of macroions coexist with free macroions.

The Derjaguin-Landau-Verwey-Overbeek (DLVO) theory had been considered valid for such solutions for more than 50 years. Accordingly, electrostatic repulsive forces had been thought to act between similarly charged macroions, as was widely discussed in technical books on colloids and even taught in chemistry textbooks in Japanese high schools. In fact, experimental observations of comparatively concentrated systems could at least be



qualitatively be described using this theory. Technological advances later made it possible to carry out experiments in dilute systems. Doing so, Dr. Ise discovered the two-state structure, which was at variance with the DLVO theory. To confirm this structural heterogeneity, Dr. Ise subsequently performed a systematic study on various solutes. He, for example, used digital video imagery to study dilute dispersions of ionic colloidal particles, that were large enough to be observed through microscopy, and was able to convincingly confirm the two-state structure at low concentrations after stringent purification in 1983, which was independently verified by Grier in 1996. The  $2D_{\text{exp}}$  was directly determined from micrographs and found to be smaller than  $2D_0$ , which conformed with the conclusion previously derived through his SAXS study.

Dr. Ise further discovered through a trajectory analysis of particles that two diffusional modes exist in homogeneous dispersions, providing a solution to the long-unsettled controversy over the interpretation of data on the dynamic light scattering of macroion solutions. Using a confocal laser scanning microscope (CLSM), Dr. Ise was able to find the presence of particle-lacking void structures in otherwise homogeneous dispersions in 1988. This unprecedented finding was confirmed by Rao in 1989. (It is worth mentioning that stable voids can exist in the interior of the dispersion and are sometimes quite large [ $50 \times 50 \times 200 \mu\text{m}^3$ , for example].) According to Prof. Robert Fitch, this void structure shows the inadequacy of the DLVO theory while proving the presence of an attractive interaction (hence the Langmuir-Ise-Sogami concept) between similarly charged solutes ("Polymer Colloids", Academic Press, 1997).

Moreover, Dr. Ise supervised a group study that successfully constructed ultra-small-angle X-ray scattering (USAXS) apparatuses for the first time in Japan. This method made it possible to study large structural fluctuations of a magnitude that could not be investigated by SAXS. For example, he succeeded in observing 22 scattering peaks from single crystals of silica particles, which made it possible to precisely determine lattice constants of colloidal crystals as large as  $0.3 \mu\text{m}$  by the X-ray scattering. Carrying out Monte-Carlo simulations, he demonstrated that the void structure can be reproduced, by the Sogami potential, which contains long-range attraction as well as short-range repulsion, further proving that the DLVO theory does not hold for dilute solutions.

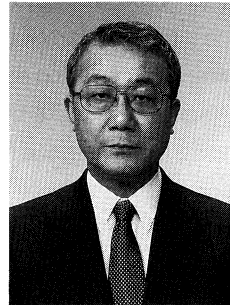
This long-range attraction appears to be characteristic of systems composed of two interacting elements (such as ionic systems). Its occurrence can be qualitatively understood through analogy with ionic crystals or hydrogen bond. The microscopic inhomogeneity found by Dr. Ise is so important that it will require a partial revision of the traditionally accepted view of the structure of condensed systems.

***Japan Academy Prize to:***

Hideaki YAMADA  
Professor, Faculty of  
Engineering, Toyama  
Prefectural University;  
Emeritus Professor,  
Kyoto University

and

Teruhiko BEPPU  
Professor, College of  
Bioresource Sciences,  
Nihon University;  
Emeritus Professor,  
University of Tokyo



for “Basic Studies for Development and Application of  
Microbial Functions”

***Outline of the Work:***

Development of unique processes in microbial industries has primarily been based on the diversities of microbial functions, which have mostly been pursued through the screening of new microbial strains from nature. Recent rapid advances in recombinant DNA technologies have also paved the way for another approach; that is, knowledge-based design of microbial functions for application in the production of useful substances. Dr. Yamada and Dr. Beppu have collaborated in extending their works within these fields and have made many outstanding contributions.

Dr. Yamada established the basis of biocatalysis technology through his discovery of many novel microbial enzymes and through his elucidations of their catalytic mechanisms. He discovered the reverse synthetic reaction of amino acid-degrading enzymes, such as  $\beta$ -tyrosinase and tryptophanase in enteric bacteria, and clarified their catalytic mechanisms. Using these enzymes, he established effective processes for producing L-tyrosine, L-tryptophan, as well as L-DOPA, which is useful as a chemotherapeutic agent for Parkinson's disease. He also discovered a unique enzymatic activity of hydantoinase, one that stereospecifically hydrolyzes a D-isomer of the racemic hydantoins to produce D-amino acids. He applied the enzyme in a hybrid process with chemical synthesis to produce D-hydroxyphenylglycine, a material of the semi-synthetic penicillin, amoxicillin. Through wide screening he found a new enzyme, D-specific aldonolactonase, from a fungal strain, which led to the development of a process for producing D-pantothenate from chemically synthesized DL-pantoyllactone. In addition to these, he discovered varieties of unique catalytic activities and enzymes in microbial cells and applied them to produce various useful substances such as amino acids, vitamins, coenzymes, and polyunsaturated fatty acids.

