

AWARD OF MEDALS

The Eighty-third Annual Award of Medals was held on Monday, June 7, 1993, 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.

The Medals and Prizes were presented to the following recipients.

Imperial Prize and Academy Prize to Issei TANAKA
for "A Study of the Ritual Theatres in China"

Imperial Prize and Academy Prize to Yasuo TANAKA
for "The Relativistic Properties of Celestial X-ray Sources"

Academy Prize to Takashi NEGISHI
for "History of Economic Theory"

Academy Prize to Akito ARIMA
for "Theoretical Studies on Dynamical Models and Electromagnetic Interactions of Atomic Nuclei"

Academy Prize to Michio JIMBO
for "Studies on Solvable Lattice Models and Quantum Groups"

Academy Prize to Takanori OKOSHI
for "Research on Coherent Optical Fiber Communications"

Academy Prize to Toshiro KINOSHITA
for "Genetical Studies on the Interaction between Cytoplasmic and Nuclear Genomes, and the Application of These Studies to Actual Crop Breeding"

Academy Prize to Hajime YAMAMOTO
for "Use of Lasers for Caries Prevention and Other Applications in Dentistry"

Academy Prize to Keiya TADA and Goro KIKUCHI
for "Studies on Hyperglycinemia"

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

Issei TANAKA

A Study of the Ritual Theatres in China

Professor Tanaka's study has come to its completion for the present by publishing the following three works:

Ritual Theatres in China, University of Tokyo Press, 1981

Lineage and Theatres in China, University of Tokyo Press, 1985

Village Festivals in China, University of Tokyo Press, 1989

In these three books, the author explains how theatres originated from village festivals, developed and were spread in China, on the assumption that theatres in China should have originated from village festivals.

Ritual Theatres in China explains logically the process of creation of theatres from village festivals and their development and diffusion. As for the 'creation', the *comedy* originated from the ritual intercourse between Shaman and God at the village festivals celebrated in springs and falls, and the *tragedy* from the contradance and the songs sang between haunting orphan souls and exorcists in the festivals on the 7th day of the 7th lunar month and the exorcistic rites celebrated to avoid evil consequences of orphan souls who died an unnatural death. As for the 'development', the ritual organizations in China were divided into the territorial ones based on villages and markets and the consanguineous ones based on lineages. In the history of Chinese theatres, the territorial type popular theatres and consanguineous type elegant theatres flourished or declined alternately along with the rise and fall of the lineages who governed the villages. As for the 'diffusion', the territorial type theatres could only be spread slowly to the neighbors by the immigration of the village peoples. On the other hand, the consanguineous type theatres were able to spread far and rapidly through the network of sociality and marriage among the lineage leaders, including local gentry, government officials and influential traders. The above three points are explained consistently by the wide variety of references to historical documents and the precise field researches.

Lineage and Theatres in China analyzes what coloration the lineages governing the villages gave to the ritual theatres in China, showing the villages governed by the lineages in Hong Kong as examples. Especially, the creation mechanism of the *tragedy* is explained in details by many examples of the exorcistic rites celebrated in the villages in Hong Kong once every ten years.

Village Festivals in China analyzes how the shamanistic ritual in the villages was transformed to the theatres by the expansion of the ritual organizations. Also, the further and deeper investigation is made on the village shamanistic ritual as the womb where the theatres originated from, making field researches on the shamanistic mask performances for expelling

evils found recently in China.

The essence of these three writings lies in the unique viewpoint; that is, it had been considered that the theatres originated from the amusements in cities, but actually they originated and developed from the village festivals. This viewpoint and the original research method affected largely on the study on the theatres in China, Hong Kong, Taiwan and the United States and led the study on local theatres to today's prosperity.

Yasuo TANAKA

The Relativistic Properties of Celestial X-ray Sources

Since the discovery of celestial X-ray sources in 1962–63, X-ray astronomy has become one of the most productive fields of astrophysics. Among others, neutron stars and black holes which had only been the subject for theoretical studies were revealed to be the real existence from X-ray observations. General relativistic effects which should be significant in the vicinity of these compact objects are considered to be observable in X-rays.

