Geological and Corporate Controversies at the Homestake Mine, 1926-1931

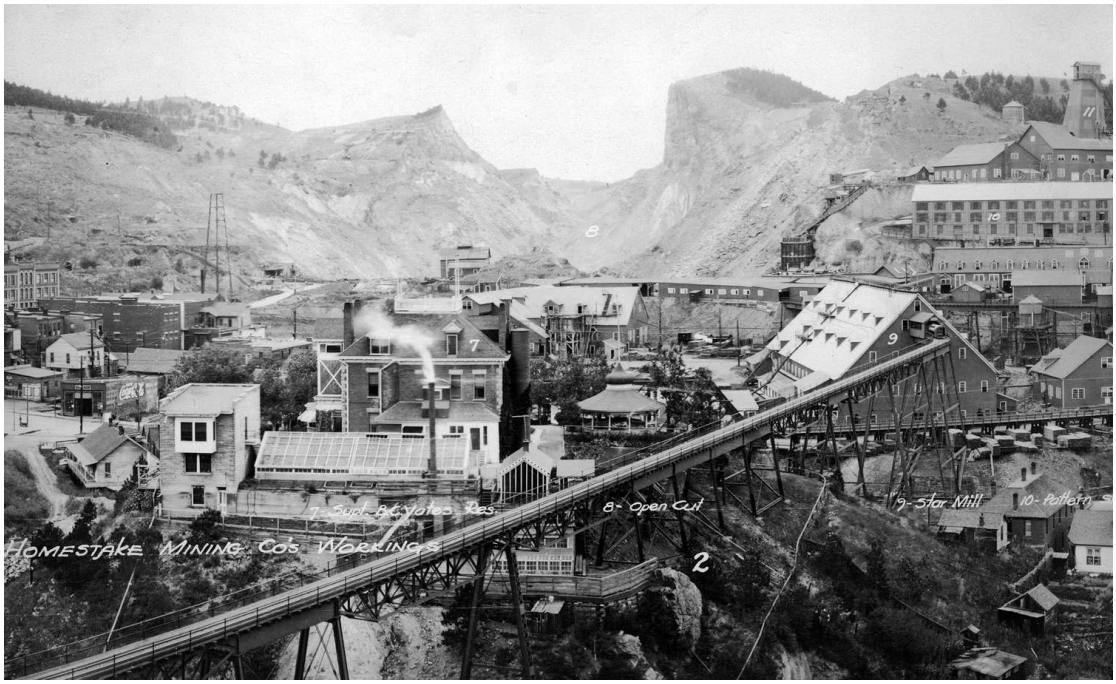
By Robert Sorgenfrei and Heather L. Whitehead

Introduction and Geology

The Homestake Mine near Lead, South Dakota, "perhaps the greatest gold mine in the world,"[1] was initially worked using bulk mining techniques suitable for a low-grade gold mine. During the 1920s, detailed underground mapping produced a better understanding of the mine's complex geology, and also revealed a higher-grade deposit that could be selectively mined. Homestake geologist Lawrence Wright, USGS geologist Sidney Paige, and others were responsible for the detailed mine maps and early understanding of the subsurface trend of the mine.

By 1926, the ore appeared to be pinching out. Homestake consulting geologist Donald McLaughlin was brought in for a second opinion and is credited with finding the deeper sub-surface ore that allowed the mine to continue operating. The Wright and McLaughlin years at Homestake were influenced by differences between these men; differences that included personality, background, and their theories of the origin of the ore.

The Homestake Mine occurs in Precambrian rock in the Black Hills of South Dakota. The 2.5 billion-year-long rock record shows evidence of compression, metamorphism, and intrusion by rhyolite and granite. The rocks are folded,



Homestake Mining Company's workings, 1922. (Mary McLaughlin Craig/ Skewes-Cox Papers, Arthur Lakes Library, Colorado School of Mines, Golden.)