Dr. Beppu has contributed much to the establishment of recombinant DNA techniques for producing various useful enzymes, especially calf chymosin—a milk-coagulating aspartic proteinase for cheese production. He cloned and expressed the cDNA of prochymosin, a precursor of chymosin, in *E. coli*, and developed a method for refolding and converting prochymosin to an active enzyme. He also cloned a fungal milk-coagulating proteinase and

established its effective expression-secretion system in yeast cells. Based on these works, he advanced protein engineering of these enzymes, which enabled him to improve their properties as milk coagulants and provided an insight on the structure-function relationships in these aspartic proteinases. His other works were focused on the molecular genetics of industrial microorganisms such as *Streptomyces*. He confirmed that a diffusible autoregulatory factor, named A-factor, is essential for the initiation of both streptomycin production and sporulation in *Streptomyces griseus*. He further showed the involvement of a specific binding protein as a receptor and elucidated the A-factor-dependent promoters in this regulatory system. He also showed the involvement of the “eukaryotic” Ser, Thr-proteinkinases in controlling secondary metabolism in *Streptomyces*. These results provided substantial evidences for characterizing the signal transduction system in this group of bacteria, which are useful in breeding antibiotics-producing strains.

Collaboration between Dr. Yamada and Dr. Beppu has led to many innovative achievements, exemplified by their work on the novel microbial enzyme nitrile hydratase. Although nitriles had been believed to be almost unmetabolized chemicals, Dr. Yamada discovered the enzyme hydrating nitriles to the corresponding amides from various bacterial strains involving *Rhodococcus rhodochrous*. He characterized the enzyme as metalloproteins containing Fe or Co and elucidated their catalytic mechanisms. Dr. Beppu conducted the cloning of the nitrile hydratase gene clusters from several bacterial strains, and developed a host-vector system for *Rhodococcus*. Simultaneously, he also elucidated the regulatory mechanisms of the nitrile hydratase gene cluster. Based on these results, Dr. Yamada developed an enzymatic process for producing acrylamide from acrylonitrile with an unusually high yield exceeding 600 g/l. This opened the door to applying biocatalysts to the production of commodity chemicals on an industrial scale.

These unique and pioneering works conducted by Dr. Yamada and Dr. Beppu have made great contributions to the development of novel microbial production processes as well as to a better basic understandings of industrial microorganisms.

***Japan Academy Prize to:***

Shoshichi NOJIMA  
Emeritus Professor, University of Tokyo

for “Structure and Metabolism of Membrane  
Phospholipids— with Special Emphasis on  
*Escherichia coli* Phospholipases”



***Outline of the Work:***

Phospholipids are the major lipids of the various biological membranes and an essential component for the formation of the lipid bilayer. Phospholipids are composed of a polar head group, a phosphodiester, and two hydrophobic hydrocarbon chain tails, which are usually fatty acid esters. Phospholipids in the membrane lipid bilayer are not only structural building blocks, but also act as precursors for bioactive molecules. Phospholipases hydrolyze fatty acid esters or phosphodiesterases and produce bioactive molecules, which play important roles in cellular signal transduction.

Dr. Nojima began his study of the biochemistry of phospholipids in 1955. At that time, the concept of the membrane lipid bilayer had not yet been proposed, and the physiological importance of phospholipids in the membrane was not at all clear. However, the presence of a phosphodiester structure in phospholipid molecules like nucleic acids attracted the attention of many biochemists. Dr. Nojima identified the membrane phospholipids of acid-fast bacteria and *E. coli*. He, then, extended his work to immunochemistry and the metabolism of phospholipids and finally to the molecular genetics of phospholipases of *E. coli*.

1) Membrane phospholipids of acid-fast bacteria.

Dr. Nojima isolated and identified the individual phospholipids of acid-fast bacteria, *BCG*, and *Mycobacterium phlei*. He found, for the first time, phosphatidylinositol-oligomannosides (PIOM) in the wax fraction of *BCG* lipids. PIOM was distributed in both the cell membrane and cell wall, and was a fixed complement in the presence of the sera of patients with leprosy.

Cardiolipin, one of the ubiquitous phospholipids, is contained within the mitochondrial inner membranes of animals and plants, as well as in the cell membranes of various bacteria. Cardiolipin reacts with antibodies in the sera of patients with syphilis, and these antibodies were named "reagin". Dr. Nojima synthesized cardiolipin and a series of its analogues chemically, and examined their reactivities with the sera of syphilitic patients. He successfully determined the epitope in cardiolipin as 1'-phosphoglycerol-3'-phosphoryl structure (1965). He reported that a mixture of cardiolipin and methylated bovine serum albumin effectively elicited anti-cardiolipin antibodies in rabbits (1967). This was the first report of the preparation of antibodies against well-defined phospholipids. He also prepared rabbit antibodies against phosphatidylinositol and determined their specificities.

