

THE CHEMIST AS CONSULTANT IN GILDED AGE AMERICA

Benjamin Silliman, Jr. and Western Mining

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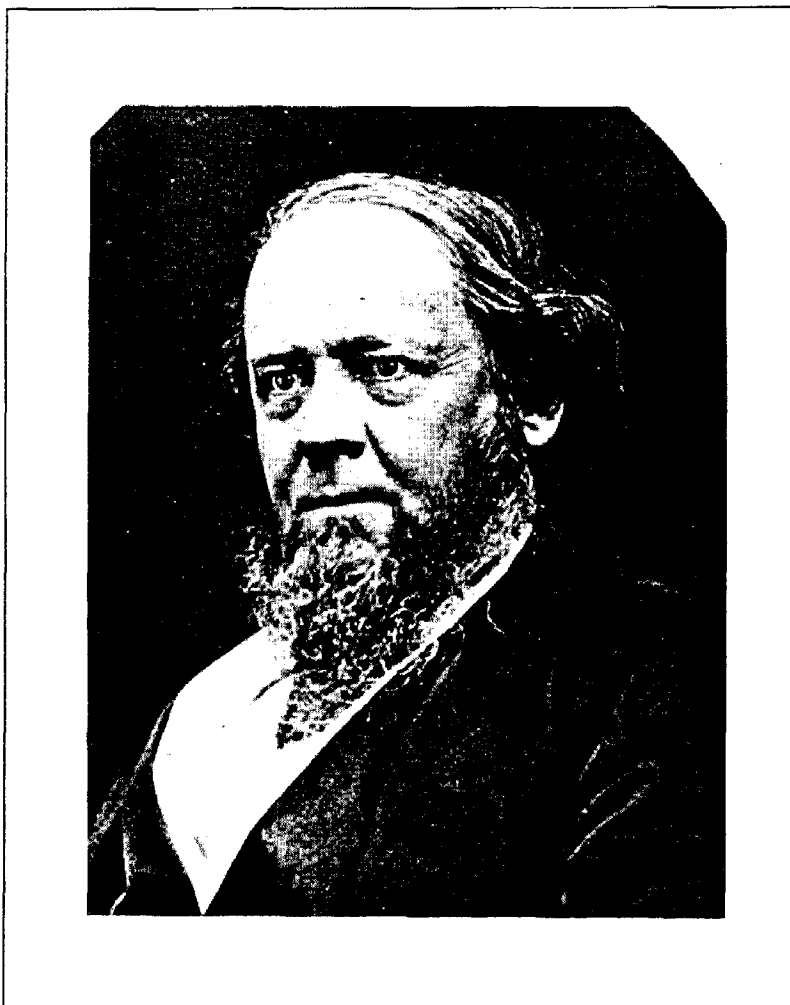
The role of scientists in the growth and development of the American West has only recently emerged as a topic for historical investigation. Although scientists remained an important part of Western exploration, settlement, and economic development throughout the 19th century, historians have generally focused on supposedly more dramatic events surrounding military expeditions, gold rushes, and overland migration. For the historian of chemistry, however, the American West provides many examples of the profession's significance in the development of the region. Among the more important of chemists' activities was their service as consultants to the mining industry which increasingly represented the region's economic base. Mining consultants proved particularly valuable to the industry in two respects. Their scientific knowledge allowed them to suggest more efficient methods to extract and process ores. Equally important, however, favorable reports from consultants would help to attract new investors, who became increasingly important as western mining evolved from placer to hard rock techniques (1). Among the most intriguing of these consultants was the Yale chemist Benjamin Silliman, Jr. (1816-1885).

The younger Silliman descended from a distinguished New England family which included his father, one of the most eminent scientists of the first half of the 19th century. Benjamin, Sr. (1779-1864) served in various faculty positions at Yale and published a standard chemistry text, *Elements of Chemistry*, in 1830 (2). Perhaps his most important contribution to the growth of American science, however, was the establishment of *American Journal of Science and the Arts*, the first issue of

which appeared in 1818. Benjamin, Jr., early expressed interest in scientific matters and, after graduation from Yale in 1837, assisted his father while pursuing graduate studies, receiving the master of arts degree in 1840.

Silliman continued to assist his father for the next half dozen years, after which he gained a faculty appointment as "professor of chemistry and the kindred sciences as applied to the arts." During the next decade, he was primarily concerned with the organization of the Yale (later Sheffield) Scientific School, in which he taught chemistry, mineralogy, and metallurgy. After his father's retirement in 1853, the younger Silliman became professor of general and applied chemistry, as well as giving chemistry lectures in the medical department of Yale College. Silliman was also active in the editorial work of the *American Journal of Science*, serving in various positions from 1838 until his death. In 1847, he published the text, *First Principles of Chemistry*, which appeared in two later editions with a total sales of some 50,000 copies. Silliman wrote another successful text in 1859, *First Principles of Physics, or Natural Philosophy*, revising this volume in a second edition two years later (3).