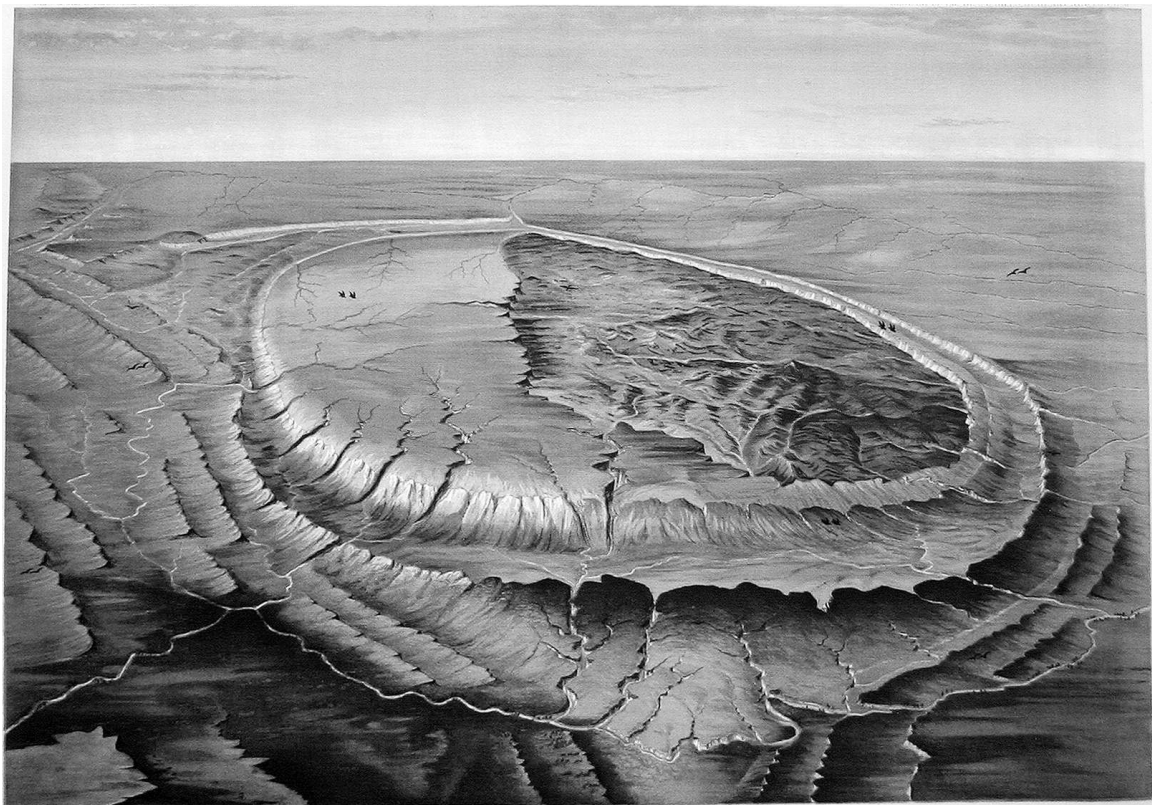
sheared, tilted, and metamorphosed, sometimes more than once. Uplift during the tectonic events that formed the Black Hills eroded at least six thousand vertical feet of rock, exposing part of the Homestake Formation at the surface.[2]

The Homestake Formation, originally a sixty- to ninety-foot thick chemically precipitated sequence of iron-rich rocks, has been metamorphosed to a distinctive fine-grained schist. Rock units are strongly deformed, with folds that have been refolded; formation thickness ranges from zero to four hundred feet. The regional structure is a plunging complex of narrow, contorted anticlines and synclines. Mineralization is confined to a series of elongate, discontinuous, pencil-like bodies ("ledges") within the Homestake Formation. Each ore ledge contained a varied number of disconnected, discrete ore bodies. By volume, only about 3 percent of the Homestake Formation in the mine area included ore bodies.[3]