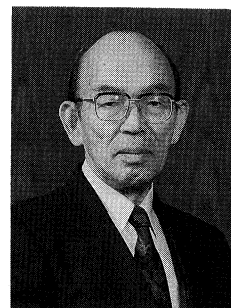
2) *E. coli* phospholipases.

Dr. Nojima presented evidence that each of the individual phospholipids of both acid-fast bacteria and *E. coli* had a characteristic turnover rate at the logarithmic phases of their growth. He studied enzymes which hydrolyze acylesters of phospholipids, and clarified their dynamic behaviors. He purified and characterized a membrane-bound phospholipase A1 from *Mycobacterium phlei* and four kinds of phospholipases from *E. coli*, detergent-resistant (DR)-phospholipase A (1966, 1984), detergent-sensitive-phospholipase A (1976), lysophospholipase L1 (1975, 1997), and lysophospholipase L2 (1985). He also carried out genetic mapping of the loci for DR-phospholipase A (*pld A*), lysophospholipase L1 (*pld C=tes A*), and lysophospholipase L2 (*pld B*) on *E. coli* chromosome.

Dr. Nojima's studies of phospholipids from viewpoints of biochemistry, metabolism, immunochemistry, and molecular genetics, are very solid and fundamental. His studies have had a strong impact on the recent development of phospholipid research in Japan, as well as abroad. Due to these significant contributions, he received the Award of the Japanese Pharmaceutical Society and the Purple Ribbon Medal from the Japanese Government.

***Japan Academy Prize to:***

Kazuo SASAKI  
Director-General, National Institute for  
Physiological Sciences;  
Emeritus Professor, Kyoto University



for “Studies on Integrative Functions of the  
Central Nervous System”

***Outline of the Work:***

D. Kazuo Sasaki has studied the integrative functions of the central nervous system of higher mammals, including cats, monkeys and humans, using electro- and magneto-physiological methods. In particular, he discovered the neuronal connections between the association areas of the cerebral cortex and the cerebellum and investigated their functions in organizing and learning voluntary movements. He, then, found the suppressor activity of voluntary movements in the prefrontal cortex, called “no-go potential”, in monkeys and later in humans with magnetoencephalography (MEG). He recorded “frontal mental theta waves” in the frontal cortex of humans with MEG and localized their electrical current origins in the cortex.

Dr. Sasaki investigated initially, from 1955 to 1963, the accommodation of spinal motoneurons of a cat with intracellular electrodes and found that accommodative properties of the neuronal membrane can dynamically change depending upon the synaptic barrages onto the neurone. He also made intracellular recording from the ocular motoneurons of a cat and examined the characteristic features of the neurone as compared with spinal motoneurons.

Dr. Sasaki worked in the Department of Physiology, John Curtin School of Medical Research, Australian National University (Canberra) from 1963 to 1966 with Prof. J. C. Eccles, Dr. R. Llinás and Dr. P. Strata, where they elucidated in considerable detail the synaptic organization and functional mechanisms of the cerebellar cortex.

Dr. Sasaki identified and clarified the two thalamo-cortical (T-C) projection systems, i.e., superficial and deep T-C projection systems, while at Max-Planck-Institute for Brain Research (Frankfurt/M) in 1968–1969. The concept of the two T-C projection systems has been extremely useful in his later investigations of the cerebral cortex in cats, monkeys and humans. At Kyoto University, he found that the neocerebellum (hemispherical part of the cerebellum) has reciprocal connections with the association area of the cerebral cortex, i.e., the parietal association cortex in cats (1972–1975) and the premotor and prefrontal cortex in monkeys (1976–1979). That concept and the idea of reciprocal connections were further utilized in chronic experiments with monkeys on the organization and learning processes of voluntary movements. They have also been an important basis for recent MEG studies with human subjects.

Dr. Sasaki has, since 1978, been developing a new method for recording trans-cortical field potentials in various areas of the cerebral cortex using chronically implanted electrodes, which can last for many months and which can follow changes in the activities of the cortical areas during motor learning processes and also in compensatory processes after a localized lesion is applied to the cerebral cortex and the cerebellum. Thus he found two types of processes in learning voluntary hand movements in response to visual or auditory stimuli (reaction-time movement), namely the processes of “recognition learning” and “skill learning” (1982). In the former, association of the external stimulus with the hand movement is accompanied by increasing activities of association

cortices; and, in the latter, it is necessary for cerebrocerebellar interaction to be recruited. He also demonstrated that there are three distinguishable compensatory processes in the central nervous system after a localized disorder of the system, i.e., substitution, relearning and reorganization (1984).

