Preface

Rivers as we know them are the most interesting creatures on Earth—they are wild and independent, they are friendly and dangerous, and they are fearsome and fragile all at the same time. For us they are charming when working with them as scientists.

In simple terms, rivers are bodies of water with current moving in one general direction. They can vary in size, with smaller versions of rivers being referred to as streams, creeks, creaks, brooks, licks, torrents, gills, flows, burns, or runs. Life on Earth would be very different without rivers. In addition to the life-giving water of rivers, fluvial processes physically transform landscapes. Among all the various land-forming agents, the work of running water is the most ubiquitous. Nearly, every part of the Earth has seen the imprint of fluvial processes at sometime in its geologic past.

It is more the rule than the exception that scientists examine separately either the physical aspects of river systems or its environmental or ecological components. Also, the tradition of writing books on particular aspects of river systems has developed, and therefore, we have an abundance of literature items devoted to sediment transport, water quality problems, and open-channel hydraulics separately. This volume is deliberately interdisciplinary because the issues addressed do not fit into one discipline. The focus of this book is on physical, fluvial, and environmental linkages in river ecosystems, and there is a systematic treatment of the mechanisms behind these linkages. Thus, this book should be very important for professionals from a practical point of view. The research questions posed in this book are analyzed through an interdisciplinary, international, and often case-study approach. The essential feature of this volume is to mobilize a wider range of considerations and sources of information than those used in conventional approaches. Our contributors are world-renowned experts representing as many as **28** research institutions from **15** countries, namely Austria, Canada, Germany, Finland, France, India, Italy, the Netherlands, Norway, Poland, Portugal, Spain, Switzerland, the UK, and the USA. We mention here only the authors of the book chapters, but when the reviewers (from 10 countries) are added to this list, we may claim that we practically cover the expertise in the field from every corner of the globe.

The idea of writing this book originated from discussions with a number of colleagues from all over the world who all complained about the lack of such a state-of-the-art report from which one can learn about various aspects to more fully understand rivers. We believe that the reader of this book will get to know and gain more understanding about the physical phenomena that we deal with in rivers and will see how those phenomena influence fluvial and environmental processes. We want this volume to serve as a practical guide for specialists and students to better understand rivers and have the wealth of knowledge at their fingertips. We will be happy if this single text serves pure scientists, field engineers, researchers, and designers.

It is fair to say that study of the dynamics of rivers has revolutionized in the past few decades, largely through the development of new techniques for measuring turbulent flow and bed morphology in both natural conditions and experimental flumes as well as the development of computational methods. We hope this volume well represents the current state of knowledge. Bertrand Russell in his "A history of Western philosophy" said "Science may set limits to knowledge but should not set limits to imagination." Understanding river systems requires such imagination—they are extremely complex, cause and effect closely interact, and most of the river processes are nonlinear by nature. The consecutive chapters are based on the progress made by river research worldwide.

The first eleven chapters of the book are related to basic physical processes that occur in rivers. The first one prepared by John Fenton is a kind of an introduction to the entire volume; he mainly concentrates on the basics of modeling river flows. Since all river flows are turbulent in nature, the paper of Franca and Brocchini covers the subject of river turbulence from theoretical and experimental viewpoints. The paper of Ferraro and Dey continues this subject but with the emphasis put on formation mechanisms of bedforms and their stability. Another aspect of riverbed changes, namely the characteristics of scouring downstream of low-head hydraulic structures, is given by Pagliara and Palermo. Since some environmental flows can be considered as shallow, the chapter by Uijtewaal discusses the basic physics and ways of modeling of such flows. Three consecutive chapters deal with modeling issues, namely with the problem of one- to three-dimensional flows in rivers (Gąsiorowski et al., Moussa and Cheviron, and Oertel). The next two chapters deal with laboratory experiments; the one of Bung concerns capacities and limits of hydraulic modeling, whereas the chapter by Kozioł and Kubrak covers the turbulence structure in compound channels. The last chapter in this part *Physical Processes* deals with an important issue of uncertainties that are an integral part of modeling and is written by Warmink and Booij. Church opens the second part *Fluvial Processes* with his in-depth discussion of the problems of morphodynamics and morphology of rivers. The principles of sediment transport are given by Ferreira and Hassan. Da Silva provides a review of the present understanding of the kinematics of meandering flow, and its relationship to bed deformation as well as downstream migration and lateral expansion of meander loops. Braiding, as a separate fluvial process, is covered by Surian. Bialik deals with another scale of the process, and he touches the topic of solid particle motion in open channels. The last

chapter in this part of the book, provided by Velasco and Ubeda, concerns a completely different topic, namely the problem of soil erosion in watersheds after forest fires. The final part *Environmental Processes* starts with the discussion by Hilderbrand and Utz on the notions of ecological thresholds and resilience that help us understand how lotic ecosystems change. In the next chapter, Gibbins provides an insight about how physical and biological processes are coupled, particularly how flowing water influences benthic organisms. Radecki-Pawlik shows in what way bankfull and dominant discharges influence environmental processes in river channels. The chapter by Aberle and Järvelä concentrates on hydrodynamic processes that govern flow patterns in vegetated channels, while the next three chapters are devoted to the transport of various kinds of pollutants in rivers. Manson and Wallis discuss the problem of stream metabolism; Zaramella et al. focus on pollutant transport and retention processes induced by the transient storage in the dead zones by the riverbed topography and vegetation and by evapotranspiration; and Kalinowska and Rowiński concentrate on the fate of heated water in rivers.

We are very thankful and give our appreciation to those authors who contributed to this volume. We are also grateful to those colleagues who provided constructive reviews of the papers. We are indebted to Anna Dziembowska, Ewelina Brulińska, and Karolina Branicka for spending much time ensuring this book is both professionally produced and published. Finally, we are thankful to our mother institutions: Institute of Geophysics of the Polish Academy of Sciences in Warsaw and Agricultural University in Cracow, for the support of this important work.

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