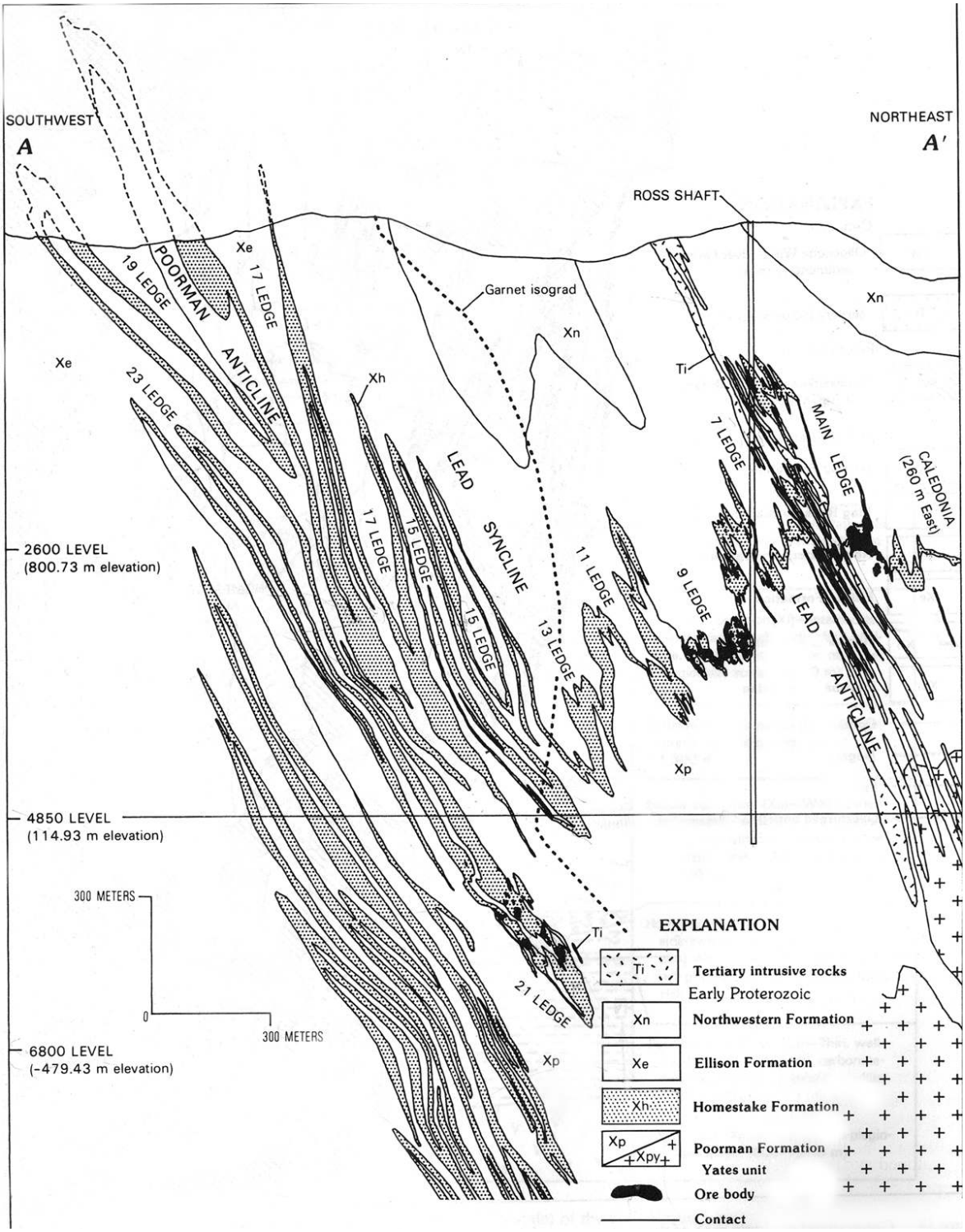
Lawrence Wright

Lawrence Boynton Wright was born in 1892. From 1910 to 1914, he studied mining engineering and geology at the University of Washington, but he did not graduate. As he put in it in his autobiography, he never petitioned for graduation because he could not afford to rent the cap and gown needed for the ceremony. Later he wrote that his lack of a degree "handicapped" him professionally.[4]

Wright worked at the Alaska Treadwell Mine as both a miner and an accountant. When a flood closed the mine, he enlisted in the army and served in World War I. After military service, he wrote to Russell Wayland at Homestake and asked him for work. Wayland offered Wright a job, but did not mention the type of job. When Wright got to Lead in 1919, he was hired as a mine laborer, what he later characterized as a "menial job."[5]



A bird's eye view of the Black Hills to illustrate its geological structure. (Department of the Interior, Geographical and Geological Survey of the Rocky Mountain Region (U.S.), 1879.)



Generalized cross section of the Homestake Mine area, showing the mineralized areas (in black) within the ledges of the Homestake Formation (stippled). (Caddey et al, "The Homestake Gold Mine," J8.)

Lawrence B. Wright, front, in 1968.
(Wright, Fifty-Six Years of Exploration*, 213.)*

However, he got a lucky break in 1920, when a fire started on the 800-foot level of the mine. Homestake owned German-made Draeger oxygen suits for fire fighting and mine rescue, but no one except Wright and a couple of others had any experience with the bulky suits. They trained others in use of the suits, formed teams, and spent weeks fighting the fire. According to Wright's recollections, this impressed Homestake superintendent Bruce Yates. Yates called Wright into his office after the fire and asked Wright what kind of job he would like at the mine. Wright immediately answered that since there were no geologists on staff and no geological maps of the mine, he would like to map the geology. He requested that another geologist, Joseph Hosted, be assigned to work with him.[6]