Dr. Sasaki extended his chronic experiment with monkeys to an investigation of the prefrontal function, and found “no-go potential” in and around the principal sulcus of the prefrontal cortex (1986). Two different colour light stimuli of 500 ms in duration were delivered in front of a monkey at random time intervals and in irregular order: one colour was a “go” stimulus with a reward gotten by lifting a lever and the other was a “no-go” without a reward. The monkey learned this go/no-go discrimination task in a few weeks and the electrical activity (no-go potential) appeared in the principal sulcus of the prefrontal cortex on each side according to the learning process. Electrical stimulation of the cortical area with the no-go potential was proved to suppress the hand movement on the go stimulus (1989). This prefrontal region is thus considered to be the suppressor area of learned movements.

Using EEG and MEG, Dr. Sasaki located the suppressor area in the human cortex: and through his MEG studies, he was able to localize the electrical current origin (dipole) for the no-go potential in the prefrontal cortex (around middle frontal gyrus) of humans (1993).

Investigating the human frontal cortex with MEG, he observed 5–7 Hz rhythmic activities (theta waves) in human subjects while they concentrated on thinking, e.g., mental calculation, mental playing of music, etc. The theta waves, called “frontal mental theta wave”, were found to be generated in the wide area of the frontal cortex on both sides during the mental activity (1994). He also localized the motor speech centre in the frontal lobe with MEG (1995).

In summary, Dr. Sasaki has worked to clarify the mechanisms of the integrative functions of the central nervous system, the spinal cord, cerebellum, thalamus, motor cortex and frontal association cortex employing electro- and magneto-physiological methods, and has achieved numerous significant results using his original methodologies.

***Duke of Edinburgh Prize to:***

Tatuo KIRA  
 Adviser to Shiga Prefectural Government;  
 Vice Director General, International Lake  
 Environmental Committee Foundation;  
 Emeritus Professor, Osaka City University

for “Contributions to the Development of  
 Quantitative Plant Ecology and the Conser-  
 vation of Natural Environments”



***Outline of the Work:***

Dr. Kira’s extensive achievements in plant ecology and related fields of science are characterised by his forerunning efforts to develop quantitative and modelling approach to the study of ecological processes, deep concern for environmental issues, and broad worldwide perspective. On those bases he contributed greatly to the conservation of forest and inland water ecosystems and environments both theoretically and in practice.

His work may be summarised in the following five aspects.

- 1) Ecogeographical studies on the correlation between the distribution of climates and that of vegetation types:  
Dr. Kira's experiences during the scientific expeditions to Micronesian islands and the Great Hinggan (Khingan) Mountains of northeastern China in the early 1940's led him to propose a new global system of parallel classification of climate and vegetation types. He also clarified the thermal factors responsible for the differentiation of forest zones in Japanese Archipelago according to this new approach, which has since been frequently adopted by domestic and foreign researchers.
- 2) Studies on the population ecology of higher plants:  
During the 1950's, Dr. Kira and his collaborators carried out experimental and field studies on the effect of population density and other factors on the growth of higher plants in pure stands. Some of the resultant findings, such as the Law of Constant Final Yield and the 3/2 Power Thinning Law, were quite new to plant ecology. Particularly, the latter law, which formulated in a very simple style the process of self-thinning, or the auto-regulation of population density in overcrowded pure stands due to inter-plant competition, stimulated similar studies in many countries. The British Ecological Society, on the occasion of its 75th anniversary, mentioned the law among the most important fifty concepts in ecology that contributed to an understanding of the natural world.
- 3) Studies on the primary production rate and carbon cycling in forest ecosystems:  
From 1958 through the 1960's and 1970's, his research group in the Osaka City University concentrated on this theme in cooperation with the groups in a few other research institutes. The OCU group, sometimes called the Osaka School, contributed particularly to the development of basic methodology of primary production (organic matter production) assessment and various field techniques to overcome difficulties caused by the enormous size of trees and forests and the heterogeneity of forest habitats. Japanese forest ecologists could thereby accumulate a large amount of reliable data on the primary productivity of various forest types ranging from Hokkaido to Okinawa, and take the leadership in this field during the International Biological Programme (IBP) on *Biological Productivity and Human Welfare* (1965~1974). Dr. Kira served as a member of the international and domestic steering committees for this first international joint biological research project.
- 4) Ecosystem studies on tropical rainforests of Southeast Asia:  
He was keenly interested in tropical forests since his first study in Micronesia in 1941, and led forerunning studies in Thailand and Cambodia in 1957~1965. With the start of IBP, he organised an integrated ecosystem study of a lowland rainforest in Pasoh Forest Reserve of Peninsular Malaysia jointly with British and Malaysian scientists. The Japanese team, consisting of 16 ecologists, worked at Pasoh for four years (1971~75) under his leadership. As for the outcome of the project of which he was directly in charge, it was demonstrated that the primary productivity or the rate of carbon dioxide uptake was certainly higher in tropical rainforests than in temperate forests, being approximately proportional to the length of the growing season, and that an undisturbed primeval forest was in a steady state with respect to its biomass turnover and carbon cycling. These results are still being used as important basic data for the predictive simulation of global warming.
- 5) Contribution to the conservation of natural ecosystems and environments, especially of forests and lakes:  
Dr. Kira has served for many years as an officer of the Nature Conservation Society of Japan and the member of relevant councils for National Environment Agency and Cultural Affairs Agency. In 1962, he drafted an appeal on the protection of primeval forests from the Ecological Society and the Science Council of Japan to the Government,

while contributing a paper on its rationale to the Society's journal.

