AWARD OF MEDALS

The Eightieth Annual Award of Medals was held on Monday, June 11, 1990, 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 second 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 Academy Prize to Koji NAKANISHI
for "Structural and Mechanistic Studies of Functional Natural Products"

Academy Prize to Yoshihide SUZUKI
for "A Philological Study of Deuteronomy"

Academy Prize to Masahiko AOKI
for "The Co-operative Game Theory of the Firm" and "Information, Incentives and Bargaining in the Japanese Economy"

Academy Prize to Masashi TAZAWA
for "Physiological Studies on Giant Algal Cells Taking Advantage of Cell Perfusion and Cell Models"

Academy Prize to Shigeru IITAKA, Shigefumi MORI and Yujiro KAWAMATA
for "A Study of the Theory of Classification of Algebraic Varieties"

Academy Prize to Hiroshi TSUJI
for "Studies on the Structure of Flames"

Academy Prize to Tetsuo TAKEMATSU
for "Basic Studies on World Agricultural Land Weeds and Their Controls"

Academy Prize to Kiyoshi HAMA
for "Functional Morphology of Nervous System with Special Reference to Quantitative Three-Dimensional Analysis Using High Voltage Electron Microscope"

Academy Prize to Toju HATA and Satoshi ŌMURA
for "Studies of Biologically Active Microbial Metabolites—Especially Macrolide Antibiotics"

The Duke of Edinburgh Prize to Terumi MUKAI
for "Studies on Genetic Structure of Natural Populations of the Fruit Fly, *Drosophila*"

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

The function was closed at noon.

The Outlines of the Recipients' Works

Koji Nakanishi

Structural and Mechanistic Studies of Functional Natural Products

I. Retinal Proteins.

The visual pigments rhodopsin (Rh) and the pigments in *Halobacterium halobium, i.e.*, bacteriorhodopsin (bR, proton pump), halorhodopsin (hR, chloride pump), sensory rhodopsins-I and II (sR, responsible for phototaxis) all contain isomers of retinal covalently bound to the apoprotein. His group has synthesized over 100 retinal analogs, incorporated them into various retinal proteins, and have clarified many key aspects of these membrane proteins. The analogs have not only been sent to institutes worldwide but also have played decisive roles in making analog studies one of the most powerful tools to investigate these complex systems.

External point charge models: The variance in the absorption maxima of various retinal proteins, ranging from the UV to 640 nm, had been a central problem in this field. On the basis of extensive experimental data and theoretical calculations, his team proposed external point charge models and rationalized the phenomena by electrostatic interactions between the chromophore and peptidic charges within the binding site. This is now a generally accepted concept.

Pigments with retinals in which double bond isomerizations are locked: He has proven that 11-cis/all-trans and all-trans/13-cis isomerizations are essential for the function of rhodopsins and *H. halobium* pigments, respectively, by showing that such pigment analogs are inactive.

Tertiary structural studies of bR and rhodopsin: Incorporation of ^{14}C-3-diazoacetoxyretinal into bR followed by cleavage and sequencing; incorporation of analogs with C-9 side-chains of various lengths having terminal sulfate groups; noncrystalline X-ray measurements of bromo- and mercurio-bR analogs have contributed greatly to the understanding of its tertiary structure.

Chlamydomonas photoreceptor: Incorporation of the blind mutant of *Chlamydomonas* with retinal analogs gave predictable shifts in phototactic maxima, showing that algae could be used for rhodopsin

studies. Moreover, phototaxis is induced by analogs where double bond isomerizations are blocked, and even by n-hexanal; this is discovery of a new transduction mechanism.

Fourier transform IR (FTIR) difference spectroscopy: This has demonstrated the involvement of protonation/deprotonation of four Asp and two Tyr residues in bR proton pumping.

II. Microscale Oligosaccharide Structure Determination by CD.

Nakanishi has developed the circular dichroic (CD) exciton chirality method into a general technique for determining absolute configurations of microgram quantities of sample in solution. This simple and extremely versatile solution method has been expanded and applied to numerous types of compounds. Based on the theoretically and practically important discovery that entire CD curves can be represented by pair-wise addition of all interacting chromophores, he has devised a totally new CD nanomolar level method for determining glycosidic linkages; it requires no reference compound, and also establishes the absolute configurations of the monosaccharides. The free hydroxyls in a sugar are bromobenzoylated; the glycosidic linkages are cleaved; the free hydroxyls arising from glycosidic linkages are methoxycinnamoylated; and the CD is compared with the characteristic 160 reference curves which have been made available. It provides a new tool for studies of glycoproteins, gangliosides, cell walls, etc.

