

## Preface

This second volume of the Springer series *Late Cenozoic Yushe Basin, Shanxi Province, China: Geology and Fossil Mammals* focuses on small mammal fossils about 6.5 to 1 million years old from an area of North China that played a role in the emergence of vertebrate paleontology as a modern science. Yushe Basin fossils present a view of changes in Northeast Asian terrestrial faunas during the Late Neogene, and therefore are a key to developing the biochronology for a vast part of the continent. Yushe strata record in one area a succession of faunas that has figured prominently in the definition of land mammal ages in the North Asian biogeographic province. Much of the basis for this system of ages has been the large mammal fauna, and now we can add the small mammals. Field and laboratory work of the last quarter century has added a rich small mammal component to the paleontology of Yushe, which greatly increases the understanding of evolution of its faunas as paleobiological communities. This volume presents the small mammal fossil record of Yushe Basin in the biostratigraphic framework dated by magnetostratigraphy, as developed by Neil Opdyke (University of Florida) and colleagues in Volume I of the Late Cenozoic of Yushe Basin.

The advances in micromammal paleontology presented in Volume II, “Small Mammal Fossils of Yushe Basin” were made possible by a team approach organized around the principle of attention to biostratigraphic detail. A large number of individuals carefully built and dated a stratigraphic framework in which fossil localities were placed relative to their horizons of occurrence. This approach yielded vastly better resolved provenance data for individual finds than were recorded in early historical collections. Secondly, we applied modern wet-screen techniques to process large volumes of sediment from fossiliferous concentrations. This provided improved representation of the micromammal assemblages preserved at individual localities and reduced bias toward representation of “large” small mammals at the expense of species characterized by small body size.

The Yushe teams were inspired by co-leaders Zhan-Xiang Qiu (Institute of Vertebrate Paleontology and Paleoanthropology, IVPP) and Richard H. Tedford (American Museum of Natural History, AMNH), who designed the project to maximize the biostratigraphic potential of Yushe Basin. They established a collegial atmosphere for collaboration by individuals from many institutions of China, the United States, and other countries. Figure 1 shows many of our group from 1987, the first full field season, including visitors S. Mahmood Raza and I.U. Cheema from Pakistan, and an army of paleontologists who made numerous surface finds of small mammal fossils.



**Fig. 1** The Yushe Basin Team at the outset of field work, in front of the Yushe County Guest House. Left to right, front row, second from left, De-Fa Yan, fourth to seventh are Wen-Yu Wu, Zhan-Xiang Qiu, Richard Tedford, Will Downs, and at far right, Yi-Zheng Li; back row, left, is Tai-Ming Wang of the Yushe County Museum, fourth from left, Neil Opdyke, S. Mahmood Raza, I.U. Cheema, Xiao-Feng Chen, Jie Ye, and Gen-Zhu Zhu. Photo: September, 1987, by L.J. Flynn

The principal small mammal researchers for the Yushe project were Wen-Yu Wu, Zhu-Ding Qiu, and Lawrence J. Flynn, all of whom would admit that the great success of our work was due to the creativity, drive, and imagination of our colleague William R. Downs. Will, now deceased, prepared numerous fossil finds. Our team developed the succession of small mammal assemblages of Yushe to accompany the large mammal record in a comprehensive biostratigraphy by screening many new fossil localities throughout the succession of strata. The assemblages we developed represent changes in the small mammal community of the Yushe Basin, revealed on a fine scale not previously achieved. Detailed systematic studies on small mammal groups proceeded under the care of specialists, as presented in the chapters of this volume.

### Acknowledgments

We express our deep gratitude to all the institutions and individuals, local and more broadly, who warmly supported the Yushe Project in various ways. We thank the people of the town of Yushe for their help and hospitality, and particularly the staff of the Yushe Hotel, who tolerated our screening program in their parking lot. For financial support we thank the National Natural Science Foundation (NSFC, China), the National Science Foundation (NSF, USA), and the Chinese Academy of Sciences. The two NSF grants EAR 8709221 and BSR 9020065 enabled our field work; later synthesis was supported under EAR grants 0716186 and 0958178. We acknowledge the authorities and our colleagues of the Institute of Vertebrate Paleontology and Paleoanthropology, the Tianjin Natural History Museum, and the American Museum of Natural History.

We thank especially our mentors, Zhan-Xiang Qiu and Dick Tedford, who created the atmosphere of scientific inquiry in which our project flourished. Their encouragement and support made our work possible. Sadly, Dick Tedford's health declined in recent years, and he

passed away in 2011, but the inspiration behind the project remained. We also think of Will Downs. Will died prematurely before he could see this volume published, but he steadfastly supported our work. Will found many of the fossils we present and processed most of them from the concentrate produced by screening. His spirit of scientific inquiry and enthusiasm carried us all forward as we developed a series of superposed small mammal horizons that span the entire Late Neogene sequence of Yushe Basin. He is sorely missed. Volume II benefitted from the contributions of many colleagues and associates of IVPP in Beijing and staff members of AMNH in New York, especially Frank Ippolito, Judy Galkin, Susan Bell, Ruth O'Leary, Alejandra Lora, Chester Tarka, and Loraine Meeker. Some of Frank's artwork developed with Dick Tedford for Volume I was adapted for Volume II.

Comparative collections are crucial to realize success in systematic work. For the small mammal fossils studied here, we relied heavily on the comparative collections of IVPP and the Paleontology Division at AMNH, but also on the mammal collections of various institutions. We thank their curators and collection managers. The Department of Mammalogy (currently under the day to day care of Eileen Westwig) at AMNH holds important reference collections, as do the Museum of Comparative Zoology, Harvard University (Judith Chupasko and Mark Omura), and Kunming Institute of Zoology (Song Li). We thank all for opening their collections to us.

We thank the entire Springer staff, particularly Sudeshna Das, for their help in realizing the Yushe Basin volumes. The meticulous efforts of series editors Eric Sargis and Eric Delson are deeply appreciated. They encouraged the maturation of the final product and its artwork. Finally, we acknowledge the constructive help of external manuscript reviewers. They devoted considerable time to help us to improve and update the following systematic accounts. Their careful reading led to increased clarity throughout the volume.

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Late Cenozoic Yushe Basin, Shanxi Province, China:

Geology and Fossil Mammals

Volume II: Small Mammal Fossils of Yushe Basin

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2017, XI, 227 p. 92 illus., 16 illus. in color., Hardcover

ISBN: 978-94-024-1049-5