

**“American Mining Engineers in the Kimberley and Witwatersrand Mines  
*circa* the turn of the 20<sup>th</sup> Century”**

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**Background**

The history of American mining, particularly in the shallow and deep lodes of the western United States, was in very many ways similar to that of South African mining, especially in Namaqualand, Griqualand West, and the Transvaal. Some of the illuminating American parallels were:

- the warring with indigenous Indian tribes, defeating them by force of superior arms and taking their lands and livestock;
- forming diggers’ committees which administered diggers’ justice and barred Indians and Mexicans, from whom the land had been taken, from staking any claims;
- the working of shallow claims with little capital and labour, rudimentary equipment and no skills until the beginning of deep-lode mining and formation of large mining companies, to which flocked many immigrant labourers, greater amounts of domestic and foreign capital (especially from Europe), large machinery and the indispensable skilled Cornish mining artisans; and
- the encouragement of Chinese labourers. These were initially welcomed as buyers of worked-out shallow claims and later tolerated on large deep-lode mines, only to be driven off, violently in some cases, by white labour and some state legislatures as potential competition for white American labour.<sup>1</sup>

Some of the major differences between the histories of western mining in the United States and mining in the Cape Colony and Transvaal were the times when the discoveries occurred and development of the mines took place, and the scale of operations. Placer mining started in California in 1848, two years before opencast copper mining began in Namaqualand. When deep-level mining began on the Comstock lode in Nevada around 1850, copper mining in Namaqualand had just started, diamonds had hardly been discovered, and Griqualand West

did not exist. When the silver–lead lodes of Coeur d’Alene in Idaho were discovered in 1885 and the Bunker Hill and Sullivan Mining and Concentrating Company was formed,<sup>ii</sup> the Struben brothers in the Transvaal had discovered the ‘Confidence Reef’ but knew nothing about the main reef series. American mining was advanced when South African mining was beginning, and British mining capital recognised and appreciated this fact.<sup>iii</sup>

### **Institutionalisation of Mining Engineering**

The rapid advance in mining in the United States was helped by the institutionalisation of the teaching of engineering in some colleges and universities, such as the Lawrence Scientific School at Harvard, Massachusetts Institute of Technology, Columbia College, and the University of California whose engineering curricula dated back to the 1860s.<sup>iv</sup> By 1876, the number of educational institutions in the United States teaching mining engineering had increased to fourteen, although nothing was published about the curricula of mining and metallurgy in these and other schools until 1886.<sup>v</sup> In the meantime, a few of the earlier graduates of these programmes had continued their studies abroad at several prominent European mining academies in Germany and France, particularly at the *Königliche Sächsische Bergakademie* (the Royal Saxony Mining Academy). This institution was respected for its programme which emphasised both theory and practice, the former consisting of courses such as mining engineering, metallurgical engineering, mine surveying and metallurgy, and the latter covering actual mining and smelting during the spring and summer.<sup>vi</sup> Combining the experience of respected foreign schools with domestic circumstances and needs, American mining schools developed to a point where US President Herbert Clark Hoover (1929–1933) wrote in his *Memoirs*:

It was the American universities that took engineering away from the rule-of-thumb surveyors, mechanics, and Cornish foremen and lifted it into the realm of applications of science, wider learning in the humanities with higher ethics of a profession ranking with law, medicine, and the clergy.<sup>vii</sup>

Another factor that facilitated the development of mining was the founding of the American Institute of Mining Engineers (AIME) around 1868, which was a powerful medium for disseminating information on mining and metallurgy.