Early Geological Exploration

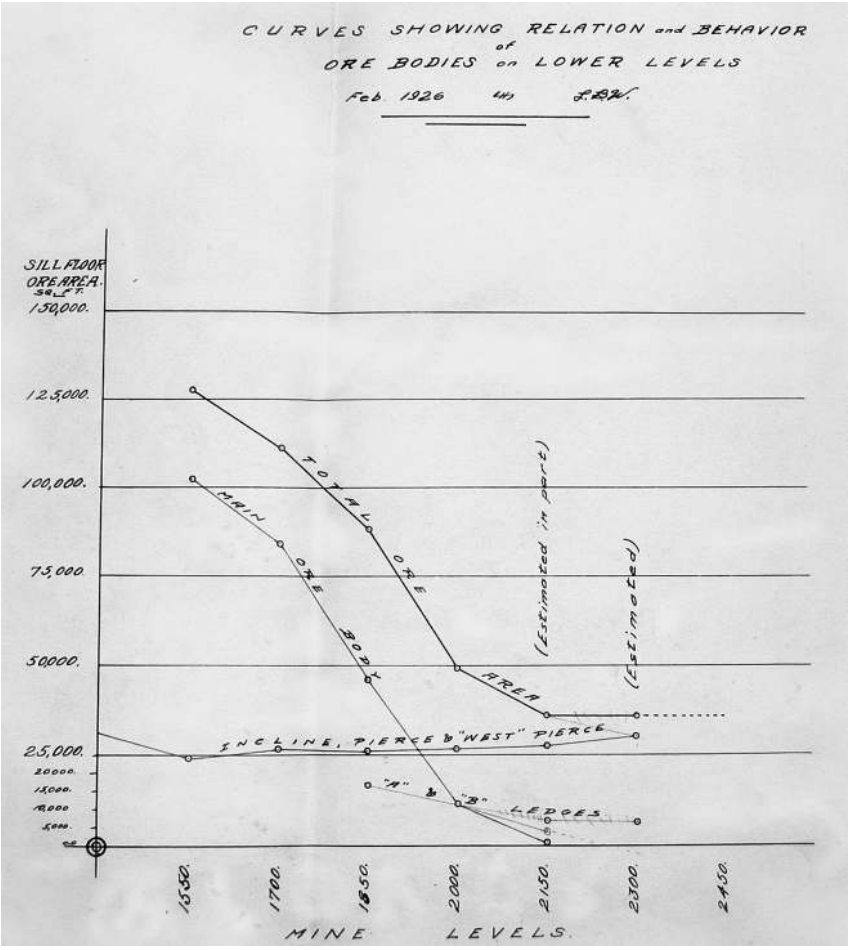
In 1920, Wright and Hosted became the first official geologists in the Homestake's forty-four year history. Under Wright's direction, they began to map the geology of some eighty miles of the Homestake's workings and to look for new sources of ore. It was a dream job for Wright, but it came with its problems; the major one was that the mining department did not take the geologists seriously.

Wright could map out all the geology he wanted, but his maps ended up lying in map drawers in the mine office unseen by anyone involved in mining. The mining department simply ignored the geologists. The department had been practicing mass mining rather than selective mining since the Homestake began, and saw little need to change its operations. In fact, Alec Ross, mine foreman at the time, considered it "taboo" for his miners to discuss how they mined with the geologists.[7]

However, Homestake Superintendent Bruce Yates took Wright's work seriously. Yates reported directly to Edward H. Clark, president of Homestake Mining Company. Clark made most of the key decisions for the company, which he ran from New York and San Francisco, with occasional visits to Lead. Clark left the everyday running of the mine to a management team that included Yates, who kept him informed of all important developments at the Homestake. Through Yates, Clark heard pessimistic things about the future of the mine.[8]

Wright reported to Yates, based on diamond drill core exploration and mapping, that the rock containing the main ore body played out at about the 2150-foot level, and that there was no other ore of commercial value in the vicinity. Rumors that the mine might close circulated in Lead, and the value of real estate declined as some people sold out and moved on. Joseph Hosted, who had been working with Wright, was convinced the ore was playing out and took a job in Peru, where he thought the long-term job prospects were better.[9]

Nevertheless, the possibility existed that Wright might be wrong about the ore body. Additional diamond core drilling had found ore at



"Curves Showing the Relation and Behavior of Ore Bodies on the Lower Levels of the Homestake," by Lawrence B. Wright, Feb. 1926. (Mary McLaughlin Craig/Skewes-Cox Papers, Arthur Lakes Library, Colorado School of Mines, Golden.)

the 2150-foot level and there were indications of mineralization going deeper.[10] With evidence countering Wright's pessimistic geological reports, Yates and Clark decided to seek another opinion. Edward Clark chose someone he knew well for that second opinion: Donald McLaughlin.

Donald McLaughlin

Donald Hamilton McLaughlin was born in 1891 in San Francisco. After his father died in 1898, his mother found a job working for Phoebe Apperson Hearst, widow of George Hearst and heiress to one of the great nineteenth-century mining fortunes. This association with the Hearst Family would open professional doors for McLaughlin.

Mrs. Hearst sponsored his education, and McLaughlin graduated from the University of California with a degree in mining engineering in 1914, and a PhD in geology from Harvard in 1917. McLaughlin worked as a chief geologist in Peru. In 1925, he returned to Harvard where he was appointed Professor and Chairman of the Department of Geology and Geography and Division of Geological Sciences. At age thirty-four, he was the youngest full professor at Harvard.

Edward Clark had known Donald McLaughlin for most of his life, from visits to the Hearst Estate in California, and had developed a very fatherly attitude toward him. In his role as president of the Cerro de Pasco Mining Company in Peru, Clark had been instrumental in McLaughlin's appointment there as geologist. While at Cerro de Pasco, McLaughlin had organized the exploration work and mapped the mine's geology so that the mine could be developed appropriately. McLaughlin's work in Peru had impressed Clark,

who had great confidence in him.