Yasuo Tanaka initiated soft X-ray observations at Nagoya University in 1967 on his return from Leiden, the Netherlands, where he had been the acting leader of the Cosmic-ray Working Group. He and his associates discovered the presence of a huge cavity filled with tenuous hot plasma within which the solar system is embedded. Later, in 1974, he joined the Institute of Space and Aeronautical Science, University of Tokyo.

In the 1980's, the Japanese X-ray astronomy group took the firm lead with two satellites, *Tenma* and *Ginga*, while X-ray astronomy satellites were scarce in the world. Yasuo Tanaka's leadership has been internationally recognized through active promotion of cooperations with U.S. and European scientists. His works which are related to the title are summarized below.

He and his group successfully developed gas scintillation proportional counters for space and used them on *Tenma*, and discovered by virtue of their high spectral resolution, an absorption line in the energy spectra of X-ray bursts, which was most probably a redshifted iron line due to super-strong gravitational field on the neutron star surface.

From *Tenma* observations of low-mass X-ray binaries involving a neutron star, he and K. Mitsuda *et al.* discovered that the energy spectra of these sources were composed of two components; one from the accretion disk and a blackbody component from the neutron star surface. This result provides means to study the neutron star surface and the disk separately.

Although the discovery of X-rays from the supernova SN1987A by *Ginga* is a group's credit, it was Yasuo Tanaka who supervised the observations and led to the discovery of much earlier emergence of X-rays

than theoretically predicted, which resulted in a new concept of turbulent mixing of the stellar interior during outburst.

While a variety of investigations have been performed by Japanese as well as international scientists utilizing *Ginga*, Yasuo Tanaka has focused his interest on black holes. For a long time, it has been a fundamental difficulty to identify black holes observationally. Cyg X-1, an X-ray source in the constellation *Cygnus*, had long been considered to be a black hole, since the compact object of Cyg X-1 was much more massive than three solar masses and theoretically it should have collapsed to a black hole. As Cyg X-1 exhibited rapid and erratic “flickering”, a property which appeared distinct from most other X-ray stars, sources which exhibited flickering had also been considered as black hole “candidates”. However, it turned out later that flickering was not a unique finger-print of a black hole.

Yasuo Tanaka performed systematic studies of the energy spectra of many X-ray stars observed from *Ginga*, and found the presence of a class of sources whose spectra consisted of an ultrasoft component and a second component extending to higher energies. He showed that the properties of this class of sources were fundamentally different from the X-ray sources known to involve a neutron star, and by interpreting their unique properties he proposed a new method of distinguishing black-hole X-ray sources from neutron star X-ray sources. This interpretation is widely accepted today. With this method of classifying black hole sources, he shows that the number of black hole X-ray sources in our galaxy will most probably be as many as or even more than neutron star X-ray sources. This result imposes a strong constraint on the origin of black holes.

He also points out close similarities between the spectra of the black hole X-ray sources in our galaxy and those of active galactic nuclei (suspected to be supermassive black holes), suggesting that similar physical processes are taking place in these two systems of vastly different scales.

For his achievements so far, Yasuo Tanaka received the Matsunaga Prize, the Asahi Prize (as a member of the awarded group), the Nishina Memorial Prize, and the Toray Science and Technology Prize. He is also a member of the Royal Academy of Sciences of the Netherlands.

Takashi NEGISHI

“History of Economic Theory”

Professor Takashi Negishi’s book consists of ten chapters. After giving a brief bird’s-eye view of the history of economics and methodological perspective in the introduction, the author presents three pre-Smithian writers; John Locke, David Hume, and François Quesnay as pioneers in economic theory in Chapter 2. Chapters 3–5 examine classical economics. Chapter 6 is devoted to Marx’s economics. Whereas Chapters 3–6 are

mainly concerned with classical themes, the remainder of the book deals with neoclassical issues. In Chapter 7, the author takes the general equilibrium theory of Léon Walras and discusses the peculiarity of the Walrasian general equilibrium. Chapters 8 and 9, respectively, are devoted to examine the Austrian school (with emphasis on Menger, Friedrich von Wieser, and Böhm-Bawerk) and the stream of theory characterized by the works of Gossen, Jevons and Edgeworth. The final chapter, with a very interesting section on A. Marshall as precursor to Keynes, shows the uniqueness of Marshall's economics compared with the Walrasian theory of pure real-exchange economy.

