Apuntes 80, 49-74
ISSN: 0252-1865
eISSN: 2223-1757
doi: http://dx.doi.org/10.21678/apuntes.80.904

Article received on November 24th, 2016
Approved for publication on March 17th, 2017

Society, science, and technology: Mariano de Rivero, mining and the birth of Peru as a Republic, 1820-1850

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Abstract: This article studies the relationships between society, science, and technology through an analysis of the personal life of the Peruvian scientist Mariano Eduardo de Rivero y Ustáriz. Starting with his education at the Seminario de San Jerónimo in Arequipa, the Highgate School in London, and the École Royale des Mines in Paris, this study focuses on Rivero's activities related to mining in Peru and its vicissitudes, from the development of Simon Bolivar's strategy for the country after Independence had been achieved, through to the uncertainties of the subsequent period of *caudillaje*. Particular attention is given to capital investments, especially foreign and British, and the technology employed in the mining sector (especially in Cerro de Pasco) in this early Republican period.

Keywords: Scientific education; Simon Bolivar; mining technology; British capital investments; Republican Peru.

Acronyms and abbreviations

ACN	Archivo del Congreso Nacional, Peru
AGN	Archivo General de la Nación, Peru
CDIP	*Colección Documental de la Independencia del Perú*
CLADHE	Latin American Congress of Economic History (Congreso Latinoamericano de Historia Económica)
IQ	Intelligence quotient

1 A preliminary version of this paper was presented at the 5th Latin American Congress of Economic History (CLADHE), held at Universidade de São Paulo on July 19 to 21, 2016.

MCNINE	*Memorial de Ciencias Naturales y de Industria Nacional y Extranjera*.
SCM	Peruvian Mint Section (Sección Casa de Moneda)
SHMH	Sección Histórica del Ministerio de Hacienda, Peru

How was science practiced and applied in the Peru of the 1820s? Did the state promote a science and technology agenda during the emergence of the Peruvian Republic, between 1820 and 1850? Or was it pursued privately, as a product of individual and family interests?

Private enterprise can be ruled out as a driver of scientific and technological research, since it still did not exist. Private enterprise, in the form of corporations to which partners provided capital, only began to be established in Peru in the late 19th century (Deustua, 2002, pp. 284-300).

I approach this issue not from the perspective of international knowledge networks or the combination of "popular wisdom/scientific knowledge," but by taking a more traditional approach. I start by discussing the biography of Mariano Eduardo de Rivero y Ustáriz – a very important Peruvian criollo, who played a fundamental role in the accumulation of knowledge in physics, chemistry, and, above all, in what was then known as mineralogy – a mixture of the above disciplines along with geology. I then discuss his activities after he returned to Peru following more than 12 years in Europe: participating in the Bolivarian project to construct a Republican Peru, and managing the mining sector, one of Peru's most important export areas prior to guano, and the technological dilemmas that arose in this field. Finally, I evaluate his actions and endeavors in this as well as other sectors, in order to illustrate how he inhabited two worlds: that of the international networks of scientific knowledge and expertise, generated by the Enlightenment in Europe (and especially France); and the local world of Peru's mining centers, such as Cerro de Pasco and Puno, and Peruvian politics (especially in Lima).[2]

1. The individual (and society)

In May 1822, the then-young scientist from the Peruvian city of Arequipa, don Mariano Eduardo de Rivero y Ustáriz (hereafter Rivero), was approached in Paris by Francisco A. Zea, a minister of Gran Colombia, with a view to founding and administering a School of Mines in Bogotá, joining a scientific mission to research the natural resources of the until-recently viceroyalty of New Granada, and founding a museum of natural history. By then, Rivero had been in Europe (where he was an outstanding student), and away from Latin America, for 12 years.

Rivero's education began in his native Arequipa, where he studied at the Seminario de San Jerónimo. The intention was not, of course, for him to enter the priesthood, but to expand the knowledge of a boy and then

2 For a discussion of scientific knowledge and folk wisdom for the case of mining in Mexico during the same period, see Uribe Salas (2016).

an adolescent who showed clear signs of genius.[3] For instance, between the ages of 12 and 19, he studied mathematics, physics, and languages (Latin, French, and German) at the Highgate School in London. It should be borne in mind that the precocious youth already spoke and wrote Spanish, and that an effortless command of English was required to study in London.[4] This is to say that he was a true polyglot.[5]

Further proof of this came in 1817 when, at the age of 19, he moved to Paris to continue his education at what was then known as the École Royale des Mines, though this "royal school" obviously did not bear this name between 1793 (when the decapitation of Luis XVI ushered in the French Republic) and 1814 (when, to the relief of realists and the other European monarchies, including Great Britain, Napoleon was defeated at Waterloo).[6]

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3 Needless to say, there were no intelligence quotient (IQ) tests back then, but the following shows that Rivero was an exceptional child who would have had a very high IQ. One might say that this is a naive assertion.

4 There is no doubt that Rivero received the basis of his education, especially in Latin, at the Seminario de San Jerónimo in Arequipa. And knowledge of Latin makes it easier to learn Romance languages like Italian and Spanish, which are based on the ancient language of the Roman Empire. Of course, the list of Romance languages also includes Portuguese, Catalan, and even Romanian. Among many references, see especially Harris and Vincent (1988).

5 Biographies of Mariano de Rivero can be found in Mendiburu (1934) and Tauro del Pino (1967; the latter is also included in the 17-volume edition published by El Comercio, Lima, 2001); see also Alcalde Mongrut (1966) and Deustua (1986, especially pp. 25-37 for information on Rivero and references for the study of the Peruvian mining cycle of silver production; pp. 57-66 on the mining cycle and conditions in the *callana* of Pasco and the mining center of Cerro de Pasco; and pp. 86-96 for that of Puno). Rivero analyzed and experienced the mining conditions of Cerro de Pasco, later writing his "Memoria sobre el rico mineral de Pasco," originally published in the *Memorial de Ciencias Naturales y de Industria Nacional y Extranjera* (*MCNINE,* 1828), of which Rivero himself was founder and editor. For Puno, see his *Visita a las minas del departamento de Puno* of 1826, which also appeared in *MCNINE* and in his (relatively) complete works (Rivero y Ustáriz, 1857). Some unpublished manuscripts and part of his correspondence is housed in the Archivo General de la Nación (AGN), Lima, Sección Histórica del Ministerio de Hacienda, SHMH, PL 6, expedientes (files): exp. N° 164 and 177; PL 7, exp. N° 225; and the Dirección General de Minería, OL 164, 175 and 186.
The *MCNINE* was a science, natural sciences, and, to some extent, economics journal that was published regularly in Lima from 1827 to 1829 by Rivero and his indispensable assistant, the deputy director-general of mining, Nicolás de Piérola, also from Arequipa - father of the eponymous Nicolás de Piérola who was later finance minister and twice president of Peru, the former toward the end of the 1860s and the latter during the War of the Pacific against Chile and again in 1895-1899. Some copies of the *MCNINE* can be found in the National Library of Lima. I believe this to be just as important a publication as *El Mercurio Peruano*, from the end of the colonial era, or *La Abeja Republicana,* from 1822-1823. Both of these publications have been reproduced in facsimile but the *MCNINE* has been completely overlooked. Nor have the aforementioned near-complete works of Rivero, first published in 1857, been reproduced, in contrast to those of Antonio Raimondi, *El Perú*, from the second half of the 19th century, which merited a facsimile reproduction in the 1960s by the press of the Universidad Nacional de Ingeniería. Why, then, are Rivero's works so disregarded and overlooked?

