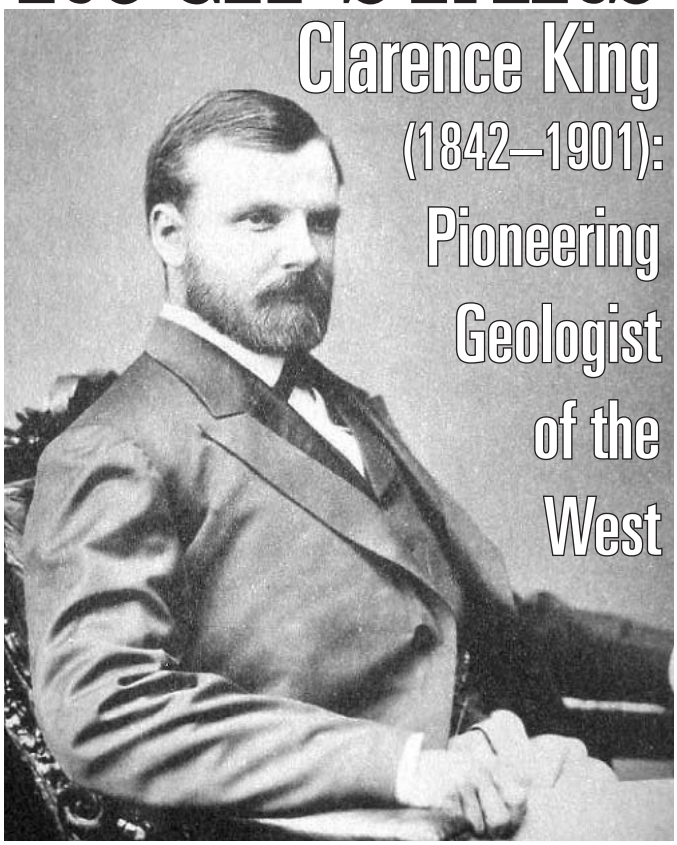
ROCK STARS



Clarence King (1842–1901): Pioneering Geologist of the West

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Introduction

Clarence King is well known for his organization of one of the principal post–Civil War geological surveys of the American West, the *Geological Exploration of the Fortieth Parallel.* The fact that, at the age of 25, he was given complete command of a five-year mapping project from the Sierra Nevada across the Rocky Mountains attests to a remarkably charismatic personality. His survey volume, *Systematic Geology*, ranks as one of the great scientific works of the late nineteenth century.

Young Clarence King

Clarence King was born in 1842 to a prosperous and religious Rhode Island family. In spite of the untimely death of his father in 1848 and economic adversity, King's mother devoted herself to his education, initially emphasizing literature, art, and music. She relocated first to New Haven and then to Hartford to assure good schooling. Later, she encouraged Clarence's interests in natural history, reading to him from Hitchcock's *Geology* after he expressed an interest in fossils. Following his mother's remarriage, King's stepfather financed an undergraduate education at Yale, where King enrolled in the newly established Sheffield Scientific School. He excelled in geology under Professors George Brush and James D. Dana and was graduated in 1862 in the first Sheffield class. During the winter following his graduation, he attended lectures in glaciology by Louis Agassiz at Harvard. King also socialized in the New York City art community, which spawned an interest in art and elegant living.

In 1863, Josiah Whitney's geological exploration of California and the accounts of Mount Shasta by William Brewer, Whitney's chief assistant, called King west. He traveled via wagon train and on horseback, visiting rip-roaring mining towns and experiencing harrowing encounters with unsavory miners. These experiences are recalled in King's *Mountaineering in the Sierra Nevada*, regarded by S.F. Emmons in 1902 (p. 236) "... as far the best book of its kind that had ever been written." Once in California, King convinced Whitney to allow him to serve as a volunteer on the new California Geological Survey. During three years with Whitney, he made many Sierran first ascents and named summits such as "Dana," "Brewer," "Lyell," and "Whitney," as well as "King." Although they did not always agree, Whitney considered King a competent employee. While in California, King conceived of organizing a more extensive survey of the American West, which would connect Whitney's survey with the Hayden survey 800 miles to the east, along the route of the transcontinental railroad.

Fortieth Parallel Survey

Though young, King convinced Congress to fund geologic mapping of some 100,000 square miles of desert, with King in charge. His success derived in part from endorsements by Brewer, Dana, and Agassiz directed toward the powerful bureaucrat, Secretary of War Edwin Stanton; from King's prior naming of a Sierran peak in honor of California's statesman John Conness; as well as from King's skill in social settings. Moreover, he adroitly stressed the potential economic benefit of the survey for the discovery of more precious metals deposits like Nevada's fabulous Comstock Lode.