The aim of this work is to transfer the past heritages to the present generation and to promote the modern development of economic theories by critically examining and reconstructing past economic theories from the standpoint of contemporary economics. For this purpose, Professor Negishi emphasizes the importance of translating the past theories into mathematical models as far as possible and necessary. Here, methodologically, the author rejects T. S. Kuhn's theory of the development of sciences but follows Lakatos' theory that "the history of science has been and should be a history of competing research programs (or paradigms)." Therefore, it is necessary to study theories even if they are regarded as past ones from the point of view of modern economics.

Secondly, this is a history of economic *theory* written with wide and deep understanding in the modern theory of economics and it serves as an excellent insight. For example, in the third chapter, the author clearly points out that Smith's international trade theory, based on increasing returns through extension of the size of the home market, should be distinguished from Ricardian analysis of comparative advantage. Also the short but suggestive two sections on T. Malthus in Chapter 4 presents Malthus as a precursor of J. M. Keynes and concludes that both Malthus and Keynes emphasized the importance of effective demand; however, Malthus is concerned not with Keynesian effective demand, but with Smithian effective demand, which assures the individual capitalists motives to produce. Malthus is not so much an underconsumptionist as supply sider.

Thirdly, Professor Negishi very selectively chooses from the wide range of possible choices of schools and persons, and he provided a very rigorous examination of the theoretical problems to the extent of that it is possible and necessary. By translating theories into mathematical models, it is hoped that mistakes made by past masters can be corrected.

The book is a well-crafted, comprehensive survey of recent studies on economic theories done from the standpoint of modern economics. It could be done only by a person like Professor Negishi who has both wide knowledge on recent theoretical economics and a deep interest in the history of economic theory.

Akito ARIMA
Theoretical Studies on Dynamical Models
and Electromagnetic Interactions of Atomic Nuclei

Atomic nuclei are quantum-mechanical many-body systems consisting of strongly interacting protons and neutrons so that they defy simple mathematical descriptions. Consequently, it has been useful to construct an appropriate model by stressing proper degrees of freedom basic to the interpretation of a given aspect of nuclei.

Prof. Arima has a deep insight into the nature of complicated nuclear phenomena and he never failed to select and develop a proper model of nuclei when a new problem came up.

Atomic nuclei display particularly stable configurations when the number of protons or that of neutrons is one of the magic numbers thereby suggesting the existence of some kind of shells as in the case of atoms. In 1949 the shell model of nuclei was introduced by Mayer and Jensen to explain magic numbers. It was a very successful model of nuclei, but in many problems it had to be refined by taking some of the residual interactions into account. The efforts of Prof. Arima was often directed to its refinement.

Prof. Arima in collaboration with Prof. H. Horie investigated the core-polarization effect caused by the excitation of nucleons from the core to valence shells. This corresponds to introduction of a new configuration of a nucleus to be mixed with the naive shell model configuration, and it led to a successful explanation of the deviation of nuclear magnetic moments from the naive shell model as well as other related properties of nuclei.

In nuclei above ^{16}O up to ^{40}Ca valence nucleons occupy s and d orbitals according to the shell model. Prof. Arima and his collaborators made important contributions to the refinement of the shell model by giving extensive studies of the sd shells and established a standard treatment of this problem.

In light nuclei with mass number not exceeding 20 nucleons exhibit a tendency to form alpha clusters. Prof. Arima and his collaborators tried to reconcile this tendency with the shell model and established a unified model. On the basis of this new approach they could account for the energy levels, alpha decay widths, alpha transfer reactions and other related properties of light nuclei.

Prof. Arima in collaboration with Prof. F. Iachello also introduced the interacting boson model (IBM) by treating the strongly interacting valence nucleon pair as a boson. This model allowed them to develop a powerful group-theoretical method to predict various patterns of energy levels and electromagnetic properties of nuclei in accordance with experimental data. Although it started from the shell model it is also related to the collective

model in the extreme cases.