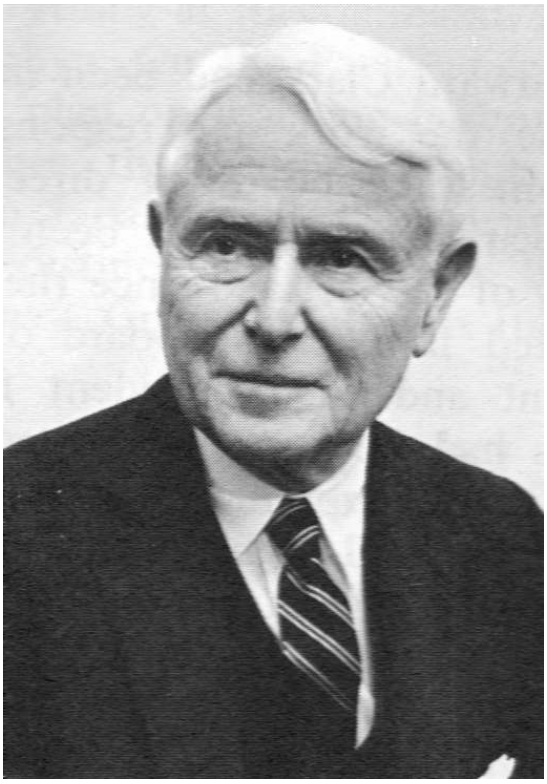
McLaughlin undoubtedly had a full plate of work at Harvard as a professor and department head, but it would have been hard for him to turn down the request from Edward Clark, a mentor, to be consulting geologist at the Homestake Mine. This would be his first work in a gold mine, but that mattered little. Clark wanted a person in whom he had absolute trust and confidence, since he was just about convinced that the Homestake's days were numbered. Clark may have also seen this as the perfect opportunity to get McLaughlin started at Homestake to begin grooming McLaughlin to someday succeed him. McLaughlin began working at Homestake in the summer of 1926.[11]

Two Geologists

Lawrence Wright must have wondered what to expect from Donald McLaughlin, who was coming essentially to check his work. Perhaps as a way of mollifying Wright, the company changed his title to chief geologist in 1926.[12] Edward Clark wanted the two geologists to work together, discussing their findings and geological theories. Clark asked McLaughlin to make a report advising him on the future of the mine, the potential for finding more ore, and what should be done to further development if ore were found.

McLaughlin was accustomed to working in an academic world where dissertations were defended, differences of opinion hotly debated, and agreeing to disagree accepted. McLaughlin once got into an argument over the origin of the Kennecott copper deposits that ended with Louis Graton, his professor at the time, leaving the room saying: "I don't see why the hell you studied geology anyway." McLaughlin thrived on spirited, lively academic exchanges.[13]

Wright had been working in a very different world. He had been born into a family with little wealth and few connections. He had no influential patrons and was no one's special protege.



Donald H. McLaughlin in 1968. (Fielder, The Treasure of Homestake Gold*, 338.)*

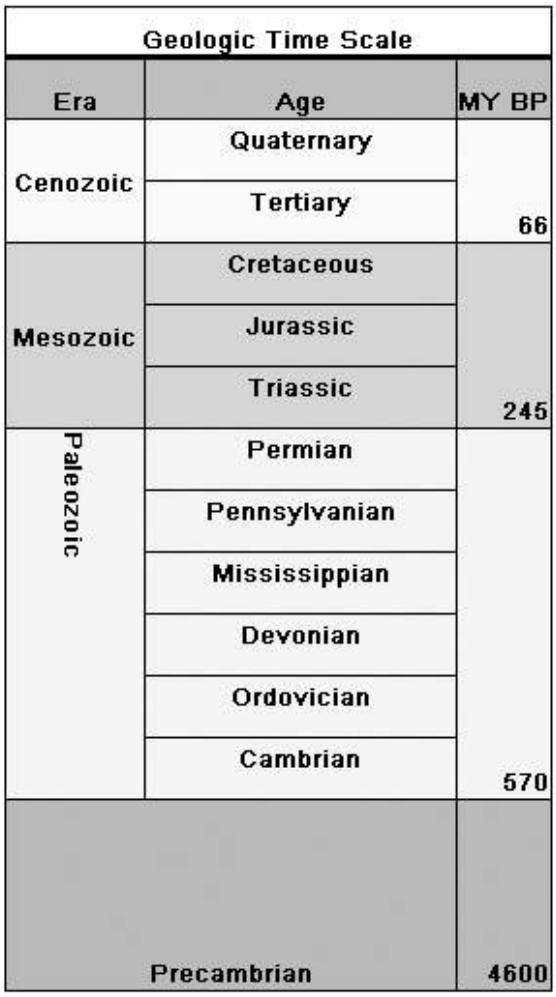
Wright had worked his way up from the bottom on just about every job he had held. Most of his knowledge came from practical on-the-job experience and observation. Later in life, Wright wrote that he welcomed a consultant and found McLaughlin to be "a charming person, always ready with a quip." He added that McLaughlin initially complimented his and Hosted's work "with special reference to our segregation of the rocks of the district into identifiable types, and naming them for future use in the study of the mine's deeper geologic structures."[14]