As a result of learning the traditional Cornish artisanal mining skills, increasing the

introduction of technical education in colleges, and working in various mines both in the United States and abroad, American mining engineers emerged in the late 1880s as the most sought-after superintendents or mine managers, consulting engineers, and evaluators of mining properties and investments. British mining capital wanted them and was willing to pay handsomely<sup>viii</sup> for their services in the United States,<sup>ix</sup> South America, Africa, Asia and Australasia. In 1886, Richard Rothwell, editor of the *Engineering Mining Journal*, wrote:

Every year brings a wider recognition of the fact that in mining and in practical metallurgy, our American engineers are the most successful and economical in the World, and their services are in request in nearly every country of the world. The difficult and unusual conditions under which they have been forced to carry on their work have developed an ingenuity and fertility of resources, that, guided as they now are by very thorough scientific training, have made the American mining engineer and metallurgist the most successful in the world.<sup>x</sup>

John H Curle, a British engineer-author and regular contributor to *The Economist* on issues affecting gold, called this period from around 1890 to 1914 '[t]he Elizabethan Age of gold mining ... short and brilliant, like its prototype in dramatic literature'.<sup>xi</sup> Herbert Hoover referred to it as the 'Golden Age of American mining engineers in foreign countries ... during which their services were in demand at premium prices'.<sup>xii</sup>

### **American Mining Engineers Abroad**

The expedient marriage between American mining engineers and British mining capital during this period seems to have begun with an invitation extended to Baron Edmond de Rothschild by Hamilton Smith, an American mining engineer who was president of the North Bloomfield hydraulic mine in California, to visit this operation late in the 1870s.<sup>xiii</sup> After this meeting Hamilton Smith became consulting engineer for the Rothschilds in Paris and London, where he was based. He recruited another American mining engineer, Edmund De Crano, and together they formed the London Exploration Company, which was backed by

the Rothschilds.<sup>xiv</sup> It was on De Crano's recommendations that the Rothschilds gave Cecil Rhodes the funds to purchase the last diamond mining firm holding out against amalgamation, and achieve complete control over the whole Kimberley mine. It was also through the London Exploration Company that Gardner F Williams was recruited from California, first for the Transvaal Gold Exploration and Land Company in the Lydenburg district, and then for the job of managing De Beers Consolidated Diamond Mines for Cecil Rhodes's syndicate. Henry C Perkins was also recruited by Smith and De Crano and recommended by Lord Rothschild to Lord Randolph Churchill to accompany the latter on his visit to South Africa and Mashonaland in 1891, shortly after Cecil Rhodes's British South Africa Company (BSA Co.) had expropriated all of Mashonaland.

London was the principal centre for organising and deploying vast sums of British mining capital, accompanied by highly ranked and experienced American mining engineers, to the many different mines of the world, including those in South Africa. The other method whereby American mining engineers went to South Africa was through the actions of those already managing various properties on the Witwatersrand, who wrote to friends, colleagues, and former professors in the United States inquiring about and requesting the dispatch of men with specific qualifications and skills.

### **American Mining Engineers in South Africa**

American mining engineers who went to South Africa through the good offices of their colleagues in London, Kimberley and Johannesburg came from many different mines in and outside of the United States. The most important mines in the United States from which some of them graduated and gained valuable experience in managing mines and mills on a large scale were: the North Star in Grass Valley, California; the Standard Consolidated at Bodie, also in California, known for pioneering work in the use of the cyanide process and electrical transmission; Bunker Hill and Sullivan in Idaho, which produced John Hays Hammond, Victor M Clement, and Fred W Bradley; and the North Bloomfield in Nevada County, California, which turned out men like Hamilton Smith, Henry C Perkins and James Hennen Jennings.<sup>xv</sup> Outside the United States, the most pertinent mine was the El Callao gold

mine in Venezuela whose superintendency had been under Henry C Perkins, Hennen Jennings, George E Webber and Barry Searls. Others who worked on or near the El Callao mine in other capacities were Thomas Mein, who was Perkins's first mine-captain at El Callao before becoming a mine manager at the Nacupai mine nearby; Louis Seymour, who was Perkins's assistant in mechanical engineering; Maurice Robeson, who was mechanical engineer at Nacupai and El Callao mines; EA Blanton, who was an expert on milling at the Union mine in the El Callao district; and Richard Bowen, John Walsh, J Klimke (former surveyor at El Callao) and FHP Cresswell of the Chile mine.<sup>xvi</sup> All these men went to occupy mine management and specialist positions in some of South Africa's dominant mining groups.