III. Structure Determination.

He is an international leader in the development of techniques for structure determinations, and has elucidated structures of over 160 bioactive compounds that are available in only very limited quantities. These include the ginkgolides, ponastgerones (the first insect molting hormones from plants), the adducts of nucleic acid and benzpyrene (carcinogen), nucleic acid and mitomycin C (antitumor drug) etc. He has published over 500 papers and is engaged in research at Columbia University and at the Suntory Institute for Bioorganic Research. He has given over 200 plenary and named lectures. His honors include Award in Pure Chemistry, Chem. Soc. Japan (1954), Asahi Cultural Award (1968), E. Guenther Award, Am. Chem. Soc. (1978); Chem. Soc. Japan Award (1979), Centenary Medal, British Chem. Soc. (1979), E. E. Smissman Medal, Univ. Kansas (1979), Remsen Award, Am. Chemn. Soc. (1985), P. Karrer Gold Medal, Univ. Zurich (1986), E. Havinga Medal, Leiden University (1989), A. C. Cope Award, Am. Chem. Soc. (1990).

Yoshihide SUZUKI

"A Philological Study of Deuteronomy"

The book of Deuteronomy is composed as a speech of Moses to the Israelite. It is something striking that Moses addresses his speech to the people not at the Mt. Sinai but in the land of Moab. Due to this literary setting, Deuteronomy is different from the book of Exodus. In addition to this uniqueness, it is noted that Moses transmits the Torah to the Israelite by various styles. Basically he uses the second person singular form of address when he transmits the instructions of Yahweh to the people. However, he often changes his style to the second person plural form in the context. This stylistic interchange between the second person forms of address is called as the "*Numeruswechsel*", which creates the stylistic tension in the context. Biblical scholars has scrutinized the various cases of this phenomenon in order to explain why each stylistic tension was left unharmonized in the Hebrew Bible. On the other hand, they admit unanimously that the deuteronomic law code was the basis of authority for the reformation which was initiated by the Judahite king Josiah in the 7th century B.C. It is said that the law was put on Moses' mouth so that it would bear an authentic legal tradition.

Because of the stylistic complex, scholars once insisted that the deuteronomic law was composed with two or three different literary sources by the editor(s). Some of the scholars accepted the hypothesis that the "*Numeruswechsel*" is regarded as the "*Numerusmischung*", i.e. the mixture of both forms of address. None of them could solve the riddle, for they failed to distinguish the "*Numeruswechsel*" from the "*Personenwechsel*", i.e. interchange of persons. Dr. Suzuki investigated this stylistic problem in his dissertation, *The "Numeruswechsel" in Deuteronomy* submitted to the Claremont Graduate School in 1982. The methodology he uses is the form critical interpretation of the text. His book in Japanese of 698 pages published in 1987 is based on his dissertation, however is fully revised this time. It consists of six chapters in addition to the prologue and the epilogue with bibliography. The goal of his investigation is set to clarify the composition history of the deuteronomic law code by regarding the stylistic interchange as the composition device. According to the author, both "*Numeruswechsel*" and "*Personenwechsel*" are nothing but a crucial signal that reveals the seam of redactional work.

After reviewing scholary discussions, he clarifies his approach of the stylistic analysis to the phenomenon: First he argues about three types of "*Numeruswechsel*" in the first, the second and the third

person. He also sets a stylistic criterion to distinguish the case of "*Personenwechsel*", which sometimes creates various stylistic tensions too. Dr. Suzuki believes that he found three different perspectives of the second person singular form of address in Deuteronomy. Each represents the setting in life of the addressee, individual (citizen), institutional (administrator) and national (Israel as a whole). He says that these three signify three different stages of composition. Scrutinizing the stylistic functions of each number and person, he has reached to the conclusion that most stylistic interchanges are due to an artistic composition, by which the editor(s) revised the code despite the stylistic tension. Dr. Suzuki says that the editor(s) enlarged the code with various materials from the need of revision in facing certain historical crisis.

In the chapter three, the author takes the case law formulation as a proof for his theory that the "*Numerus-*" and/or "*Personenwechsel*" must be the seam of the redactional composition. He follows the process of how editor(s) employed particular number and person to construct the case law formulation. Its pattern consists of apodosis and protasis of legal instructions. After that, the total text of Deuteronomy is analized by the author in view of the history of composition. In the next chapter, he seeks a historical link between the reformation movement by King Josiah and the composition process of the deuteronomic law code. Dr. Suzuki believes that there were three stages in the first composition of the law code edited with the second person singular, which reveal the aim of centralization of the administration of justice under the reign of King Josiah. However, the death of the king made this reformation breakdown and purge the reformers out of the royal court. As a result, the reformers became in the minority. It is the cause that they changed the style into the second person plural form of address, for they could no longer address Israel as a whole. After the destruction of the nation, they started to use the first person plural form. It symbolizes that each individual was required to join the exilic community only by means of confessing with Moses the common legal history manifested in Deuteronomy.

Then Dr. Suzuki inquires who is supposed to address to whom in the chapter six. In other words, he tries to clarify who worked for establishing the legal institution by organizing the law code under the command of King Josiah. According to the author, the Levites the priests who kept the Mosaic tradition were assigned by King Josiah to the administration of justice. They were the actual speaker of the law. From this point of view, Dr. Suzuki says that the policy of the centralization of the cult, the destruction of pagan sanctuaries and the establishment of the central court could be explained properly.