6 Among many other references, see Hudson (1936). I single out this text because it was written by a female academic at a time when most historians - those from Britain at any rate - were men.

Rivero studied Mineralogy and Chemistry there. Without doubt, he had an insatiable mind. In a few short years, all during his youth, Mariano Eduardo progressed from mathematics, physics, and languages to disciplines more closely aligned to the mining industry in Peru and elsewhere. It is for this reason that I now write these pages.[7]

It was during his stay in Paris that Rivero met Alexander von Humboldt, the great German sage and scientist who was also a man of liberal ideas. Humboldt had conducted research on Peru after a series of discussions with King Carlos IV, ruler of the Spanish Empire, resulted in authorization to travel at his own expense between and within the Hispano-American colonies, from 1799 to 1804. Humboldt, who had recently received a sizable inheritance, duly did so, accompanied by his colleague, Aimé Bonpland. The product of this experience was his *Relation historique du voyage au régions equinoxiales du nouveau continent*, finally completed in 1834 and comprising 34 volumes, the last three of which were his *Narrativa personal*. The rest contain his natural, mineralogical, geographical, and other studies (Humboldt, 1995).

Humboldt and Rivero established a very close relationship, the former as mentor to the latter. For instance, upon graduating from the École Royale des Mines, Rivero commenced his professional practice by working and visiting mines in England, France, Germany, and Spain. While in Bohemia, then part of the German Empire, he discovered a previously unknown iron oxalate and called it Humboldtine in honor of his German mentor. And it was Alexander von Humboldt who recommended Rivero for his work on the scientific expedition to Gran Colombia, through its counsel in Paris, Francisco Zea.[8]

To complete this section on the biography of Rivero, I should add that in Paris he also met and worked with the famous French scientists Joseph Louis Proust and Joseph Louis Gay-Lussac. The latter discovered what is now known as Gay-Lussac's law, which to this day provides a basic understanding of the behavior of gases.[9]

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7 I do not know of anyone who has delved into the archives of the old Seminario de San Jerónimo in Arequipa, where one would surely find papers, exams and/or theses or dissertations by the young Rivero. An official letter sent on August 2, 1828 by Nicolás de Piérola, in his capacity as Deputy Director-general of mining and Rivero's assistant, to the Minister of Finance, José Larrea, is found in AGN, SHMH, PL 7, exp. N° 68, and refers to the distribution of gunpowder for mining in Puno and Lampa.

8 While I am unaware of any studies on the correspondence between Humboldt and Rivero, such documents must exist, especially those written by Humboldt.

9 Gay-Lussac also studied chemical combinations and the reaction of water with alcohol. As a result of these experiments, the Gay-Lussac principle is used today to determine the levels of alcohol in,

2. Independence and the Bolivarian project

Rivero's time in Colombia did not last long. Near the end of 1825 he returned to Peru, where he settled and remained until 1851, when the then-president, Ramón Castilla, appointed him the ambassador of the Republic of Peru to Belgium (at the time, the formal name of the position was Counsel General of Peru). Six years later, on November 22, 1857, he died in Paris.

Rivero was, therefore, one of the actors in the Bolivarian project in Peru, even though he arrived too late to be fully involved in it. Indeed, by then the calls for Simón Bolívar to leave the country, and the denigration of the "Colombian tyrant," were a constant in Peruvian politics, above all in the capital of the Republic. The Bolivarian project came to be seen as an authoritarian undertaking,[10] even though it was the Congress of the Republic itself that in 1824 granted Bolívar sweeping powers to defeat the forces of Viceroy José de La Serna, which continued to occupy the central and southern highlands of Peru.[11]

The Bolivarian project was at odds with its San Martinian counterpart with regard to the design of a future independent country, and whether it should be a constitutional monarchy, as San Martín and his minister Monteagudo had once believed and even attempted to establish, or a republic, as per Bólivar. However, in Bolívar's version, because "America was ungovernable" or "like plowing the sea" this stage could only be reached by way of a prior dictatorship.[12] Bolívar started out as a liberal in his youth,

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for example, the blood or the breath (and to establish whether someone is driving drunk, partially drunk, or without alcohol in the bloodstream, and thus in the brain). On Gay Lussac, see Tilde (1921).

10 The Peruvian historian Efraín Trelles (personal communication in 2015) has proposed that had Bolívar not permanently abolished the Andean curacazgos, the country's fate would have been different. As such, it is interesting to note the praise lavished by the cacique, or *kuraka*, of the Puno province of Azángaro, José Domingo Chukiwanka - later Hispanicized to Choquehuanca - on Simón Bolívar during his trip from Cusco to Upper Peru on August 2, 1825. On this, see Ramos Zambrano (2012). See also Guarisco (2003), where an individualist conception of citizenship is contrasted with another, more corporate one associated with "indigenous rights," or the "República de Indios."

11 They were based in the city of Cusco, from where the viceroy governed the few isolated pockets that remained of the once-mighty Spanish Empire. On realistic and patriotic regionalism, see Fisher (1979).

