

A Legendary Glaciologist: Academician Shi Yafeng on His Ninetieth Birthday

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Source: Arctic, Antarctic, and Alpine Research, 40(3) : 600-604

Published By: Institute of Arctic and Alpine Research (INSTAAR),
University of Colorado

URL: [https://doi.org/10.1657/1523-0430\(2008-1\)\[TRIBUTE\]2.0.CO;2](https://doi.org/10.1657/1523-0430(2008-1)[TRIBUTE]2.0.CO;2)

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Tribute

A Legendary Glaciologist: Academician Shi Yafeng on His Ninetieth Birthday



Academician Shi Yafeng working on Glacier No. 1 at the Tianshan Glacial Observation Station in September 1984.

Introduction

Systematic study of glaciers and permafrost in China began in the late 1950s, initiated and led by Academician Shi Yafeng, the pioneer and father of glaciology in China. This tribute honors Academician Shi, who began as a young geomorphologist and later became a legendary glaciologist with 50 years of contributions to glaciological science.

To honor his contributions to glaciology and cryospheric science in China, a special symposium will be held in Lanzhou, China, on 20–22 May 2009. This special symposium is being organized by the China Society of Geography and the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), Chinese Academy of Sciences (CAS). National and international guests, Academician Shi's colleagues, and his former students will participate in this event. High-level officials and distinguished guests will give speeches on Academician Shi's lifetime contributions to glaciology, followed by extensive academic plenary presentations on glaciers and frozen ground studies.

Academician Shi Yafeng has been head of the Glaciology and Geocryology Division in the Institute of Geography, CAS; deputy director of the former Institute of Glaciology, Geocryology, and Desert Research, CAS; and director and honorable director of the former Lanzhou Institute of Glaciology and

Geocryology (LIGG). Academician Shi has also served as vice president, president, and honorable president of the Geography Society of China; director general of the China Society of Glaciology and Geocryology; director general of Zhu Kozeng's Research Association; honorable member and council member of the International Glaciological Society; reporter to the International Permafrost Association; and consular member of the International Mountain Research Association. He has also been an honorable member of the Geological Society of London and International Quaternary Association.

Chronological Sketch of Major Academic Accomplishments

Academician Shi Yafeng was born in March 1919 in Haimen City, Jiangsu Province. He graduated from the Department of Geography, Zhejiang University, in 1942 and obtained his Master's degree from the graduate school of Zhejiang University in 1944. He devoted his early career to modern geomorphologic and Quaternary geological sciences. Together with many other scientists, Professor Shi strongly recommended a comprehensive investigation of the Qinghai-Tibetan Plateau in the 1950s. In June 1957, he led a scientific team to conduct a geomorphologic survey in the Hexi Corridor, Gansu Province. This was the first experience for him and his colleagues in snow-covered mountains at higher elevations. When they were traveling from the north side of the West Qilian Mountains to the south side, they found that the snow-covered mountains at higher elevation had flocks and herds and tens of Mongolian tents at the pediment on the north side, but when they arrived at the south side of the mountain, there was a perfect desert scene, with no glaciers at high elevation and no water available at all. This condition compelled the entire team to leave quickly to survive. This event led Professor Shi to propose that glacier ice meltwater resources should be rationed for humans and for local economic development in this region.

Soon after the completion of his team expedition, Professor Shi proposed a comprehensive survey of glacier resources in western China to the then CAS deputy president, Academician Zhu Kezeng. Academician Zhu approved Shi's proposal and asked him to initiate and lead a glacier expedition team. In June 1958, Academician Shi came back to Lanzhou and reported to then Governor Zhang Zhongliang of Gansu Province about the importance of glacier water resources in this region. Governor Zhang told Professor Shi that development in western Gansu Province requires water and asked Professor Shi and his team to complete a regional glacier inventory within one year. Although Professor Shi told the governor that it was impossible to conduct the task within such a short period of time, Governor Zhang replied that Gansu Province needed water and his administration