This research is unique in the argument to make an actual bridge between the cause and result of the stylistic interchanges and the process of composition of deuteronomic law.

Masahiko AOKI

"The Co-operative Game Theory of the Firm" and "Information, Incentives and Bargaining in the Japanese Economy"

The author, AOKI Masahiko, Professor at the Institute of Economics, Kyoto University, Henri and Tomoye Takahashi Professor at the Department of Economics, Stanford University, and a Fellow and Council Member of the Econometric Society, published "The Co-operative Game Theory of the Firm" (Japanese edition: *Gendai no Kigyo*), in 1984 and "Information, Incentives and Bargaining in the Japanese Economy", in 1988. In his first book, he attempted to establish a new approach to comprehend the actualities of modern firms in all their complexity and of constructing a theory of modern firms for that purpose. In the second book he advances this work further. Constructing theoretical frameworks for comparative study of structure and behavior of firms in industrialized nations, he makes clear the structures of efficient Japanese firms through application of these models.

We shall begin with the first book and direct our attention to Prof. Aoki's treatment of the firm (or, more precisely, the modern firm). It has become a habit in economics to treat the firm in its simplest form at the time of theoretical research. Differing from this treatment, Prof. Aoki contends that the firm should be regarded, even in theoretical research, as an entity, which consists of many characteristic elements; in other words, it should be treated as a complex entity.

Most important is his view that present-day economics has theoretical apparatuses applicable to these elements and the firm can be, therefore, treated as a complex combination of these characteristic elements, even in theoretical investigation. In the case of Prof. Aoki, this insight is accompanied by an ability to accomplish these theoretical researches.

We shall consider the treatment of these characteristics in more detail. According to the commonly held view of the firm in economics, all its activities are considered as being controlled by a single and unified interest, such as the maximization of total profit of shareholders. Prof. Aoki's view is different from this. According to him, the modern firm subsists on the basis of coalitions between different interests of multiple actors. As a representative form of this coa-

lition, he considers the relation between the body of a firm's shareholders and that of its employees as the substance of the modern firm. On this basis, a professional manager works either as an agent of shareholders or as a kind of referee between the conflicting parties. Prof. Aoki applies the co-operative game theory to the study of the process of bargaining between them.

This bargaining process is, according to Prof. Aoki, very important to modern firms. But the firm also has other noteworthy characteristics. Firms act for short-term objectives as well as long-term ones. Firms sell their products each of which has its own brand recognition and its own market. One of the key elements in the firm is the team-like group of employees, within which the abilities of workers—the firm-specific human resources—are, to a considerable extent, developed, maintained and even improved by the group itself.

Various apparatuses of economic theory are then applied to the study of these characteristic elements of modern firms. The respective theories developed in this way are integrated into one theory, which gives a systematic explanation of the structure and functioning of modern firms; the theory of the bargaining process holds the central position within the overall theory.

In his "Principles of Economics" (1st ed. 1890), Alfred Marshall, the famous British economic theorist, established "knowledge and organization" as the fourth factor of production, in addition to the three factors of Land, Labor and Capital. Through this proposal, Marshall contended that the study of the activities of firms is important from the point of view that economics should pay more attention to the realities and human elements in economics in order to acquire a firmer grasp of its character. Prof. Aoki seems to have attempted to implement this teaching of Marshall.

Prof. Aoki's theory of the firm is, as said above, that of the modern firm. It is presented at first as a theory of modern firms in general, and subsequently developed into theories of special models resulting from particular case studies of modern firms. Thus Prof. Aoki's book of 1984 consists of three parts—Part I, Re-examination of the Orthodox Theories of the Firm; Part II, The Co-operative Game Model of the Firm; Part III, Efficiency of Three Legal Models of the Firm.

Next, we shall turn to the second book, published in 1988.—As is well known, Japanese firms show notable fundamental characteristics as to the structure and behavior in each field of activity, such as labor, labor relations, company finance and subsidiaries. The relation between these characteristics and the productivity of firms became an important issue as a result of the continuous high rate of growth of the Japanese economy. Prof. Aoki's second book deals with

this issue.

When both Japanese and foreign scholars noticed several features of firms in early postwar Japan as being of a noteworthy social character, they considered these characteristics as a reflection of deeply rooted traditions and as something that would gradually disappear in the process of economic progress. Having later observed the continuance of economic growth with almost unchanging structural foundations in firms, scholars changed their views and began to take notice of the reality of Japan, where firms are being run quite orderly, in the same way as in western countries, through the careful efforts of well-disciplined managers and workers. Thus excellent research on the micro-structure of the Japanese economy was conducted from this point of view and published in and outside of Japan.

Pursuing his studies within the context of this new stream of research, Prof. Aoki made several new contributions. His studies are not limited to one specialized field, but extend over almost every field of firm activities. Further, in order to study the micro-basis of economies in advanced industrialized nations comparatively and to examine the nature and causes of productivity of Japanese firms thoroughly, he has devised several ingenious theoretical models.

