Anniversaries

Geology of Mount Everest 100 years ago

ALEXANDER MACMILLAN HERON - FIRST GEOLOGICAL SURVEY OF THE EVEREST REGION, 1921

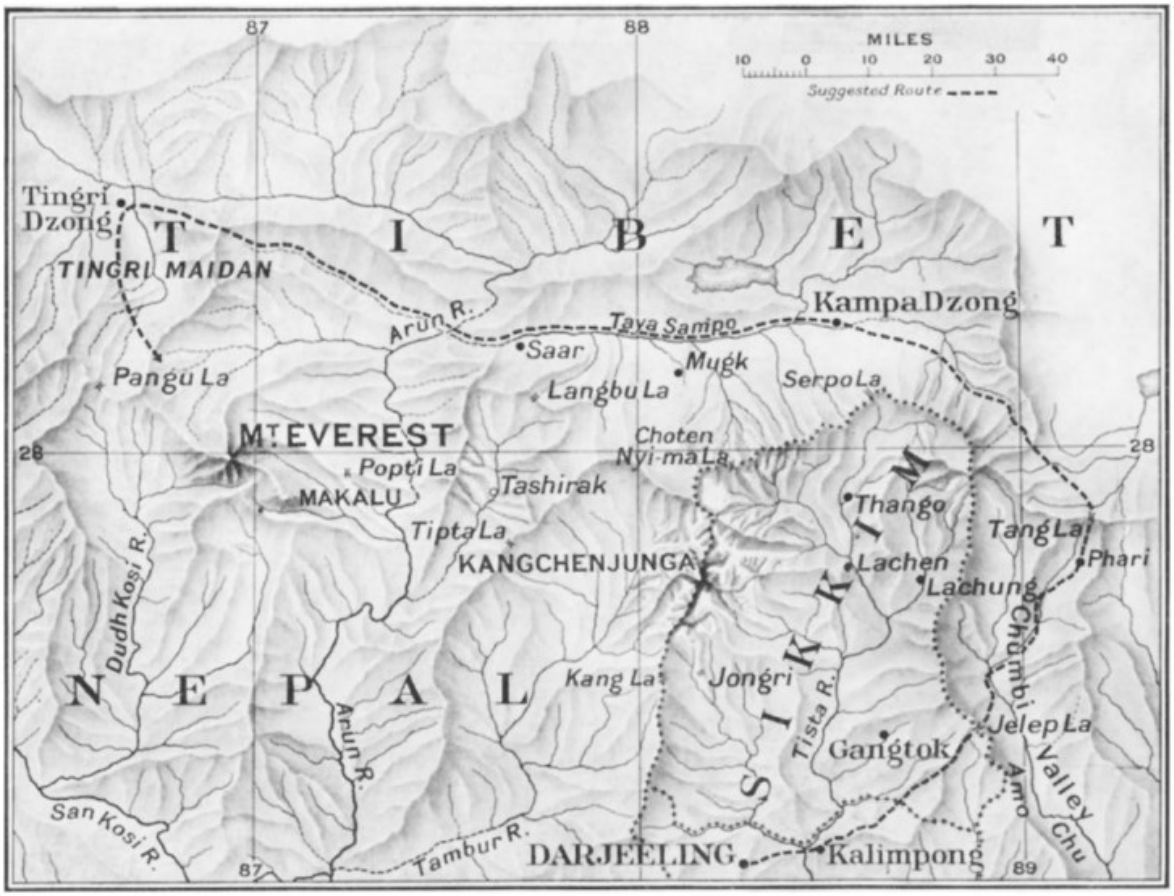
Ezio Vaccari (ITALY)

In January 1921, during a meeting held in London, the Royal Geographical Society and the Alpine Club established a joint Everest Committee in order to organize the first reconnaissance expedition to Mount Everest. Previous attempts to explore and map the mountains of the Himalayas, undertaken by officials of the British India Survey since the early 19th century, as well as the first climbs in that mountain chain by mountaineers such as Martin Conway and Charles Granville Bruce in 1892, had increased the interest on an impressive and apparently inaccessible mountain, which had been defined in 1856 by the General Surveyor of India, Andrew Scott Waugh, as "most probably the highest of the world" and was later officially named Everest by the Royal Geographical Society in 1865. Moreover, some photographical reports, like those by the Italian Vittorio Sella during a journey with Douglas Freshfield in 1899, by Claude White during a secret mission in Tibet led by Colonel Francis Younghusband for the British government and later by the British explorer and photographer John Noel (during a journey in Tibet in 1913), contributed to reinforce the idea to climb Mount Everest and to explore in detail the geography of its region.

Fig. 1 - Members of the 1921 Mount Everest expedition: (standing l-r) S. Wollaston, C. Howard-Bury, A.M. Heron (in a camel-hair greatcoat), H. Raeburn; (sitting l-r) G. Mallory, O. Wheeler, G. Bullock, H. Morshead (Howard-Bury et al., 1922, p. 178).

