

**ELIZABETH RAYMOND KING –
A GEOLOGIST INSPIRED BY BAY OF FUNDY
MINERALS AND THE NOVA SCOTIAN
INSTITUTE OF SCIENCE**

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Geologist Elizabeth Raymond King (1923-2010) was born in Halifax, Nova Scotia, and home-schooled by her parents who were both accomplished scientists. According to her father, chemist Harold Skinner King (1892-1967), Elizabeth became interested in geology after several mineral collecting trips along the shores of the Bay of Fundy.

Our daughter early developed an interest in geology, and we have spent our vacations visiting mines and touring the Province in search of minerals. We have watched coal being mined many miles out under the sea. We have risked our necks collecting zeolites from perpendicular cliffs. We have experienced the tremendous Fundy tides and have walked on the bare sea bottom where, in a few hours, forty feet of red, mud-laden waters obliterated our tracks. (King 1942: 564).

Harold S. King graduated from Harvard in 1917 and joined the Chemistry Department at Dalhousie University in 1922. Elizabeth's mother, Susan Raymond King (1892-1970), was also an accomplished scientist. Having completed a Bachelors from Smith College, Massachusetts, in 1913, Susan was a Nantucket Associate Fellow in 1915, a Marie Mitchell Memorial Fellow at Harvard Observatory in 1916-1917 (Annual Report 1948), and attended specialist conferences (Fig 1) before completing her dissertation at Smith College (Raymond 1919b). Susan published a summary of her results (Raymond 1919a) that used new photographic methods to study the variability of asteroids, methods that had been established by Harold's father, Edward Skinner King (1861-1931), a prominent Professor of Astronomy at the Harvard Observatory (Campbell 1931). It is likely

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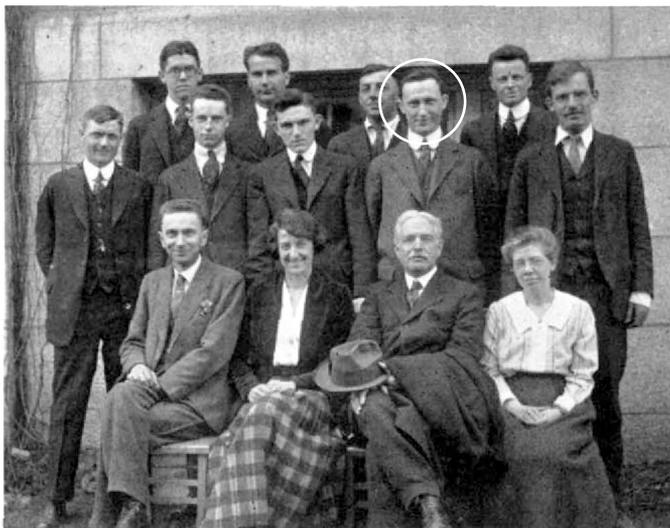
FORMAL ORGANIZATION MEETING OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS, CAMBRIDGE, MASSACHUSETTS, NOVEMBER 10, 1917.

Fig 1 Susan Raymond shown at the meeting of the American Association of Variable Star Observers, Cambridge, Massachusetts, Nov. 10, 1917. From *Popular Astronomy* No. 251.

through Susan's work in astronomy that she met Harold (Fig 2), who at the time was associated with the Professor Richards laboratory at Harvard (King 1959b).

Susan and Harold were married on September 12, 1922, in Northampton, Massachusetts, before moving to the Armdale neighbourhood of Halifax when Harold joined the faculty at Dalhousie University. Shortly after arriving in Halifax, Susan and Harold were both elected as members of the Nova Scotian Institute of Science (NSIS) on November 30, 1922 (*PNSIS* 1926). Over the coming years, Harold became an active member of the NSIS, publishing his first paper in the Proceedings in 1923 and contributing an article in nearly every issue until 1935, often describing new insights of an analytical chemistry topic. One of these papers was a summary of his Harvard dissertation research (King 1927), which focused on studies of isotopes. Harold was the editor of the NSIS Proceedings from 1929 to 1938, and the President of the Institute from 1938 to 1940.