12 In the case of Bolivia, the country's first constitution proclaimed the dictatorship for life of Simón Bolívar - a form of monarchy, one might say, but without the bonds of nobility or of "royal blood" - or "blue blood," to use the colloquial styling. Haiti, the first independent nation in Latin America as well as the first proclaimed republic, quickly moved on to dictatorship and even to the imperial form of government, as occurred during the empire of Joaquín Iturbide in Mexico and in Brazil under Dom Pedro I. On this, see Bethell (1989), Klein (1992, especially pp. 87-103) and, more recently, O'Phelan (2001), McEvoy, Novoa & Patti (2012), and finally, Contreras & Glave (2015). Of course, the bicentenary of the proclamation of Peruvian Independence (2021) has prompted a flurry of studies on the subject, of which the three aforementioned texts are an example.

but ended up a conservative and dictator. Both in Peru and, above all, in Bolivia, he established a dictatorship for life, although in neither case did his quasi-monarchist pretensions endure. Rather, the continuation of the Bolivarian projects for the construction of a republican state manifested itself as a struggle between *caudillos*, in which, to begin with, Bolivarians were pitted against "nationalists." In Peru, this meant a conflict between Santa Cruz and La Mar on the one hand, and Gamarra on the other. In socioeconomic terms, however, Bolívar was a protectionist with an interest in promoting state involvement in the economy: a Peruvian Alexander Hamilton, as was once remarked.[13]

Thus, while José de San Martín and his political and military forces negotiated with viceroys Pezuela and La Serna before and even during the occupation of Lima, Bolivar represented a more aggressive dynamic in his confrontation with the forces of colonial control that still endured - such as the armies and the political authorities controlled from Cusco by Viceroy La Serna - and the *caudillos* and supreme political authorities of Peru who, following the loss of their bases and their relationships with the Congress, clamored for a connection with the viceroy and the Spanish monarchy.[14] I refer above all to the role that José de la Riva Agüero and Sánchez Boquete, and later the Marquis of Torre Tagle, played in the process of national independence.[15]

Thus, Rivero arrived in Peru when the Bolivarian project was nearing completion, and soon found himself enmeshed in the *caudillo* disputes that followed the attainment of national independence. Presidents Andrés de Santa Cruz and then José de La Mar, Bolivarians in a certain sense, were instrumental in the appointment of Mariano de Rivero y Ustáriz as Director-General of Mining, then in his founding and promotion of a School of Mines in Lima, and finally, in his role in the planning and creation of Peru's first National Museum of Natural History, Antiquities, and History. The latter two tasks were not completed, since the influence of the "Colom-

13 Among several references, see Bushnell (2004).

14 On September 4, 1823, Bolívar wrote to José de la Riva Agüero and Sánchez Boquete, the first president of Peru, from Lima on the implications that his conduct had for the country, telling him: "You find yourself in open warfare with the national representation of your homeland […] [even though] you owe your appointment to the presidency to the authority of the Congress" (quoted in Pérez Concha, 1973, pp. 61-62). Riva Agüero has been considered the first coup leader in Peru, the first *caudillo*, and even a traitor to the country.

15 A classic of its kind is Thimothy E. Anna, who called for Bolívar's intervention in Peru – that is, the Bolivarian project – "the military solution" to the problem of national independence (1979, pp. 214-238; a Spanish edition was published by Fondo de Cultura Económica, Mexico, 1981). On the San Martinian and Bolivarian projects, see also Gálvez (2001, pp. 319-350).

bians" (some of the rank-and-file and officers of the Bolivarian army) and the nationalist reaction against them during the administrations of Santa Cruz and La Mar – both royalists before becoming patriots – ultimately put an end to anything that reeked of the "Colombian tyrant" who, in any case, was a Venezuelan from Caracas.[16] Rivero was seen at that time as one of the agents of Bolivarianism in Peru. The anti-Bolivarian reaction towards the end of the 1820s was led by a new and powerful *caudillo* from Cusco, Agustín Gamarra, the "black angel" who raised the banners of conservatism against the "liberal" leaders of the day.[17] The word "liberal" certainly merits the quotation marks, as the liberalism of the early 19th century was a distinctive and very Peruvian offshoot of the Enlightenment liberalism of the late 18th century and the subsequent national liberalisms.[18]

3. Public policies, private policies

Until then, clearly Bolivarian plans and Riveros's role in them were, in public-policy terms, an effort to promote the role in the economy played by the state – in this case, in a post-colonial state that was a mixture of economic liberalism and protectionism. The General Directorate of Mining (Dirección General de Minería), a state institution, was tasked with promoting mining development; thus, Rivero traveled to, explored, and studied many parts of the country, and Cerro de Pasco and Puno in particular, to identify the obstacles to development and promote solutions. Likewise, he promoted the creation and development of the so-called *bancos de rescate*, state-run banks whose objective would be to protect mining activity by promoting public credit and the purchase of minerals, especially silver, at higher prices than those paid by the private "enablers," "aviators," and "rescuers."[19] The *bancos de rescate* were charged with curbing the interference and quasi-domination that traders, in large part oligopolistic, exercised over mining production and companies. In 1821, the same year that Peruvian independence was declared, Dionicio de Viscarra attested to this in written correspondence to José de San Martín's minister of state, Hipólito Unanue.

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16 See, among others, Ortemberg (2012; especially pp. 245-250).

17 On this, see Walker (1999; especially pp. 121-151. See also Aljovín de Losada (2000) on the interactions between the Peruvian *caudillos*, liberalism, and conservatism, and the several constitutions in place between independence and the government of Ramón Castilla. Luis Alayza y Paz Soldán, in his 1941 study on La Mar, calls Gamarra "the black angel" (see Walker, 1999, p. 123).

18 On this, see McEvoy et al. (2012) and Aljovín de Losada (2000). Also, Irurozqui Victoriano (2005b).

19 *"habilitadores," "aviadores"* and *"rescatistas."*

> […] there existed in Pasco some Merchants of silver with the name of Rescuers […] whose practice has been to equip the scavengers with cloth, firewater, quicksilver, tools, and some money […] this trade being so lucrative, and safe, that so many who have engaged in it are opulent capitalists, while the miners are miserable indigents.[20]

Moreover, this commercial domination over mining production was based in Lima; that is, networks were formed between large-scale urban traders located in the capital of the Viceroyalty – and later of the Republic – and smaller-scale traders, as well as the muleteers and llama herdsmen that connected the capital with the numerous regional markets that formed the country's economic structure.[21]

San Martín and, to a greater extent, Bolívar attempted to break this aspect of the colonial yoke by establishing new forms of operation for commerce and mining activity. Thus, the *bancos de rescate* were designed, in which the union of mining producers would participate, as was a Banco de la Emancipación, though the purpose of this was to tackle the coin shortage and the panic that the Wars of Independence had caused in the country's commerce and business, especially in Lima (Camprubí, 1960, 1963). In 1827, the matter of the *bancos de rescate* again came before Congress, when Juan José Landaburu stated in a report that he felt that the traders, financiers, and private "enablers," some of them now foreign, were again exercising a hegemony over mining production, transportation, and commerce, and that the *bancos de rescate*, customs, and even the Casa de Moneda de Lima, the country's mint, should have a role in the marketing and distribution of silver "pastes" and its benefits. Landaburu, for example, proposed that the silver purchasing prices (the "*rescate*", or rescue) should be differentiated according to the regional markets where production took place. Thus, in Pasco, where more silver was produced and it was easier to collect, purchase, and send the metal to Lima, the prices had to be lower than in La Libertad (Hualgayoc, for example), from where silver had to travel 200 leagues to its intended destination (the city of Trujillo, and what is now known as the port of Salaverry).[22]

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20 AGN, Serie Minería C-12, file 71, year 1821, "Informe de Dionicio de Viscarra a Hipólito Unanue" (November 6, 1821). See also Deustua (2008); an earlier and shorter version of the same article is found in Deustua (1994). Translation by *Apuntes*.