As the year 1926 progressed, whatever honeymoon the two had had must have quickly faded. Edward Clark directed Wright to report on his work to McLaughlin by monthly letter. These letters show that from the latter half of 1926 until he resigned in early 1931, Wright's work was subject to continual, detailed criticism. It was almost like McLaughlin considered Wright one of

his graduate students, and each letter that Wright wrote was part of a dissertation that McLaughlin expected him to reconsider and revise.[15]

Age of the Gold

Wright and McLaughlin had different opinions about the age and origin of the gold mineralization at the Homestake Mine. Clarence Kravig, a geologist under both Wright and McLaughlin, described the two as being "cross threaded" over the issue. In his published papers, Wright wrote that "it is our belief that the Tertiary dikes in the Homestake mine are responsible for most if not all of the mineralization." McLaughlin's published works include this contradictory statement: "The Homestake mineralization is believed to be of pre-Cambrian age. The evidence is positive and compelling that the ore bodies were formed at great depth and that they are not related to the . . . period of Tertiary intrusives."[16]



The issue is a recurrent theme in the letters between Wright and McLaughlin. In fact, the topic must have been part of their earliest discussions. McLaughlin arrived at Homestake in the summer of 1926, and a summary document of their initial discussion, dated 3 July 1926, listed forty-seven agreed-upon facts. Each fact was annotated by Wright as to whether it supported a Tertiary or Precambrian age for the gold.[17]

These two geological periods are several billion years apart, but rocks from both time periods occur in the Lead area. The rocks of the Homestake Formation are unquestionably of Precambrian age, but the age of the gold mineralization is not necessarily the same as the age of the host rock. Evidence exists for at least three alternative ages for the gold.[18]

The ore could be the same Precambrian age as the rock that hosts it, being formed together, possibly as an ocean floor hydrothermal deposit. Or the ore could have migrated at a later time into the Homestake Formation rocks, which had physical or chemical properties that made them receptive to mineralization. Fluids related to intrusion of rhyolite dikes during the Tertiary are a probable source. The third possibility was that ore was initially Precambrian, but was enriched during the Tertiary period.

The direction of mining operations at Homestake could have been affected, depending on who was in charge and which of these theories he followed. However, Wright wrote that "should occasion arise where exploration is to be recommended or directed and its nature influenced by theories of ore genesis, I recognize that the Tertiary idea is of 'minority support' and should under the circumstances be subordinated to the pre-Cambrian theory, so have no fear that my conclusions will be favored to the point of misleading development work."[19]

Delayed Publication

In 1930, after four years with McLaughlin as the consulting geologist and Wright as the chief geologist, the differences between the men crossed into a new area. An article Wright wrote on geological concepts was intensely criticized by McLaughlin, just as it was going to press.

Wright observed several times that the richest areas of Homestake gold occurred near constrictions in the rhyolite dikes, but that relationship was considered a mere coincidence by those in authority at Homestake. Wright heard that a similar idea came up at a Canadian mining meeting in relation to another gold mine, and he hastened to be the first to publish his ideas and observations. If a similar dike structure and mineralization relationship existed at other mines, it could be a valuable predictive tool for finding ore, and Wright wanted credit for the idea.[20]

Although his article had already been accepted by the publisher of the journal, he sent a copy of his manuscript to McLaughlin for approval. By 1 April 1930 McLaughlin had taken only a "hasty glance" at the paper. On 25 April, Wright wrote to McLaughlin that "I was particularly anxious to get credit for the idea before someone else did."[21]

On 30 April, McLaughlin finally responded. He sent a telegram that began: "Still think your geological arguments open to criticism." He also sent a letter that cautioned that "we should be careful to avoid getting into weak positions. I am afraid your present paper might put you in such a situation. . . . There is undoubtedly something significant about the association between ore and constricted areas of various sorts . . . [but] I cannot follow the arguments . . . nor do I see that your conclusions with regard to them follow from the observations."[22]

Wright revised the manuscript and wrote that he was satisfied with it, but realized that it deviated from "traditional lines of thought." The revised manuscript was published in June, 1930.[23]

Parting Ways

No additional correspondence between the two geologists survives, but this episode may have been the final straw for Wright. It is tempting to read between the lines that the largely self-trained, rough-around-the-edges Wright had had enough of his geological theories being second-guessed by the Harvard professor. Late in life, Wright summed up his professional difficulties with Donald McLaughlin: "During the ensuing four years, Dr. McLaughlin began to find fault with our manner of recording geologic structure and especially that our maps did not show (thousands of) minor details of twisted rocks but in our view having no relation to the future of the mine."[24]

In a report dated 8 January 1931, Wright summarized Homestake Mine's operations during 1930. He then looked back at his body of work at Homestake from 1921 through 1930. He listed his accomplishments—exploration work, unraveling the folding structures in the mine, a better understanding of changes with depth, money saved by selective mining based on rock characteristics versus blind prospecting—and stated that the mine structures supported his conclusions that the ore was of Tertiary origin. Then, in a startling change of focus in the narrative, he wrote that "as a result of continued serious 'checking' of the work accomplished and the inferred criticism of details, I am forced here to tender my resignation."[25]

Outcome

Both men went on to long and successful careers, McLaughlin eventually as president and CEO of Homestake, and Wright as a consulting geologist in California and Nevada. Homestake continued operations until economics forced it to close in 2001; at that time, ore was being mined below eight thousand feet. The predicted pinch-out at 2,150 feet proved incorrect, as the ore-bearing formation changed direction and con-

tinued deep into the Earth. The age and origin of its gold are still open to interpretation. Although the majority of evidence supports a Precambrian age for the Homestake ore, arguments about complex geological issues are seldom totally settled. Somewhere, the ghosts of Wright and McLaughlin may still be debating it.

