

Obituary—Professor Syomatu Yokoyama Founder of Modern Electrophysiology of the Enteric Nervous System



S. Yokoyama
(1913-1992)

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In 1966, Prof. Syomatu Yokoyama recorded the action potentials of the myenteric plexus (Auerbach's plexus) for the first time in the world. He successively elucidated the neural mechanism of the peristaltic reflex by means of an electrophysiological method: excitation above and inhibition below the stimulated spot of the intestine (the law of the intestine by Bayliss and Starling, 1899). Furthermore, he localized a minimal neural circuit necessary for the peristalsis into the myenteric plexus without yet eliminating the additional role of the submucous plexus (Meissner's plexus). As Dr. J.D. Wood (U.S.A.) stated in 1985, enteric neurophysiology began with the work of Yokoyama.

Dr. Yokoyama was born in 1913 in Ojiya City, Niigata Prefecture (in the northern part of Honshu, on the sea of Japan) as the son of an extremely poor peasant. The young Yokoyama once observed his father bringing half of their harvest to their landowner for rent and still thanking him deeply, an incident which caused him to feel a contradiction in the social system of Japan before World War II. In spite of his father's hesitation, and thanks to his mother's encouragement and "complicity", the boy entered middle school. Yokoyama finished his studies of medicine with high honors at the Niigata Medical College, one of the oldest medical schools in Japan. During his school days, he could buy only one medical text book, a second hand one, "Grundriss der klinischen Diagnostik" by G. Klemperer (1931 edition). He learned all its contents by heart.

Dr. Yokoyama's first job was as an assistant to Prof. T. Hukuhara, an eminent Japanese physiologist at Peking Medical College in China. At the time, Japanese teachers were employees of the Chinese puppet government controlled by the Japanese army. In spite of this political situation, Yokoyama made an important observation with Dr. Fukuhara, on the existence of the conduction system, an equivalent tissue of Tawara's node (1906) at the base of the each

valve of the mammalian heart.¹⁾ This important discovery (1944), however, was never known in world of science because the ship carrying this news was torpedoed and sunk.

Despite the occupation by Japanese army, Yokoyama showed great sympathy for China and her people. Even those students of his who participated in the resistance against Japanese army came to greet him when they left school. At that time Hukuhara and Yokoyama also published a report on a cinematographic method to study intestinal movements through a window made in the abdomen of the rabbit.

In 1945, Yokoyama was called up as an army medical officer and ordered by Lieutenant General Ishii of the Japanese Kanto Army stationed in China to practice a medical experiment to observe the effect of shooting on the intestinal movement of Chinese prisoners. His reaction was to refuse this order. Yokoyama's belief in experimental medicine cultivated by the philosophy of Hippocrates and of Claude Bernard compelled him to do so. Ishii turned pale, hit the door with his foot and left Yokoyama, uttering the hypocritical and diabolic sentence, "You should be afraid of human mystery!" Yokoyama feared he would be executed, since at that time disobedience to military orders was interpreted as against the will of the Emperor. Fortunately, however, he was only sent to the front in south China as a military medical officer. He taught himself to play the violin as recreation, which he enjoyed until the end of his life.

After Japan surrendered in 1945, he came back from the south to the north of China, walking over 1,000 km, with Japanese civilians. Although it was winter, Japanese people were not allowed to sleep inside the house on the way. However, at the entrance of each village, Yokoyama noticed a Chinese slogan saying "Do not respond to the violence with another violence." He felt great generosity of the

Chinese political leaders toward Japan.

He came back to Japan with his family in 1946, and three years later was named professor of physiology at Fukushima Medical College (northern Honshu, on the Pacific coast). He established the department of physiology with Associate Professor K. Ishii. With Prof. T. Osaki, department of anatomy, he studied the function of the Auerbach's plexus in an extremely friendly atmosphere.

From 1962-63, he spent a sabbatical year in the laboratory of Prof. K. Greven in Frankfurt am Main in Germany. Prof. Greven was studying for the first time the action potentials of the smooth muscles. Yokoyama intended to record the action potential of Auerbach's plexus as early as possible. Dr. Greven, being very careful, advised against this risky project and said to Yokoyama, "For such long term work, I had better find you a German wife!" Because of the time required Yokoyama performed this experiment only after coming back to Fukushima,²⁾ with the aid of an electrode which he had made himself by reading a German electronic text book brought from Frankfurt am Main.