21 See Deustua (1986, especially pp. 55-109; 2009, especially pp. 139-179).

22 Archivo del Congreso Nacional, Lima (ACN), "Asuntos remitidos a la Comisión de Hacienda," file 1, N° 16, "Proyecto de Don Juan José de Landaburu sobre minería" (Lima, July 18, 1827). On the hegemony and commercial domination in Peru, especially from Lima and in Cerro de Pasco,

Debates and disputes between advocates of free trade and of protectionism, and those concerning the idea of an interventionist state versus one that did not intervene in the economy, were not confined to the question of Peruvian independence. They were also played out in the United States: in 1791, a few short years on from its independence from the British metropolis, and following the establishment of a constitution and the republic, Alexander Hamilton and Thomas Jefferson became embroiled in a heated debate on whether or not an official state or national bank was needed. The objective of such a body would be to preserve the monetary stability of the silver dollar, as in Peru, only in a country that did not produce the coveted metal but depended on its exports to obtain it.[23] Jefferson, hostage to his physiocratic schemes to perceive the "wealth of nations,"[24] was opposed to the creation of the bank, which he regarded as yet another symptom of centralism and the potential authoritarianism of a unitary federal government; while Hamilton, representative of trade and the New England mercantile interests, saw in such a bank an instrument of commercial and financial stability that would allow the trading houses of Boston, New York, Philadelphia, and Baltimore to expand their business across the seas of China, India, the Antilles, Africa, and northern Europe (Artaud & Kaspi, 1977, p. 43). Hamilton won this debate, and an official bank, like that in Britain, was established; it lasted until 1811, when Congress let it expire without renewing the laws that provided for its existence. In the 1820s, however, at the insistence of President James Madison, Congress approved a second Bank of the United States; the controversy surrounding the matter was a source of profound amazement to the French philosopher,

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in the late colonial period – between 1770 and the boom of the 1810s – see Fisher (1977).

23 It was for this reason, among others, that in 1764 the British government passed the Sugar Act and the Currency Act, so that sugar, indigo, coffee, pepper, wine, and textile imports would be paid strictly in silver money rather than paper money or bills of exchange. Britain's constitutional monarchy and its Empire had depleted almost all of the treasury's monetary reserves in precious metals, especially in the North American colonies, during the Seven Years' War (1754-1763), known (and manifested) in North America as the French and Indian War. This compounded the resentment felt by the traders and citizens of the 13 colonies, who began to look toward their independence. On this, see *A young patriot. The American revolution as experienced by one boy*, by J. Murphy (1996, p. 2), based on the narrated memories of Joseph Plumb Martin: *A narrative of some of the adventures, dangers, and sufferings of a revolutionary soldier* (1830).

24 Jefferson was a follower of Quesnay and Turgot and not of Adam Smith. For him, wealth came from the soil and the land's natural value and productivity, rather than from human (wage) labor or from capital and its machines, including, to be sure, steam engines. Moreover, he endorsed African slavery, in spite of his liberal and republican political leanings. As some authors have pointed out, Jefferson had an Aristotelean view of citizens' rights and of the justification of slavery. For him, only the members of the *polis* had the right to political benefits, not the rest of the population – and especially not Africans or Afro-descendants, Native Americans, or women. Among several references, see Peterson (1970).

traveler, and writer Alexis de Tocqueville, who wrote in his *La democratie en Amérique* that it was "the object of an intense hatred;" this was in contrast to the Bank of France, which was viewed at the same time, the 1830s, as a "natural and uncontroversial arm of the state." For the Americans, then, especially southern farmers and plantation owners, the Bank of the United States was a sign of New England's "profound fears" over tyrannical federal government and the commercial cities of the northeast (Lowenstein, 2015; Tocqueville, 1835/1984).

The Bank of the United States, along with other public measures to promote the state's role in the economy and protectionist policies to defend domestic manufacturing against foreign industrial imports, especially from Europe, served to develop the U.S. economy to a laudable degree. Of course, there were also other factors, such as rising European immigration, which pushed down labor costs and increased its supply proportionally, as well as the expansion of the agricultural frontier, first to the Mississippi River and then, after the Mexican-American War, to the Pacific Ocean: "from sea to shining sea." It was no wonder, then, that between 1790 (during the debate between Jefferson and Hamilton) and 1807 (after Jefferson, now president, bought Louisiana from the French Empire of Napoleon Bonaparte), U.S. exports rose from $20.2 million to $108.3 million, an increase of more than 537%. Moreover, during those years the proportion of foreign trade carried by American vessels – reflecting the increase in shipbuilding to undertake such transactions as well as the creation of a weighty merchant-navy fleet – climbed from 59% to 92%, while the earnings of these shipping companies increased from $5.9 million to $42.1 million. Ultimately, this enormous growth in exports and revenues "financed a 400% increase in domestic import consumption," which the historian Charles Sellers called "the market revolution" in the first half of the 19th century – a revolution that, according to this historian, led to the manufacturing, or industrial, revolution of the second half of that same century (1991, p. 22).[25]

Thus, for the specific case of Peruvian mining at the time of independence and then during the beginnings of the Republic, there were initiatives to strengthen the role of the state or, more accurately, to continue to some degree with the interventionist role of the Bourbon state within a liberal and republican government structure. At the same time, there were other,

25 I thank Debra Reid of Eastern Illinois University for introducing me to the debates and questions surrounding the market revolution as part of the 19th century history of the United States. I also thank Jon Coit and Michelle Le Master, two other colleagues of mine in the Department of History, for the same.

more radical, calls to "wipe the slate clean" with a liberal, open, *laissez faire, laissez passer* state; this, according to some studies, occupied the struggles over policy, commercial legislation, and customs duties until at least the 1840s (Wu Brading, 1993; Gootenberg, 1989[26]). This did not keep private traders, whether nationals or foreigners, from turning up at mining centers from the 1820s or even earlier to buy pure silver and silver bars at bargain prices, which they then sent to major international markets such as London, Paris, Hamburg, and even Santiago de Chile, by then an international player with an interest in the benefits of Peruvian mining and foreign trade.[27] I will now turn to the matter of the technological dilemmas at the time of Mariano Eduardo Rivero y Ustáriz.