DOI: 10.1657/1523-0430(2008-1)[TRIBUTE]2.0.CO;2

would provide all the support that the glacial expedition team might need. Within a few days, Professor Shi submitted his plan to the governor and his plan was approved the following day. The first glacial expedition team, officially called the Alpine Snow and Ice Utilization and Investigation Team, was established in the middle of June 1958 in Lanzhou. It consisted of scientists from institutes and universities with support staff of more than 100 members. Led by Professor Shi, the team arrived at a glacier at an elevation of 5100 m on 1 July 1958; thus, the glacier was named July First Glacier. "This is the first glacier discovered and named by Chinese scientists and is the foundation glacier for glacial studies in China," Professor Shi recalled in the early 2000s. After some basic training on the July First Glacier, the expedition team was divided into seven groups to survey the more than 10 glacier distribution areas with 941 glaciers in the region. After careful synthesis of preliminary results from each group, Professor Shi and his colleagues published China's first glaciological monograph, entitled *Investigation Report of Modern Glaciers in the Qilian Mountains* (Alpine Snow and Ice Utilization and Investigation Team, CAS, 1959). This monograph summarized the first regional-scale glacier investigation and became a major milestone of modern glacier study in China.

A Soviet Union glaciological expert, L. D. Dolgushin, who served as an advisor, came to Lanzhou with Professor Shi in June 1958. Dolgushin suggested to Professor Shi that in addition to glacial studies, permafrost was also an important issue for China. China has large areas underlain by permafrost. Study of permafrost is critical for economic development and for the exploration of natural resources in permafrost regions. Professor Shi then proposed a permafrost study to CAS, and his proposal was approved quickly.

One of the Professor Shi's successes was to recruit young researchers and scientists from various sources. For permafrost studies, the first person was a new college graduate, Youwu Zhou. Zhou graduated from Moscow State University with a major in geocryology, or permafrost science. Professor Shi encouraged her to join him to study permafrost in Lanzhou. Zhou agreed without hesitation and joined the newly established division of glaciology and geocryology in February 1960. Zhou was appointed as the head of the permafrost study group and basically began permafrost study in China from scratch. Later, Professor Shi went directly to Ministry of Geology Academician Li Siguang and requested another young Moscow State University graduate, Tong Boliang, also majoring in permafrost science and a classmate of Zhou's. Tong joined the permafrost study group and became one of the leaders in permafrost science in China. Both Professor Zhou and Professor Tong devoted their careers to permafrost science. The first comprehensive field permafrost investigation was conducted over the Qinghai-Tibetan Plateau from 1962 through 1965 (Zhou and Du, 1963). Over the past several decades, permafrost study in China has made significant progress, contributing to cryospheric science and local and regional economic development and natural resources exploration. Permafrost scientists and engineers in China directly participated in the expansion of the Qinghai-Xizang Highway from 1973 through 1984. The State Key Laboratory of Frozen Soil Engineering (SKLFSE) was established at the former LIGG in 1991 and is open to national and international scientists and engineers to conduct related studies and experiments. The Sixth International Conference on Permafrost was held in Beijing in 1993 and Academician Guo-Dong Cheng was elected as the president of the International Permafrost Association. An updated *Map of Frozen Ground Distribution in China* was compiled by Zhou et al. (2000), who systematically summarized the characteristics and environmental controls of frozen ground, covering research results over the past several decades in China. Permafrost scientists and

engineers in China, led by Academician Cheng, made significant contributions for the construction of the Qinghai-Tibetan Railroad (Cheng et al., 2008). For more information on the history of permafrost research in China, the readers may refer to detailed reviews by Cheng (1990) and Zhang (2005).

With his background in field exploration, Professor Shi thought that a long-term glaciology and cryopedology research group should be established to study environmental changes and their impacts on societal and economical development and natural resources exploration in China. In the autumn of 1959, Professor Shi proposed that CAS establish a new research entity for glaciology and geocryology. As expected, CAS quickly approved the proposal. A Division of Glaciology and Cryopedology, Institute of Geography, CAS, was established in 1962 with a clear objective of long-term study of glaciers, permafrost, and arid zone hydrology. The then CAS deputy president Zhu Kezeng suggested that glacier and permafrost study should be located in Lanzhou. After carefully discussions with his family, Professor Shi decided to move his family from Beijing to Lanzhou, a remote and undeveloped city in northwest China. The Lanzhou Institute of Glaciology, Geocryology, and Desert Research was officially established in 1965. He and his family stayed in Lanzhou and he continued his long journey of glaciological study in western China for the next 50 years.