The development of these theoretical frameworks and their application is one of the significant contributions of Prof. Aoki's 1988 publication to the research of the micro-structure of the Japanese economy and to the theory of modern firms.

Masashi TAZAWA

Physiological Studies on Giant Algal Cells Taking Advantage of Cell Perfusion and Cell Models

By developing a new method of cell perfusion, Dr. Tazawa succeeded in replacing the vacuolar sap of the giant, cylindrical internodal cell of Characeae (mostly *Chara* or *Nitella*) with artificial solutions. Further, this method made it possible to remove the vacuolar membrane, or tonoplast, by adding a chelating agent of Ca^{2+} (EGTA) to the perfusing solution. Using the tonoplast-free cell thus obtained, he was able to modify or control the chemical condition of the cytoplasm from the cell interior without destroying the functions of the surface cell membrane and the capacity of the cytoplasm to flow. Thus, this is a unique cell model. When the cell is plasmolyzed with a slightly hypertonic solution containing EGTA under low temperature, the cell membrane becomes leaky while the cytoplasm is still kept streaming and the tonoplast also remains intact. This system allows us to control the chemical condition of the cytoplasm

from the outside and hence this is another new model of a plant cell.

Applying mainly these methods developed by Dr. Tazawa, he and his coworkers elucidated molecular mechanisms underlying a variety of functions of the plant cell and demonstrated significant roles played by Ca^{2+} in them. His extensive work is briefly summerized for convenience' sake in three categories as follows.

1) Cytoplasmic streaming

The cell perfusion method not only gave us an opportunity to measure the motive force for cytoplasmic streaming, but also made clear the cause of instantaneous cessation of the streaming on excitation. The cessation was brought about by the sudden loss of the motive force and not by the increase of cytoplasmic viscosity. The motive force is lost by a transient increase in $[Ca^{2+}]$ in the cytoplasm triggered by the opening of voltage-dependent Ca^{2+} channels on excitation. In the normal cell, the transiently increased Ca^{2+} is resequestered lowering cytoplasmic $[Ca^{2+}]$ to the order of less than 10^{-7} M and the streaming resumes. He could further show that the inhibitory action of Ca^{2+} on cytoplasmic streaming was effected by way of protein phosphorylation and dephosphorylation.

2) Membrane physiology

There had been no direct evidence in plant cells to show that ATP per se controled the membrane potential. Modifying the intracellular concentration of ATP using the tonoplast-free cells of *Chara*, Dr. Tazawa was able to demonstrate, in the plant cell membrane, the existence of electrogenic ion pump driven by hydrolysis of ATP for the first time. He not only showed, using ^{45}Ca and aequorin, the presence of a voltage-dependent Ca^{2+} channel which opens on excitation, but also activation of the Cl^- channel by increased intracellular Ca^{2+}. These findings have brought to an end the argument about the causal relationship regarding which channel opens first on excitation.

3) Osmophysiology

Cells of brackish characean alga, *Lamprothamnium*, regulate their turgor pressure just like cells of many marine algae. Transfering the *Lamprothamnium* cells to a hypotonic solution, the turgor increases at first, but gradually comes back to its normal level by releasing both K^+ and Cl^-. Ca^{2+} is once again found to be involved in this process. Namely, higher turgor opens the Ca^{2+} channel and induces Ca^{2+} influx from the outside so that the Ca^{2+} level of the cytoplasm is heightened. This in turn activates K^+ and Cl^- channels causing the efflux of both ions. Thus the cell's osmotic pressure decreases and the turgor pressure comes down to the normal level.

Dr. Tazawa has demonstrated convincingly the cardinal roles of Ca^{2+} for the regulation of a variety of important functions of plant cells through the development of the cell perfusion technique and cell

model making. His work has made a new breakthrough in plant cell physiology research.

Shigeru IITAKA, Shigefumi MORI and Yujiro KAWAMATA

A Study of the Theory of Classification of Algebraic Varieties

Algebraic geometry covers large segments of mathematics. However the main problem in algebraic geometry *proper* is the study of the structure of algebraic varieties.

The structure of algebraic curves was known since Riemann.

Toward the end of the last century to the beginning of this century, Enriques and other Italian geometers carried out an extensive study of the structure of algebraic surfaces and succeeded in creating an impressive theory of birational classification for smooth algebraic surfaces. The key to the success was the existence of the minimal model of any algebraic surface which is not a ruled surface.

The theory of classification of algebraic surfaces of Italian geometers was partly based on results obtained by their intuition without rigorous proof. In the 1960's there was a revival of interest in the study of structure of algebraic surfaces, and the Enriques classification of algebraic surfaces was rebuilt on a solid base.

