Remembering Professor Kenneth C. Ludema

International Conference on Wear of Materials 2017, Long Beach, CA

- Good evening everyone. Good to see you all.

- I feel honored and privileged to be standing here in front of you this evening.

- I would like to thank Prof. Tom Scharf and his team for the kind invitation and giving me this opportunity.

- I am glad that Jo Ludema, Prof. Ludema's wife, and her family members are here with us this evening. Please stand up and be recognized.

- Prof. Ken Ludema and I were in Tashkent, Uzbek Soviet Socialist Republic, now called the Republic of Uzbekistan, at the invitation of the Institute of Mechanics of the Soviet Academy of Sciences to attend a tribology conference in 1980. One evening, there was a conference reception and dinner including a live band. Ken and I were sitting around at a table with few other delegates. Out of nowhere, a beautiful and real tall lady, as tall as Ken, appeared at our table. She asked Ken to dance with her. Until then, I did not know Ken was such a good dancer.

- Since the conference was all in Russian, Ken and I decided to go sightseeing one day to Samarkand. Complications: we were not allowed to travel to another city without a special visa. But the visa could be arranged, according to our host, if we were willing to pay in US dollars and also pay for the transportation and the guide/interpreter. We decided to cough up the money. The next morning, a huge black limousine showed up to pick us up; with one driver and a guide/interpreter. We were traveling at high speed on a two-lane highway using both lanes and the traffic police saluted us along the way instead of stopping us. We were VIPs. I hope you get the picture. Samarkand was a fascinating city, being an ancient city on the Silk Road connecting Europe to Asia. On the way back, the limousine ran out of gas on the highway; in the middle of nowhere; no petrol stations in sight.

- Then, Ken and I flew together to Yerevan, Armenia to meet up with Prof. Albert Pogosian. Jo Ludema knows him well as he spent sometime at the University of Michigan visiting Ken. Ken and I were on Armenian TV discussing science and politics: Ronald Reagan was running to be president.

- Then Dr. Nicholas Myshkin escorted us to the Institute of Mechanics in Belarus being run by Prof. Bellyi. We were on their TV as well.

- Ken and I flew out of Moscow going to Paris.

- We took a bus from the Charles de Gaulle airport to Hotel Concord Lafayette and arrived at the ground level of the hotel. We had to take an elevator to reach the reception level. The elevator was small and 4 of us were squeezed in tight. As soon as we reached the next level, the two guys walked out of the elevator. Right away, Ken says "my wallet is missing". Ken ran after the two bad guys while I was watching our luggage. Some time went by and Ken came back with his recovered wallet. These two youngsters could not outrun Ken. Ken was a good runner.

- So it was 1976 when I was visited by Ken, Bill Glaeser of Batelle and Dr. H. Lee of Xerox at Bendix Research Center where I had been just appointed Director of Materials and Processes Department one year earlier. We discussed the feasibility of organizing a conference on wear, which would be sponsored by the American Society of Mechanical Engineers. In those good old days, I had sufficient resources and staff to carry out activities like this. I supported the idea and we decided to proceed. Dr. Lee of Xerox proposed to call the conference "International Conference on Wear of Materials". The conference was going to be one time event. After a couple of meetings, Dr. Lee of Xerox stayed away, so Ken, Bill and I had to carry on. We did not know how many attendees to expect; 100? 200? The first conference was held in St. Louis in April 1977. To our surprise, some 270 people came from all over the world including the Soviet Union. Our keynote speaker was Prof. David Tabor of Cambridge, Ken's PhD thesis advisor, Ken the conference chair and I the program chair. We received positive feedback and decided to try one more time in two years, maintaining the same organizational structure. The second conference was more successful. We decided then to continue and hold the conference every two years. Here we are 40 years later.

- If you are not successful, nobody pays much attention to you, but if you are successful, you receive a lot of attention, some desirable, others undesirable. The Wear conference belonged to the Lubrication Division of the American Society of Mechanical Engineers, and their officers wished to take over at the time of the third conference in San Francisco in 1981. That was the time we had to think about separating away from the American Society of Mechanical Engineers, with mixed emotions.

- Ken used to say lubrication people looked at high friction coefficients and wear simply as a failure of lubrication.

- Ken was asked to prepare a manuscript on friction coefficients to be included in a handbook. He showed friction coefficients could vary from 0.1 or less to 1.0 or much greater. Many believed friction coefficients had to be around 1/3 by definition and his manuscript was rejected and never published. Believe it or not, this is what happened in the name of science; politically incorrect!

- Fast forward. In 2010, Prof. Peter Filip of Southern Illinois University, Prof. Georg Ostermeyer of Technical University of Braunschweig and I decided to organize the International Forum on the Fundamentals of Sliding Friction and Vibration to exchange and discuss new ideas or concepts in a friendly environment without constraints as compared with technical conferences. The Forum was by invitation only. The first and second Forums were hosted by Peter Filip and some 12 participants came each time representing several countries. Ken was one of the participants. One of the issues I brought up was the fact that technical data do not support the Amontons-Coulomb's Laws of Friction, which states that 1) friction coefficient does not depend on the load, 2) on the contact area and 3) on the sliding speed. Only two people were willing to support my idea. Ken was one of them. Making a long story short, we asked Prof. Yannick Desplanques of Ecole Central de Lille to review Coulomb's original manuscript. To our surprise, the manuscript demonstrates that Amontons' proposition of the load independence and contact area independence of friction coefficients is not exactly correct if the testing ranges are wide, and also Coulomb demonstrates the speed dependence of friction coefficients. Up to now, we do not know who has created and invented the Amontons-Coulomb's Laws of Friction. I hope some of you are not teaching these false "laws". Those of you who like to join the Forum, please let me know or let Peter Filip or Georg Ostermeyer know. The 7th Forum will take place in Korea in June, this year.

- Ken wished the Wear Conference would embrace its better half called friction as friction and wear go together. I strongly support his wish. In the beginning of the Wear Conference, friction was excluded for political reasons. I hope future planners of this conference will consider including friction, which will be very much consistent with Ken's wish and also my wish.

- Ken was born on April 30th, 1928 in Coopersville, Michigan, a small farming town, and passed away on April 13th, 2015, at the time of the 20th International Conference on Wear of Materials in Toronto, Canada. When

he passed away, Ken and Jo had 6 children, 17 grandchildren and 8 great grandchildren. He attended a small Christian liberal arts college called Calvin College in Grand Rapids, Michigan. He told me he almost flunked out of the college in his first year as he did not know how to study and he was counseled by the dean of his college. He went on to get his PhD in Mechanical Engineering at the University of Michigan. One PhD was not enough for him. He went on to Cambridge University to receive another PhD. Then he joined the University of Michigan to teach. He was full of intellectual curiosity on science, engineering and religion. He was still working on a new book when he passed away. He was going to include in this new book discussions on the Amontons-Colomb's Laws of Friction. He was always ready to smile, gentle and kind.

- Ken and I always had interesting discussions, technical and non-technical whenever we got together for lunch or dinner. On one of those occasions, Jo told me how much she enjoyed living in Cambridge and that some times she wondered if Ken cared more about his laboratory work than caring about her. We know the feeling very well; just 30 minutes more or just 40 minutes more and on and on. I miss him a lot as a professional colleague and as a good friend. We all do.

- Thank you very much for listening. In closing, I suggest we have a moment of silence and remember Ken.

Seong Kwan Rhee
March 2017