Glacier studies had become systematic and field investigations gradually expanded to all of western China by the early 1960s. Field exploration of glaciers in the Pamir Mountains of far western China was conducted in 1961/1962. Ground-based measurements and monitoring of the Tianshan No. 1 Glacier to the south of Urumqi City started in 1962 with the establishment of the Tianshan Glaciological Research Station. In 1964, together with a mountain expedition team climbing Mt. Xixabangma (previously called Mt. Shisha Pangma, 8027 m a.s.l.) in the Himalayas, Professor Shi Yafeng led glaciologists to conduct a detailed glacier survey of the region. Preliminary results of the characteristics and evolutionary history of glaciers at the low-latitude mountain regions were reported at an international symposium in Beijing (Shi Yafeng and Liu Tungsheng, 1964). Professor Shi and his close colleague, Xie Zichu, published a paper, "Basic characteristics of modern glaciers in China" (Shi Yafeng and Xie Zichu, 1964), another major milestone of glacier research in China. Meanwhile, two monographs were published, entitled *Study on Glaciology and Hydrology of the Urumqi River* and *Permafrost Investigation along the Qinghai-Tibetan Highway* (Division of Glaciology and Cryopedology, Institute of Geography, CAS, 1965a, 1965b). Professor Shi later considered these three major studies as the first synthesis of glaciology in China.

A large-scale scientific expedition to Mt. Everest was carried out from 1966 through 1968, including field investigation of glaciers in the region. Although most of the proposed research was suspended due to the so-called Cultural Revolution movement that began in 1966, a series of publications were still produced from this work, and a new follow-up project, "Comprehensive Tibetan Investigation," was initiated in 1972. A key article entitled "Basic features of glaciers of the Mt. Jolmo Lungma region, southern part of the Tibet Autonomous Region, China" was published in *Scientia Sinica (Science in China)* in both Chinese and English (Division of Glaciology, Lanzhou Institute of Glaciology, Cryopedology, and Desert Research, Academia Sinica, 1975). This work, together with many others, won the First Class Award of the National Natural Sciences of China in 1987. During the summers of 1974 and 1975, a glaciological group led by Professor Shi conducted a comprehensive field investigation of the Batura glaciers, 59 km in length, in the Karakorum

Mountains of Pakistan. Based on historical climate data and extensive field work, they provided quantitative predictions of glacier advance, the maximum discharge of glacier meltwater, and stability of drainage channels. Based on these results, the glaciological research group recommended a rehabilitation plan for safe operation of the Sino-Pakistan Highway. A monograph entitled *Professional Papers on the Batura Glacier in Karakorum Mountains* was produced (Lanzhou Institute of Glaciology and Geocryology, CAS, 1980), and many other related articles were published in both Chinese and English scientific journals. This achievement also won an award of the National Natural Sciences of China in 1982.

In 1978, the Lanzhou Institute of Glaciology, Cryopedology, and Desert Research was divided into two institutes: the Lanzhou Institute of Glaciology and Geocryology (LIGG) and the Lanzhou Institute of Desert Research. Professor Shi became the LIGG director. Under his leadership, international exchange and collaboration in glacier studies in China was greatly enhanced. Many colleagues at LIGG attended national and international scientific conferences and workshops, and studied and worked in international institutes. At the same time, many international experts and guests visited the LIGG and worked on cooperative research projects with LIGG colleagues. The Tianshan Glaciological Observation Station, which was suspended for a few years during the Cultural Revolution, was reactivated again in 1979. LIGG started to publish its new quarterly scientific periodical, *Journal of Glaciology and Geocryology*, in Chinese with English abstracts in 1979. In 1980, Professor Shi Yafeng was promoted to CAS Academician Shi Yafeng, the first CAS academician in glaciology in China. Beginning in 1979/1980, LIGG offered graduate studies for Master's and Doctoral degrees in glaciology and geocryology. Both authors of this article were former LIGG graduate students under the supervision of Academician Shi and many others in the early 1980s and benefited significantly from this graduate program. The Ice Core and Cold Region Environment Laboratory was established at LIGG in 1994, and later became a State Key Laboratory of Cryosphere and Environment in 2007. This laboratory greatly improved China's glaciological research. The CAS reorganized research institutes at Lanzhou in 2000 and a new institute was established, called the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI). In addition to many other research projects, the CAREERI studies a variety of glaciological research subjects, including:

- study of ice cores on the Qinghai-Tibetan Plateau,
- snow and ice disasters,
- glacier inventory and regional investigations,
- observations and glacier monitoring at Tianshan Station and many other stationary sites,
- seasonal snow cover,
- observations and monitoring of glacier meltwater runoff in alpine regions, and
- Quaternary glaciations and environments.