The El Callao Mine in Venezuela features prominently as a bench mark American mining engineers applied in their work on the Witwatersrand gold mines. This mine was situated about 150 miles (241.395 kilometres) south of the Orinoco River, in a latitude of about 7 degrees north of the equator, without any railway communication, and with very bad roads, and in its early history was considered most unhealthy; so high wages had to be offered to induce skilled men to come to the mining site. This mine was pertinent in the way it prepared its American mining engineers, particularly mine managers for the South African mines. Hamilton Smith, consulting engineer for the El Callao, wrote in the 1884 report of the mine's operations:

In 1884 a new regime was started, and high grade machinery with increased stamping power, and high grade men put to work, the Company giving them a free hand and every encouragement to do their best, and expenses were lowered in eight years from £6 2s. 3d. to £1 19s. 9d. per ton. The cardinal feature in this reduction was the improvement in machinery and mining methods, but another was the encouragement of negro labour obtained from the West Indian Islands. At first this class of labour was considered hopelessly incompetent, but by patient training and judicious graduation of wages in proportion to work done, it was finally possible to run the mine with 11 and a-half per cent of the white labour the mine originally required, and the blacks were better able to stand the climate. The Government of Venezuela, which was not in sympathy with the alien mining population, believed in high and onerous tariffs, monopolies and concessions, and did very little to foster the industry, in fact tried in every way to extort as much as possible out of it. The present unfortunate condition of the mining industry there is, I think, in no small measure due to the attitude of the Government.<sup>xvii</sup> The ruling rates of wages during the late years, when good

work has been done are:

White, average per month	35 pounds (This does not include the Superintendent)
Blacks, per day	6 shillings and 6 pence

These conditions were quoted by Hennen Jennings in 1897 before the Transvaal Mining Industry Commission, which was inquiring into the grievances of the gold mining industry under the South African Republic regime. He found that the conditions prevailing in the South African Republic were similar to those he had encountered in Venezuela, and the experience of the United States in dealing with its black populace was instructive for the Republic to consider emulating. Jennings used the Venezuelan example to draw attention to the factors responsible for the high cost of mining which had led to the closing of mines, including the El Callao gold mine.

When Jennings left El Callao in Venezuela in 1889 he went to London where he was appointed by the firm of Jules Porges & Company – the predecessor to Wernher, Beit & Company, the parent firm of Hermann Eckstein & Company – and proceeded to the Witwatersrand.<sup>xviii</sup> Having developed close relations with Gardner F Williams in Kimberley, the Eckstein firm had solicited his advice in suggesting the ‘ablest’ American mining engineers for their Witwatersrand mining properties. Williams recommended that they contact Hamilton Smith and Edmund De Crano in London, who then wrote to Hennen Jennings and prevailed on him to take the Eckstein appointment.

Other leading American mining engineers recruited by the Eckstein group of mining companies for the Witwatersrand during the early years between 1887 and 1903 included Joseph S Curtis, 1887; Sidney J Jennings (Hennen Jennings’s brother), 1889; Charles Butters, 1890; Thomas Mein, 1891–1892; and George E Webber 1893–1894.<sup>xix</sup> Another American mining engineer, who was perhaps as instrumental as the Smith and De Crano firm in recruiting his peers for the Witwatersrand mining capitalists, was John Hays Hammond.<sup>xx</sup> He also first went to the Witwatersrand via London, where the firm of Barnato Brothers hired him in 1893 to manage their Witwatersrand mining properties. By 1894 he had joined the Consolidated Gold Fields of South Africa as chief consulting engineer, and through him

