obituary

Sin-itiro Tomonaga, 1906-1979

SIN-ITIRO TOMONAGA, who shared the Nobel Prize for Physics in 1965, died on 8 July 1979 at the age of 73. His memory will be cherished for many years to come because of his witty personality and his sparkling ideas which contributed to the development of quantum electrodynamics in the post-war period.

Tomonaga was born in 1906 in Tokyo as a son of an eminent philosopher, and moved to Kyoto in 1913 with his family. In 1923 he entered the Third High School, and in 1926 he was admitted in Kyoto Imperial University where he specialized in physics. Through these years he became acquainted with Hideki Yukawa, another Nobel laureate, and they studied together. They remained lifelong friends.

It was in 1931, two years after Tomonaga graduated from the university, that he met Yoshio Nishina. Nishina, fresh from Bohr's Institute in Copenhagen, visited Kyoto to give a series of lectures on quantum mechanics. He brought back not only the celebrated Klein-Nishina formula but also the stimulating Copenhagen spirit to Japan and inspired in the young audience a fascination for the new frontier. This gave Tomonaga an excellent opportunity to enjoy Nishina's generous personality, so that the following year he decided to accept an invitation from Nishina to work at the Institute of Physical and Chemical Research in Tokyo as his research associate.

Nishina directed Tomonaga's interest to quantum electrodynamics, and they started to work together on this subject. This was the beginning of Tomonaga's life work, for which he was later awarded the Nobel Prize. Those stimulating days in the free atmosphere of the institute shaped a fertile brain that came into blossom a decade later. Tomonaga often recollected that the joint colloquia at the institute were a constant inspiration to him.

In 1937, he went to Leipzig to join the theoretical group led by Professor Werner Heisenberg and stayed there for two years. During his sojourn there he published a paper on thermal and mechanical properties of nuclear matter. In 1939, after his return home from Europe he was awarded the degree of Doctor of Science from Tokyo Imperial University upon presentation of his dissertation based on the outcome of his stay in Leipzig. In 1940, he married Ryoko Sekiguchi, a daughter of the then director of the Tokyo Astronomical Observatory. In 1941, he joined the

faculty of Tokyo Bunrika University which was later absorbed into the Tokyo University of Education in 1949.

At that time (1941) he concentrated his thoughts on a non-perturbative approximation method in meson theory which developed afterwards into the strong coupling theory, as well as on the generalization of Dirac's many-time formalism to field theory. In the same year World War II broke out, and everybody had to get through a very difficult time. However, Tomonaga's spirits were high in those days, and he was widening his repertory of specialities ranging from field theory to electronics. He completed a relativistically invariant formulation of the quantum theory of wave fields, the so-called super-multiple-time formulation, as the ultimate form of Dirac's many-time formalism. He had to wait for the war to end, however, before his theory could bear fruit: the renormalization programme. During the war he developed a theory of microwave systems as an application of the S-matrix formalism. He also clarified the oscillation mechanism of magnetrons on the basis of an intuitive model and secular perturbation. For these contributions he was awarded the Japan Academy Prize in 1948 together with his collaborator Masao Kotani.

When the war was over in 1945, Tokyo had been reduced to ashes, and everybody had to go through all kinds of hardships. Research on nuclear physics was banned in Japan, and the cyclotron built by Nishina was dumped in the Bay of Tokyo. Yet Tomonaga reached the loftiest pinnacle of his scientific activities in this post-war period. His deep-rooted idea on the renormalization programme was ripe, and he immediately started to work towards completion of his theory with his young associates. They gathered to hold seminars in the midst of ruins. At that time Japanese physicists had almost no access to scientific journals from abroad, but Tomonaga learnt of the discovery of the Lamb shift and its interpretation by Bethe through the popular science column of an Americn weekly magazine. This hint was sufficient to convince him of the correctness of his idea and soon he established his version of quantum electrodynamics. Another fruit was the formation of the Tomonaga school through his collaboration with young physicists in this period.

In 1949, Tomonaga was invited to the Institute for Advanced Study in Princeton and stayed there for a year. There, he broke new ground in the many-body problem.

In 1951, Nishina died, and Tomonaga had to assume many of his administrative responsibilities. After reaching the highest scientific achievement, Tomonaga then paid special attention, in Nishina's place, to the improvement of the working conditions of young scientists. He dedicated his best efforts to the cause of starting research laboratories and facilities such as the Norikura Cosmic Ray Observatory and the rebuilding of a cyclotron at the Institute of Physical and Chemical Research. He also took the leadership in establishing the Institute for Nuclear Study and later the National Laboratory for High Energy Physics.

In 1956, he was elected President of the Tokyo University of Education and remained in this position unti1962. Then he served as President of the Science Council of Japan from 1963 to 1969. Since 1964 he was President of the Nishina Memorial Foundation established to encourage young atomic scientists. This was the position that he held until his death. In 1965, Tomonaga shared the Nobel Prize for Physics with Julian Schwinger and Richard P. Feynman. His scientific achievement was honoured also with the Order of Culture, Japan, in 1952 and the Lomonosov Medal, USSR, in 1964. He

was a member of a number of academies and learned societies both domestic and foreign.

Almost a year ago I visited him in a hospital and we talked about a book he was preparing, but then I had not the slightest idea that I was never to see him again.

Kazuhiko Nishijima

Gilbert Stead

PROFESSOR STEAD, who died on 5 July 1979, aged 91, was one of a small group of physicists who helped to establish radiology as an independent medical discipline.

Medical interest in X-rays was sparked off by a lecture given by Silvanus Thompson to the Clinical Society of London in March, 1896, and during the next 25 years, largely through the enthusiasm of younger doctors with no special training, the use of X-rays for diagnostic purposes spread rapidly. These pioneers often built and maintained their own apparatus!