Because of his interest and expertise in applied science, Silliman frequently served as a consultant to government, business and industry. During the 1840s and 1850s, Silliman travelled throughout the eastern United States, pursuing various mineralogical and chemical investigations. Among the most important of these early activities was his examination of petroleum deposits in Venango County, Pennsylvania, in 1855. Silliman's report on these deposits focused on methods of distillation



Benjamin Silliman, Jr. (1816–1885) (Photo in Polit. Hist.)

and the potential uses of refined petroleum, encouraging the investors who had hired him. Two years after the publication of this report, Edwin Drake initiated the exploitation of the Pennsylvania oil fields by drilling his famous well. Silliman's later consulting activities involved him with diverse clients, including the city of Charlestown, Massachusetts, and a group of mining companies interested in Nova Scotia gold deposits (4). The most dramatic examples of Silliman's consulting activity, however, emerged from the several trips he made to the Far West beginning in the mid-1860s. Focusing on mining and petroleum properties, Silliman became involved in numerous efforts to attract capital to this underdeveloped region, frequently with unanticipated and discouraging results.

Silliman's first western trip began in mid-March 1864 when he sailed from New York with his assistant Frank Semple, a Yale chemistry student. Planning for this trip had begun a few months earlier, after Silliman agreed to examine mining properties for several Philadelphia investors. The major investor in this group was Thomas A. Scott, a vice president of the Pennsylvania Railroad and a well-known promoter of petroleum and mining ventures. Among the properties Silliman was to investigate for Scott were mineral deposits in northwestern Arizona and the New Almaden Quicksilver Mine south of San Jose, California. The Yale professor had also signed a contract with the New York banking firm of Duncan, Sherman & Company, who were primarily concerned with the potential value of gold deposits in

Bodie, Nevada. Small-scale mining activity had been evident in Bodie since 1860, leading the New York bankers to solicit Silliman's opinion concerning these properties. Although hired by two separate concerns, Silliman would be free to arrange other consulting activities once he reached the West Coast.

Arriving in San Francisco on 9 April, Silliman quickly began his western investigations. By the end of the month, he had examined mining properties near Sacramento, visited the mines in Virginia City, Nevada, and travelled to Bodie to gather information for his New York employers. Silliman's report proved extremely enthusiastic, leading to the incorporation of the Empire Gold & Silver Mining Company and his own decision to file a mining claim. Silliman then returned to Virginia City in early May to examine the Potosi Mine. His report encouraged the Potosi owners to continue their mining and milling activities in an effort to tap the rich deposits Silliman assured them were present. The Yale chemist also examined mines in Aurora, Nevada, northwest of Bodie, and revisited Scott's New Almaden Quicksilver Mine before returning to San Francisco's Occidental Hotel on 11 May (5).

Easily securing new clients, Silliman remained in San Francisco only a few days before beginning his second western journey. The last two weeks of May found Silliman at the Mariposa Estate on the Merced River, investigating the gold mines of the Mariposa Mining Company. The directors of this company had paid him \$1500 to visit the mines and prepare a report, which estate superintendent Frederick Law Olmsted found encouraging. During early June, Silliman was back in Virginia City, serving as an expert witness for the famous Gould and Curry Mine in a title suit between his clients and the North Potosi Mine. Silliman's testimony, in which he argued that the Comstock Lode represented one ledge rather than many, convinced the referee to support the Gould and Curry claim. On his way back to San Francisco, Silliman examined mining properties in the Placerville area of California, further establishing himself among mining investors and promoters (6).

Silliman spent the next month examining various properties in California before beginning his next major trip in mid-July. Scott's mining claims in the Fort Mohave region of Arizona had been of intense interest to the Philadelphian since the spring of 1863, when California business associates informed him of promising gold strikes in the area. Quickly organizing mining companies to take advantage of this information, Scott dispatched a preliminary exploring party in December of 1863, shortly before he arranged for Silliman to investigate the mineral deposits more closely. After the

difficult desert journey from Los Angeles to Fort Mohave, Silliman spent ten days investigating the various mining claims along the Colorado River. Although his examination of these claims led to occasional optimistic statements, the gold and silver deposits in northwestern Arizona proved inadequate to justify significant development (7).