Since 1970, it is quite natural that the study of the structure of algebraic manifolds of dimension three or greater has become the subject of active research. In 1971 Iitaka conceived an ingenious idea of introducing a new invariant $\kappa(M)$ of an algebraic variety by means of asymptotic behavior of the plurigenera of M[1].* He called $\kappa(M)$ the Kodaira dimension of M, showed that the Enriques classification becomes transparent by means of Kodaira dimension and proposed a grand program of classification of algebraic manifolds of dimension three or greater [2]. The program is based on his conjecture to the effect that, for any fibration $f : M \to B$ of an algebraic manifold M with general fibre F_b, $b \in B$, the addition formula

$$\kappa(M) \geq \kappa(F_b) + \kappa(B)$$

holds.

Following the Iitaka program, K. Ueno, E. Viehweg, T. Fujita and Kawamata succeeded in proving the addition formula for certain important cases. Even though they have not succeeded in solving the Iitaka conjecture in full generality, their partial solutions are powerful enough to derive many remarkable results. For instance, Kawamata showed that an abelian variety can be characterized by

* The number refers to the list of references on page 13-14.

its Kodaira dimension and irregularities (i.e. the number of linearly independent holomorphic 1-forms on the variety) [10].

Meanwhile Mori conceived an ingenious idea of introducing the notion of extremal rays [5, 6]. The Hartshorne conjecture in algebraic geometry or the Frankel conjecture in differential geometry claimed that the projective space can be characterized by the ampleness of tangent bundles. By means of extremal rays Mori succeeded in proving this conjecture. Furthermore he obtained the cone theorem to the effect that the structure of the space of effective 1-cycles looks like a cone [6].

In 1984 Kawamata succeeded in proving the finiteness of canonical rings of minimal algebraic manifolds of general type [12, 13]. His proof relies upon a generalization of Kodaira's vanishing theorem. Applying the same idea, Kawamata succeeded in generalizing Mori's cone theorem [11].

Recently Mori succeeded in proving the existence of the minimal model of any algebraic manifold of dimension three not dominated by a ruled variety of the same dimension. The minimal model is an algebraic variety possibly with a certain type of singularities of which the canonical divisor is numerically effective. One of the keys of his proof is the bi-anticanonical system theorem proved by Kawamata [14]. A lot of general results follow from the Mori theorem as corollaries.

Thus Iitaka, Mori and Kawamata have succeeded in establishing the theory of classification of algebraic manifolds which is one of the monumental works in mathematics of the century.

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Hiroshi TSUJI

Studies on the Structure of Flames

Elucidation of the flame structure and fundamental properties of flame such as burning velocity and flammability limits holds the key to the progress of combustion science and technology. The flame is directly affected by the flow field, and Dr. Tsuji introduced a novel experimental method in which counterflow flames established in the forward stagnation region of a porous cylinder immersed in a uniform stream are used for fundamental studies of flame, because the flow field in that region is well-defined and stably-behaved.

Flames of gaseous reactants are commonly divided into two classes, the premixed flame and the diffusion flame. First, Dr. Tsuji conducted the study of the counterflow diffusion flame established

when a fuel gas was ejected from a porous cylinder into a uniform air stream. He showed that this flame was suitable both for studies of the structure of diffusion flame and for studies of flame properties closely related to the flame-extinction phenomena and to the onset of luminous yellow carbon zone. He then proceeded, by structure analysis of flame, to make clear the profiles of heat-release rate and net-reaction rate of each stable chemical species in the flame zone. This study has been regarded as the starting point of the modern study of laminar diffusion flame.

The study of the stretched premixed flame in a non-uniform flow field is essential to elucidate the flammability limits and turbulent combustion. The simplest non-uniform flow with a premixed flame is the stagnation point flow impinging on a wall. To remove the effects of nonadiabatic and catalytic wall, Dr. Tsuji established the counterflow, premixed, twin flames in the forward stagnation region of a porous cylinder, by ejecting the mixture of the same composition as the uniform stream from the cylinder surface. Having recognized the effects of transport properties such as thermal conductivity and diffusion on the structure and behavior of the stretched flame, he demonstrated that there are two distinct extinction mechanisms of the stretched flame, the thermal extinction and the chemical extinction, depending on the relative magnitudes of the thermal diffusivity of the mixture and the diffusion coefficient of the deficient reactant.

Dr. Tsuji extended his study to the partially premixed diffusion flame, and he found that the flame strength increased remarkably as the result of variation of the flame structure and increase of the flame temperature when the reactants were partially premixed. These results give a promising clue to the study of turbulent diffusion flame which has become considered as an ensemble of partially premixed laminar diffusion flamelet.

An advantage of the porous cylinder burner is that the flame can be easily controlled from pure diffusion flame to premixed flame. Dr. Tsuji proposed a novel method to measure the burning velocity over a wide range of mixture ratio, and he also suggested an interesting method to determine the flammability limits after careful examination of the inner flame structure to have the self-propagation velocity. Recently, his counterflow flames have been widely used in the fundamental studies of flame and the usefulness of the porous cylinder burner has been amply proven.

