Wu Zhengyi and his contributions to plant taxonomy and phytogeography

Wu Zhengyi, a master in science and a giant in botany, was born in Jiujiang, Jiangxi province, China 100 years ago and passed away on June 20, 2013 in Kunming, China. He was an Academician of the Chinese Academy of Sciences, Professor and Director Emeritus of Kunming Institute of Botany, Chinese Academy of Sciences, and first editor-in-chief of Plant Diversity (formerly Acta Botanica Yunnanica) (see Fig. 1).

Wu developed an early interest in Botany at home in his garden. His father left the office and brought home numerous books from Beijing for his eight-year-old son. Wu had the opportunity to read these books. He was especially interested in two on the subject of botany: one, called the Chinese Botanical Illustrated Book (《植物名实图考》), was written by the Qing dynasty botanist Wu Qi-yong, and the other was the Japanese Botanical Illustrated Book. Based on the pictures in these books, he tried to identify the plants in his family’s garden (Wu, 2014). Whilst at middle school Wu was lucky to meet two teachers who taught him biology. Mr. Tang Shou, his primary middle school botany teacher, took him out in the field and taught him to recognise plants and to collect plant specimens. By the time he reached high school, Wu had already collected and identified 200 specimens. When his high school biology teacher, Mr. Tang Yao, discovered this, he held an exhibition in the class for Wu. Wu was profoundly inspired by his teachers and decided on a career as a botanist. In 1933, Wu entered Tsinghua University in Beijing and received his BA in Biology in 1937.

After leaving university Wu started his scientific career, which spanned over 70 years. He made outstanding contributions introducing botany to China and internationalising Chinese botany in the botanical domain around the world (Peng et al., 2013). Many papers have been written addressing Wu’s contributions in science (Kunming Institute of Botany, Chinese Academy of Science, 2014; Raven, 2016). Here, our aim is to emphasise his contributions to plant taxonomy and phytogeography. China is home to more than 32,500 species of vascular plants, over 50% of them endemic, slightly less than 10% of the world’s total number of vascular plants (Blackmore et al., 2013; Turkington and Harrower, 2016). Because of the huge number of species, the rich diversity and poorly established academic community in China at the time, it became a very difficult task to compile the Flora Republicae Popularis Sincae (FRPS), which was started in 1958 but only completed in 2004. Wu became the fourth editor-in-chief of the Editorial Committee of FRPS in 1987, and 82 books making up 54 volumes were published under his editorship (80 volumes in total) (Peng et al., 2013). During the compilation of the FRPS, Wu also served as the chief editor for four more great works: Flora Yunnanica, Flora Xizangica, Vegetation of China and Vegetation of Yunnan. In order to make FRPS understood by non-Chinese speakers, Wu and Peter H. Raven acted as co-chairs of the joint editorial committee. All 25 volumes of Flora of China were published in 2014, one year after Wu passed away. Apart from serving as the chief editor, Wu also did a lot of detailed taxonomic research. Independently and with colleagues, Wu was responsible for establishing 17 genera and describing 936 species, all recorded in the Kew Bulletin.

By compiling the FRPS Wu and his colleagues answered the big question of how many plant species we have in China. His phytogeographical research answered the next big question: “where are these plants growing.” Wu’s “Tropical affinity of Chinese floristics” (Wu, 1965) is an important paper in which he classified 2980 genera of Chinese seed plants into 15 ‘areal-types’ and 31 ‘sub-areal types’. In 1991, Wu (1991) summarised the results of previous studies and proposed a term named ‘areal type’ to document the distribution of a genus of seed plants. In that summary, 15 areal types of seed plants distributed in China were defined and described, making this paper highly cited. Furthermore, Wu employed this method to the family level. He classified 517 world families of seed plants into 18 areal types. This scheme has been widely used in analysing the national and regional floras of China at various levels and is helpful in understanding biogeographic issues, such as endemism, vicariance and disjunct distributions.

It took Wu and his students 10 years to write and revise The Areal-type of Seed Plants and their Origin and Differentiation (Wu et al., 2006), a book which summarised the results of his research and achievements in phytogeography. Taxonomical history, concepts and treatments of 3201 genera of seed plants from China were revised and their areal-types and distribution were also discussed. Furthermore, Wu proposed detailed explanations and hypotheses on how areal types formed. He also postulated the origin and differentiation of distribution patterns of many seed plants from China. These hypotheses have become an important legacy for biogeographical research. Many research projects have been proposed based on Wu’s hypotheses.