After his return from the desert, Silliman continued his consulting activity in California and Nevada. Between mid-September and the end of the year, he examined Nevada's Reese River mining region, approximately 170 miles east of Virginia City, and returned to the latter location to examine further the Comstock Lode. In the employ of a new client, the Empire Mill and Mining Company of Gold Hill, Silliman expressed optimism concerning the long-term prospects of the Comstock Lode, despite its recent decline in production. Silliman spent the next six weeks in California, surveying mines in the Mother Lode region of Sierra and Nevada counties. He was particularly impressed with the gold-bearing quartz veins in the Grass Valley region, becoming part of a syndicate which later purchased the Eureka Mine. Although Silliman intended to return to the East via the Idaho and Colorado mining regions, he cut short his western trip after learning of the death of his father. Quickly completing a few remaining tasks, Silliman left California in early January, arriving home by the end of the month (8).

The last few months of Silliman's western trip, however, involved him in a new venture which would have far-reaching consequences. Upon his return from the Arizona desert, Silliman increasingly focused his efforts on the petroleum deposits of southern California, again at Scott's request. From his initial investigation of Rancho Ojai, seven miles east of Ventura, Silliman emerged as one of the most optimistic observers of the area's oil lands and encouraged Scott and his associates to invest heavily in southern California. Silliman's report on the Ojai property served as the basis for the prospectus of the California Petroleum Company, which Scott capitalized at \$10,000,000. The Yale chemist's positive comments on other oil properties not only convinced Scott to purchase various holdings, but also fueled the speculative orgy which characterized the southern California oil boom of the mid-1860s. Unfortunately for Silliman's reputation, the boom collapsed almost as rapidly as it inflated, leading investors to question Silliman's optimistic reports. Rumors of salted petroleum samples and negative comments concerning Silliman's scientific integrity also surfaced, casting gloom over the Yale professor's trip (9).

Despite the long-term difficulties Silliman would face as a result of his western journey, his trip nonetheless proved profitable. Several articles based on his investigations appeared in the *American Journal of Science*, accompanied by three papers read at meetings of the National Academy of Sciences (10). Equally important, Silliman gained a significant amount of financial security from his initial western trip. His consulting work in the West netted him \$40,000 in gold from more than two dozen clients. When added to fees from his earlier work in Nova Scotia, Silliman's consulting income for 1864 was over \$54,000 as contrasted with his Yale salary of less than \$3000. Later reports and commissions from his western endeavors brought Silliman nearly \$30,000 during 1865 (11). Not surprisingly, his connections with Eastern capital led Silliman to extol the virtues of outside investment in the Far West. In a letter to his wife written a few days before Christmas, 1864, Silliman contrasted the outlook of southern Californians with the dynamic perspective of his clients. Echoing a common sentiment among Eastern observers viewing the Hispanic traditions of California, Silliman referred to "semi barbarous Santa Barbara" and told his wife that he had been indirectly responsible for "doing an incalculable benefit to California" by encouraging people like Scott to invest in the state. Silliman emphasized that outside capital would result in "the opening of a new era of material prosperity" for California, as well as introducing "entirely new and improved social and moral elements into a part of the State hitherto sunk in the deepest Spanish degradation." He expressed similar observations of the importance of capital to California in a letter to the *New York Times* on 17 March 1865. Describing mining activity in California and Nevada, he stressed that "cheap capital is much needed in California," and predicted that the investment of such capital would be "amply rewarded" (12).

Silliman's interest in and devotion to the economic aspects of western mining and petroleum development may well have clouded his professional judgment, as a growing number of critics suggested after his return to New Haven. In fact, Silliman spent most of the rest of his life attempting to regain the scientific credibility which had been damaged by his association with questionable enterprises in the Far West. The southern California oil fiasco was, perhaps, the most dramatic of these unfortunate events, but Silliman's western trip also involved him in similar difficulties with mining ventures. His optimistic report on the Bodie area served as an important part of the 1864 prospectus issued by the Empire Gold & Silver Mining Company to promote the

sale of 10,000 additional shares to gain funds for development. Although this sale brought some \$300,000 into the company's treasury, the sum proved inadequate to make the Bodie mines profitable. By the end of 1865, Bodie was virtually deserted, once again involving Silliman in a seemingly fraudulent venture. Silliman's identification with questionable western enterprises led to a decline in his reputation at Yale as well. Questions concerning his scientific integrity led to a gradual ostracism by many of his colleagues and Silliman's decreasing activity in the affairs of the college. By 1870, he had resigned from both the Sheffield Scientific School faculty and the academic department of Yale College, although he continued to lecture in the medical department until his death (13).

