PREFACE: COMMEMORATING THE LIFE AND TIMES OF ART BERGLES (1935 – 2014): HE PEDALED FAR AND WIDE, MADE A DIFFERENCE . . . AND THE TRAIL IS AN ENRICHING LEGACY

Arthur E. Bergles (1935 – 2014)

"Consider a man riding a bicycle. Whoever he is, we can say three things about him. We know he got on the bicycle and started to move. We know that at some point he will stop and get off. Most important of all, we know that if at any point he stops moving and does not get off the bicycle he will fall off it. That is a metaphor for the journey through life of any living thing."
- quote attributed to William Golding, author of *Lord of the Flies*, by Justin D. Belmont, in his "Prologue: On Bards and Bicycles," in *The Art of Bicycling: A Treasury of Poems,* J. D. Belmont, ed., p. 21, Breakaway Books, Halcottsville, NY, 2005.

It was a sad Monday on 17th March, 2014, when Art "stopped" and got off his life's "bicycle." His passing, after an extended but tenacious battle with a malignant brain tumor, left a void in the heat transfer and thermal science community that would be hard to fill. My e-mail that went out to his many worldwide friends and colleagues with this unfortunate news read: "Art was a dear friend, mentor, wise sage, gentleman, respected educator, pioneering researcher, selfless leader in our heat transfer community, and much, much more to many of us. There are not enough words to describe him and his interactions with us. He will be missed very much, but surely we will cherish the many memories of our association with Art." There was an outpouring of heartfelt condolences in response, and the following samplings quite eloquently capture the sentiments of his friends and colleagues:

". . . It is truly the end of an era."

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"...Art was a major force in the field. He was engaged in making technical contributions till the last few days of his life. Besides, he was a great human being who [was] always helping others."

"Art was a great person, full of life and always helpful. His kindness was legendary ...always admired his humility, decency, and selflessness. ...he was an embodiment of a true scholar – great accomplishments but still very humble and generous. His presence was larger than life."

"...He leaves behind a legacy and a huge vacuum in terms of wisdom and integrity."

"Art was a remarkable human being."

"...Art befriended many an engineer that he only met one or two times and was an inspiration to many of those who would otherwise have been strangers."

"...Gem of a person and a great teacher. He made HT [heat transfer] class interesting and relevant to engineering application."

That Art worked and contributed to the professional community "till the last few days of his life," was evident from his participation in the 75th Anniversary Celebrations of the ASME Heat Transfer Division at the Summer Heat Transfer Conference, July 2013, in Minneapolis, MN, only a few months after his tumor diagnosis and start of treatment. In the Energy-Water Nexus symposium at this conference, he gave an hour-long presentation, as well as made one other presentation for the division's celebrations, and then actively attended (with questions) the session on enhanced heat transfer. Incredible grit indeed! The photo below, taken at the anniversary banquet in Minneapolis, perhaps says more about his fortitude and remarkable character than words could ever articulate.

Art often alluded to the metaphor of the 'art' of riding a bicycle in the context of his own life and remarked "if you do not keep pedaling, you will fall." He was 78 when he did stop, but by then he had pedaled far and wide, and the exceptional trail he traversed has left a lasting and inspirational legacy. The path he journeyed in his exemplary, more than five-decades-long academic and professional career would be hard to emulate. His scholarship spanned the full spectrum of the field of thermal science and heat transfer, with seminal and ground-breaking contributions in boiling and two-phase flows, process heat transfer, refrigerant evaporation and condensation, electrical and micro-electronic cooling, and enhancement or augmentation of heat transfer, to list a few representative areas. In fact, it is due to his untiring efforts and pioneering work that the field of heat transfer enhancement has transformed from its "origins" as a "second-generation heat transfer technology" to a rapidly growing "third-generation"

Art Bergles making a presentation during the 75th Anniversary Banquet of the ASME Heat Transfer Division, 2013 Summer Heat Transfer Conference, Minneapolis, MN.

and "fourth-generation" technology[1]. The art and science of enhancement is now a "household-name" endeavor in not only the laboratories and computer simulation rooms of researchers across the globe, but with practitioners as well in their quest for new technology transfer avenues and engineering applications. And this growth is underscored by the present-day "Energy-Water Nexus" crisis and the challenges of energy storage systems that warrant, among other solutions, greater need for new research in and implementation of heat and mass transfer enhancement techniques.

It is this enriching and lasting legacy of Art Bergles that is celebrated in these multiple special issues of the Journal of Enhanced Heat Transfer. The technical paper contributions in the ensuing pages range from original new work to the much needed state-of-the-art reviews of critical subfields of enhancement. Besides the science and engineering art that have been reported, these articles on multifaceted topics and diverse aspects of high-performance heat exchange also reflect, in many ways, Art's

[1]See, for example, the following references for some discussion on this growth and transformation: Webb, R. L., and Bergles, A.E., "Heat Transfer Enhancement: Second Generation Technology," Mechanical Engineering, vol. 115, no. 6, pp. 60-67, 1983; Bergles, A. E., "Enhanced Heat Transfer: Endless Frontier, or Mature and Routine?" Journal of Enhanced Heat Transfer, vol. 6, nos. 2-4, pp. 79-88, 1999; Bergles, A. E., "Exhft for Fourth Generation Heat Transfer Technology," Experimental Thermal and Fluid Science, vol. 26, nos. 2-4, pp. 335-344, 2002; Bergles, A. E., and Manglik, R.M., "Current Progress and New Developments in Enhanced Heat and Mass Transfer," Journal of Enhanced Heat Transfer, vol. 20, no. 1, pp. 1-15, 2013.

personal philosophy of life. It embodied determination and seeking opportunity in setback, and this belief is quite succinctly captured by another bicycling analogy (as narrated by Justin D. Belmont in the prologue to his edited compendium, The Art of Bicycling: A Treasury of Poems, wherein he quotes Bob Roll, the pro-cycling commentator and his own take on the Zen of mountain biking) as follows:

> *"The more you cease seeing trails as problems to be solved, the more you will transcend the forces of gravity and mechanics. When you finally disconnect, the trail will look different. There will be no obstacles. You'll see it like a canvas or piece of paper on which you can express yourself."*

This was true of Art's life and times, and is true now in our present as well as for the time of the generations to come. It is hoped that this guiding principle would continue to engender profound scientific and technological expressions on the canvas of enhanced heat and mass transfer, so as to further enrich and expand Art's legacy.

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