4. Technological changes and dilemmas in mining during the early Republic

To borrow the terminology of Henri Sée (1929)[28] to summarize the largely European history of technology – whether commercial, financial, or industrial – from the outset of capitalism, the first advances in agricultural development were made in the 13th century; then, in the 16th century, came navigation and financial accounting (and the use of finances to promote commercial exchanges)[29]; followed by James Watt's steam engine and the

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26 A Spanish edition is available.

27 Of the dozens of cases I have found on this, see the example of John Begg, a Scottish trader who in 1821 had business dealings worth 30,711 pesos "at current currency values and in pure silver" with the Count of Lurigancho and the Casa de Moneda de Lima. In 1825, Begg was a creditor of the Peruvian state to the tune of 60,000 pesos, to be paid "in hard cash" (silver pesos and/or promissory notes from London-based trading houses) (AGN. Sección Casa de Moneda, SCM, CMR-0034, "Constancia del Conde de San Juan de Lurigancho," Lima, October 23, 1821; see also AGN-SHMH, PL 6, N° 119, 1826, "Don Juan Begg, sobre que se afiance la cantidad de 60,000 pesos"). Another case is that of Patrick Guinness, or Patricio Ginez, who sold "gold and silver pastes" via the port of Huacho, in what was thought to be a "clandestine" or smuggling operation (AGN, SHMH, PL 6, N° 318, 1826).
For more on the transportation and trade of minerals and metals before the arrival of the railroads, see Deustua (2009, pp. 139-179); and on the smuggling or "clandestine trade in pastes," Deustua (1986, pp. 45-54). On the growing importance to Peruvian foreign trade of Chile, its capital Santiago, and the port of Valparaiso, see Hunt (1973), who ranks the country among Peru's top five trading partners, alongside the U.K., France, Germany, and the U.S.A.

28 See also his *Modern capitalism: Its origin and evolution* (Sée, 1968).

29 See, among many, Braudel (1979) and Ferguson (2008). While Braudel takes a critical position on capitalism and its tendency to create monopolies and oligopolies, Ferguson is more optimistic, regarding it as a system that permanently creates wealth and, in the case of finances, one in which money creates money.
Lastly, the advances in the technology of inter-oceanic navigation began with Henry IV of Portugal, which enabled the exploration of the coasts of Africa and later the Americas. In this case, it was a company backed by the state, specifically the monarchy, while private technological innovations were driven by the traders and navigators of the city-states and republics of northern Italy: Geneva, Venice, Florence, etc. On this, see Bakewell (1997, especially Chapter 3); and

start of mass industrial production, much of it in Britain (Dunn & Mitchell, 2015).[30] In the case of mining, the historians Benoît and Chapelot have pointed out that steel was produced during the Roman Empire in modern-day Belgium and Luxembourg, in Liège and between the Sambre and Meuse rivers, whose waters were used to quell the flames and the heat of the active furnaces. By the 16th century, Liège was one of Europe's most important steel centers, with 24 furnaces in daily operation (Chapelot & Benoit, 1985; especially pp. 274-297). Of course, for this they needed to be supplied with vast quantities of coal that the kingdom of Belgium – specifically, Flanders – and the north of France provided incessantly.

In the case of Latin America, although there was a historical tradition of using mining and metallurgical technologies in the extraction and processing of gold, silver, copper, tin, and other metals, the 16th century ushered in fundamental changes, especially when the patio process and mercury amalgamation were introduced to obtain pure silver – or *plata piña*, as it was known locally until the end of the 19th century.[31] Mexico, and later Peru and Bolivia, thus became international mining centers par excellence, competing with mines in Germany and other parts of Europe.[32] However, while these three Latin American countries (as well as Chile, with its cycles of gold, silver and copper, to quote Vicuña Mackenna; Colombia, in the Antioquia and Chocó areas; and Brazil, in Minas Gerais) produced mainly silver,[33] Europe – from the 16th century, as we have seen, but to a greater extent in the 18th century – had embarked on the mass-production of minerals for industry and energy, such as iron and coal.[34] Thus, a dichotomy

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Tenenti (1985), his *Il prezzo del rischio. L'assicurazione mediterranea vista da Ragusa, 1563-1591* (co-authored with Branislava Tenenti), stresses the role of insurance in the expansion of the rice trade on the Mediterranean Sea, seen from the city and port of Ragusa.

30 See in particular pp. 613-618, the section on "mines and machines," which the authors include as part of the "energy and industrial revolution."

31 On pre-Hispanic Andean excavation and processing of gold, silver, copper, hard copper, tin, and copper and tin alloy to produce bronze, see Ravines (1978; especially pp. 475-571); on mining and the Inca technologies for the exploitation of precious metals, see Berthelot (1978). A classic for understanding the "technological revolution" that required the use of mercury for processing gold and silver ore is undoubtedly Barba (1640).

32 On colonial Latin American mining, a good general overview is provided by Bakewell (1984); see also Herrera Canales & Ortiz (1994). The Spanish conquistadors started to exploit the silver mines of the Aztec Empire, such as Taxco, but then began their expansion to the likes of Pachuca and Guanajuato in the north. However, by the 1550s, the mining center of Potosi in Bolivia had been discovered, and thus began Andean predominance of silver mining. On this, see Deustua (1998), which notes that when the Mexican mining center of San Luis Potosí was discovered, its Hispano-colonial founders named it after Potosí in Bolivia and Saint Louis of France.

33 Brazil, Colombia and Chile also produced gold, though the latter moved into silver mining for the remainder of its colonial period.