Speculations and "What Ifs"

It is interesting to speculate on what might have happened if Edward Clark had not called Donald McLaughlin to Homestake, and Wright had been left to continue his geological exploration. On his own, would he have found the deeper ore deposits and directed the mining toward them? Some evidence indicates that this would have happened, notwithstanding McLaughlin's rather harsh opinion that Wright's geological background was limited, and that he wasn't much of a geologist.[26]

Wright's formal education may have been limited, but he had more experience in gold mines in 1926 than McLaughlin. Wright had valuable experience from his years working underground and mapping the geology of the mine. Wright may have been rather slow and plodding compared to McLaughlin—he was a cautious, introspective person, not willing to take the risks that McLaughlin did—but Wright's views on where the ore deposits had gone at depth changed over time.

In an interesting one-page document entitled "Memorandum Regarding Trend of Homestake Structure to Deeper Levels," dated 6 September 1930, Wright stated that he had reached the conclusion that there was a strong possibility of ore at depth. He acknowledged that this new conclusion "disproves" his previously held views on the nature of the ore body. He sent this memorandum to Edward Clark, Homestake president, Bruce Yates, Homestake manager,

Donald H. McLaughlin (left), Edward H. Clark, A. J. M. Ross, and Clarence Kravig; 1932 inspection trip in the Homestake Mine. (Fielder, The Treasure of Homestake Gold*, 295.)*

Donald McLaughlin, and other key personnel. He also had Clarence Kravig, who was working with him at the time, initial the document.

Of all of Wright's documents extant, this one is unique. It demands an explanation as to why he created it. At face value, the memorandum shows that Wright was changing his views on the ore body, that he no longer felt, as he did in 1926, that the ore was pinching out at the 2150 level. He had found new evidence that it went deeper and wanted his view known for the record. Looking past the information in the memorandum, perhaps he was stating his position for the record because he felt his position as a geologist, not just as Homestake's chief geologist, was seriously threatened by late 1930.

McLaughlin is credited with arriving on the scene at the Homestake in 1926, rejecting existing pessimistic views about the future of the mine, and coming up with the theory that the Homestake veins did not pinch out, but plunged to greater depths, and that the ore body could be carefully delineated and selectively mined. Under his guidance, the Homestake continued to mine because his theories on the deposit proved accurate. Also, by selectively mining in areas where the ore body was the richest, he changed the notion that the Homestake was a low grade mine.[27]

This was all done at considerable risk; he could have been wrong and the ore body might not have been found where he thought it was. If that had happened, McLaughlin could have returned to Harvard and continued his career in academia. Wright did not have that option. It was easy at the time to confuse Wright's so-called pessimism about the depth of the ore body with caution and an unwillingness to make predictions without adequate information.

Whatever the reasons for the 6 September 1930 memorandum, Wright did resign a few months later. Clarence Kravig stated that Wright resigned under pressure. If so, it was likely because of the four-year "cross threading" he underwent with McLaughlin.[28]

After early 1931, Wright was no longer chief geologist at the Homestake Mine, but that was not the end of his professional involvement with the geology of the region. In 1937, Wright published a paper on his theories on the Homestake ore deposits entitled "Gold Deposition in the Black Hills of South Dakota and Wyoming." He still maintained in this paper that mineralization at the Homestake occurred during the Tertiary period. A written discussion followed the paper, with geologists such as Sidney Paige, Louis Graton, and of course, Donald McLaughlin, joining in with their opinions. These differed from Wright's, who made a final comment addressing theirs.[29]

This paper was Wright's effort to tell the geological profession that although he was no longer chief geologist at Homestake, his theories had a place in the geological literature and mattered. He was confident that his predictions on where the ore bodies had gone would be proven correct, regardless of whether the ore was of Precambrian or Tertiary age. He wrote in his final comment: "It is hoped that full information on deep-level gold distribution may be made available, following which the accuracy of past predictions may be appraised and their bearing on this problem fully considered."[30]

Where did the Homestake eventually mine? Did they mine the area where Wright thought the ore continued? The answer is in the Homestake Company's records. ■

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Notes:

[1] Sidney Paige, "Geology of the Region Around Lead South Dakota and Its Bearing on the Homestake Ore Body," U.S. Geological Survey *Bulletin no. 765* (1924).