numerous prominent American mining engineers went to the Witwatersrand.<sup>xxi</sup> His papers contain letters introducing American mining engineers visiting South Africa to other American colleagues who were managing numerous mines on the Witwatersrand;<sup>xxii</sup> and letters to friends engaged in mining in the United States, asking them to recommend the best mine managers, shaft sinkers, skilled miners and foremen, and offering to pay travel expenses, high salaries, bonuses and other incentives,<sup>xxiii</sup> and advice to Fraser & Chalmers on how to compete with British firms and win more orders for mining machinery, with an offer to help in the process. In a letter dated 18 October 1894 and written by Eben E Olcott, a New York City-based mining engineer, to Enoch Kenyon of Johannesburg, Olcott mentioned that a subordinate of Hammond had purchased electric hoists from General Electric, visited drum and shaft manufacturers in Akron (Ohio) and EP Allis Company of Milwaukee for electrical transmission equipment, and inspected the Anaconda works in Montana before returning to Johannesburg.<sup>xxiv</sup> The other mining groups also recruited their American experts, among whom were Thomas H Leggett, Fred Hellman and Dr George F Becker of the United States Geological Survey, who conducted a geological survey for the Neumann group of mining companies.<sup>xxv</sup>

There was also a sizable contingent of British mining engineers and geologists and a few experts from Europe who were on the Witwatersrand for the express purpose of evaluating its gold mines, including the industry's prospects. They included Professor L de Lauray of the *Ecole de Mines* in Paris and Bergrath Schmeiser, a German government engineer. Nevertheless, the Americans were dominant. This fact was referred to in frustration and anger by some Britishers as 'the Americanisation of British mines'.<sup>xxvi</sup>

### **Notable contributions by American mining engineers**

Some of the notable contributions American mining engineers made to the Witwatersrand gold mining industry in its formative years were:

- the introduction of one or two large inclined shafts by Hennen Jennings toward the end of 1889;<sup>xxvii</sup>
- the significant advances in the speed with which larger shafts were sunk, especially by

Leslie Simpson and his crews at the Robinson Deep Mine, where they set world records;<sup>xxviii</sup>

- the introduction of the ‘direct treatment method’ by Hennen Jennings, in which all the pulp from the battery was passed through *spitzluten* (hydraulic classifiers) where the slimes were eliminated and the rest of the pulp run directly into the leaching tank to be treated with cyanide;<sup>xxix</sup>
- the introduction by Charles Butters of the bottom discharge in the treatment of large accumulations of tailings by the MacArthur-Forrest cyanide process;<sup>xxx</sup>
- the introduction of electric power, which replaced steam power in hoisting operations, by Maurice Robeson;
- the adoption of a uniform mapping scale that used either feet or metres, and had proportions such as 1:500 or 1:1000 instead of 1 inch to 40 feet;<sup>xxxi</sup> and
- the founding of a number of professional and technical associations (and companion journals) such as the South African Association of Engineers and Architects in 1891, the Association of Mine Managers in 1892, the Chemical and Metallurgical Society of South Africa in 1894, and the South African School of Mines and Technology in 1896.

In addition to these contributions, the scientific, technical and organisational experience of American mining engineers in managing large-scale operations were critical factors in the development of the Witwatersrand gold mining industry from 1890 into the period 1902–1910. For those like Hennen Jennings and others who came directly from the El Callao Gold mine in Venezuela, the South African Republic’s underdevelopment, the adversarial relationship between its regime and mining capital, the difficulties and exorbitant transportation costs incurred in bringing in mining machinery and equipment, the importation of black labourers to the gold mines, and the frequent reduction of black wages in order to maintain profitability were all very familiar problems and methods. And for both former employees of El Callao and those mining engineers who came directly from the United States, the hierarchical division of labour based firstly on race, secondly on skills, and thirdly on increased differentiation of tasks, particularly in deep-level mining, were also recognisable

features. At an earlier period, western alluvial and hard-rock mines of the United States had used skilled and unskilled white and Chinese labour, and a greater division of labour, during the opening up and development of deep-lode mines.