34 On gold mining in Peru from the end of the colony to the mid-19th century (and beyond), see also Deustua (1984); on gold mining in Colombian Chocó worked by slave labor, see Sharpe

was established between the Latin American countries, which produced or exported precious metals (ergo, money); and the European countries, engaged in the production of industrial metals, especially iron for the railroads, and energy minerals, such as coal, to fuel the Industrial Revolution[35] (the industrial capitalism that Henri Sée wrote of in the early 20th century).[36]

Thus, at the start of the 19th century, the time of Rivero, Peruvian mining in particular was marked by a contrast between the recently-introduced extractive technologies that were developed during the British Industrial Revolution; and the old colonial technologies which, since the 16th century, had demonstrated their productive effectiveness, chiefly by lowering production costs or allowing more silver to be extracted from the ore.[37] Such was the dilemma faced by mining in Cerro de Pasco vis-a-vis the introduction of steam engines brought to Peru in 1812 by a group of investment partners and mining entrepreneurs (Pedro Abadía, Francisco Uville, and José Arismendi); in 1826 – when Rivero was already in the country and serving as Director-General of Mining – the British-owned Peruvian Pasco Company sought not only to obtain and/or buy the technology, but also to use it exclusively to drain the mines in Cerro de Pasco.[38] Meanwhile, the excavation and construction of tunnels like Yauricocha, San Judas or Yanacancha, Avellafuerte, and the later examples of Quiulacocha and Rumiallana – the latter led in the 1820s by the Cerro de Pasco Miners' Association (Gremio de Mineros del Cerro de Pasco) with state subsidies, in the form of both provision of labor and fiscal contributions through the *real en marco* tax – proved the effectiveness of these old technologies

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(1976); on Brazil, see Eakin (1989); and most recently, for Latin-American mining in general, see Brown (2012).

35 Kenneth Pomeranz (2002), the University of Chicago historian, makes a distinction between the industrialization process in the international economy between, on the one hand, the peripheries of the European Old World (North America, Latin America, etc.), which expanded their land-intensive exports of agricultural products, lowering the costs of European consumption, and of natural resources such as minerals; and on the other hand, Europe's increasing specialization in the production of high-added-value manufactured products. Pomeranz's article was discussed publicly at one of the symposiums of the Department of History of Eastern Illinois University at the Dudley House, Charleston, Illinois.

36 Chile embarked upon the mass production of copper at the end of the 18th century and the start of the 19th; Mexico experimented with iron production during the early Republic. Meanwhile, copper and tin also became export goods in the late 18th and early 19th centuries, and continued to be so throughout the latter. Moreover, the extraction and production of coal, lead, and iron began during the Republic, in what has been called a "plebeian economy" (see Vayssière, 1980; Deustua, 2009, 67-87; 2014).

37 I refer to the use of mercury or quicksilver and to the patio system, in comparison with the huayra system and earlier Andean technology (see Note 31).

38 See Fisher (1977, pp. 202, 228); Proctor (1923/1973, p. 34; extract of *Narrative of a journey across the cordillera of the Andes*); and Deustua (1987, p. 35-75; especially p. 63).

in extracting groundwater from the mines, allowing a return to mining at depth and an increase in silver production up to a peak in 1842, when 586,609 silver marcos were extracted and recorded in the *callana* of Villa de Pasco and valued at 5,807,433 pesos (Fisher, 1977, pp. 223-227; Deustua, 1986, pp. 147-150; 1987).[39]

The British-owned Peruvian Pasco Company and the Compañía de Máquinas a Vapor para el Desagüe de las Minas del Cerro de Pasco, on the other hand, turned out to be neither productive nor efficient – quite the reverse. To begin with, the Peruvian Pasco Company was created at the same time as four other British firms (the Chilean and Peruvian Association; the Potosí, the La Paz and Peruvian Mining Association; the Peruvian Trading and Mining Company; and the Anglo-Peruvian Mining Association) amid the speculative environment of the London Stock Exchange of 1822 and 1825, when the Latin American nations had just gained their political independence and it was believed that the continent's "fantastic" natural riches could be had by British interests. After London investors and speculators were gripped by a fever to "fish for pearls in Colombia, steam along the rivers of South America, establish gold and silver mines, and export milk churns to Buenos Aires" (Humpreys, 1969a, p. 55),[40] reality compelled them to use any possible means to make whatever gains they could from the local Latin American economies, since, as was established soon after, the Latin Americans "preferred their national independence to the cotton and muslin fabrics" of Great Britain (Humpreys, 1969b, p. 16).[41] The nominal capital of the Peruvian Pasco Company, according to the London Stock Exchange's valuation, was 5 million Peruvian pesos, or £1 million – equal to the value of Cerro de Pasco's entire silver-mining output in the boom year of 1842. In other words, a fantasy figure that was highly speculative, as I have mentioned elsewhere.[42] It came as no surprise, then, that once the

39 See also Fort and Fisher (1901). Peruvian silver mining's great technological innovation, especially in the ore-refining process, was the abandonment of the patio system and the introduction of leaching in the second-half of the 19th century (on this, see Contreras, 2004, pp. 114-146).

40 Translation by *Apuntes*.

41 The latter quote paraphrases Walter Scott's *The Life of Napoleon Buonaparte*.

42 The nominal capital of all British mining companies incorporated in London to operate in Chile, Peru, and Bolivia, without any knowledge of the specific Latin American reality, was £4,600,000 – 23 million Peruvian silver pesos or Spanish dollars. The nominal capital of all British companies operating in Latin America "fishing for pearls in Colombia and steaming along the rivers of South America" was £25 million or 125 million pesos – again, absolute fantasy figures. See Rippy (1947); see also English (1825), a crucial primary source for analyzing the speculative boom in this particular political and economic environment, above all because English himself was a stockbroker; finally, see Bonilla (1980, p. 426).

company was operating in Cerro de Pasco, its earnings, profits, and yields left a great deal to be desired.[43]

The rapacity of British usury manifested itself not only in this crazy financial speculation for the creation of companies active in mining and other sectors, most of them extractive, but also in the investment of state funds[44] – known today as sovereign debt.[45] According to one calculation, £18,542,000, or 92,710,000 Spanish dollars, were loaned by Great Britain to seven Latin American countries between 1825 and 1836 at an annual interest rate of 5 and 6%. These countries were Peru, Gran Colombia, Chile, Argentina (the text states Buenos Aires), Guatemala (or as it should have been recorded, the United Provinces of Central America) and Mexico.[46]

In the Peruvian case, three diplomatic missions were sent from Lima to London to negotiate sovereign debt loans. The first, led by Juan García del Río and James or Diego Paroissien, left at the end of 1821 and acquired a loan of £1,200,000, or 6 million Peruvian pesos. The second, led by John Parish Robertson, left at the end of 1822 and secured another loan for £616,000, or 3,080,000 Peruvian pesos.[47] Finally, the mission led by Joaquín Olmedo and José Gregorio Paredes at the end of 1825, after the war had ended and Viceroy La Serna had capitulated in Ayacucho, did not manage to obtain a loan at all, because, of course, the stock-exchange crash had already occurred and acquiring fresh capital was like finding "a needle in a haystack." However, of all the capital acquired in London, the Peruvian government was only able to avail itself of £947,000 (4,735,000 pesos -- that is, 52% of the total), since the rest was lost to disbursements in Europe, commissions, speculation, and even graft, showing that just as

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43 See Deustua (1987, pp. 63-66).

