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PREFACE: THE ENDURING RELEVANCE OF ENHANCED HEAT AND MASS TRANSFER

As we celebrate the 20th year of publishing archival contributions in the *Journal of Enhanced Heat Transfer* (JEHT), it is appropriate to reflect upon its journey since the inaugural issue (vol. 1, no. 1, 1993); the second through fourth issues of the first volume of what was then a quarterly publication were printed in 1994. In starting this journal, the objective of its founding editor, Late Professor Ralph L. Webb (1934–2011), was "to make JEHT '*the place*'[1] to publish important papers on enhanced heat transfer, and to find the '*pulse*' of industrial application" (Webb, 1994a). For the latter, a *Technology Review* section was included and so designated editors were appointed to seek "publishable information from engineers in industrial organizations" (Webb, 1994b). In an implicit acknowledgement of this goal, and recognize-ing that industrial practice of that time had "led the way in the creation and development of enhanced heat surfaces and their application" (Webb, 1994b), the dedicated publishing of new research has always had a broader scope by including *high performance* heat and mass transfer. This objective, however, is underscored by new advancements in science, engineering, and application of "intentional" methods for improving the heat or mass transfer of a device or system over that prevailing in "normal" usage. An elaborate taxonomy, developed by our founding advisory editor, Professor Arthur E. Bergles (1983), characterizes the different enhancement methods.

With its early beginnings in 1965 as a project for a survey and evaluation of the literature on enhanced heat transfer at that time (Bergles and Morton, 1965), the effort to widely disseminate the growing technical information evolved into a full-fledged computerized library of citations and the first of its kind comprehensive bibliography was published by Bergles et al. (1983); this was accompanied with a physical library with hard copies of over 95% citations on hand. This compilation has since grown considerably (Manglik and Bergles, 2004) and has been supplemented by periodic updates (Manglik and Bergles, 2004; Bergles et al., 1991; Jensen and Shome, 1994), which include reports that have targeted specific modes of heat transfer and/or applications (Bergles et al., 1991; Jensen and Shome, 1994; Manglik and Bergles, 2002).

[1]Emphasis added in the quotation.

Moreover, several broader literature reviews and discussions of newer developments in the field (Somerscales and Bergles, 1997; Bergles, 1998; Manglik, 2003; Webb and Kim, 2005) have provided the much needed resources for both the researcher and practitioner. Needless to add that the generational transformation (Bergles, 2001) of this important area of research and development continues to expand. It has adapted to new engineering challenges (Bergles, 1999), and is critical more than ever to the pressing needs of energy and water conservation, mitigation of environmental degradation, and sustainability (Manglik, 2012; Bergles, 2012). The *Journal of Enhanced Heat Transfer*, of course, continues to play a central role in this evolving engineering quest by providing a dedicated international forum for research dissemination.

Perhaps by fortuitous coincidence and reflecting the early contribution of our founding editor (Webb et al., 1972), 45% of the published papers in the inaugural issue (vol. 1, no. 1, 1993) of this journal were on enhancement due to rough surfaces in single-phase flows. In fact, 78% papers dealt with single-phase flows and remaining 22% addressed two-phase heat transfer, and with the same percentage distribution, respectively, between *passive techniques* and *active techniques*. Moreover, apart from those on rough surfaces, passive techniques included 11% each on extended surfaces, displaced enhancement, and additives for liquids; active methods were solely focused on electrical field effects. This snapshot of enhancement activity two-decades ago is somewhat representative of the current engagement as well. In 2012, as discussed in one of the articles in this issue (Manglik et al., 2013), of all the papers published in the six issues of JEHT, 60% were on single-phase flows and 40% on two-phase flows. Passive techniques again take the predominant share of 74%, where use of rough surfaces and extended surfaces each have the larger share of contributions ($\sim$21% each). Notably, $\sim$24% papers dealt with flow boiling, a mode of heat transfer in which the application of enhancement techniques has several unanswered questions (Manglik and Bergles, 2013) and provides a fertile ground for new investigations, and $\sim$7% addressed compound enhancement techniques. Over time, however, with the altered socio-economic landscape and the concomitant engineering needs, the applications for enhanced heat and mass transfer techniques have also changed.

The present-day imperatives of energy (and *water*) conservation (Bergles, 2012), notwithstanding the previous energy crisis of the 1970s, have once again reinvigorated the engineering challenges of sustainable development that indeed include new avenues for heat and mass transfer enhancement. To address emerging questions in this arena, two papers (Kedzierski et al., 2013; Beaini and Carey, 2013) in this special issue of JEHT have tackled the problem of enhancement of condensation heat transfer. One contribution (Kedzierski et al., 2013) considers finned and corrugated surfaces for vapor-space condensation of newer alternative refrigerants, and the other (Beaini and Carey, 2013) traverses the use of MEMs-based manufacturing of patterned surfaces for promoting sustained drop-wise condensation. Both enhancement of refrigerant condensation and dropwise condensation (especially of water) have critical implications for energy conservation in HVAC and power generation. Addressing the air-side forced convection in fin-tube cores, typically the dominant thermal resistance in refrigerant or waste-heat-recovery exchangers, another study (Kim and Youn, 2013) has explored the use of enhanced wavy-slit fins. The advances in micro-scale manufacturing has also provided new avenues for constructing miniature flow channels and micro jets for cooling and thermal management, as explored by Warrier and Dhir (2013), and for generating structured porous surfaces (treated surfaces) in mini-channels for two-phase flow enhancement (Carbajal et al., 2013). These emerging issues as well as several other new developments in enhanced heat and mass transfer are surveyed by Bergles and Manglik (2013), and the current status of activity associated with all enhancement techniques in all modes of heat transfer are discussed so as to bring recent work to the attention of our readers.

In closing, the changing engineering needs of the global economic engine and attendant problems of consumption and conservation not only present many new challenges but also provide exciting opportunities for continuing research in enhanced heat and mass transfer. The platform for both experimental and theoretical (computational) explorations encompasses phenomena over the full spectrum of physical scales – from very small devices (mini-micro-to-nano-scales) to very large heat exchange equipment (power boilers, condensers, HVAC systems, etc.). The need for greater thermal efficiencies across the two ends of the size spectrum, it is earnestly hoped, would rejuvenate the scientific discourse amongst our readers as well as the broader heat and mass transfer community. It is further anticipated that the *Journal of Enhanced Heat Transfer* would continue to be the forum of choice for disseminating the consequent archival papers.

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