Dr. Yokoyama's character was simple, robust and joyful. He left behind in Europe a number of anecdotes which are funnier than jokes. One episode happened in an express train to Vienna in Austria. One hot summer day, despite his well known weakness to alcoholic drinks, he bought a bottle of beer. Drinking on an empty stomach, he soon lost consciousness and fell down. Surprised by this, an Austrian lady in the compartment took a perfume bottle from her handbag and poured its contents over Yokoyama's nose in order to wake him up. Hopelessly, she searched for a medical doctor in the train, asking "Is there any doctor on the train?" The express train stopped. Suddenly, Yokoyama, with a look as if he were coming back from purgatory, said "Ich bin Arzt" (I am a doctor). All the people laughed and the train started again.

After returning from Germany, he published with his Japanese colleagues in Fukushima works on the propagation of action potentials through the myenteric plexus.^{3,4)} These provided an experimental basis for understanding the mechanism of peristaltic movement. His participation at the International Congress on Physiological Sciences in Munich in 1971 had a decisive influence on Dr. A. North and Dr. J.D. Wood of the U.S.A. Later, North worked with Yokoyama, and Wood considered Yokoyama the founder of modern electrophysiology of the enteric nervous system.

Dr. Yokoyama retired in 1979 and was invited by

Dr. A. North to Chicago, where previously Drs. K. Koketsu and S. Nishi had discovered non-cholinergic late slow EPSP in the sympathetic ganglion. Yokoyama was so modest as to ask Dr. North to treat him as a postdoctorate student. He published works with Dr. North on the role of substance P-like substance in the peristaltic movement.⁵⁾ In the United States, he also enjoyed the deep friendship of Prof. E. Bozler, an eminent solitary physiologist of smooth muscle.

After Chicago, Yokoyama came to Paris in 1981 to continue to observe, in our laboratory of neurocytology, the peristaltic movements of the intestine by means of an old kymograph. He won the deep respect and friendship of Prof. R. Couteaux and J. Taxi, outstanding French neurocytologists, working in our laboratory. During trips, Prof. Yokoyama would unintentionally walk with his violin about 30 meters in front of his wife, who followed him with their suitcases, a habit which several scientists found socially unacceptable. Incidentally, because of tuberculosis, Yokoyama had only one lung. However, it seems that he enjoyed a sort of Japanese *maschismo*, thanks to the exceptional goodness of his wife. According to my French wife, who highly appreciated Dr. Yokoyama's personality, he was a typical Japanese husband.

After living in U.S.A. and Europe, he came back to Japan through China. In Peking, Prof. and Mrs. Yokoyama met the famous Dr. Wang Tang-Wang, his student of 40 years earlier. They recalled that the brilliant and beautiful Miss Wang-Tang-Wang had taught him Chinese and young Yokoyama had taught her Japanese many years earlier.

In the last ten years of his life, he often visited the National Institute for Physiological Sciences in Okazaki near Nagoya, continuing to work on enteric nervous physiology with his young disciple, Dr. T. Ozaki, who was his assistant at Fukushima Medical College. Here, the peristaltic movement, which he had observed in Paris in the segment without mucosa, could be seen even in segments deprived of both mucosa and submucosa.⁶⁾

In these last ten years, he continued to give special lectures on the history of medicine at the University of Fukushima. At the same time, he was actively involved in the movement against nuclear bomb tests. Though deeply convinced of the value of this movement, he never asked us to participate in anti-nuclear demonstrations with him. For several years, Japanese Government had offered him a decoration. This, however, he did not accept, probably owing to his experience during the war. He did not believe in God,

but read with deep interest the Old and New Testaments, the “Pensées” by Blaise Pascal and the “Phénomène Humain” by Pierre Teilhard de Chardin, theologian and anthropologist. Yokoyama knew that Teilhard de Chardin had been in China, at the same time as he, for exploration of *Sinanthropus pekinensis*.

Two months before his death, he wrote a review of his work, which was published after his death. We do not know an example of a manuscript for the publication of which so many friends and colleagues cooperated.⁷⁾

Several hours before his death, he wrote in French “Je pense” (I think) . . . We could not read the rest of the sentence. But we suppose that he intended to write “donc, je suis” (therefore, I am). This sentence of Descartes on the reason for the existence was a favorite of his.

When I sent a telegram to his family saying “The Life of Syomatu, Scattered in the World, Is a Light for the World”, the postman who delivered the message did not believe it to be a telegram of condolences. I like to think that this means that Yokoyama is still living among us.

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Born in Tokyo in 1936. After completion of the master course at Tokyo University of Education, he studied in the laboratory of Prof. K. Greven in Frankfurt am Main from 1962 to 63, where he met Prof. S. Yokoyama. In 1965, he moved to the laboratory of Prof. R. Couteaux in Paris, and since has worked in CNRS. His speciality is acetylcholine esterase and acetylcholine cytochemistry.