The Mine Managers' Association of the Witwatersrand, pioneered by American mining engineers in 1892, was characterised as being an intermediary between capital and labour and of providing important services, such as:

- ... an interchange of experiences upon such subjects as
  - (1) the relative advantage of employment of white or kafir labour in the various departments of mining work,
  - (2) the introduction of the contract [tribute] system [white skilled miners commanding gangs of African labourers performing piece-work],
  - (3) the efficiency and economy of hand as opposed to machine drilling [by Africans]
  - (4) the numerous problems presented in mill management ...<sup>xxxii</sup>

Apart from the obvious racial attitudes mine managers exhibited they were also very anti-trade unions, even when the latter were exclusively white. Again, some of these mining engineers had achieved notoriety in the United States as being totally and actively opposed to combinations by labourers, and in some cases played leading roles in breaking up strikes, before they went to the Witwatersrand.<sup>xxxiii</sup> These attributes, functions and experiences of American mining engineers, and their contributions to the state of the art in gold mining, all helped in some ways to shape the labour structure that evolved on the Witwatersrand gold mines between 1890 and 1899.

### **Some Revealing Observations**

“Johannesburg, in the Transvaal is like an American city, and is the center of the mining industry.”

*The Engineering and Mining Journal* December 3, 1887

“... many of the leading men in Johannesburg are Americans; indeed, the mining industry is chiefly under the guidance of American mining engineers.”

*The National Geographic Magazine* November, 1896

“The place (Witwatersrand) has an attraction for the American. It has size in its favour; its plant is designed on a large scale – on an American scale.”

*The South African Mining Journal* April, 1907

The first quote is from a brief news piece written by Richard P Rothwell and Rossiter W Raymond, two of America’s distinguished mining engineering writers who were co-editors of *The Engineering and Mining Journal* (E&MJ) which was based in New York City. Rothwell and Raymond were informing their readership in general terms how the diamond mines of Griqualand West (especially Kimberley) and the gold<sup>xxxiv</sup> mines of the Transvaal (the Witwatersrand in particular) had attracted capital and labour from nearly every part of the world as well as how both mining industries were “developing at a wonderful rate.” The *E&MJ* was established in March 1866 and was the major medium through which American mining engineers communicated with one another their knowledge, experiences and opinions concerning mines in which they had worked throughout the world.

The second quotation is from a paper titled “The Witwatersrand and the revolt of the Uitlanders” authored and read by Dr George F Becker before the National Geographic Society on October 16, 1896.<sup>xxxv</sup> Dr Becker’s paper dealt essentially with the geology of the main gold-bearing rock strata, estimates of its gold content made by experts from England, Germany and France, the history of the Afrikaners, particularly why and how they came to settle across the Vaal river (Transvaal) and founded the South African Republic (S.A.R.) in which promising gold deposits were discovered.<sup>xxxvi</sup> Becker was employed by the United States Geological Survey Office based in Washington, D.C. as a representative of the western states’ mining industry. He was the first of many eminent American mining and European geologists to visit the Witwatersrand gold fields where, early in 1896, he conducted a geological survey for the S Neumann group of mining companies.<sup>xxxvii</sup> One of the primary investigations was to search for the westward continuation of the main reef series which were discovered in 1884 and were similar in importance to the mother lode in California. After several months of work, he established the existence of an extensive fault, a

sudden break in the rock structure in which the gold veins were embedded, beyond which the main series was lost.<sup>xxxviii</sup> He constructed a model to illustrate his findings which were subsequently proved correct and useful in determining how to pursue the lost veins. Dr Becker later became an honorary member of the mine-owners' organisation, the Witwatersrand Chamber of Mines which was formed in 1887.