Toward the end of the 1970's, he organised a group study on the environmental status and changes in Lake Biwa, the largest lake and the most important source of freshwater in Japan, emphasizing the viewpoint that a lake and its watershed should be dealt with as an integrated system. On request from Shiga Prefectural Government in 1981, he left the university to establish the Lake Biwa Research Institute, which aimed at promoting multidisciplinary studies on the conservation and management of the lake's environments, sustainable use of its water resources, and measures to cope with eutrophication and other environmental degradation. During the following years, he also contributed actively to the environmentally sound management of world lakes/reservoirs and their resources, mainly in developing regions, by serving as the coordinator for the first World Lake Conference held in Shiga (1984), and as the first chairperson of newly founded (1986) International Lake Environment Committee.

### Main Publications of Dr. Kira

(\* Publications written in Japanese)

#### [Books]

- Kira, T. (1949) \*Forest Zones of Japan. Ringyo Gijutsu Kyokai, Tokyo & Sapporo. 42 pp.
- Kira, T. (ed.) (1949) \*Plant Ecology, II. Kokon Shoin, Tokyo. 402 pp.
- Kira, T., Umesao, T., Iwata, K. & Yosii, R. (ed.) (1961, 1962, 1964, 1965, 1967, 1969, 1971) Nature and Life in Southeast Asia, Vol. I–VII. Japan Society for the Promotion of Science, Tokyo. 454, 276, 466, 402, 312, 213, 354 pp.
- Kira, T. (1971) \*An Ecologist's View of Nature. Kawade Shobo, Tokyo. 295 pp.
- Kira, T. (1976) \*Terrestrial Ecosystems: A Compendium. Kyoritsu Shuppan, Tokyo. 166 pp.
- Kira, T. (1976) \*Thoughts on Nature Conservation. Jimbun Shoin, Kyoto. 254 pp.
- Shidei, T. & Kira, T. (ed.) (1977) Primary Productivity of Japanese Forests (JIBP Synthesis Vol. 16). University of Tokyo Press, Tokyo. 289 pp.
- Kira, T., Ono, Y. & Hosokawa, T. (ed.) (1978) Biological Production in a Warm-temperate Evergreen Oak Forest of Japan (JIBP Synthesis Vol. 18). University of Tokyo Press, Tokyo. 288 pp.
- Kira, T. (1983) \*Ecology of Tropical Forests. Jimbun Shoin, Kyoto. 251 pp.
- Kira, T. (1987) (ed.) \*Conservation of Water Resources—Problems in the Catchment Area of Lake Biwa. Jimbun Shoin, Kyoto. 231 pp.
- Kira, T. (1990) \*Lake Biwa in the Global Environment. Jimbun Shoin, Kyoto. 277 pp.
- Kira, T. & Lake Biwa Research Institute (ed.) (1993) \*Lakes of the World. Jimbun Shoin, Kyoto. 269 pp.
- Jorgensen, S. E., Kawashima, M. & Kira, T. (ed.) (1977) A Focus on Lakes/Rivers in Environmental Education (ILEC Guidelines of Lake Management). International Lake Environment Committee Foundation, Kusatsu. 167 pp.

#### [Articles]

##### 1) Eco-geography

- Kira, T. (1945) \*New classification of climates in Eastern Asia as the basis for agricultural geography. Research Paper from the Institute of Horticulture, Faculty of Agriculture, Kyoto University. 23 pp.
- Kira, T. (1945) \*New classification of climates in Southeast Asia and Western Pacific. Ibid. 24 pp.
- Kira, T. (1948) \*On the altitudinal zoning of climates in terms of the warmth index. Kanchi-Nogaku (agricultural



science for cold regions), **2**(2), 143–173.

- Kira, T. (1953) \*Ecological ordination of the deciduous conifer forest. *Daikoanrei Tanken* (Explorations in the Great Khingan Mountains) (ed. Imanishi, K.), pp. 476–497. The Mainichi Press, Osaka.
- Kira, T. & Yoshino, M. (1967) \*Thermal distribution of Japanese conifer species. *Shizen: Seitaigakuteki-Kenkyu* (Natural History: Ecological Studies) (Contributions in Honour of Dr. Kinji Imanishi on the Occasion of his Sixtieth Birthday, Vol. I; ed. Morisita, M. & Kira, T.), pp. 133–161. Chuo-Koronsha, Tokyo.
- Kira, T., Shidei, T., Numata, M. & Yoda, K. (1976) \*Vegetation of Japan—its position in the global vegetation system. *Kagaku (science)*, **46**(4), 235–247.
- Kira, T. (1991) Forest ecosystems of East and Southeast Asia in a global perspective. *Ecological Research*, **6**(2), 185–200.