To conclude Prof. Arima made many important contributions to the theoretical development of nuclear physics worthy of the highest recognition.

Michio JIMBO

Studies on Solvable Lattice Models and Quantum Groups

During the past quarter of a century or so, many exciting encounters were brought to the limelight between spearhead topics of pure mathematical theories and major streams of the modern theoretical physics. Thus some phenomenal advancements took place in the field of mathematical physics. The theory of solvable lattice models, arising from the statistical mechanics, was the one in which Michio Jimbo produced numerous important works and established his reputation as an international leader by publishing his discovery of the notion of quantum groups in 1986. It is interesting to note that the same important discovery was done independently and simultaneously by a Russian mathematician Vladimir G. Drinfeld who had also made important contributions to the study of solvable lattice models.

Jimbo's technical strength has been largely attributable to the combined power of algebraic analysis and group representation, in that he was blessed with many excellent teachers and coworkers in the world-renowned school of algebraic analysts, or the Sato school, at the Research Institute for Mathematical Sciences, Kyoto University. The list of Jimbo's collaborators includes Mikio Sato himself, Masaki Kashiwara, Tetsuji Miwa, Etsuro Date and some of his students.

Jimbo began publishing his research works in 1977, jointly with Sato and Miwa, to establish the theory of holonomic quantum fields in which the correlation functions of certain quantum fields, defined by nonlinear differential equations, were in fact identified as parameters appearing in the description of the monodromy-preserving deformations of certain linear ordinary differential equations. They clarified the extent of nonlinearity associated with deformations of linear equations. For the 2-dimensional Ising models, all the n -point correlation functions were explicitly determined by their method.

Next in 1981 moving to the study of soliton equations, KdV equations in particular, he formed a research team with Kashiwara, Date and Miwa, and they together led the world in the new research on the geometric description of the soliton dynamics in which the representation theory of infinite dimensional affine Lie algebras was further advanced and effectively applied. In their theory, the transformations among the solutions of a soliton equation, such as the Boson-Fermion correspondences, were given

clear descriptions by means of the basic representations of affine Lie groups.

At about the beginning of 1981, Jimbo and Miwa were inspired by the 1980 work of R. J. Baxter in which Rogers-Ramanujan formulae had been unexpectedly rediscovered in his computational process of the local state probability for the hard hexagon model. Knowing that the same formulae reappear in the representation theory of affine Lie algebras, Jimbo and Miwa developed the theory which relates solvable lattice models to the character formulae for affine Lie algebras. They indeed found the way to describe the local state probability in terms of the characters of affine Lie algebras.

Finally, the notion of quantum groups, or the quantized Lie algebras, was discovered by Jimbo in Kyoto and independently by Drinfeld in Moscow. The notion is of central importance in the theory of solvable lattice models, because the representation theory of the quantum groups naturally yields solutions of the Yang-Baxter equations and those solutions produce the Boltzman weights for solvable lattice models. Jimbo, sometimes by himself and often with his junior collaborators, made important contributions in this connection by producing complex solutions and hence advanced models.

In recent years the notion of quantization attracted attention of a broader range of mathematicians than just the students of mathematical physics, and its wider applications and new connections have been discovered by such mathematicians as group theorists, number theorists, algebraic geometers, topologists and others in the world of mathematics.

Takanori OKOSHI

Research on Coherent Optical Fiber Communications

Professor Takanori Okoshi has made significant achievement in microwave and lightwave engineering. In particular, he advocated in 1979 the research on coherent optical fiber communications and solved himself a number of technical difficulties to demonstrate its feasibility in the following years, thus creating the worldwide research trend toward its realization.

The modulation/demodulation scheme now used in optical fiber communications is the intensity-modulation/direct-detection scheme, which has advantages in its system simplicity and low cost, but it is accompanied by low sensitivity and the difficulty in the frequency-division multiplexing for transmitting a large number of light signals. In contrast, radio-wave communications have since 1930s taken advantage of coherent modulation/demodulation schemes and heterodyne reception techniques to realize high receiver sensitivity and excellent frequency selectivity.