Dr Becker's paper focused on the conflict that developed with the growing influx of "uitlanders" (outlanders or foreigners) who came from many parts of the world to search for and mine gold or trade on the mining fields within the republic, especially on the Witwatersrand (White waters ridge) where they were concentrated. These outlanders comprised mining capitalists, mining engineers, miners, petty capitalists and other fortune seekers. The mining capitalists and mining engineers in particular had organised themselves into what they called a Reform Committee which consisted of eighty armed men, seven of them Americans.<sup>xxxix</sup> This Committee was an important detachment of Cecil Rhodes' and Dr Leander Starr Jameson's abortive attempt around late 1895 and early 1896 to seize the Witwatersrand and overthrow the Afrikaner republic. Of the seven Americans on the Committee, five were very well-known mining engineers. These were John Hammond Hays, a leader in the Committee, Thomas Mein, Charles Butters, Vincent M Clement and Joseph Curtis Story.

John Hammond Hays was the consulting engineer for Cecil Rhodes' Consolidated Gold Fields of South Africa, a position he retained as he operated out of London from late 1896 until 1900 when he returned to the United States where he continued to be a mining consultant for large mines financed by British capitalists. In 1903 he became general manager, consulting engineer, and a director of the Guggenheim Exploration Company which was then the largest mining corporation in the world. When he severed his relations with this firm in 1907, he was "the highest salaried man in the world."<sup>xl</sup> At the Republican Party Convention of the summer of 1908, he was the leading Vice-Presidential candidate from the state of Massachusetts but dropped out at the last minute when word arrived that any but a New York Vice-

Presidential candidate would jeopardise the election of William H Taft.

The two remaining Americans who were in the Reform Committee were Richard A Parker who had helped smuggle guns, and Gardner F Williams who was also Cecil Rhodes' General Manager of De Beers Consolidated Mines Limited and American Consular Agent in Kimberley. Gardner F Williams was one of the earliest graduates of the University of California and the first in the long line of American mining engineers who constituted the technical backbone of South Africa's minerals industry during its formative years.<sup>xli</sup> He operated from Kimberley where he supervised the packing of guns into Standard Oil drums with false bottoms and assigned these to John Hammond Hays in Johannesburg who had them stored on different mining properties under his charge. It is therefore evident that Dr. Becker's article on the revolt of the foreigner, who included Americans, against the South African Republican regime and the Rothwell-Raymond piece on the growth and Sdevelopment of the diamond and gold mining industries reveal respectively the earlier connections between the United States mining engineers and the South African mining industries as well as the growing interest in these industries in the United States especially among mining engineers, mining geologists and prospective investors.

The third quote was by WR Grace, one of the two sons of William Russell Grace, the "Pirate of Peru," founder of W R Grace & Company, the first Catholic Mayor of New York City (1881 – 2, 1885 -6), and a major stockholder of Ingersoll-Sergeant Drill Company whose mining drills were used extensively on the Witwatersrand but was also in fierce competition with another American drill manufactured by the Rand Drill Company. This competition was eliminated in 1905 when both firms merged into what was called Ingersoll-Rand under the laws of the state of New Jersey. The younger W R Grace was the first vice president of Ingersoll-Rand and a director of W R Grace & Company. He had gone to South Africa to visit his company's operations which had started in 1904 under the name Ingersoll-Sergeant as well as gather intelligence on business opportunities in that country. In the

interview which was reported in *The South African Mining Journal* (S.A.M) of April 27, 1907 Grace was asked a number of questions including the following: his impressions of Johannesburg, how the Witwatersrand compared with American mining fields, whether the Witwatersrand was likely to attract American capital, and whether the Transvaal (British) colony had an agricultural future.<sup>xlii</sup> His replies to these questions were that the Witwatersrand was the most “Yankeelike” and “hustling” place he had seen outside the United States; the Witwatersrand mining fields compared “very well indeed” to those of the United States;<sup>xliii</sup> there was “no reason why our investors should not follow our engineers in the exploitation of the (Witwatersrand) Rand, but many that they should;” the Transvaal most decidedly had an agricultural future.