The 1921 expedition, which took place from April to October, included nine members (fig. 1): colonel Charles Howard-Bury as leader, the mountaineers Harold Reaburn, George Mallory, Guy Bullock and Alexander Kellas (who was a chemist expert in the effects of altitude on humans, but died for an heart attack in June in southern Tibet, before to reach Everest), two cartographer officers of the British Survey of India, Henry Morshead and Oliver Wheeler, the medical officer and naturalist Sandy Wollaston and, as a geologist, Alexander Macmillan Heron, "in order to study the geology of the country through which it was about to go, and about which nothing was known, and to investigate the problems which surround the age and the structure of the Himalayan range." (Howard-Bury, 1922, p. 26).

Born in 1884 near Edinburgh in Scotland, Heron graduated in engineering in 1906 and in the same year was employed by the Geological Survey of India as Assistant Superintendent. In 1919 he completed his doctoral dissertation at the University of Edinburgh on the 1909 Beluchistan earthquake in India. When he joined the 1921 Everest expedition, Heron was considered a competent geologist and stratigrapher, particularly skilled in fieldwork, who had published since 1911 a series of papers in the *Records of the Geological Survey of India* and in 1917 a detailed memoir on the geology of the north-eastern Indian region of Rajputana. Heron joined the expedition on behalf of the Geological Survey of India and reached the other members in Darjeeling, in the north-west of the Indian state of Bengal and at the foothills of Himalaya, around the middle of May.



SKETCH-MAP OF THE MOUNT EVEREST REGION SHOWING REVISED ROUTE OF THE EXPEDITION

Fig. 2 - The planned route of the 1921 reconnaissance expedition to Mount Everest (Younghusband et al., 1921)

After a month, the expedition reached the village of Tingri in southern Tibet, 40 miles (64 km) north by north-west of Mount Everest (fig. 2), where the base camp was set for further explorations and all the members of the expedition undertook their tasks. Heron began his work

as planned, mainly collecting and studying rock specimens in the surroundings: besides climbing and topographical surveying, as stated by Howard-Bury while presenting the plans of the expedition at the Royal Geographical Society early in March, "there is also the geological work. We are probably getting either an officer or assistants from the Government of India for making a geological collection" (Younghusband et al., 1921, p. 274). Although Heron had no previous climbing experience, he undertook a series of excursions and fieldwork also on high grounds: at the end of June he explored the area around the Kyetrak Glacier up to the passes of Nangba La and Khumbu La to Nepal (west from Everest) with Howard-Bury. Later, they continued for a longer expedition to Rongbuk, Kharta and Kama valleys, east from Everest. Heron worked usually alone, as during several excursions in the valleys north-west from Tingri: however, he was also joined in some occasions by Oliver Wheeler, who was a professional surveyor and a good mountaineer. In October, on the way back to Darjeeling, Heron, with Raeburn and Wheeler, left the group in order to explore the Teesta valley in Sikkim.

Although he was not a climber, Heron gradually achieved George Mallory's respect and consideration: in his private correspondence Mallory referred to Heron as a "solid treasure" of "cheerful and good nature", with a particular ability to deal with porters and sherpas (Davis, 2011, pp. 235, 345). Also the leader of the expedition, Howard-Bury, defined Heron "our indefatigable geologist, himself travelled over the greater part of this area, and has carefully investigated the geology of the whole region" (Howard-Bury, 1922, pp. 179-180) However, his work of sampling rocks with "energetic shovelling was soon to arouse the religious suspicion of the Tibetans" (Isserman & Weaver, 2008, p. 87). In fact, the local authorities and monks believed that digging would have disturbed "the fierce demons" guardians of the underground. Moreover, an official complaint sent by the prime minister of Tibet to the British diplomatic representative in Sikkim at the end of September also assumed that members of the British expedition had dug and carried away gems and precious stones from sacred land. This incident will force the Everest Committee to exclude Heron from the team selected for the second Everest expedition in 1922 (Firstbrook, 1999, p. 92).

Fig. 3 - Geological map of the Mount Everest region by A.M. Heron (published in Heron, 1922a; Heron, 1922b)

While the major alpinistic success of the 1921 expedition was to reach the North Col on Everest (at about 7000 meters) by a group led by Mallory on late September 1921, from the point of view of the cartographical and geological survey the work undertaken by Morshead, Wheeler and Heron produced a preliminary topographical map and a geological map of the region. The geological survey by Heron, over about 8000 square miles, produced the first geological map of the area around Mount Everest (fig. 3), based on Morshead topographical map at the scale 1:750,000 (11,84 miles to an inch). The map was presented at the Royal Geographical Society on April 10, 1922, within a report on the *Geological results of the Mount Everest expedition* (Heron, 1922a; Fox et al., 1922) and was also published with a note in the Appendix III of the official report of the 1921 reconnaissance expedition.