This was the academic family environment in which their daughter Elizabeth grew up. Susan focused her attention on raising



Wolcott Gibbs Memorial Laboratory personnel in 1920. From left to right: *Front row*, Dr. Henry Krepelka, Miss Edith H. Lanman, Professor Theodore W. Richards, Miss Rosella J. Borthwick (sec.). *Middle row*, William M. Craig, Oscar C. Bridgeman, John Russel, Harold S. King, Dr. Emmett K. Carver. *Back row*, Charles P. Smyth, A. Sprague Coolidge, William Manning (jan.), Sylvester Boyer.

Fig 2 Harold Skinner King (second from right, middle row) in 1920 when associated with Professor Richards' laboratory at Harvard University.

and schooling the two children, Elizabeth, and her younger sister Nancy. Susan even taught the two girls Greek (King 1948) and eventually prepared them for college. This home-school education and the scientific backgrounds of her mother and father resulted in Elizabeth achieving several publications as a teenager. In January of 1935, at the age of twelve, Elizabeth presented a paper as a student member of the NSIS titled "The Goldenville-Halifax Boundary at Fairview, NS" (King 1935a). Elizabeth's first geology paper was inspired by her discovery of two angular limestone pebbles on Dutch Village Road that she interpreted as transported as glacial drift. In her paper, she described occurrences of 'limestone' beds near the boundary of the Goldenville and Halifax Groups (Fig 3), and referenced contemporary sources such as the Physiography of Nova Scotia (Goldthwait 1924) and the Faribault geology map of the area (Sheet 68). Elizabeth offered an interpretation of her geology observations that demonstrated an understanding of complex geological concepts. The limestone units that Elizabeth identified

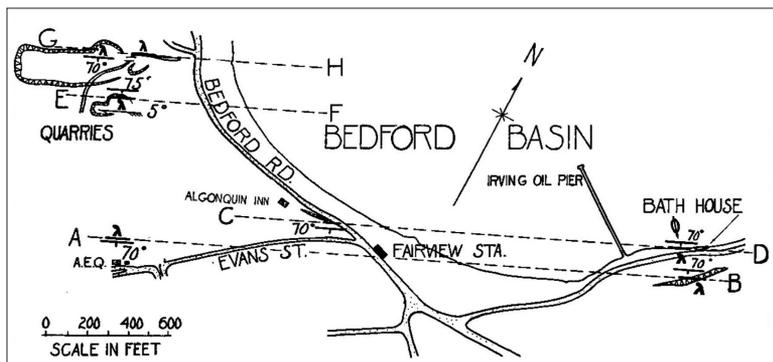


Fig 3 Map of Fairview, Halifax, region showing boundary and limestone beds. From King (1935a).

in the Goldenville are now considered calcite-rich metasandstones (Chris White, pers. comm.) but her original paper continues to be cited in modern work (White 2010).

As a young girl, Elizabeth also contributed several short articles to the *Rocks and Minerals* magazine. In July, 1935, she published a short article summarizing *Pleochroic Haloes*, concentric rings that form inside biotite as it crystallized in magma (King 1935b). This short note was a summary of research that was being carried out by Dr. G. H. Henderson, who had joined the Department of Physics and Atmospheric Sciences at Dalhousie University in 1924. Elizabeth contributed a second article to *Rocks and Minerals* magazine (King 1936), providing a comment about an article from a previous issue and referencing her study of the pebbles that were the focus of her PNSIS paper.