An analysis of Grace’s interview shows a few interesting aspects of how the Witwatersrand was Americanised. Plant design in the Rand gold mines (and on the Kimberley De Beers Consolidated Mines Limited) was on a large scale like the large mines in the western mining districts of the United States such as the Bunker Hill & Sullivan Mining and Concentrating Company in Idaho, the North Bloomfield in California and the Standard Consolidated at Bodie, also in California. These mines were operated on the principle of specialisation in the execution of numerous and differentiated tasks involved in mine exploration and development in particular. Efficiency in the mining the ore, transporting, crushing and treating it in large quantities at minimum cost per ton was the most desirable objective pursued by every mine manager. Large-scale plant layouts, both on the surface and underground, and the efficient as well as cost effective processes were brought to the Rand (and Kimberley) by American consulting mining engineers who had acquired the requisite technical knowledge and experience in managing large and deep level mines primarily in the United States. Surface mining equipment on the Rand gold mines was modern and as good as that which was found anywhere else. Some of this equipment was imported from the United States especially from Chicago and New York – New Jersey areas. Firms such as Babcock & Wilcox, Fraser & Chalmers, General Electric and Ingersoll-

Sergeant were house-hold names on both the diamond and gold mines of the Cape (British) colony and the Transvaal respectively long before the Union of South Africa came into existence in 1910. Evidently, early United States-South Africa connections went beyond technically skilled and very highly paid American engineers who worked on the diamond and gold mines of South Africa.

W R Grace's remark concerning American capital following American mining engineers into the Witwatersrand mines was realised a decade later in 1917 when the Anglo-American Corporation was formed with British and American capital.<sup>xliv</sup> The latter was put up by J P Morgan & Company and Newmont Mining Company following the advice of yet another prominent American consulting mining engineer W L Honnold who had served as a consulting engineer to the Consolidated Mines Selection Limited on the Rand where he later became a director. Honnold cooperating with another leading American mining engineer, Herbert Clark Hoover, who had also been employed by British mining capital, facilitated Morgan's and Newmont Mining's willingness to invest in Ernest Oppenheimer's (Harry Oppenheimer's father) mine holdings on the Witwatersrand.<sup>xlv</sup> Herbert C Hoover later became the thirty-first President of the United States from 1929 to 1933. Apparently, British and American capitals at different stages in the history of mining in many parts of the world, relied heavily on American consulting engineers for advice, technical evaluation of mining properties and mine management. Consequently, their services were in great demand especially in regions where mining was underdeveloped when compared to the United States. South Africa was one such place.

## ENDNOTES:

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- i. Mark Wyman, *Hard Rock Epic* (Berkeley, California: University of California Press, 1979), pp. 39, 41–2.
- ii. Thomas A Rickard, *The Bunker Hill Enterprise* (San Francisco: Mining and Scientific Press, 1921), p. 15.
- iii. JB Taylor, *A Pioneer Looks Back* (London: Hutchinson, 1939), pp. 133, 135–6.
- iv. RH Richards, ‘American Mining Schools’, *Transactions of the American Institute of Mining Engineers*, No. 15, 1886/1887, p. 320.
- v. *Ibid.*
- vi. Clark C Spence, *Mining Engineers and The American West* (New Haven and London: Yale University Press, 1970), p. 30.
- vii. Herbert Hoover, *The Memoirs of Herbert Hoover* (New York: Macmillan, 1951), Vol. I, p. 131.
- viii. *Ibid.*, p. 116.
- ix. Paul H Douglas, *Real Wages in the United States, 1890–1926* (Boston, 1930), pp. 137, 140, 143.
- x. Richard Rothwell, ‘Editorial’, *Engineering and Mining Journal*, Vol. 41 (2 January, 1886).
- xi. Quoted in Spence, p. 278
- xii. Hoover, Vol I, p. 116.
- xiii. Thomas A. Rickard, *Interviews with Mining Engineers*. (San Francisco: Mining and Scientific Press, 1922) p. 414.
- xiv. *Ibid.*
- xv. Spence, p. 143.
- xvi. Rickard, *Interviews*. . ., pp. 229–30.
- xvii. El Callao Gold Mining Company Limited, Reports of the Directors and Superintendent of the Mine presented to the Ordinary General Meeting of the Shareholders at the Company’s Office in Cuidad Bolivar, on the 15th of March, 1887 at 12 o’clock noon (unpublished report in the collection of the Engineering Societies Library, New York City).