44 I am not aware of any studies that have analyzed how London stockbrokers swindled so many British investors - especially those from the middle-class, who were less informed of stock-exchange "tittle-tattle." The English-language text and the Rippy article referred to in Note 42 are a good introduction. Eric Hobsbawm states that "after 1826 [and I would add, as a consequence of this crash in the London Stock Exchange] the country had a deficit not only on [British foreign] trade but also on its services (shipping, insurance commissions, profits on foreign trade and banking, and so on)." He continues: "This balance was slightly negative in 1826-30, positive 1831-5, and negative again in all the quinquennia from 1836 to 1855" (1981, p. 236 and Note 14). This article by Hobsbawm is part of Chapter 3 of his *Industry and empire*, (1968, pp. 40-60).

45 See Marichal (1989, 2007).

46 In *El Eco del Protectorado* (N° 76, July 12, 1837; quoted in Mazzeo, 2003, p. 59).

47 John Parish Robertson was a personal friend of Simón Bolívar. In 1810, amid the battles that marked the first stage of the independence of Gran Colombia and, in particular, of the Captaincy General of Venezuela, he was promoted not only to the rank of colonel, but to head of the Diplomatic Mission of Gran Colombia in London. From then on, Bolívar would have very good contacts in the financial and political circles of the capital of the British Empire, .Bierck (1951, p. I, xvi).

bloated companies were created, so too was Peruvian external debt overblown and non-productive from the outset.[48]

Small wonder, then, that the activities of the Peruvian Pasco Company in Peru and in Cerro de Pasco were also a chimera rather than a genuine injection of productive mining capital and of efficient and appropriate technology. To begin with, the members of the company in Peru were: English banker Thomas Kinder; John Paris Robertson, Peruvian government emissary, negotiator for the second British loan, and British citizen; William Cochrane, again British, relative of the Scottish sailor Thomas Cochrane, who led the Liberating Expedition of Peru and also played a crucial naval role in the independence of Brazil; two individuals about which little is now known but who may well also have been British: José Andrés Fletcher (perhaps Joseph Andrew Fletcher), and Carlos Holland (Charles Holland?); and one man who was certainly Peruvian-born, Francisco Quirós, a prominent and well-to-do local entrepreneur who went on to become prefect of Junín in 1833 (Regal, 1965, p. 14). Quirós owned mining properties in Cerro de Pasco and in other urban and rural areas of the department of Junín. He was also engaged in trading silver bars, from Cerro de Pasco to Lima.[49] Was he a front for British interests in Peru? For the Peruvian Pasco Company? Or, rather, did these representatives of British capital in Lima and Cerro de Pasco need a local actor who could help them generate profits (on a large scale) to pay back investors from the London Stock Exchange?[50] Francisco Quirós, along with Cochrane and Fletcher, also did business with the Peruvian government in 1826 to build what would have been the first steam railroad in Latin America, had it gotten off the ground.[51]

The construction, completion, and startup of the Quiulacocha tunnel was a productive and technical option that yielded far better results than the use of steam engines in the drainage of the Cerro de Pasco mines. In

48 See Palacios Moreyra (1983). An indispensable source for examining this historical problem is Volume 11 of the *Colección Documental de la Independencia del Perú (CDIP): Misiones peruanas, 1820-1826*, especially volumes 2 and 3: *Misión García del Río-Paroissien* (Álvarez Brun, 1972) and *Relaciones diplomáticas con Gran Bretaña* (Álvarez Brun, 1973). For the role of José Gregorio Paredes in this and other activities during Peru's independence, see Pacheco Vélez (1981).

49 Deustua (2009, pp. 168-169). In 1855 he was appointed minister of foreign relations, public education, and welfare by the government of President Ramón Castilla.

50 Brown excuses the investors and speculators for their "fantasies about easy profits to be made in El Dorado," adding that such illusions "bedeviled nineteenth-century investors, just as they had the sixteenth-century conquistadores" (2012, p. 93).

51 Regal (1965, pp. 4-6); Deustua (2009, p. 182; 1986, 138 and Note 28; 1987, pp. 63-64). Upon his death, Quirós, left his fortune to his relatives, Juana Quirós and Francisco Quirós (AGN. Protocolos Notariales. Notario Felipe Orellana, protocolo 496, N° 28, November 4 and 30, 1862 and January 13, 1863).

the fiscal year 1827-1828, with Mariano de Rivero on hand, 53,488 pesos were invested, and the results of the mine drainage process had started to become apparent.[52] This is in contrast to the 5 million pesos obtained from the London Stock Exchange for the creation of the Peruvian Pasco Company, a sum that was in a certain sense fictitious, and illustrative of how financial speculators stole money from British capitalists who dreamed of imperial glory in the new era of "informal imperialism," following the collapse of the Spanish colonial yoke of "formal Spanish imperialism."[53]

Of the 53,488 pesos invested in the Quiulacocha tunnel that year, 28,094 pesos (52.5% of the total) came from the "*real en marco*" levy, which the state imposed on mining with the agreement of the Villa de Pasco Miners' Association (Gremio de Mineros de la Villa de Pasco); while 25,394 pesos (47.5% of the total) were direct state contributions from the funds of the General and Departmental Treasury and contributions in the form of gunpowder provisions, a strategic resource for excavating the tunnel on whose production and sale the state held a monopoly.[54] In 1832, silver production at this mining center increased by 62%, and the water-level declined as a result of drainage via the tunnel into the Quiulacocha lagoon. From there, the water was used to move the millwheels of the "*haciendas minerals*;" that is, the mining companies engaged in refining silver ore used the hydraulic force of the streams and brooks that flowed from the Quiulacocha lagoon to crush and grind the ore, which was later mixed in the patios of the ore mills with quicksilver, just as Álvaro Alonso Barba taught the world to do in 1640.[55]

Rivero straddled two worlds and favored both during his short time as Director-General of Mining in this somewhat protectionist historical period, even if it was a new type of protectionism. But at any rate, he became mixed up in contradictory interests and near-irresolvable conflicts. Rivero was not adverse to the presence of foreign capital and interests in

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52 Rivero supported both the actions of the Peruvian Pasco Company in Cerro de Pasco and the construction of the Quiulacocha tunnel (see Rivero y Ustáriz, 1857, pp. I, 201). Of course, the key institution to understanding all the disputes and particulars associated with the economic "takeoff" of mining in Cerro de Pasco from the 1820s to the boom of the 1840s is the Gremio de Mineros, whose role is examined in Deustua (1986, especially 113-163; 1987).