Based on field measurements/monitoring and laboratory experiments, Academician Shi Yafeng and his colleagues have conducted three major glaciological synthesis studies in China over the past 50 years. The first synthesis study was conducted in 1963 as discussed above. The second synthesis study was conducted in the 1980s. A comprehensive book entitled *An Introduction to the Glaciers in China* was published in 1988 (Shi et al., 1988). In this book, Academician Shi and his colleagues systematically summarized major results of Chinese glaciological

studies since the late 1950s. The third synthesis study was conducted in the 1990s and a new book entitled *Glaciers and Their Environments in China—The Present, Past, and Future* was published in 2000 (Shi et al., 2000). Unfortunately, these two books were published in Chinese and many major glaciological research results over the past 50 years have been inaccessible to non-Chinese readers. During the past several years, Academician Shi Yafeng and his colleagues made every effort to update and translate their work into English, and as a result the book entitled *Glaciers and Related Environments in China* was published (Shi Yafeng et al., 2008). The book contains 11 chapters from 27 authors and co-authors, including index, plates, and about 800 references, of which more than 60% are in Chinese.

Using air photographs and topographic maps from the 1960s to 1970s, the first Chinese glacier inventory was conducted in the late 1970s and 1980s. Based on data and information from this glacier inventory, Academician Shi and his colleagues found that there are 46,377 glaciers in China's territory with a total glacier-covered area of about 59,425 km² and total glacier ice volume of about 5600 km³ (Shi et al., 2008). Based on mean annual and/or summer air temperatures and annual precipitation at the equilibrium line, glaciers can be classified into three categories in China (Shi et al., 2000; 2008):

- Maritime or temperate glaciers, referring to glaciers with annual precipitation ranging from 1200 to 3000 mm, mean summer air temperature from 1 to 5 °C, and mean ice temperature from 0 to -1 °C.
- Sub-continental glaciers or sub-polar glaciers, referring to glaciers with annual precipitation varying from 500 to 1000 mm, mean annual (summer) air temperature ranging from -6 to -12 °C (0 to 3 °C), and ice temperature from -1 to -10 °C.
- Continental glaciers or cold polar glaciers, referring to glaciers with annual precipitation ranging from 200 to 500 mm, mean annual and summer air temperature below -10 °C and -1 °C, respectively.

It has been documented that glaciers in China have been retreating rapidly in the last several decades and some of them may disappear in the near future. To systematically document changes in glaciers and assess glacier water resources in western China, the second Chinese glacier inventory was initiated in 2007 and will be completed during the next few years using methods from the Global Land Ice Measurements from Space (GLIMS) project.

In the 1980s, Academician Shi Yafeng led a nationwide debate in the scientific community on issues of Quaternary glaciation in East China. Many geologists led by Academician Lee J. S. (1933, 1936, and 1947) believed that glaciers might have occurred during the Quaternary in the Lushan Mountains, the Huanhshan Mountains, and mountains in Quilin of the Guangxi Zhuang Autonomous Region, a region south of 30°N with an elevation below 2500 m a.s.l. in eastern China. After a systematic survey in the 1980s, a monograph entitled *Problems of the Quaternary Glaciations and Environments in Eastern China* was published (Shi et al., 1989). Academician Shi and his colleagues (Shi et al., 1987, 1989) concluded that the Quaternary glacial remains described in Lee J. S. (1933, 1936, and 1947) are subjects of widespread systematic misunderstanding. Meanwhile, Academician Shi and his colleagues denied the Quaternary glaciations hypothesized by Lee and his colleagues. As a result of this work, Academician Shi and his colleagues won an award from the Chinese Academy of Sciences.

Since the 1990s, Academician Shi has focused his research on climatic change in western China. He organized and led many research projects. It has been documented that climate in western China became warmer and drier from the late 19th century to the early 1980s (Shi et al., 2003). However, there was a regime shift in 1987 in western China. Climate has shifted from warm-dry to warm-wet and the trend is accelerating. As a consequence, the hydrological cycle has been intensified and the ecosystem has also experienced significant changes as both air temperature and precipitation have increased since 1987.