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- xviii. Rickard, *Interviews*. . ., p. 130.
- xix. *Ibid.*, p. 244. Others recruited include Joe Richard, 1890; John Walsh, 1890; OH Hahn and WW Mein, 1891–1892; Henry G Perkins, EA Blanton, GB Poore and Richard E Bowen, 1893–1894; WH Hall, Eugene Hoefer, Palmer Carter and Lane Carter, 1895; and Louis Irving Seymour, JS Price, W Bradford, HS Stark, RG Warriner and Maurice Robeson, 1896
- xx. John Hays Hammond, ‘Resume’, *MSS Collection*, Box 3, Sterling Library, Yale University.
- xxi. Namely, Victor M Clement, Pope Yeatman, George Starr, EM Garthwarte, Hal Tilgham and Robert Catlin, SB Connor [John Hays Hammond, *Autobiography*, (New York: Farrar, 1935), Vol. I, p. 210], as well as HC Behr and Harry H Webb [Rickard, *Interviews*. . ., p. 244].
- xxii. John Hays Hammond, ‘Letter of Introduction for F.H.P. Cresswell, Nov. 2, 1894’, *MSS Collection*, Letter Book 1, Sterling Library, Yale University, p. 353.
- xxiii. John Hays Hammond, ‘Letter to Richard A. Parker, May 29, 1895’, *MSS Collection*, Box 3, Sterling Library, Yale University, pp. 93–4.
- xxiv. Eben Erskine Olcott, ‘Letter to Enoch Kenyon, Oct. 18, 1894’, *MSS Collection*, Letter Book 22, New York–Historical Society, p. 1.
- xxv. Rickard, *Interviews*. . ., pp. 244–5.
- xxvi. Spence, pp. 305–6.
- xxvii. Webb, p. 27.
- xxviii. Spence, p. 310.
- xxix. Hatch and Chalmers, p. 221.
- xxx. Rickard, *Interviews*. . ., p. 143.
- xxxi. Spence, p. 310.
- xxxii. *South African Mining Journal*, Vol. II, No. 1 (1 October 1892), pp. 1–2.
- xxxiii. Spence, p. 310.

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- xxxiv *The Engineering and Mining Journal*, Vol. XLIV, No. 23, December 3, 1887, p. 409.
- xxxv George F Becker, “The Witwatersrand and the revolt of the Uitlanders.” *The National Geographic Magazine* Vol. VII, No. 11, November, 1896, pp. 349 – 367.
- xxxvi What South African historiography calls gold “discoveries” by European colonists, explorers and prospectors before 1886, when the main reef series was indeed discovered, were to a very large extent findings of ancient gold digging site worked by Africans.
- xxxvii Thomas A Rickard, *Interviews with Mining Engineers* (San Francisco: Mining and Scientific Press, 1922), pp. 263 – 4.
- xxxviii Ibid., p. 264.
- xxxix Becker, p. 364.
- xl James E Homans, Ed., *The Cyclopaedia American Biography*, Vol. VIII (New York: The Press Association Compilers, Inc., 1918), p. 59.
- xli Clarke C Spence, *Mining Engineers and the American West* (New Haven: Yale University Press, 1970), p. 303.
- xlii “Interview with WR Grace,” *The South African Mining Journal*, Vol. IV, Part 1I, (April 27, 1907), p. 168.
- xliii He excluded underground operations with which he felt “incompetent to speak.”
- xliv Theodore Gregory, *Ernest Oppenheimer and the economic development of Southern Africa* (Cape Town: Oxford University Press, 1962), pp. 81 – 90.
- xlvi Ibid.