While her family and the NSIS community played an important role in Elizabeth's educational environment, it was also a critical period in the history of the Institute. The Nova Scotian Institute of Science had been established in 1862 and had a long history of association with both Dalhousie University and the Nova Scotia Museum. Harry Piers was the Museum Curator from 1899 until 1940, when he unexpectedly passed away (Mak 1996). In the NSIS Presidential Address in the year Harry Piers died, Harold King included detailed recommendations for a more scientific focus for the Museum when hiring a new curator (King 1941). Harry Piers' curatorial work had been of an exceptionally high standard, organizing and documenting the collection that continued to increase in

scope to include cultural artefacts. Piers published a *Catalogue of Economic Minerals* (Piers 1908) and some work on specific mineralogy occurrences (Piers 1912, 1923), among other scientific topics, but much of his museum work had focused on a wider scope of cultural areas. Looking forward, Dr. King suggested that the NSIS desired the Museum to take on more of a scientific focus. Harold's proposal was eventually partially implemented when Donald K. Crowdis became the Director of the Provincial Museum; in 1949, the museum changed its name to the Nova Scotia Museum of Science (Mak 1996). During this reorganization, the Museum also became aligned within the Department of Education and the Museum took on a more active role in public education.

Harold King and his family did not stay much longer in Halifax and so did not see this evolution of the Museum of Science. In an alumni magazine of 1942, Harold King expressed his growing dissatisfaction of living in Halifax during the war years. After sharing stories of his family's initially idyllic life in Halifax, Harold explained:

The war has changed all this. I now spend feverish days studying high explosives. Planes roar overhead; troops are training outside my laboratory window. Blackouts are a routine. Convoys pass in and out, and we try to be blind to obvious movements. Halifax is geared to war. The Foreign Exchange Control Board has put restriction on spending money out of Canada, even for educational purposes, and I find that it is becoming impossible to educate my family in the United States if I remain longer in Canada. Throughout the years I have kept up my registration at the American Consulate and am still an American citizen. At present I am looking for an opportunity of utilizing my chemical knowledge and experience in my own country and then, farewell to Canada! (King 1942: 564)

By 1943, Harold was recalled to the United States, and became a technical advisor for the Chemical Corps. Board of the USA Army, in Edgewood Arsenal, Maryland (King 1948). With Harold in Maryland, Susan King had moved back to Northampton, Massachusetts, and was listed as an Instructor of Astronomy at the Observatory, teaching a course on "Celestial Marine and Air Navigation" at Smith College (Smith College 1943: 74-75). Susan was listed as only having a bachelors (A.B.) degree, so she may not have completed

the defense of her dissertation at Smith College before moving to Halifax. During this time, Elizabeth and Nancy were with their mother in Massachusetts.

The Smith College Catalogue of 1944-45 shows Elizabeth King listed as a Freshman of the Class of 1947 (Smith College 1945: 73). However, shortly after entering Smith College, Elizabeth was afflicted with tuberculosis and spent two years recovering in a sanatorium. Elizabeth graduated from Smith College in 1947 and then moved to Baltimore to work developing photographs at a department store. Elizabeth then worked in the pathology department at Johns Hopkins Hospital, where she took photographs of cadavers and autopsied tissues (Schudel 2010). Perhaps her illness inspired some interest in medicine but her mother's expertise in applications of photography in astronomy likely contributed to Elizabeth's knowledge and interest in scientific application of photography.

After this brief period, Elizabeth King then joined the United States Geological Survey (USGS) in 1948, where she would stay to have a sixty-year long career with the USGS as a geophysicist, creating geophysical maps based on magnetic imaging aerial surveys. Elizabeth was often the only woman working in the group conducting these surveys (Fig 4), and she published a regional magnetic map of Florida (Fig 5) in the Association of American Petroleum Geologists Bulletin (King 1959a). In October of 1962, along with Isidore Zeitz and Leroy Alldredge, she presented at a meeting of the Geological Society of Washington on the "Investigation of the Arctic Ocean Basin by Airborne Magnetometer" (GSW 1962).