## 2) Plant population ecology

- Kira, T. et al. (1953–1957, 1961, 1963, 1965) Intraspecific competition among higher plants, I–XII. *Journal of the Institute of Polytechnics, Osaka City University, Series D*, **4**, 1–16; **5**, 1–7; **6**, 107–119; **7**, 1–14, 15–34, 35–72, 73–94; **8**, 161–178; *Journal of Biology, Osaka City University*, **12**, 69–82; **14**, 107–129; **16**, 27–44.
- Kira, T. & Yoda, K. (1957) \*Stand density and productivity. *Hoppo-Ringyo (northern forestry)*, **9**(6), 160–164.
- Kira, T. (1960) \*Ecological considerations on the extraordinarily high rice yield reported from China, with special reference to the high-density planting of rice. *Shizen (nature)*, **15**(7), 36–42.
- Kira, T. (1961) \*Crop yield and planting density, with reference to the high-density planting of rice. *Nogyo oyobi Engei (agriculture and horticulture)*, **36**, 1101–1106, 1265–1268, 1421–1425.

## 3) Primary production and carbon cycling

- Kira, T. & Shidei, T. (1967) Primary production and turnover of organic matter in different forest ecosystems of the Western Pacific. *Japanese Journal of Ecology*, **17**(2), 70–87.
- Kira, T., Shinozaki, K. & Hozumi, K. (1969) Structure of forest canopies as related to their primary productivity. *Plant & Cell Physiology*, **10**(1), 129–142.
- Kira, T. (1971) \*Geographical distribution of primary productivity. *Sakumotu no Kogosei to Bussitu-Seisan* (photosynthesis and productivity of crop plants) (ed. Kumura, A. et al.), pp. 225–243. Yokendo, Tokyo.
- Kira, T. (1975) Primary production of forests. *Photosynthesis and productivity in Different Environments (International Biological Programme 3)* (ed. Cooper, J. P.), pp. 5–40. Cambridge University Press, Cambridge.
- Kira, T. & Yabuki, K. (1978) Primary production rates in the Minamata forest. *Biological Production in a Warm-Temperate Evergreen Oak Forest of Japan* (JIBP Synthesis 18) (ed. Kira, T., Ono, Y. & Hosokoawa, T.), pp. 131–138. University of Tokyo Press, Tokyo.
- Kira, T. (1978) Carbon cycling. *Ibid.*, 272–276.
- Kira, T. (1980) \*Atmospheric carbon dioxide and forests—Sink or source? *Gakujutsu Geppo (Japanese Scientific Monthly)*, **32**(12), 814–819.
- Kira, T. & Kumura, A. (1983) Dry matter production and efficiency in various types of plant canopies. *Plant Research and Agroforestry* (ed. Huxley, P. A.), pp. 347–364. International Council for Research in Agroforestry, Nairobi.

## 4) Tropical forest ecology

- Kira, T. et al. (1965, 1967, 1969) Comparative ecological studies on three main types of forest vegetation in Thailand, I, II, IV, V. *Nature & Life in SE Asia* (ed. Kira, T. et al.), **4**, 13–48, 49–80; **5**, 149–174; **6**, 83–112. Japan Society for the Promotion of Science, Tokyo.

- Kira, T. et al. (1969) Production ecology of tropical rain forests in southwestern Cambodia, I, II. *Ibid.*, **6**, 1–56, 57–81.
- Kira, T. & Ogawa, H. (1971) Assessment of primary production in tropical and equatorial forests. *Productivity of Forests Ecosystems: Proceedings of the Brussels Symposium* (ed. Duvigneaud, P.) pp. 309–321. UNESCO, Paris.
- Kira, T., Kirita, H., Ogawa, H., Hozumi, K. & Yoda, K. (1973) Comparative study of carbon cycling in moist tropical and warm-temperate forests. *Planned Utilization of the lowland Tropical Forests: Proceedings, Pacific Science Association Pre-Congress Conference at Cipayung, Bogor, Indonesia, 1971* (ed. Partoatmodjo, S.), pp. 214–230. Pacific Science Association, Bogor.
- Kira, T. (1978) Community architecture and organic matter dynamics in tropical lowland rain forests of Southeast Asia with special reference to Pasoh Forest, West Malaysia. *Tropical Trees as Living Systems: Proceedings of the 4th Cabot Symposium held at Harvard Forest, 1976* (ed. Tomlinson, P. B. & Zimmermann, M. H.), pp. 561–590. Cambridge University Press, New York.
- Kira, T. (1982) \*Ecology of tropical forests. *Shizen (nature)*, **37**(2), 64–73; (3), 57–67.
- Kira, T. (1987) Primary production and carbon cycling in a primeval lowland rain forest of Peninsular Malaysia. *Tree Crop Physiology* (ed. Sethuraji, M. R. & Raghavendra, A. S.), pp. 99–119. Elsevier Science Publishers, Amsterdam.
- Kira, T. & Yoda, K. (1989) Vertical stratification of microclimate. *Tropical Rain Forest Ecosystems (Ecosystems of the World 14B)*, pp. 55–71. Elsevier Science Publishers, Amsterdam.
- Kira, T. (1992) \*Introduction—Clearing up misunderstandings. *Nettairin wo Kangaeru* (considerations on tropical forests) (ed. Yamada, I. & Yamakura, T.), pp. 11–25. Jimbun Shoin, Kyoto.