The various challenges to Silliman's credibility and integrity led him to arrange another trip to California in the spring of 1867. Although he described the purpose of the trip as an effort to clarify the salted petroleum sample incident, Silliman provided no new information and became primarily concerned with various mining endeavors in the Mother Lode country. This trip proved much less profitable than his first journey, as potential clients appeared wary of hiring a consultant whose reputation had declined. Silliman investigated various mineral deposits in Calaveras County, joining investors from San Francisco and Grass Valley in the development of gold and silver deposits at Quail Hill. Pledging his own Eureka Mine stock, he lost heavily in the Quail Hill efforts, as did other investors. The Yale chemist's second western trip ended in early January 1868 and proved both economically and professionally disappointing (14).

Silliman's next major western adventure focused on the famous Emma Mine south of Salt Lake City. In October of 1871, he travelled to the Utah mine in the employ of investors who hoped to tap the intense British interest in mining ventures. First located in 1868, the Emma Mine remained largely undeveloped because of the lack of capital, a situation Silliman's employers hoped to rectify through a favorable report on the property. The Yale chemist examined the property, preparing a favorable report and, later, a technical article for the *American Journal of Science*. The London firm coordinating the investment activity in Britain arranged for the telegraphic transmission of Silliman's report from Utah at a cost of \$3000 and published it as part of the prospectus the following month. The prospectus led to heavy investment in the Emma Silver Mining Company, with shares floated in London for more than one million pounds. Such investment success more than just-

fied Silliman's fee of \$25,000 for this and a planned second trip to Utah.

The publicity surrounding the Emma Mine encouraged investment in other Utah properties, leading to a minor boom in the region and continuing to attract investors to the Emma Mine. Silliman thus made his second trip to Utah in February of 1872 to examine recent improvements. He reported that the mine was in much better condition than it had been the previous fall, further encouraging investors and indicating that the Utah property had great promise (15). Unfortunately for Silliman, the Emma Mine failed to live up to his optimistic evaluation. As 1872 turned to 1873, the Emma ore body appeared to be playing out, calling Silliman's reports into question. The Utah situation also suggested damaging parallels to Silliman's earlier involvement with the California oil fiasco and the failure of the Bodie mining properties. Silliman's position became even more precarious as 1873 wore on, as the financial panic of that year led to a disappearance of investment capital which crippled the growing Utah mining industry. That year also witnessed the exposure of the Emma Mine promotion as one of the major swindles of the time. The suspension of dividends in the company in late 1872 raised various questions which, over the next year, convinced many observers that the sole purpose of the Emma promoters was to sell stock in the mine at inflated prices. Silliman's favorable reports had supplied them with the scientific gloss of great value in such schemes.

Silliman's role in the Emma Mine scandal seriously damaged what was left of his reputation. Colleagues at Yale continued to see him as an embarrassment to the college, despite his nebulous connection with the academic program. Several fellow members of the National Academy of Sciences (Silliman had been one of the original 50 members of the Academy) were sufficiently angered at Silliman's involvement with various questionable enterprises that they began a campaign in late 1873 to oust him from the organization. Although unsuccessful, the campaign which lasted several months provided clear evidence of Silliman's declining reputation. Press reports of the Emma Mine scandal frequently mentioned Silliman's role, occasionally reminding readers of his earlier difficulties in California and Nevada (16).

By 1876, continued rumors and disclosures of the Emma Mine scandal had led to a Congressional investigation before the House Committee on Foreign Relations. Information reached the committee that Silliman had been paid a large sum of money as a contingency fee after the sale of Emma stock. In letters to and tes-

timony before the committee, Silliman vigorously denied this charge, carefully detailing the \$15,000 fee he had received for his initial visit and emphasizing that his expenses of \$5000 had been paid out of this sum. During his testimony before the committee on 9 March, Silliman also repeated his belief that the Emma Mine was not the worthless property some had charged. The potential of the mine remained significant, he told committee members. According to the *New York Times* reporter covering the hearings, Silliman's testimony was well received by the committee and removed much of the suspicion that he had been an active participant in what the *Times* had earlier called "that very gross swindle" (17).

After the Emma Mine controversy died down, the remaining decade of Silliman's life proved much less contentious. He continued his connection with Yale through his position in the medical department and remained active as a consultant to various private ventures and public agencies. His consulting work led to several more western trips to investigate mineral properties, as well as to various publications and presentations. In November of 1880, for example, Silliman presented two papers at the National Academy of Sciences meeting in New York, one of which provided an intensive examination of the structure of gold-bearing veins. From his own and others' field work, Silliman also published widely on mineralogical topics. His articles on various minerals from Arizona and turquoise from New Mexico both appeared in the 1881 volume of the *American Journal of Science*. Although Silliman began to suffer from heart disease at about this time, he continued to travel extensively as a consultant, making two more trips to New Mexico. Beginning in October of 1884, however, Silliman's condition slowly deteriorated from a combination of heart disease and pneumonia. He died in New Haven on 14 January 1885 (18).