Elizabeth worked closely with the geophysicist Isidore Zeitz (1919-2013) at the USGS. In a published obituary of Isidore, the authors noted "We suspect that the interpretation for which he will be most remembered is the discovery, with Elizabeth King, of the Alabama-New York lineament" (Taylor *et al.* 2013). Elizabeth was the first author of this important paper (King & Zietz 1978), publishing the results and geomagnetic map of a previously hidden geological feature. This innovative result was published forty years after her first published Fig of the boundary in Fairview, Halifax, as a young researcher with the Nova Scotian Institute of Science.

While conducting the research for this paper, the location of Elizabeth's mineral collection has been located, having been stored in an



Fig 4 Elizabeth King working among the crew of the aerial survey group of the United States Geological Survey c.1956 (above), and working a graph rectifier (USGS 1952), a machine to get the continuous magnetic reading into usable form (below).

attic in Maryland along with notes and letters between Elizabeth and her father (Mills 2021). The details and significance of this collection of minerals will be considered in future work. Elizabeth's scrapbook that has been located in the possession of her nephew, Charles Reynes, is also of significance for documenting her interests in geology. Elizabeth's mineral collecting as a young girl, and her

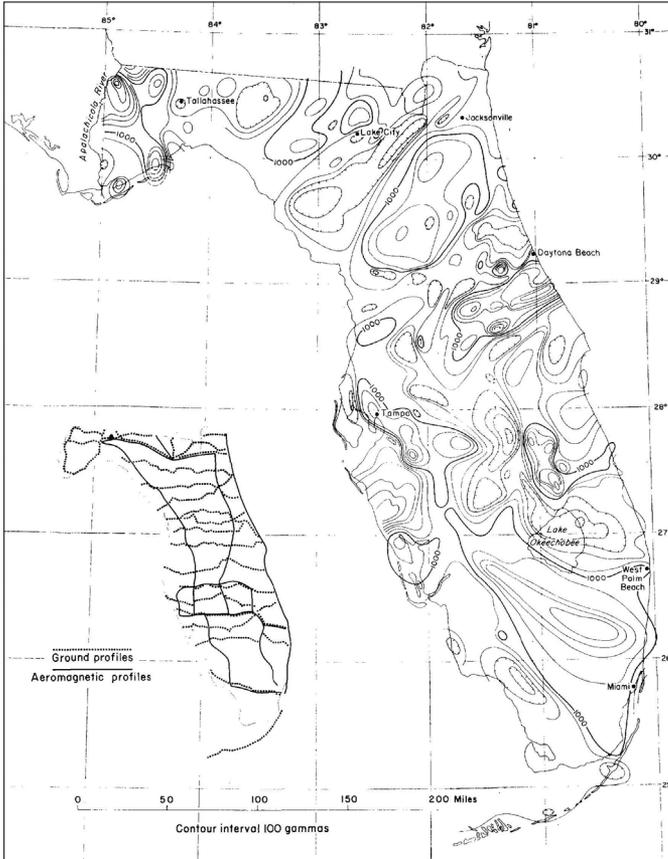


Fig 5 Regional magnetic map of Florida, published by Elizabeth King in 1959.

contributions to the PNSIS and special-interest publications such as *Rocks and Minerals* magazine, demonstrate how these publications supported her interest in science as a young girl.

Elizabeth and her family made significant contributions to the Nova Scotian Institute of Science during the time of the second world war. Elizabeth went on to have a long and interesting career as one of the first women to work as a geophysicist with the USGS and made significant contributions to a geoscience field dominated by men. She made these contributions through an application of her knowledge of geology, science, photography and mapping, which she acquired through the support of her academic parents and her early contributions to the Nova Scotian Institute of Science.

The history of Elizabeth King and her family's contribution to NSIS provide insights into the personalities and challenges facing the scientific community of Nova Scotia during the 1940s. Elizabeth King remains a positive role model for young Nova Scotians who may have an interest in minerals and could pursue their interests towards a rewarding career in the geosciences.

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