The creative studies by Dr. Tsuji have been highly estimated in the international combustion society, and he has made an important contribution to the progress of combustion science and technology. He received the Bernard Lewis Gold Medal of The Combustion Institute in 1988 "for brilliant research in the field of combustion,

particularly on fundamental aspects of flames".

Tetsuo TAKEMATSU

Basic Studies on World Agricultural Land Weeds and Their Controls

Weed controls are essential for enhancing the productivity of the world agriculture which is one of the most important keys to save huge population from undernutrition. Dr. Tetsuo Takematsu, at the early stage of his weed-controlling research career, focused the attention on the phytohormone produced by plants themselves in super fine amounts. He regarded it to be a key to solving the weed-controlling problem. In his young days, he creatively developed a "Raphanus Test" method which could determine the existence and intensity of the phytohormone activity in handy and prompt manner. Making most of the Raphanus Test, he succeeded in developing new herbicides one after another, i.e. 18 series of auxins and eight series of antiauxins, based on the mother substances which had either growth-promoting or growth-inhibiting activities (auxins and antiauxins, respectively). He named them the phytohormone-originated herbicides (herbicides derived from plant hormone). At present, those phytohormone-originated herbicides are significantly contributing to the safe and labor-saving culture of major crops such as rice, wheat, soybean, sugar beet and vegetables in the world.

Another great research accomplishment of Dr. Takamatsu is the establishment of the "Herbicide-treated Layer Theory." The weed-controlling studies using organic compounds began virtually after the World War II. In those days, world researchers mostly concentrated their attention on the practice of foliar application of the chemicals after the growth of weeds. On the contrary, Dr. Takematsu, who was aware that plants were most sensitive to phytohormone during the growth stage from right before germination through right after emergence, started the pioneering study on the feasibility of soil treatment. It aimed at inhibiting the germination of weeds by spraying herbicides on soil before or at the emergence in rice paddies and cropland. One of the key issues in this technique was the potential injury on crops. The phytotoxicity would be dependent on the degree of downward translocation of the herbicides sprayed on soil surface by subsequent rain and/or irrigation and the degree of decomposition or inactivation in how soon or how long. There, he applied the Raphanus Test to measuring the transferring quantities of the treated herbicides in soil. Consequently, he reached the conclusion as follows: "Herbicides sprayed on soil surface are mostly adsorbed and retained by both soil particles and organic

matters in the surface layer, so that they form a layer in which herbicidal substances are densely contained, in other words, the herbicide-treated layer. Some chemicals having this characteristic of certainly forming the treated layer could be good soil-treatment-type weedkillers in paddies and cropland." He reported the said "Herbicide-treated Layer Theory" in 1949. At present, approximate 70 percent of the herbicides practically used in the world are said to be of the soil-treatment-type. The fact proves the "Herbicide-treated Layer Theory" to be the basis of the soil-treatment-type chemicals protecting paddies, croplands, lawns and orchards, etc. all over the world.

The professor emeritus of the Utsunomiya Univ. travelled to many corners of the world for close examinations of the agricultural land weeds in addition to his laboratory and library studies and consequently, clarified that agricultural land weeds amounted as many as 6000 species including 1600 species of 416 genera in 73 families and their analogues. Genealogical approach was introduced in the classification taking account of weed evolution channels.

Based on the said theory and experiences, he successfully developed in 1958 an evolutional herbicide "Propanil" (3,4-dichloropropion anilide) which was safe only for the rice plant in the Gramineae and controlled the other genera in the Gramineae and weeds, by foliar application. It was the inter-genus selective herbicide commercialized for the first time in the world. All in all, Dr. Takematsu has greatly contributed to the world agriculture through his innovative accomplishments based on his creative conception during his research career for half a century.

Kiyoshi HAMA

Functional Morphology of Nervous System with Special Reference to Quantitative Three-Dimensional Analysis Using High Voltage Electron Microscope

The aim of the research of Dr. Kiyoshi Hama is to clarify morphological characteristics of the nervous system that underlie its physiological function.

His first prominent work was the electron microscopical characterization of synapses, in which the signal is transmitted either electrically or chemically. He first described that electrical synapse had a special structure, named "close apposition" (now it is generally called "gap junction"; in spite of the change in naming, his contribution as the pioneer is widely recognized). He has kept persistent concern for the electrical synapse and recently discovered a new type

of electrical synapse in hippocampus which undoubtedly plays an important role in synchronized neuron activity.

He became aware that the brain must be analyzed in three-dimensional way because of its extremely complex network and that this could be made only with the high voltage electron microscope. He succeeded in improving the electron microscope for biological purpose in collaboration with physicists and engineers. Using this machine, he showed the three-dimensional profile of glia cells, especially astrocytes, having veil-like sheets or leaflet-like appendages intermingled with one another. This has completely changed our view on these cells. He also made quantitative analysis of "spine", which might play a significant role in memory and other higher activities of the brain, and found that the total surface of spines was much larger than thought before.

Thus he has made unparalleled contribution to the physiological morphology of the nervous system by discovering the structural basis of synaptic mechanism and introducing a new technique to inquire into complex structure of the brain, the technique which has opened a new area of neuroscience.