In optical fiber communications in which semiconductor lasers are

usually used, however, the optical frequency always fluctuates and the optical spectra are far from pure. Besides, the polarization state in optical fibers is usually unstable. For these reasons, most researchers believed until late 1970s that coherent optical fiber communications using semiconductor lasers would not become practical.

Professor Okoshi came to believe in 1978 that the above difficulties could in a long range be overcome by technological progress, and started to pursue the feasibility research of coherent optical fiber communications. He showed first by preliminary investigations that a dramatic improvement of the receiver sensitivity and the resultant elongation of repeater separation (up to 100 km), as well as frequency division multiplexing with very narrow frequency separation would become feasible (1979). Next, by using deliberately designed automatic frequency-control schemes, he succeeded in stabilizing the frequency of a semiconductor laser within 5 MHz/hour (1980), and later 1 MHz/hour (1981). Further, he invented the "delayed self-heterodyne method" for high-resolution laser spectrum measurement now used worldwide (1980), and showed that the spectral spread of a semiconductor laser could be reduced to 100 kHz (1982). He proposed also the concept of "truly single-polarization fiber" (1979) to demonstrate that the polarization fluctuation in the optical fiber could be overcome. Upon the basis of such achievement, he reported the world-first bit-error rate measurement of a coherent optical fiber communication system (1981).

These early works by Okoshi and his coworkers were presented as tutorial/review or original papers at many international and domestic conferences after 1980 and/or reported at seminars at major communications research laboratories worldwide, where he claimed the technical advantages of coherent optical fiber communications and advocated the research toward its realization.

Such pioneering endeavors by Professor Okoshi triggered worldwide the research in this area, which is now the major topic at international conferences on optical communications. So far more than 100 system experiments have been reported in the world, including about ten field trials performed in USA, UK, Japan and Denmark.

In addition to his initiation of and advocacy for the research in this area, he also made a number of pioneering contributions, such as the first analysis of the biterror rate of coherent receivers taking into account the phase noise of lasers (1983), proposal of truly single-polarization fibers having axially non-symmetrical structures (1982), invention of the polarization-diversity receiver (1983), invention of various polarization-state control schemes (1984–1986), invention of phase/polarization double diversity receiver (1986), and invention of double-stage phase diversity receiver which combines the advantages of heterodyning and homodyning (1989).

He contributed to the progress of the research also through the systematization of the area. His researcher-level textbooks in Japanese and

in English were the earliest ones describing the area systematically; the latter ("Coherent Optical Fiber Communications", KTK/Kluwer, 1988) is read by almost all the specialists worldwide.

Toshiro KINOSHITA

Genetical Studies on the Interaction between Cytoplasmic
and Nuclear Genomes, and the Application of
These Studies to Actual Crop Breeding

It is widely accepted that the use of heterosis is important in plant and animal breeding. In order to produce hybrid seeds it is indispensable to use cytoplasmic male sterility in important crop species. This phenomenon is dependent on the interaction of genetic factors between nucleus and cytoplasm. Kinoshita has conducted comprehensive research in both molecular and plant levels and applied the experimental results to practical breeding of sugar beet, rice and wheat.

When breeding work on triploid sugar beet began, Kinoshita was the first to use tetraploid male sterile lines as mother plant for the production of the triploid hybrids, and the triploid plants produced indicated superiority in sugar yield over the triploid plants produced from the diploid counterpart.

In 1969 Kinoshita succeeded in inducing cytoplasmic mutation on male sterility by irradiation with gamma rays, for the first time in the world. Following this he also produced both forward and reverse mutations by using several mutagens. This approach is now successfully used to produce male sterility in rice and other crops.

In his basic study on the cytoplasmic male sterility of sugar beet, Kinoshita found four kinds of polymorphisms of mitochondrial DNA (mtDNA) extracted from an isogenic series of male sterile lines, and demonstrated that structural differences in the mitochondrial genes, *coxII* and *atpA*, are deeply related to male sterility. Building on this information, his crossing experiments at plant level indicated that different cytoplasmic types are responsible for the mtDNA polymorphisms, and a reciprocal maintainer-restorer relationship was established among the cytoplasm. The presence of multiplasm is valuable in strengthening disease resistance in hybrids.