#### 5) Nature conservation and environmental problems in general

- Kira, T. (1963) \*Reservation of primeval forests—Its urgent need and ecological significance. *Japanese Journal of Ecology*, **13**(2), 67–73.
- Kira, T. (1970) \*An ecological approach to environmental problems. *Chuo Koron*, **85**(10), 54–67.
- Kira, T. (1976) Man's place in natural ecosystems. *Science for Better Environment: Proceedings of the International Congress on the Human Environment, Kyoto 1975* (ed. Secretariat, HESC Organizing Committee). pp. 31–39. Asahi Evening News, Tokyo.
- Kira, T. (1993) Destruction of ecosystems as global environmental problems. *Proceedings, International Symposium of University of Osaka Prefecture on Global Amenity* (ed. Anpo, M. et al.), pp. 260–267. ISGA OSAKA '92, Sakai.
- Kira, T. (1994) \*Ecosystem conservations—Toward the conservation of global environment and biodiversity. *Kankyō Kenkyū (environment research)*, **93**, 48–57.

#### 6) Lake environments

- Kira, T. (1984) \*Lake Biwa—A lake in relation to its watershed. *Rikusui to Ningen-Katsudo* (inland waters and human activity) (ed. Monsi, M. & Takai, Y.), pp. 255–291. University of Tokyo Press, Tokyo.
- Kira, T. (1985) Lake Biwa—A case history of contacts between water and life of the Japanese. *Proceedings, Shiga Conference '84 on Conservation and Management of World Lake Environment* (ed. Shiga Prefectural Government), pp. 38–51. Shiga Prefectural Government, Otsu.
- Kira, T. (1988) Some aspects of ecological watershed management for the control of eutrophication—the case of Lake Biwa watershed. *International Journal of Water Resources Development*, **4**(4), 259–269.
- Kira, T. (1988) The historic role of a large lake in Japan—the case of Lake Biwa. *Toxic Contamination in Large Lakes: Proceedings, World Conference on Large Lakes, Mackinac '86, Vol. 6* (ed. Schmidtke, N. W.), pp.

31–46. Lewis Publishers, Chelsea.

Kira, T. (1994) Major environmental problems in world lakes. *Memorie dell'Istituto Italiano di Idrobiologia*, **52**, 1–7.

Kira, T. & Nakamura, M. (1994) Environmental management of Lake Biwa and its catchment area with special reference to the control of eutrophication. *Environmental Protection and Lake Ecosystem: Proceedings of an International Symposium held in Wuxi, 1993* (ed. Sund, H.), pp. 399–418.

Kira, T. (in press) Snail shell-mounds around the ancient lakes of Yunnan Province, China. *Proceedings, International Conference on Ancient Lakes, 1997*. Lake Biwa Museum, Kusatsu.

#### 7) Others

Kira, T. (1982) \*Ecological basis of food production—The earth's feeding capacity. *Chikyu-jidai no Shoku-bunka* (food and culture in the global age) (International Symposium '82) (ed. Umesao, T. et al.), pp. 129–151. Heibonsha, Tokyo.

Kira, T. (1985) \*Forest and Japanese culture. *Green Power*, **85**, 10–11; **86**, 8–9; **87**, 8–9; **88**, 8–9; **89**, 8–9; **90**, 8–10.

Kira, T. (1996) Good old days of quantitative ecology. *International Cosmos Prize 1995* (ed. S. Project Co.), pp. 26–41. The Commemorative Foundation for the International Garden and Greenery Exposition, Osaka, Japan, 1990, Osaka.



## PROCEEDINGS AT THE 920TH GENERAL MEETING

The 920th General Meeting of the Academy was held on Tuesday, June 23, 1998, at 1:05 p.m., Dr. Yoshio FUJITA, President, taking the chair. Ninety-one members were present, and the following communications were made:

- The recent usage of the term "civil society" . . . . . Kan'ichi FUKUDA, M. J. A.  
 One the estimations of world demand and supply of staple foods . . . . . Tsutomu OUCHI, M. J. A.  
 Quantitative biology and a problem of Japanese biology . . . . . Jun-ichi TOMIZAWA, M. J. A.  
 Kinetic smoothening and habit change during crystal growth . . . Masao KITAMURA and Kazumi NISHIOKA  
 Molecular dynamics simulation of high-pressure clinoenstatite . . . . .  
 . . . . . Norimasa SHIMOBAYASHI, Eiji MIURA, and Akira MIYAKE  
 Above two, communicated by Ikuo KUSHIRO, M. J. A.  
 Identification of spectral lines in photographic-infrared region from  $\lambda$  8630 to  $\lambda$  8800 in cool carbon stars. II  
 . . . . . Yoshio FUJITA, M. J. A.  
 Topochemical photopolymerization of muconic derivatives in the crystalline state via a radical chain reaction  
 mechanism . . . . . Akikazu MATSUMOTO, Toru ODANI, and Katsutaka YOKOI  
 Complex formation of neocarzinostatin chromophore and hydrophobized polysaccharide as an apoprotein  
 model . . . . . Yusuke KATO, Yukio SUGIURA, and Junzo SUNAMOTO  
 Above two, communicated by Seizo OKAMURA, M. J. A.  
 SV theory of synchronous machine. Permanent-magnet-excited synchronous machine . . . . .  
 . . . . . Sakae YAMAMURA, M. J. A.  
 Dynamics of composite functions . . . . . Kin-Keung POON and Chung-Chun YANG  
 Invariance of strong paracompactness under closed-and-open maps . . . . . David BUHAGIAR  
 Above two, communicated by Kiyosi ITÔ, M. J. A.  
 Non-genomic action of testosterone mediates avian vocal behavior . . . . .  
 . . . . . Yoko YAZAKI, Kazutoshi YAMAMOTO, Toshiya MATSUSHIMA, and Kiyoshi AOKI  
 Communicated by Kiyoshi HAMA, M. J. A.  
 Controllable deformation by plastic strain control for geomaterials . . . . .  
 . . . . . Shoichi KIYAMA and Takashi HASEGAWA  
 Communicated by Toshio SAWADA, M. J. A.  
 Regionally different noradrenergic innervation and receptor distribution in submucous plexus of guinea-pig  
 intestine . . . . . Keiji HIRAI, Ken KURIHARA, and Yoshifumi KATAYAMA  
 Communicated by Masanori OTSUKA, M. J. A.  
 Bovine stomach myosin light chain kinase with a marked discrepancy between its enzyme activity and  
 actomyosin activating effect . . . . . Setsuro EBASHI, M. J. A., Hideto KUWAYAMA, and Chizue NANKO  
 Acetylcholinesterase activity in the frog neuromuscular junction observed at electron microscopic level  
 after <<vital>> histoenzymatic reaction . . . . .  
 . . . . . Shigeru TSUJI, Keiji HIRAI, Ion MOTELICA-HEINO, and Yoshifumi KATAYAMA  
 Communicated by Setsuro EBASHI, M. J. A.  
 A criterion for a certain type of imaginary quadratic fields to have 3-ranks of the ideal class groups greater  
 than one . . . . . Yasuhiro KISHI  
 On an identity of theta functions obtained from weight enumerators of linear codes . . . Tomoaki MURAYAMA  
 Above two, communicated by Shokichi IYANAGA, M. J. A.  
 A generating function for rational curves on rational surfaces . . . . . Fumio HAZAMA  
 On compact conformally flat Einstein-Weyl manifolds . . . . . Minyo KATAGIRI  
 Above two, communicated by Heisuke HIRONAKA, M. J. A.  
 Suppression of Gal $\alpha$ 1-3Gal expression by antisense oligonucleotides specific for porcine  $\alpha$ -1,3-galacto-  
 syltransferase mRNA treatment . . . . .  
 . . . . . Akiko TAGUCHI, Masanobu ARITA, Yasunori KUSHI, and Shizuo HANDA  
 Communicated by Tamio YAMAKAWA, 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, the President announced that Dr. Yoshikazu MIYAZAKI, M. J. A., had passed away on May 20, 1998. The members rose from their seats in silence, expressing profound sense of grief.

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

Then, the President reported that the Twenty-eighth meeting of the Japan Academy Public Lectures was opened to the public in the Kyodai-Kaikan, Kyoto, at 2:00 p.m. on Saturday, May 23, 1998, with Dr. Hisayasu NAKAGAWA, M. J. A., and Dr. Seizo OKAMURA, M. J. A., as speakers, whose respective subjects were:

“Edo Period Japan as Observed by Contemporary European Intellectuals: Policy of Isolation and Commercial Spirits”.

“Studies on Polymer Chemistry in My Previous 40 Years”.

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: Masao HIRAI, Suelo IKEHARA, Ryuichiro TACHI, Saburo NAGAKURA, Hiroshi TSUJI, Masanao MATSUI, Tamio YAMAKAWA.

Finally, the President reported his attendance at the ceremony of the Royal Society, London, at which the King Charles II Medal was presented to His Majesty the Emperor of Japan on May 28, 1998.

The Meeting adjourned at 4:48 p.m.

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JUNE, 1998

# PROCEEDINGS OF THE JAPAN ACADEMY

## SERIES A MATHEMATICAL SCIENCES

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