Toju HATA and Satoshi ŌMURA

Studies of Biologically Active Microbial Metabolites —Especially Macrolide Antibiotics

Many of the microbial metabolites with the important biological activities, such as antibiotics and enzyme inhibitors, have rendered great service to the welfare of humans as medicine and agrochemicals. Dr. Hata had devoted himself to the study of antibiotics from 1946 to 1973 and Dr. Ōmura has been engaged in research on the biologically active microbial metabolites since 1965, first as Dr. Hata's coworker and later his successor.

The macrolides constitute a unique antibiotic group. They have a macrocyclic lacton skeleton and are active against viruses, bacteria, fungi, parasites and weeds, depending on their structures. Drs. Hata and Ōmura developed the first Japanese-made macrolide antibiotics, the leucomycins, and clarified all the structures of 10 analog components. Then, they discovered a wide variety of 14-membered to 22-membered macrolides and extensively studied on their structures, biological activities, biosyntheses, producing microorganisms, the relationship between structure and activity, and the development of hybrid antibiotics.

One of the most creative of their accomplishments was in the

area of biosynthesis. They discovered the whole process of aglycon formation and initiated the use of ^{13}C-NMR spectral analysis in this field. They then analyzed the detailed process after aglycon formation using celurenin to control polyketide synthesis. Celurenin is an important antimicrobial metabolite discovered by this team. It is the first specific inhibitor of the synthetic enzymes of fatty acid and polyketide. Expanding this fascinating finding, they succeeded in preparing the hybrid macrolides, e.g. chimeramycin, a combination of tylosin-type aglycon and spiramycin-type sugar. And they finally achieved the first production of the new hybrid antibiotic, mederrhodin, by genetically engineering the strain.

In addition to the basic research, they developed important pharmaceuticals, such as avermectin (a modified 16-membered macrolide discovered under the cooperation with Merck Sharp & Dohme, which inhibits GABA-mediated neurotransmission and is a prominent antiparasite); also rokitamycin and tilmicosin (both antimicrobial), and EM-536 (motilide: a gastrointestinal motor stimulant). Recently WHO has started a crusade against onchocerciasis (river blindness), a horrible endemic disease in Africa and Central and South America, using ivermectin (dihydroavermectin).

Based on their biosynthesis research, they also designed the unique fermentation processes "ammonium ion depressive fermentation" and "phosphate ion depressive fermentation", which have greatly improved antibiotic production.

Besides those macrolide studies, further distinguished contributions were the discoveries of the various important microbial metabolites, using very elegant screening systems built on the comprehensive combination of new knowledge of biochemistry, microbiology and the related science. They also developed the well known mitomycin (a widely used antitumor chemotherapeutic), nanaomycin (antifungal), frenolicin B (protozoacidal), triacsin (the first specific inhibitor of acyl-CoA synthetase), 1233A (the first specific inhibitor of HMG-CoA synthase), diazoquinomycin A,B (the first inhibitor of thymidylate synthase), phosalacine (a herbicidal inhibitor of glutamin synthetase) and staurosporine (a microbial alkaloid selected by chemical screening, the strongest inhibitor of protein kinase C).

The outstanding accomplishments of Drs. Hata and Ōmura, comprising over 600 articles, have exerted enormous influence on the progress of research on a great many natural products as well as the microbial metabolites.

Terumi MUKAI

Studies on Genetic Structure of Natural Populations of the Fruit Fly, *Drosophila*

The central aim of experimental population genetics is to clarify the nature and the amount of genetic variability contained in the species. Dr. Mukai has pursued this aim for more than thirty years, using the fruit fly, *Drosophila melanogaster*, as the main object of study. Through his studies, he has made many important contributions which have been recognized internationally. Especially, his detailed investigations on recessive lethal mutants and mildly detrimental genes are of utmost importance in understanding the genetic structure of biological populations not only of *Drosophila*, but also of higher animals including human beings. These results serve as the bases for considering such problems as the preservation of wild species with much reduced population sizes, deleterious effects of consanguineous marriages in man, harmful effects of mutations induced by environmental mutagens to human societies, and so on.

His main contributions may be summarized as follows:

(1) *Elucidation of the degrees of dominance for recessive lethal and mildly deleterious genes*

In natural populations of organisms, various kinds of mutant genes are contained, including "recessive" lethal and other deleterious genes that are concealed in heterozygous condition. In natural populations of *Drosophila*, even apparently normal individuals carry one or two recessive lethal genes in heterozygous condition. At one time, a big controversy developed regarding the degree of dominance of such "recessive" lethal mutants. Dr. Mukai has settled the issue by his careful and large-scale experiments: if we denote by h the degree of dominance of harmful effect, then the average estimated value for "recessive" lethal genes turned out to be $h=0.01\sim0.03$.