In rice plant, Kinoshita bred a male sterile line, A-58 CMS, which has several genetic markers and is most suitable for cell fusion experiments making possible the transfer of male sterile cytoplasm. He also found three kinds of polymorphisms in the mtDNAs extracted from his materials having isonuclear genic background accompanying different cytoplasm. In addition he established the two loci of economically important genes for hybrid seed production, *sd-1* (semi-dwarfness) and *Rf-1* (pollen fertility restora-

tion), by using RFLP markers closely linked with them.

In wheat, Kinoshita has demonstrated a novel interaction between the wheat nucleus and the cytoplasm derived from *Aegilops ovata*. Several agronomic characters such as growth habit, cold resistance and vegetative period have been improved rapidly by cytoplasmic substitution. These basic interactions have contributed to the production of new ecological types which are expressed as wide adaptability and high productivity in wheat breeding.

Thus, Kinoshita has elucidated the genetic mechanism of the interaction between nucleus and cytoplasm, not only in male sterility but also in other growth characters in the three species. He has also contributed to establishing a new approach to crop breeding by the use of cytoplasmic genetics.

Hajime YAMAMOTO

Use of Lasers for Caries Prevention and Other Applications in Dentistry

Based on his research on the application of lasers to dentistry, Yamamoto has pioneered in the following:

1. Prevention of dental caries by laser irradiation

The incipient phase of dental caries begins with subsurface demineralization of the enamel by acid produced by oral microorganisms in dental plaque. By contact microradiography and scanning electron microscopy, he found numerous micropores on the glossy enamel surface with no sign of caries, and presumed that the incipient enamel caries is produced by penetration of acid through these micropores.

To prevent this penetration, laser irradiation was conducted using the different operational modes of Nd:YAG laser. Comparison was made of the effectiveness in inhibiting the formation of an in vitro incipient caries-like lesions.

The irradiation with the acousto-optically Q-switched Nd:YAG laser under the conditions of peak power of 100 KW, pulse width of 100 nsec, repetition rate of 1 KHz, average output of 10 W, spot size of 3.5 mm and irradiation time of 0.8 sec was apparently the most effective, without harmful side effect on neighboring soft tissue. A laser irradiation unit optimally suited for dental use, equipped with a glass fiber manipulator, foot switch, time controller, power checker and other devices was subsequently developed. By this unit, the teeth of 50 children at the dental clinic of Tohoku University were irradiated. A ten-year study clinically confirmed the effectiveness.

2. Other laser applications in dentistry

Laser irradiation was found not only to prevent but cure incipient

enamel caries without cutting lesions and restoring. This irradiation could also prevent secondary caries at restoration margins by closing the space by fusion between the cavity margins and resinous restorations. The Nd:YAG laser was effective for treating sensitive root surfaces by closure of dentinal tubule apertures, and also for endodontic treatment by promoting additional dentin formation on pulp chamber walls.

In addition to his ingenious laser applications in clinical dentistry, he designed a compact microscopic laser apparatus for cytotechnology and succeeded with it in perforation, division and even fusion of cultured cells.

The work of Yamamoto has prompted research on dental application of laser extensively throughout the world. In 1988, he called for the first international congress in Tokyo and was the first president of the International Society for Laser in Dentistry (ISLD). In 1992, he was honored for his outstanding contribution by ISLD at the 3rd Congress held in Salt Lake City, U. S. A.

Keiya TADA and Goro KIKUCHI
Studies on Hyperglycinemia

Nonketotic hyperglycinemia (NKH) is an autosomal recessive disorder in which large amounts of glycine accumulate in body fluids. It is a well-recognized metabolic cause of overwhelming illness early in life. Most patients die within a few weeks of life, whereas the survivors have intractable seizures and little or no evidence of brain development. NKH is one of the important genetic diseases in Europe and USA. In Finland, the incidence is estimated to be 1 in 12,000. In Japan more than 40 cases of NKH have been reported.