Concluding Remarks

Academician Shi's lifetime scientific contributions reach far beyond glaciology. Perhaps his most significant contributions were to effectively organize team efforts, intensively train young researchers and graduate students, and significantly enhance national and international scientific exchange. In the late 1950s, he essentially started China's glacier and permafrost research program from its beginnings. With support from CAS, Academician Shi successfully recruited several key personnel from other institutes and universities, some of them graduated from Soviet universities, majoring in glaciology and permafrost science. He and his colleagues carefully recruited new college graduates in the early 1960s and trained them to become glaciologists to cover almost all major areas of glacier and permafrost science. During the mid 1970s, Academician Shi and his colleagues realized there was a shortage of young glaciologists and permafrost scientists, and the Lanzhou Institute of Glaciology, Cryopedology, and Desert Research jointly established an undergraduate program in glaciology and Geocryology with the Department of Geography, Lanzhou University. Although the program only lasted about six years, more than two dozen young graduates joined glaciological and permafrost studies in the late 1970s and many of them are still active key players in the cold regions research community. Academician Shi initiated a graduate study program in the former LIGG in the late 1970s, transferring knowledge to next generation and training future world class glaciologists, permafrost scientists, and engineers. He consistently promoted international exchange programs during his tenure as the former LIGG director in the late 1970s and early 1980s. Over the past 50 years, glacier and permafrost sciences in China have become a significant component of Chinese scientific programs as a whole. At present, there is a large base of scientists and engineers studying glacier, permafrost, and related scientific subjects. Of these, six have been promoted as CAS academicians, in addition to many professors, senior research scientists, and young Ph.D. graduates. Many of them play a key role in national and international cryospheric research activities and programs.

Besides overcoming the difficult working conditions of alpine glacier studies in cold and high-elevation environment, Academician Shi also experienced some political obstacles in his journey of glaciological research. In the summer of 1966, he was urged to return to Lanzhou from field work. For three years, he was isolated from glaciological research and from his family because he focused so much on his research work that he appeared indifferent to the Cultural Revolution movement. He came home and worked partly on his research until October 1969.

Over his 50-year career of glaciological study, Academician Shi Yafeng published more than 200 peer-reviewed journal articles and more than 10 books and monographs. He officially "retired" in the late 1980s, but he never stopped his scientific research. In recent years, Academician Shi has concentrated his research on

global change in western China. He still actively attends national and international scientific symposia and conferences, provides advice to young scientists and graduate students, and promotes cryospheric and global change research programs. He has set an excellent example and high standard for glaciological research. During the past five decades, Academician Shi has led glaciological science in China from field investigations on glacial characteristics and distribution in western China to broad studies, such as hydrology and climatology in glaciated regions, physics of snow and ice, glacio-chemistry, analysis of ice core records, seasonal snow cover, snow and ice hazards and their control measures, climatic and environmental changes in relation to glaciers, and Quaternary glaciation and paleoenvironmental studies (Shi et al., 2000, 2008). He has laid a solid foundation of cold region scientific research and development in China, and his work and contributions will continue to influence that field in China for years to come.

Academician Shi is a great researcher and teacher; he can communicate very well with the general public, politicians and policy makers, and scientists of various backgrounds. He has devoted much of his time to general public outreach and education. Academician Shi Yafeng often proudly tells general audiences, colleagues, and students that glaciological research, or cold regions science in general, is a heroic and adventurous job. Academician Shi says that a good glaciologist or scientist in general has to be "diligent, fair, truth-searching, a team player, and persistent." He embodies these characteristics and by his example constantly teaches his followers and students to do the same. With his effort, leadership, and contributions to glaciological research, Academician Shi Yafeng's legacy will continue for generations to come.

Acknowledgments

We would like to express our gratitude to Professor Mark Meier and Professor Roger G. Barry, both old friends of Academician Shi Yafeng, for their support and encouragement to write this tribute and Professor Anne Jennings, Editor of *Arctic, Antarctic, and Alpine Research (AAAR)*, for her approval to have this tribute published in AAAR. This work was in part supported by a cryospheric research project of the China Meteorological Administration and the Chinese Academy of Sciences International Partnership Project (CXTD-Z2005-2).

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