53 On formal and informal British imperialism, see Louis (1976).

54 "Estado jeneral de las obras que se han hecho en el socabón de Quiulacocha y demas del mineral de Yauricocha," in Mariano Eduardo de Rivero y Ustáriz: *Razón anual de los progresos y trabajos del mineral de Yauricocha presentada al importante gremio de mineros por el señor director general de Minería* (1828). See also his *Memoria sobre el rico mineral de Pasco* (*MCNINE*, 1828), mentioned in Note 5; also, see: Archivo de la Dirección Regional de Minería del Cerro de Pasco, libro copiador de notas desde 1832 hasta 1835, correspondencia (folios 20v, 60v, 96 y 99).

55 See note 31.

Peru, given his education in Britain and France. At the same time, he was a criollo nationalist who had been invited by Bolívar's government to return to Latin America – to Gran Colombia first and then to Peru – to apply his considerable knowledge of chemistry, physics, and mineralogy. Of course, there were no courses in Political Sciences at that time, nor in Sociology, and in 1829 the caudillo wars and coups d'état – first by Antonio Gutiérrez de la Fuente and then by Agustín Gamarra – did away with the position and the office of the General Directorate of Mining, and Rivero was forced to flee to Chile, where he stayed between 1829 and 1833. That is, his Bolivarian sympathies were short-lived. His exile was the thanks he got for his involvement in public administration and his influence on economic, technological, and general public-policy decision-making at a government agency that did not last long. Indeed, colonial institutions such as the Union of Miners, the Mining Council (Diputación de Minería), the General Mining Tribunal (Tribunal General de Minería), and the Consulate Tribunal (Tribunal del Consulado) had more clout than the General Directorate of Mining, created to promote more dynamic mining in the newly republican state.

Upon his return from exile, Rivero threw himself into politics, and was elected deputy for Caylloma in his native Arequipa before being appointed advisor to President Salaverry, albeit only for a brief period. In 1838 Agustín Gamarra, despite being the most-important and longest-lasting conservative caudillo to serve as president of Peru, appointed Rivero Public Works Inspector, which meant his return to public administration from the apparatus of the state. Then, under Ramón Castilla – another caudillo, but who in his second term was the most important liberal reformer in 19th-century Peruvian history, regardless of the protestations of the Peruvian historian Carmen McEvoy[56] – he was appointed prefect of Junín, and the mining center of Cerro de Pasco was again under his authority. Later, in 1848, Rivero was appointed prefect of Moquegua, closer to his beloved Arequipa. It was also Castilla who in 1851 appointed Rivero Counsel General of Peru in Belgium - ambassador, in modern terms - when he was 53 years old. It was there, in the city of Brussels, that Rivero published his *magnus opus*: *Colección de memorias científicas, agrícolas e industriales*, published in 1857

56 McEvoy vilified Ramón Castilla as just another *caudillo*, part of the Peruvian Leviathan, until the eventual arrival of "the leading liberal and genuinely republican savior," Manuel Pardo, and his Electoral Independence Society (Sociedad Independencia Electoral), which later became the Civil Party of Peru (Partido Civilista del Perú). Thus, for McEvoy, while Pardo was a true *homo politicus,* Castilla was not. See his *Homo politicus. Manuel Pardo, la política peruana y sus dilemas, 1871-1878* (McEvoy, 2007) and my criticism in *Estudios Interdisciplinarios de América Latina y el Caribe* (Deustua 2010).

by the printing press of H. Goemare in two volumes, which includes the bulk of his academic and scientific works, written staring in the 1820s. On November 22 that same year, 1857, he died in Paris, France, at the age of 59.

5. Conclusion: beyond mineralogy

During the life and times of Rivero, there was a scientific discipline known as mineralogy. This discipline no longer exists. As I mentioned at the start of this article, mineralogy was a combination of physics, chemistry, and geology. Rivero embraced it as both a student and practitioner, above all because mining was a fundamental source of wealth in Peru and Europe: in Peru, of precious metals and especially silver, while in Europe, of other minerals and metals, especially coal and iron starting with the Industrial Revolution at the end of the 18th century and the start of the 19th.

But Rivero was much more besides. As this article has shown convincingly, I believe, he was also a public administrator, an individual who believed in the state's role in modernizing the country and in applying the latest scientific and technological advances to its economic growth and development as a society and as a nation.[57] However, Rivero got caught up in the maelstrom of Peruvian politics, and his grand objectives could not always be realized. Moreover, his actions were held hostage to the conflict between multiple, opposing forces: on the one hand, the state and public administration; and on the other, private capital – above all foreign and, in the 1820s, British – as well as the business world, in the form of the Compañía de Máquinas a Vapor and the more specific, local interests of the Cerro de Pasco Miners' Union, which promoted, to cite an example, the construction of the Quiulacocha tunnel using cheap labor. Thus, this illustrious criollo who had spent many years studying in Europe was caught between the local world, represented by Cerro de Pasco and Puno, and the more international and cosmopolitan world of foreign interests in Peru.

Still, Rivero was more than a mineralogist and administrator connected to the vicissitudes and tribulations of Peruvian mining (and politics). He also had an interest in Andean fibers and agriculture, and in the advantages and benefits of exploiting guano from the isles, once more interacting with European academic centers and scientists such as his old friend and colleague Jean Baptiste Boussingault and the French Société Imperiale de

57 In 1828, for example, Rivero wrote that "amply favoring the Peruvian Republic with abundant and powerful mines of all types, the Government [...]turned to promoting public prosperity, for the many reasons within its grasp" (quoted in Alcalde Mongrut, 1966, p. 32). Translation by *Apuntes*.

l'Agriculture[58]; indeed, he described varieties of potato, olluco, and maca, as well as *huano* (as he spelled it) and saltpeter.[59] Moreover, from the first edition of his journal, *Memorial de Ciencias Naturales y de Industria Nacional y Extranjera*, Rivero showed an interest in what he called "the Peruvian antiquities;" that is, archaeological monuments and artifacts that preceded the arrival of the Spanish conquistadors, publishing *Antigüedades peruanas* in 1841, which he later expanded and re-issued in Vienna in collaboration with the Swiss traveler and scientist Johann Jakob von Tschudi (Alcalde Mongrut, 1966, p. 54). But these dimensions of his personal and professional life, as well as the scientific know-how of contemporary Peru, are beyond the scope of this study.

58 Where he published his study on Peruvian agriculture in one of his *Memoirs* of the 1850s (see Rivero, 1857).

59 On this, see Cushman (2013).

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