1. Demonstration of the enzyme defect: The enzymatic defect in NKH had long been unknown in spite of intense efforts by many investigators. In 1961, Kikuchi discovered the existence of an enzyme system in the mitochondria of rat liver by which glycine is cleaved into active one carbon (C_1), CO_2 and NH_3 in the presence of methylene-tetrahydrofolate. This reaction was designated the "glycine cleavage system" (GCS).

In 1969, Tada and Kikuchi first demonstrated that the fundamental defect in NKH was in the GCS in the livers from patients with NKH. They found that the activity of GCS was markedly reduced, whereas the activities of serine hydroxymethylase and serine dehydratase, which had been thought to be major enzymes of glycine degradation, were found to be normal. These findings clearly indicated that GCS is the main pathway of glycine catabolism.

2. Analyses of GCS: Kikuchi demonstrated that GCS is composed of four individual components: P-protein (a pyridoxal phosphate dependent glycine decarboxylase), H-protein (a lipoic acid-containing protein), T-protein (a

tetrahydrofolate-requiring enzyme) and L-protein (lipoamide dehydrogenase). Furthermore, he isolated and purified each component protein of GCS and elucidated the reaction mechanism of GCG by experiments with combinations of each component.

Basing upon the above findings, Tada analyzed the glycine cleavage activity and its component proteins in the livers from 33 patients with NKH. The glycine cleavage activity was undetectable or extremely low in the neonatal type, whereas some residual activity was detected in the late-onset type. Thus, the clinical phenotypes appeared to relate to the degree of the defect in glycine cleavage activity. Analysis of component proteins of GCS showed that the majority of NKH patients (28 out of 33, 85%) had a defect in P-protein, the remaining 4 patients a defect in T-protein and one patient with a defect in H-protein. These findings indicated that any of the components of GCS, P, T or H, could cause NKH.

3. *Identification of molecular mutations causing NKH:* Since the majority of NKH is caused by a specific defect in P-protein (glycine decarboxylase), Tada et al. cloned the cDNA encoding glycine decarboxylase from human placenta. This clone was 3,705 bp in length and encoded 1,020 amino acids. Furthermore, they have recently elucidated the structure of human P-protein gene, which is over 135 kb in length, contains 25 exons, and is located on chromosome 9p13. Using the cDNA as a hybridization probe, the primary genetic lesions in NKH were investigated. A three-base deletion in exon 19 resulting in deletion of Phe⁷⁵⁶ was found in a Japanese patient with NKH. The majority of NKH patients in Finland, where there is a high incidence of NKH, were found to have a common mutation, a point mutation in exon 14 resulting in the amino acid substitution of Ser⁵⁶⁴ to Ile⁵⁶⁴. These mutations in the neonatal type of NKH were found to localize to a particular domain of the P-protein consisting of a 10 residue amino acid sequence which is repeated twice in the protein and presumably constitutes an important domain for P-protein function. On the other hand, a mutation found in a patient with the late-onset type of NKH was far from the above domain. Thus, these mutations in the P-protein provide insight into the structure-function relationship of this protein.

4. *Elucidation of pathophysiology:* Based on clinical observations and animal experiments, Tada proposed the following hypothesis for the pathophysiology of NKH. A defect in GCS in the brain → elevation of glycine in the brain → overstimulation to NMDA receptors → intracellular Ca accumulation → activation of endonuclease → DNA fragmentation → neuronal death. This hypothesis suggests the possibility that the early treatment with an NMDA receptor antagonist may prevent the brain damage in NKH.

These are very original and significant studies. They contributed not only to the elucidation of the pathogenesis and pathophysiology of this grave illness, which opened a possibility of the treatment, but also to the discovery

of the physiological significance of GCS in the brain that GCS is important in regulating the concentration of glycine as a neurotransmitter. Thus, these studies of the inborn error NKH have provided fundamental understanding of the biochemistry, molecular genetics and pathophysiology of glycine metabolism in health and disease.