Silliman's career as a scientific consultant provides an intriguing glimpse into the role played by chemists in both the history of the West and the history of America's Gilded Age. Although academic employment remained important to chemists of the period, consulting opportunities were prevalent and profitable. Whether contributing technical expertise to improve production methods or writing favorable reports to encourage investment, consulting chemists were actively involved in the development of the mineral deposits of the Far West. The career of Benjamin Silliman, Jr., which usually focused on the financial aspect of this development, shows the risks as well as the benefits which came from consulting work. His optimistic reports on mining and

petroleum properties led to involvement with questionable investment schemes and seriously damaged his reputation. Heir to one of the great family names in the history of American science, the younger Silliman became better known as an accomplice in the economic excess which characterized the Gilded Age.

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REFERENCES AND NOTES

1. G. T. White, *Scientists in Conflict: The Beginnings of the Oil Industry in California*, Huntington Library, San Marino, CA, 1968, pp. 47-48.
2. For Benjamin Silliman Sr., see G. P. Fisher, *Life of Benjamin Silliman*, 2 Vols., Scribner, New York, NY, 1866; J. F. Fulton and E. H. Thomson, *Benjamin Silliman, 1779-1864, Pathfinder in American Science*, Schuman, New York, NY, 1947; E. H. Thomsen, Ed., *Benjamin Silliman and His Circle*, Science History Publishers, New York, NY, 1979; and C. H. Brown, *Benjamin Silliman, A Life in the Young Republic*, Princeton University, Princeton, NJ, 1989.
3. A. W. Wright, "Biographical Memoir of Benjamin Silliman, 1816-1885," *National Academy of Sciences Biographical Memoirs*, 1911, 7, 117-120, 128-129.
4. *Ibid.*, 126-127, 138.
5. Reference 1, pp. 46-51.
6. Reference 1, pp. 52-55. Details of the Gould & Curry suit may be found in E. Lord, *Comstock Mining and Miners*, Howell-North, Berkeley, CA, 1959 (orig. pub. 1883), pp. 165-171.
7. G. E. Webb, Ed., "The Mines in Northwestern Arizona in 1864: A Report by Benjamin Silliman, Jr.," *Arizona and the West*, 1974, 16, 247-270. Silliman's report appeared as "On Some of the Mining Districts of Arizona near the Rio Colorado, with Remarks on the Climate, &c.," *Am. J. Sci.*, 1866, 41, 289-308.
8. Reference 1, pp. 67-71; G. E. Webb, Ed., "Benjamin Silliman's Visit to California: A Letter to His Wife," *Southern California Quarterly*, 1977, 59, 378.
9. Reference 1, pp. 60-67, 74-142. Also see Webb, reference 8, pp. 365-368.
10. Reference 3, p. 138.
11. Reference 1, pp. 71-73; Webb, reference 7, p. 252.
12. Webb, reference 8, pp. 370-371, 374; *New York Times*, 17 March 1865.
13. Reference 1, pp. 48-50, 152-154; reference 3, p. 122.
14. Reference 1, pp. 109, 130-136.
15. C. C. Spence, *British Investments and the American Mining Frontier, 1860-1901*, Cornell, Ithaca, NY, 1958, pp. 142-143; R. W. Paul, *Mining Frontiers of the Far West, 1848-1880*, Holt, Rinehart and Winston, New York, NY, 1963, pp. 152-153. Also see B. Silliman, "Geological and Mineralogical Notes on Some of the Mining Districts of Utah Territory . . .," *Am. J. Sci.*, 1872, 3, 195-201.
16. Reference 1, pp. 166-172; *New York Times*, 6 March 1874. Good discussions of the Emma Mine scandal are Spence, reference 15, pp. 139-182 and W. T. Jackson, "The Infamous Emma Mine: A British Interest in the Little Cottonwood District, Utah Territory," *Utah Hist. Quart.*, 1955, 23, 339-362.
17. *New York Times*, 16 Mar 1874; 3, 10, 13, 17 March 1876; 19 April 1876.
18. Reference 3, pp. 130-133; *New York Times*, 17 November 1880; B. Silliman, "Turquois of New Mexico," *Am. J. Sci.*, 1881, 22, 67-71; B. Silliman, "Mineralogical Notes," *ibid.*, 198-205.

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