It was not until the Cambridge Diploma in Medical Radiology and Electrology (D.M.R.E.) was instituted in 1919 that such training became available. A course in radiological physics was begun by J.A. Crowther at the Cavendish Laboratory in 1920, with Rutherford's active support; S. Russ and L.H. Clark provided similar courses in London. In 1924, Stead took over the Cambridge teaching as University Lecturer in Physics as Applied to Medical Radiology and he continued it until 1938. From 1927 until 1942, when this Diploma was discontinued, he was also Secretary to the Diploma Committee.

Stead's connection with Guy's Hospitasl began in 1923 when he was appointed Reader in Physics in the Medical School, a part-time post. The facilities available there only allowed for under-graduate teaching, but in 1938 he was elected by the University of London to a Chair of Physics and was given proper laboratory accommodation. Unfortunately, the outbreak of war in 1939 caused evacuation to Tunbridge Wells and it was not until 1945 that he could begin to build up his department as a centre for applying physics in medicine.

He set up courses for the newer radiological diplomas which had been instituted by the University of London and by the Royal Colleges of Physicians and of Surgeons; and he acted as examiner for them at various times until he retired in 1953, having contributed greatly to setting the standards of teaching and examination which made these diplomas universally accepted. He was President of the British Institute of Radiology (the original Röntgen Society, founded by a group of medical men in 1897) in 1947/48 and delivered the Silvanus Thompson Memorial Lecture there in 1959. He was Honorary Consulting Physicist to Guy's Hospital and a Governor of the Medical School.

During his 30 years at Guy's Stead established a great reputation as a teacher. Some 3,000 undergraduates (who had to "do" physics in their first year, not always willingly!) attended his courses. Gentle in manner, patient and understanding their difficulties, he succeeded not only in overcoming their foibles but also in winning their affection. A text-book, *Elementary Physics,* which he wrote with such students in mind, is now (1979) in its eleventh edition; it was first published in 1923!

Stead outlived most of his contemporaries, but many younger people, not only in this country, remember his retiring, courteous personality. He was once described as "shrewd in discussion, wise in counsel and temperate in judgment." Those who had the privilege of working closely with him knew him also as a loyal friend.

C.B. Allsopp

Carl L. Hubbs

PROFESSOR CARL LEAVITT HUBBS, one of the world's most distinguished ichthyologists, doyen of that tribe in America, a true naturalist and a great personality, died on 7 July 1979 at the age of 84.

Born in Williams, Arizona, shortly after his mother was rescued by a train crew who had found her lost in the desert while driving a wagon, Carl Hubbs ended his distinguished career as Professor Emeritus of the Scripps Institute of Oceanography (University of California) where he had worked since 1944.

The early arousal of his interest in natural history he attributed to his maternal grandmother, one of the first woman physicians; it was further expanded by his father, a self-taught mineralogist, and was fully developed at Stanford University under the rigorous tutelage of that master ichthyologist David Starr Jordan. Hubbs obtained his bachelor's (1916) and master's (1917) degrees at Stanford, and his doctorate (1927) at the University of Michigan. After three years as a curator in the Field Museum, Chicago, he returned, for 24 years, to the University of Michigan. There, apart from his lecturing duties he was curator of vertebrates in the University Museum, and was responsible for building up that museum's collection of fishes, now one of the finest in the world.

Hubb's command of ichthyology was awesome, his research interests extensive but penetrating; their results, published in over 600 papers, could never be criticised for being superficial or trivial. Perhaps the most characteristic feature of his taxonomic work was the way in which he took account of the animal's biology and viewed his subjects in their historical context. It is no wonder that Hubbs contributed so much to unravelling the historical biogeography of American freshwater fishes, nor that his interests should have turned to distributional problems in marine fishes as well. That, in turn, led him into oceanographical and meteorological research, while his freshwater studies took him into the fields of archaeology and human palaeoecology.

With his wife Laura, a mathematician and a dedicated companion, Carl Hubbs pioneered several studies into the genetics of fishes, in particular the application of hybridization studies to the systematics of several taxonomically "difficult" groups. Together they were responsible for discovering the now famous matroclinous and gynogenetic reproduction of the Amazon Molly, *Poecilia formosa.*

Problems of speciation and evolution, especially amongst the rich freshwater fish faunas of north and middle America, also attracted Hubbs. Interestingly, the phrase "new systematics" was first coined by him several years before it was used, apparently as a neologism, by Huxley as a title for that now classic collection of taxonomic essays he edited in 1940.

Conservation was a long standing concern of Hubbs'. He was instrumental in protecting forests, elk, fur seals, the Pacific gray whale and, after a forcefully conducted fight, the desert pupfish of Devil's Hole, Nevada.

That quite inadequate summary of Carl Hubb's research and influence on World ichthyology has overlooked his role in the development of many American research institutes and professional societies, his importance as a teacher, especially of post-graduate students, and his dedicated involvement in the more pragmatic aspects of his great love, ichthyology.

Many honours were conferred on him, including election to the National Academy of Sciences, the award of the Joseph Leidy Medal, the Shinkishi Hatai Medal of Japan, the sole honorary membership of the Japanese Ichthyological Society, and election to Foreign Membership of the Linnean Society of London.

Informally Carl Hubbs will long be remembered with warm affection by those who knew him, in particular by fellow ichthyologists for whom, irrespective of their status in the discipline, and despite his many commitments, he could always find time to share his knowledge and give his critical encouragement. Historically his contributions to ichthyology will ensure him a degree of immortality vouchsafed to few.

P.H. Greenwood