According to Heron (1922b, pp. 338-340), "geologically this area is divided into two broad divisions: *(a)* Tibetan and sedimentary, *(b)* Himalayan and crystalline, a distinction which is clearly displayed in the topography resulting from the underlying geological structure, for to the North we have the somewhat tame and lumpy mountains of Tibet contrasting with the higher, steeper and more rugged Himalayas on the South". The Tibetan plateau was described as "an intensely folded succession of shales and limestones, with subordinate sandstone quartzites, the folds striking East-West and mainly lying over toward the South". The shales, "practically unfossiliferous", were dated from upper-middle Jurassic to Lias, while the uppermost limestones "yield an assemblage of fossils which determine their age as Cretaceous and Eocene". The "Himalayan and crystalline zone" was instead considered as "essentially composed of foliated and banded biotite-gneiss": in particular, according to Heron, "the group of high peaks to the north-west of Everest (overlooking the Khumbu pass) is made up of these [biotite-gneiss] and intrusive schorl granite, and it would seem that the precipitous North-western face and spurs of Everest are the same". Regarding the possible presence of mineral resources, Heron considered the region "devoid of interest" as "barring a little copper staining on a few boulders of moraines no traces of ores were seen".

During his fieldwork near Mount Everest, Heron also identified the presence of "complicated inter-relationships of the metamorphosed sedimentaries and the associated gneisses and granites": he was hoping to continue this research with a "detailed survey of the vicinity of Mount Everest" as a member of the 1922 expedition, but this was not allowed by the Foreign Office in London, in order not to create problems with the Tibetan authorities after their complaint on the geological excavations in 1921. Consequently Heron did not come back to Mount Everest and the geological research on this area continued with some difficulties in the following years. A small collection of rock specimens, sampled at heights between 7000 and 8200 meters during the second expedition in 1922, was examined and reviewed by Heron: "the specimens show Mount Everest to be a pile of altered sedimentary rocks - shales and limestones - converted into banded hornfels, finely foliated calc-silicate schists, and crystalline limestones."; between 8200 and 8400 meters "extends an almost horizontal belt, a sill in fact, of schorl muscovite granite, along the whole length of the mountain […] Above this again are black schists. […] As to the age of the rocks forming Mount Everest, they may perhaps be assumed, for the present, to be Jurassic or Trias." (Heron, 1922c).

In the second edition of the 1908 memoir by Henry Hayden and Sidney Burrard, *A sketch of the geography and geology of the Himalaya mountains and Tibet*, which was published in 1933, Heron revised and updated Hayden's geological contributions, as well as the geological map of Himalaya and Tibet, where the area around Mount Everest substantially confirmed the results of the 1921 survey (fig. 4).

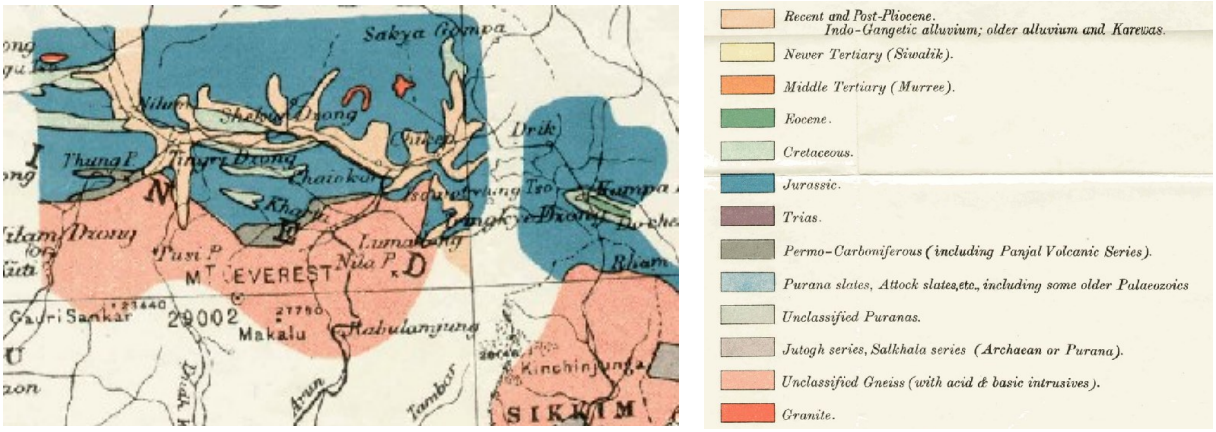


Fig. 4 - Detail of the region of Mount Everest, from the geological map of Himalaya and Tibet revised by Heron and published in Hayden & Burrard, 1933.

In 1935 Heron was appointed Director of the Geological Survey of India and later, in 1949, he joined for two years the Pakistan Geological Survey until his retirement in 1951. After several years of research in north-western India he published in 1953 a monograph on *The geology of central Rajasthan* (Memoir 79, Geological Survey of India). He died in 1971, at the age of 87, in southern India.

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Author: Prof Ezio Vaccari
President of INHIGEO: IUGS International Commission on the History of Geological Sciences (INHIGEO)

Department of Theoretical and Applied Sciences,
University of Insubria,
Varese, Italy
Email: ezio.vaccari@uninsubria.it