PROCEEDINGS AT THE 870TH GENERAL MEETING

The 870th General Meeting of the Academy was held on Tuesday, June 8, 1993, at 1:05 p.m., Dr. Yoshitaro WAKIMURA, President, taking the chair. Eighty members were present, and the following communications were made:

- Affirmative action Masami ITO, M. J. A.
 The first system of political economy Noboru KOBAYASHI, M. J. A.
 Some new examples of eigenmaps from S^m into S^n Keisuke UENO
 On multiplicative semigroups of Von Neumann regular rings Kunitaka SHOJI
 Above two, communicated by Heisuke HIRONAKA, M. J. A.
 The relationships between oxygen consumption and duration of pupal-adult
 development in the silkworm *Bombyx mandarina* Weide SHEN and Kunikatsu HAMANO
 The relationships between pupal development and ecdysteroid levels in summer
 diapausing silkworm, *Bombyx mandarina* Weide SHEN, Kunikatsu HAMANO, and Hajime FUGO
 Relationships between an application of KK-42 and pupal development in the
 silkworm, *Bombyx mandarina* Weide SHEN, Kunikatsu HAMANO, and Hajime FUGO
 Role of the brain on the resumption of development in summer diapausing pupae
 of *Bombyx mandarina* Weide SHEN, Kunikatsu HAMANO, and Hajime FUGO
 Above four, communicated by Seojiro MOROHOSHI, M. J. A.
 Precise lithium isotopic analysis by thermal ionization mass spectrometry using
 lithium phosphate as an ion source material Takuya MORIGUTI and Eizo NAKAMURA
 Communicated by Syun-iti AKIMOTO, M. J. A.
 Tsukuba hypertensive mice. Transgenic mice carrying both human renin and
 human angiotensinogen genes Kazuo MURAKAMI and Akiyoshi FUKAMIZU
 Communicated by Hisateru MITSUDA, M. J. A.
 A divisor problem. I. Akio FUJII
 A note on the rational approximations to $\tanh \frac{1}{k}$ Takeshi OKANO
 Discrete mean values of Hurwitz zeta-functions Masanori KATSURADA and Kohji MATSUMOTO
 A remark to the paper "On the stabilizer of companion matrices" by J.
 Gomez-Calderon You ASAEDA
 On the measure on the set of positive integers Kōsaku OKUTSU
 All congruent numbers less than 10000 Kazunari NODA and Hideo WADA
 Center curves in the moduli space of the real cubic maps Kiyoko NISHIZAWA and Asako NOJIRI
 Fully idempotent semirings Javed AHSAN
 Above eight, communicated by Shokichi IYANAGA, M. J. A.
 Le problème de Cauchy pour certaines équations aux dérivées partielles du type
 de Schrödinger, X; symétrisations indépendantes du temps Jiro TAKEUCHI
 Mountain pass theorems for non-differentiable functions and applications Vicențiu D. RĂDULESCU
 On integrated semigroups which are not exponentially bounded Isoa MIYADERA, Masashi OKUBO, and Naoki TANAKA
 Above three, communicated by Kiyosi ITÔ, 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. Hideo YAMASHITA, M. J. A., had passed away on May 25, 1993; Dr. Masao KOTANI, M. J. A., had passed away on June 6, 1993. The members rose from their seats in silence, expressing profound sense of grief.

Next, Dr. Saburo KURUSU, M. J. A., paid a tribute of admiration to the late Dr. Masaakira KATSUMOTO's meritorious services to academic circles.

Then, the chairmen of both Sections made reports of the matters dealt with at the respective Sectional Meetings.

After that, the President reported that the eighteenth 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 15, 1993, with Dr. Toshio SAWADA, M. J. A., and Dr. Yasutomi NISHIZUKA, M. J. A., as speakers, whose respective subjects were:

“Beautiful Dams and the Improvement of Water Environment”

“Mechanism of Hormone Action and Tumour Promotion”.

Finally, it was reported on the result of election of half the members of the Administrative Committee, which had taken place at the Sectional Meetings. The Committee members elected are: Tatsuro YAMAMOTO, Shigemitsu DANDO, Ryuichiro TACHI, Ryogo KUBO, Ryukiti HASIGUTI, Yoshiaki ISHIZUKA, Takashi SUGIMURA.

The Meeting adjourned at 4:50 p.m.

日本学士院紀要

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