[2] A. L. Slaughter, "The Homestake Mine," in *Ore Deposits of the United States, 1933-1967*, v. 2 (New York: AIME, 1968), 1436-59. Stanton W. Caddey, Richard L. Bachman, Thomas J. Campbell, Rolland R. Reid, and Robert P. Otto, "The Homestake Gold Mine, an Early Proterozoic Iron-Formation-Hosted Gold Deposit, Lawrence County, South Dakota," U.S. Geological Survey *Bulletin 1857-J* (1991): 67.

[3] John Paul Gries, *Roadside Geology of South Dakota* (Missoula, MT: Mountain Press, 1996), 217. Caddey, "Homestake Gold Mine," J1.

[4] Lawrence B. Wright, *Fifty-Six Years of Exploration: A Search for Gold* (Lawrence B, Wright, 1974), 35-6.

[5] Wright, *Fifty-Six Years of Exploration*, 36.

[6] Wright, *Fifty-Six Years of Exploration*, 36-8.

[7] Clarence Kravig, "From Geologist to Assistant Manager, 1929-1971," oral history conducted by Eleanor Swent, 1993, in "Homestake Mine Workers, Lead, South Dakota, 1929-1993," Regional Oral History Office, Bancroft Library, University of California, Berkeley, 1995, 8-9.

[8] Donald H. McLaughlin, "Careers in Mining Geology and Management, University Governance and Teaching," oral history conducted by Harriett Nathan, 1970-1, Regional Oral History Office, Bancroft Library, University of California, Berkeley, 1975, 173.

[9] Mildred Fielder, *The Treasure of Homestake Gold* (Aberdeen, SD: North Plains Press, 1970), 275, 276-7.

[10] Fielder, *Treasure of Homestake Gold*, 276.

[11] Kravig, "Geologist to Assistant Manager," 11. McLaughlin, "Careers," 173.

[12] Fielder, *Treasure of Homestake Gold*, 277. Wright also mentions his promotion at the time McLaughlin came to Homestake in his memoirs, *Fifty-Six Years of Exploration*, 53-4.

[13] McLaughlin, "Careers," 95.

[14] Wright, *Fifty-Six Years of Exploration*, 53-4.

[15] Lawrence Wright to Donald McLaughlin, letter dated 14 Mar. 1927, Mary McLaughlin Craig/Skewes-Cox Papers, fl. 1879-1964, Arthur Lakes Library, Colorado School of Mines, Golden. In the letter, Wright refers to Clark directing him to correspond with McLaughlin monthly.

[16] Kravig, "Geologist to Assistant Manager," 11. J. O. Hosted and L. B. Wright, "Geology of the Homestake Orebodies and the Lead Area of South Dakota–II, *Engineering and Mining Journal-Press* 115, no. 18 (1923): 842. Donald H. McLaughlin, "Ore Genesis and Structure," *Engineering and Mining Journal* 132, no. 7 (1931): 325.

[17] McLaughlin-Craig/Skewes-Cox Papers. "A Tabulation of Facts Relative to the Homestake Ore Bodies. Agreed Upon by Dr. D. H. MacLaughlin [sic] and L. B. Wright," 3 July 1926.

[18] James A. Noble ("Ore Mineralization in the Homestake Gold Mine, Lead, South Dakota," GSA *Bulletin* 61 (1950): 221-52) offers a detailed analysis of the evidence and its interpretations.

[19] Wright to McLaughlin, letter dated 25 Apr. 1930, McLaughlin-Craig/Skewes-Cox Papers.

[20] Wright to McLaughlin, letter dated 25 Apr. 1930, McLaughlin-Craig/Skewes-Cox Papers.

[21] McLaughlin to Wright, letter dated 1 Apr. 1930, Wright to McLaughlin, letter dated 25 Apr. 1930, McLaughlin-Craig/Skewes-Cox Papers.

[22] McLaughlin to Wright, telegram dated 30 Apr. 1930, McLaughlin to Wright, letter dated 30 Apr. 1930, McLaughlin-Craig/Skewes-Cox Papers.

[23] Wright to McLaughlin, letter dated 21 May 1930, McLaughlin-Craig/Skewes-Cox Papers. Lawrence B. Wright, "Pressure Zones and Metal Deposition," *Engineering and Mining Journal* 129, no.12 (June 1930): 600-2.

[24] Wright, *Fifty Years of Exploration*, 54 (parentheses original).

[25] Lawrence B. Wright, "Geological Work during 1930," 8 Jan. 1931, McLaughlin-Craig/Skewes-Cox Papers, 4.

[26] McLaughlin, "Careers," 167.

[27] Duane A. Smith, *Staking a Claim on History: The Evolution of the Homestake Mining Company* (Walnut Creek, CA: Homestake Mining Company, 2001), 97.

[28] Kravig, "Geologist to Assistant Manager," 11.

[29] Lawrence B. Wright, "Gold Deposition in the Black Hills of South Dakota and Wyoming," *AIMME Transactions* 126 (1937): 390-414. The written discussion appears on pages 415-25.

[30] Wright, "Gold Deposition," and discussion, 390-414, 425.