King's proposed survey required preparation of suitable topographic base maps at a scale of 4 miles to the inch and a contour interval of 300 feet. The Hayden, Powell, Wheeler, and later surveys adopted his example in making topographical maps the basis for portraying geology. Despite bouts of illness, which affected the entire survey party, and the need to replace some of his staff, the survey field work, begun in 1867, was completed in 1872. Throughout, King demonstrated a gift for buoying flagging morale. Survey results were published in seven volumes as the *Geological Exploration of the Fortieth Parallel*, with two accompanying atlases. King arranged that *Mining Industry* (v. 3, 1870) appear first in order to demonstrate the utility of his survey. *Descriptive Geology* (v. 2, 1877) and King's own *Systematic Geology* (v. 1, 1878) appeared shortly thereafter. A major coup was to persuade the world leader in the new petrographic study of rocks, Ferdinand Zirkel, to prepare *Microscopical Petrography* (v. 6, 1876). Other volumes reviewed aspects of paleontology, botany, and ornithology. Of *Systematic Geology*, G.K. Gilbert stated, "Few American geologists have undertaken as wide a range of theoretic and economic studies and none have ac-

quitted themselves with greater credit" (Wilkins, 1988, p. 227).

Later Career

King led efforts to found a national geological survey to oversee exploration of the West, and, in 1879, with endorsements from the foremost geologists of the day, he was appointed first director of the U.S. Geological Survey (USGS). He set the highest standards and focused survey endeavors on mineral exploration, mapping, and experimental petrology. He also established a physical laboratory to investigate the effects of pressure and temperature upon the melting point of rocks. King had accepted the directorship with the understanding that he would serve only to launch the USGS. In 1881, having placed the organization on a firm footing, he arranged transfer of the directorship to his handpicked successor, John Wesley Powell.

With extravagant interests in art collecting, literature, travel, and elegant living, King now hoped to use his geological talents to acquire a fortune in mining. He traveled throughout the continent but met with little success. In 1872, King's exposure of a major diamond fraud made him a sought-after expert witness in mining disputes, providing him with supplemental income. However, a worldwide economic depression, technical difficulties associated with several promising mining prospects, and lack of ready capital forced King to borrow heavily from friends. His health began to fail due to recurrent spinal inflammation, and he suffered bouts of depression. He largely withdrew from the scientific world and concentrated on mineral exploration and his life as a clubman in New York City. As a scientist, aesthete, and highly regarded raconteur, King moved in the highest social circles of New York and Washington. His reputation was such that King was received at Court in England on a triumphal grand tour of Europe from 1882 to 1884, during which he spent far in excess of his income collecting art. He was an intimate friend of both President Lincoln's former secretary, John Hay, and political historian Henry Adams, who viewed King as "...the best and brightest man of his generation, with talents immeasurably beyond any of his contemporaries..." (Adams, 1918, p. 388).

To recuperate from one of his ever more frequent bouts of illness and a nervous breakdown, King went to Cuba in 1894, where he reveled in both geology and interaction with the natives. (Adams [1919] reflected on his love of exotic culture and the adventurous aspect of consorting with Cuban rebels intent on overthrowing Spanish colonial rule.) King's long-term common-law marriage in 1888 to an uneducated black woman, Ada, 20 years his junior, was known only to Adams and Hay, who upon King's death provided a stipend for support of Ada and their five children. Clarence King died of tuberculosis in Arizona on December 24, 1901, at the age of 59.

King's Geology in the Context of his Era

When viewed in the context of his times, the interpretations that King presented in *Systematic Geology* and later papers reflect superb critical thinking. By recognizing several unconformity-bound depositional sequences, he established a framework for orogenic history that has remained largely unchanged. In evaluating King's geology, one should realize that conventional wisdom of the time held all coarsely crystalline rocks to be Archean and that Archean topography greatly influenced Phanerozoic structural development of a region; Archean faults and mountain ranges were lines of weakness where later orographic movements would express themselves. These ideas reflected the influential teachings of his Yale mentor, Dana.

King clearly described the effects of terminal Paleozoic orogenesis, based in part upon the appearance of western-derived siliciclastic sediments, and correctly delineated major structural effects of both the Sevier and Laramide orogenies. King appreciated the change of tectonic style within the Great Basin during the Cenozoic, a transition marked by a shift from chiefly east-west crustal shortening to extension. He noted the transition from predominately rhyolitic to basaltic volcanism during the Neogene, and he mapped the extent of Pleistocene glaciation in many ranges, as well as that of both pluvial lakes Lahontan (which he named) and Bonneville.

King was convinced that Lyellian uniformitarianism, a theory of gradualism and constancy of processes, could not explain the geologic evolution of the region surveyed, especially late Cenozoic effusive volcanism and the magnitude of glacial drainages. These views led King to be classed as a catastrophist. However, he was in good company with most late nineteenth century geologists in calling for greater variations of both rates and intensities of processes than Charles Lyell preached. King also believed that evolution did not proceed at a steady pace. Blending catastrophe and "adaptivity," he proposed that the former was an integral part of the cause of change. Destruction of biological equilibrium engendered by catastrophic change contributed to rapid morphological change among what he termed "plastic species" (King, 1877, p. 468–469). King in essence proposed a blending of Darwin's ideas on natural selection with the variable rate of change of geological processes. Employing data on rock fusion gathered at the USGS Physical Laboratory, King (1893) attempted to advance to new precision Kelvin's estimate of Earth's age deduced from terrestrial refrigeration, determining a maximum age of 24 Ma. Given this young age, insufficient time remained to construct a Lyellian geologic record of the Fortieth Parallel area.

Under King's sound leadership, the USGS became a successful government agency, and by personal example, he put an end to internecine warfare among geologists mapping the American West. He demonstrated the utility of allying science, government, and industry, perhaps his greatest contribution to our science.

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