The year 2016 marks 100 years since Wu Zhengyi’s birth. We take this opportunity to publish this special issue commemorating Wu’s 100 years. Eight research articles and one memorial article are collected in this special issue. We start with an appreciation written by Dr. Peter Raven, renowned botanist, colleague and good friend of Wu's.
Wu Zhengyi. Raven recalls Wu’s contribution to botany, particularly in plant taxonomy, and their cooperation in editing “Flora of China”, as well as their friendship (Raven, 2016).

The second paper is contributed by Soltis and Soltis (2016). They point out: “The current global challenges that threaten biodiversity are rapidly growing”. These biodiversity challenges demand approaches that meld bioinformatics, large-scale phylogeny reconstruction, the use of digitised specimen data, and complex post-tree analyses. Recent developments in phylogenetics coupled with emerging cyberinfrastructure and new data sources provide unparalleled opportunities for mobilising and integrating massive amounts of biological data, driving the discovery of complex patterns and new hypotheses for further study. The ongoing integration and development of biodiversity tools is transforming biodiversity science. By the use of an integrative, multifaceted, big data approach, researchers can now undertake biodiversity projections to provide crucial data not only for scientists, but also for the public, land managers, policy makers, urban planners, and agriculture (Soltis and Soltis, 2016).

Fossils, as “hard evidence”, play a critical role in the research of phylogeny, biogeography and ecology. Huang and his colleagues summarise plant diversity, floristics and climates in the Cenozoic of Yunnan in the third paper. Based on the summary, 386 fossil species of ferns, gymnosperms and angiosperms, belonging to 170 genera within 66 families have been reported from the Cenozoic and, in particular, the Neogene of Yunnan. Angiosperms display the highest richness represented by 353 species grouped into 155 genera within 60 families (Huang et al., 2016).

In the fourth paper, Li presents a family- and genus-level phylogeny that includes all families and genera of extant seed plants in China, and uses both phylogenies to examine whether areal types or distribution patterns of families and genera of seed plants are non-randomly distributed across the Chinese tree of life. His study shows that the areal types of families and genera of seed plants exhibit significant phylogenetic signals across the family- or genus-level phylogeny in China (Li, 2016).

Based on the distribution, habit and geological history of 1009 stenochoric endemic species, Liu and Peng propose a new system for the floristic regionalisation of Yunnan in the fifth paper. This piece of work further confirms the hypotheses emphasised by Wu Zhengyi (Liu and Peng, 2016). Wu thought that stenochoric endemic species play a key role in floristic regionalisation (Wu, 1984).

In the sixth paper, Zhu and his colleagues (2016) report on the establishment of six 1-ha sampling plots in these forests to compare their floristic similarity at different levels. They found floristic similarity is high at family- and genus-level, but low at the specific level. In the plots, floristic elements are dominated by tropical biogeographical elements at the family and genus levels. In contrast, at the species level, endemic species are dominant. Due to their great sensitivity to climate, high endemism and island-like, distribution patterns, conservation of these forests are especially needed (Zhu et al., 2016).

In the seventh paper, Luo and his colleagues characterise trait variation across different ecological scales in plant communities along a 1200 m elevational gradient in Yulong Mountain, Yunnan. Their results provide evidence that species that coexist in understory herbaceous communities might be structured by differential niche-assembly processes. This approach — integrating different biological scales of trait variation — may provide a better understanding of the mechanisms involved in the structure of communities (Luo et al., 2016).

The eighth and ninth papers are taxonomic works. In the eighth paper, Deng and his colleagues describe a new genus, Wuacanthus, (Acanthaceae) from the Hengduan Mountains, China. They report phylogenetic analyses and find that the new genus belongs to the Pseuderanthemum lineage of the tribe Justicieae (Deng et al., 2016). In the ninth paper, Zhang and Chu revise Neoborydiurn (Che- nopodiaceae) systematics and describe four new species, two from China, one from South America and one from Africa (Zhang and Chu, 2016).

We thank all the authors for their contributions to this special issue “dedicated to 100 years of Wu Zhengyi”. Most of the contributing authors can trace their academic pedigree back to Wu, either as one of his former students, or as a student of one of his students. However, three contributors, Peter Raven and Doug Soltis and Pam Soltis, have the special distinction of being great collaborators of Wu Zhengyi. Upon hearing about this special issue, they graciously offered to contribute their own articles to commemorate their former friend and colleague. For this, we would like to extend our warmest appreciation.

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