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Preface

Granular systems are abundant in nature and widely used in industry. Possible examples range from sands and powders on Earth, to dilute granular systems in space, termed as granular gases; planetary rings, comprised of myriads of icy particles, are a magnificent example of natural granular gases. Granular matter exhibits very unusual properties. Under small loads it behaves like a solid, preserving its shape and volume, while under a significant load or agitation it demonstrates a fluid-like behavior, that is, it can flow. Snow avalanches, motion of sand dunes, rock and land slides are examples of granular flows in nature. The industrial transport of loose particulate substances also occurs as a rapid granular flow. Fluidized granular materials behave in many respects like molecular fluids and exhibit well-known phenomena, such as shear flows, Poiseuille and Taylor-Couette flows, Rayleigh-Bernard convection, Faraday waves/crispations. At the same time, the rheology of granular fluids is significantly more rich than that of ordinary fluids. Plenty of new effects, typical only for granular fluids, like cluster and vortex formation, generation of "oscillons" (localized excitations) in vibrated granular layers, plug-flow regimes in sheared fluids, and many others, have been recently observed. These numerous phenomena, revealed during the last decade, together with their theoretical study, constitute, now, a new area of hydrodynamics – "Granular Hydrodynamics". The theoretical apparatus to describe the exotic phenomenology of this field of research started to develop in the mid eighties in the pioneering works of Haff and Jenkins and Richman and, in application to planetary rings, of Shukhman, and Araki and Tremaine. During the last two decades many excellent scientists have contributed to the subject's development. One of the seminal contributions to Granular Hydrodynamics which strongly influenced its current state has been that of Professor Isaac Goldhirsch. He agreed to submit an article to this volume, which would have been a great honor for us, but his sudden and untimely death in April 2010 prevented this from happening. This was a shock for the whole granular community, where Isaac was highly esteemed and loved for his scientific enthusiasm, deep understanding of the subject, incomparable mathematical skills, not to mention his admirable humor and warm amiability. This volume, therefore, is dedicated to the memory of Isaac – our friend, colleague and one of the founders of Granular Hydrodynamics.

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