Dr. Lam Lay Yong, an honorary member of the Society, was awarded the prestigious Kenneth O. May Medal at the 21st International Congress on History of Science in Mexico City in July 2001. The Kenneth O. May Medal, named in honour of the founder of the International Commission on History of Mathematics, is awarded once every four years in recognition of outstanding contributions to the history of mathematics.

Dr. Lam was a Professor at the Department of Mathematics, National University of Singapore until her retirement in 1996. She is internationally known for her research into the history of Chinese mathematics. An active member and a past president of the Society, she had also held various other offices in the committee of the Society.

The Medley interviewed her at her home on 6 December 2001.

Tracing Fleeting Footsteps:

An Interview with Lam Lay Yong

Cheng Kai Nah, Leong Yu Kiang & Wong Yan Loi

Medley: When did you get interested in mathematics? When and how did you decide to specialize in the history of Chinese mathematics?

Lay Yong: I was always interested in mathematics while in school.

From 1957 to 1960, I was a student in mathematics at the University of Cambridge and during that time I met Dr Joseph Needham. Coincidentally, he was finalizing Volume 3 of his monumental *Science and Civilization in China*, the volume that contains the history of mathematics in China. At that time I knew nothing of the subject. Dr Needham was a most tactful and modest person when he talked about his works and it was inevitable that my curiosity for the subject was aroused.

When I joined the Department of Mathematics at the then University of Singapore, I had to look for a topic of research leading to Ph.D. In one of my whimsical moods, I decided on the history of Chinese mathematics. Surprisingly, everything went very smoothly thereafter. The Head of the Department gave his approval and I found a most enthusiastic supervisor in Professor Ho Peng Yoke, who was then with the Department of Physics and was already collaborating with Dr Needham. My research topic was on a thirteenth century mathematical treatise: *Yang Hui Suanfa (Yang Hui Methods of Computation)*.

Medley: Were you from a Chinese school?

Lay Yong: No. The standard of my Chinese was "O-Level" in an English school.

Medley: What is the major obstacle encountered in your undertaking of research in the history of Chinese mathematics?

Lay Yong: In doing research of this nature, one has to delve into the original texts and I can think of two main obstacles.

In any mathematical treatise, there are numerous technical phrases which an ordinary sinologist would not understand. Part of my work was to make a laborious study of these phrases in order to understand and to write down what they meant.

In studying a text, it was also necessary to go into other ancient texts for historical perspectives and sometimes these were written in pithy *wen yen* (classical Chinese) and mixed with technical phrases. I find such readings tedious and difficult.

Medley: Among your numerous publications, could you single out a couple which you are most proud of?

Lay Yong: Yes definitely, they are the publications that led to my thesis that the Hindu-Arabic numeral system has its origins in the Chinese rod numeral system, as propounded in my book *Fleeting Footsteps*.

Before this thesis was formulated with established evidence, I underwent a long period of rigorous inward questioning, during which time more insights into Chinese scripts were obtained and worldwide research on the origins of the Hindu-Arabic numeral system were conducted. Eventually when this important thesis was written, I was quite satisfied with it.

Medley: What was the general reaction to this idea that the Hindu-Arabic numeral system could be traced back to the Chinese rod numeral system?

Lay Yong: There was disbelief in the beginning, which led me to write more papers about it. To date, there have not been any publications contradicting my findings.

Medley: In most books on the history of mathematics, the contributions of ancient Chinese mathematicians are left out completely. Would you like to comment on this and suggest what can be done to rectify this omission?

Lay Yong: I presume you are talking about non-Chinese books. Since the publication of Needham's work mentioned earlier, there has been a steady increase of research publications on the Chinese contributions to mathematics. Publications in the Chinese language are quite prolific and a number of works of good quality have been translated into other languages. In time to come, more and more Chinese contributions to mathematics will come to light and will be mentioned in books on the history of mathematics.

Having said that, I would like to add that academic papers on the history of Chinese mathematics are not easy to read. Sometimes it does take someone close to a genius to grasp the texts of the publications and to condense them into one chapter or even one paragraph.

Whether it's writing a paper or a book, I always believe that the standards of writing should be maintained at as high a level as possible, even at the sacrifice of slow output.

On a personal side, I am most privileged to receive the Kenneth O May Award as this is an ultimate recognition of my publications at a very high level. It is bodies such as The International Commission on History of Mathematics and The International Academy of the History of Science that have contributed to the maintenance of high standards in such academic publications.

Medley: Are there now more books written on the history of Chinese mathematics?

Lay Yong: Yes, especially in Chinese.

Medley: Who do you think is the greatest Chinese mathematician of antiquity? What were his main contributions?

Lay Yong: I personally do not think that there is a greatest Chinese mathematician of antiquity, though there are numerous great mathematicians. However, I would like to point out the most important ancient Chinese work, you probably know it, *Jiu Zhang Suanshu*

(Nine Chapters on the Mathematical Art). It is also a unique work in the world history of mathematics as it is the earliest most significant book on arithmetic that was based on a numeral system which had the same concept as our present numeral system.

Medley: Who was the author of *Jiu Zhang Suanshu?*

Lay Yong: It's unknown. This is a collection of works and Liu Hui, who lived in the 3rd Century, was one of the commentators. Over the years, more mathematicians added more explanatory notes to it.