In general, mutant genes affecting viability of individuals are called viability genes. Most of them, termed viability polygenes, are mildly deleterious and they do not reduce viability as severely as lethal genes. Dr. Mukai has shown that the degree of dominance of such mildly deleterious genes is much larger than that of lethal genes, and that the average degree of dominance ($\bar{h}$) is about 0.4. His work has turned out to be of fundamental importance in our understanding of the mechanism by which lethal and deleterious genes are maintained within populations of various organisms.

(2) *Measurement of the mutation rate of viability polygenes*

Dr. Mukai was the first who succeeded in estimating the mutation rates of viability polygenes by using an ingenious technique of ac-

cumulating these mutations for many generations with a specific experimental line. He has shown that the rate of occurrence of this type of mutations is extremely high, being more than 20 times as high as that of recessive lethal mutations on a chromosomal basis.

(3) *Experimental studies on protein polymorphisms*

Starting from the mid-1960's, it has been revealed that in most biological populations there exist unexpectedly large amounts of variation regarding genes coding for enzymes. In order to explain the mechanism of such variation, two opposing hypotheses, namely the selection hypothesis assuming balancing selection and the neutral hypothesis assuming selectively neutral mutations, were proposed. Dr. Mukai conducted decisive experiments concerning this problem and obtained results which strongly support the neutral hypothesis.

(4) *Studies of population genetics at the DNA level*

Recently, in collaboration with his students and associates, Dr. Mukai has been conducting intensive studies on genetic variation in natural populations at the DNA level, and has obtained a number of interesting results concerning gene duplications and the behaviour of mobile genetic elements in populations.

As described above, Dr. Mukai has made many important contributions to clarifying the mechanisms of variation and evolution of species. His work has been cited in most of the text books and reference books on population genetics throughout the world.

PROCEEDINGS AT THE 840TH GENERAL MEETING

The 840th General Meeting of the Academy was held on Tuesday, June 12, 1990, at 1:05 p.m., Dr. Yoshitaro WAKIMURA, President, taking the chair. Eighty-seven members were present, and the following communications were made:

Nationality, domicile, and habitual residence in private international law . . . . . Sueo IKEHARA, M. J. A.

Japanese enterprisers in the Meiji period —Rizaemon Minomura, Hikojiro Nakagamigawa and Eiichi Shibusawa— . . . . . Kazuo YAMAGUCHI, M. J. A.

A new dental caries treatment system developed in Japan . . . . . Takao FUSAYAMA, M. J. A.

Corroborating evidence for "cold" fusion reaction . . . . . Yoshiaki ARATA, M. J. A., and Yue-Chang ZHANG

On strain Ictero No. I which was the first causal agent of Weil's disease isolated by Inada and Ido . . . . . Shutaro YAMAMOTO, M. J. A., and Ryo YANAGAWA

Construction of certain maximal p-ramified extensions over cyclotomic fields . . . . . .Humio ICHIMURA

Diophantine approximations for periods of exponential and elliptic functions . . . . . Noriko HIRATA-KOHNO

A note on the Artin map. II . . . . . Takashi ONO

On certain homotopy-homomorphic elements of $\pi_{n+1}(X)$ . . . . . Akira SASAO

Solution of a problem of Yokoi . . . R. A. MOLLIN and H. C. WILLIAMS

Askey-Wilson polynomials and the quantum group $SU_q(2)$ . . . . . Masatoshi NOUMI and Katsuhisa MIMACHI

Above six, communicated by Shokichi IYANAGA, M. J. A.

Dynamic aspects of the contractile system in *Physarum* plasmodium. IV. Local asynchronism in the generation cycle of actomyosin fibrils and its relationship to the shuttle streaming . . . Mitsuo ISHIGAMI

Communicated by Noburô KAMIYA, M. J. A.

Strange Raman band of diamond particulates contained in Antarctic meteorite, Yamato-791538 (ureilite) . . . . . Hiroyuki KAGI, Kazuya TAKAHASHI, and Akimasa MASUDA

Communicated by Minoru ODA, M. J. A.

A note on the mean value of the zeta and L-functions. VII . . . . . Aleksandar IVIĆ and Yoichi MOTOHASHI

On a generalization of MacPherson's Chern homology class. II . . . . . Shoji YOKURA

Deformations of complex analytic subspaces with locally stable parametrizations of compact complex manifolds . . . . Syôji TSUBOI

Above three, communicated by Kunihiko KODAIRA, 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. Itiro TANI, M. J. A., had passed away on May 28, 1990; Dr. Yuichi YAMAMURA, M. J. A., had

passed away on June 10, 1990. The members rose from their seats in silence, expressing profound sense of grief.

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

Then, 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: Shirô HATTORI, Ryosuke ISHII, Mikio SUMIYA, Noburô KAMIYA, Shinji FUKUI, Masanao MATSUI, Yasuji KATSUKI.

Finally, it was submitted to elect Dr. Donald Lawrence KEENE (Japanese Literature) to the Honorary Membership of the Academy on the recommendation of Section I. This was approved unanimously.

The Meeting adjourned at 4:45 p.m.

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