Medley: What other works of the ancient Chinese would you have liked to translate and analyse?

Lay Yong: Before my retirement I was toying with the idea of studying Cheng Dawei's *Suanfa Tongzong (Systematic Treatise on Arithmetic)*. This book was written in 1592 and many regarded it as an important work as it uses abacus calculations instead of rod numerals. I view it from another angle - that it brought about an end to the development of Chinese mathematics that began with *Jiu Zhang Suanshu*.

Though mathematics had been developed to a very advanced stage through the rod numeral system, calculations through the use of the rods were becoming increasingly clumsy and slow in sharp contrast with the pace of development of mathematics. The abacus was invented to shorten the time of calculation but in so doing, numerous methods had to be learned by rote. Because of this, reasoning, so essential to the development of mathematics, was discarded, and, inevitably, mathematics declined.

Medley: It seems that significant mathematical discoveries were made in China while Europe was in a state of scientific stagnation during the Middle Ages (5th to 15th Century), and yet those early Chinese achievements had little impact on the later development of science in general and of mathematics in particular. What do you think are the reasons for this?

Lay Yong: I disagree entirely with this observation that the Chinese achievements had little impact on the early development of mathematics and science in Europe. Our arithmetic, whether it's now or in medieval Europe or in ancient China, was built on the concept of what we now call the Hindu-Arabic numeral system; more correctly, it should have been called the ancient Chinese rod numeral system.

On such a numeral system, advanced achievements were made in addition, subtraction, multiplication and division. Just try to multiply two large numbers using Roman numerals and you would immediately grasp the enormous usefulness of such a numeral system. The topics of arithmetic in 15th or 16th century Europe were similar to those in *Jiu Zhang Suanshu*.

With the foundation of arithmetic, we know that algebra developed. Along a parallel line, the ancient Chinese texts also have algebraic problems including simultaneous equations and equations of several variables.

With the establishment of arithmetic in medieval Europe, trade and science subsequently flourished. In ancient China, knowledge of science and technology was at a very high level, and for more of this, please refer to Needham's books.

In short, without the foundation of the concept of the rod numeral system, arithmetic, algebra and science would have remained stagnated in Europe without much progress for a long time to come.

Medley: Why didn't Chinese mathematics develop subsequently?

Lay Yong: After they introduced the abacus, Chinese mathematics declined so there were no further developments. The Chinese made a critical mistake of not transferring the rod numeral system into a written system, which would then have been identical with the Hindu-Arabic numeral system.

Medley: You think that the Hindu-Arabic numeral system originated from China? You don't think that it was an independent invention?

Lay Yong: The Chinese had been using the rods to add, subtract, multiply and divide for many centuries since the Warring States period (475-221 B.C.). They carried their bundles of rods just as we would carry our calculators today. So the methods of calculation were easily available to foreigners, who might have been visitors eager to learn new ideas and inventions from the Chinese, or merchants and traders, such as those along the Silk Road. Some foreigners took the Chinese idea and adapted it into a written system.

The Hindu-Arabic numeral system could not have been an independent invention because the earliest record of the methods of multiplication and division of two numbers were identical with those in *Sun Tzu Suanjing (Mathematical Classic of Master Sun)* which I translated in my book *Fleeting Footsteps*.

Medley: Were the ancient Chinese able to compute square roots?

Lay Yong: Yes, they could compute square roots, and cube roots too, using the rod numerals. They could also solve systems of polynomial equations in several variables.

Medley: How would you advise a person who is interested in working on the history of Chinese mathematics?

Lay Yong: He should familiarise himself with the available literature on the history of Chinese mathematics before he selects his area of research and subsequently he should be knowledgeable on the parallel developments of mathematics in other parts of the world.

Medley: Are there a lot of other ancient Chinese mathematics texts that are not translated into English?

Lay Yong: While some have been translated there are still many others that have not been wholly translated.

Medley: Do you think that topics in the history of mathematics should be offered in an undergraduate mathematics curriculum? If so, what topics in the history mathematics should be taught to undergraduates?

Lay Yong: It would be interesting and useful to include them in the curriculum.

However as mathematics is the oldest science, the range of topics is so wide, stretching from ancient to modern times. What is more important is to have them easily accessible, for example on the Internet, so that those who search for such knowledge would find them and have their horizons widened.

There are quite a lot of websites containing information on the history of mathematics. Some of these contain information on Chinese science and mathematics, and some are in Chinese.

Medley: Would you consider setting up your own website to share the research that you have done so far?

Lay Yong: There are no such plans at the moment, but it could be explored in the future.

Medley: When did you first join the Singapore Mathematical Society? Would you like to say something about the activities of the Society at that time?

Lay Yong: Your first question is difficult to answer as I canπt recall the date. In those days, I remember Dr Richard Guy was a very active member of the Committee, and he made numerous contributions to the Society. Bulletins were then on cyclostyled sheets and we had quite regular meetings with interesting and knowledgeable speakers.

Medley: Could you tell us about your life after retirement?

Lay Yong: In one word, "wonderful". My husband and I travel quite a lot. I have now more time to be more health conscious and to focus on meaningful activities that I enjoy.