

The Role of Science in Latin American Independence Revolution

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Abstract

In the past, historians tended to think that the Latin American independence revolution was just a political revolution or political struggle. But to my opinion, the independent revolution in Latin America is above all a revolution about scientific thoughts and knowledge. Along with the armed revolution, another revolution took place in the heart of Latin American society. This revolution was intellectual in nature and led to the conception of the full sovereignty of nations. But this great role science played in the independence revolution was little known until now.

Since the 17th century, especially from the 18th century on, scientists and historians of science started to use the concept of revolution to describe the progress of science. Just as Joseph Priestley pointed out, when referring to the times of his life (18th century), that it was both a time of a philosophy or scientific revolution and also a national revolution age. It was clearly a period of crisis and instability in the 17th and 18th centuries, and there seemed a universal revolution, and events in different regions are only particular manifestation of this revolution. Occurred in the late 18th and early 19th century, American War of Independence, the French Revolution and the independence of Iberian-America's revolutionary war was precisely accompanied by a second scientific revolution.

I divide this article into three parts. In the first part I mainly discuss the historical background of science in Spanish America. In my opinion, there are six factors that contributed to the development of colonial science in Spanish America: mining and other economic activities; secularized education; scientific and technical newspapers and magazines; public and private libraries; various kinds of scientific communities; secret societies. The second part focuses on two new features of modern scientific paradigms in Spanish America: one is the mixed character of science and the other is its Utilitarian nature. The last part examines the role of science in Latin American independence revolution mainly from two distinguished aspects. First, in the 18th century, science became an important political tool for the revolution and independence war in Europe and European colonies. Second, scientific research in the Spanish American colonies also helped to form national identities which were indispensable for the independent movement of Latin American colonies.

Keywords: science Latin America independent revolution

Historical Background of Colonial Science in Spanish America

In my opinion, there are six factors that contributed to the development of colonial science in Spanish America: mining and other economic activities; secularized education; scientific and technical newspapers and magazines; public and private libraries; various kinds of scientific communities; secret societies.

First, the development of colonial economy, especially agriculture and mining, needed new science and technology to emancipate the productive forces.

The modernization and popularization of science had a tentative beginning in several countries of Latin America in the 18th century, when local intellectuals became convinced that science would raise the economic level of their countries. Meanwhile, during the 18th century and early 19th century, social and economic life in Spanish American colonies became more dynamic. Intense economic activity was needed for the development of diverse locally produced materials and intellectual inputs, because it was not always possible to obtain these from the distant and sometimes chaotic home country. Indeed, this need triggered the search for raw materials (like mercury and iron) in several places and the development of technical innovations for industry (in the extraction and processing of minerals and the minting of currency and coinage, etc.) and for agriculture (e.g., for the cultivation of sugarcane, tobacco, silk, cotton, and indigo). These innovations occasionally or permanently broke the bans formerly imposed by the home country. In order to obtain these inputs, geography and natural resources were surveyed. It was quickly understood that by developing technology, Hispanic Americans would also contribute to increasing the wealth and prosperity of their territories, no longer for Spain's or Portugal's exclusive benefit but for the colonies' benefit as well. Therefore, the scientific modernization is the product of the social dynamics including economic, demographic, cultural, technical, and scientific dynamics, that the region underwent and also an answer to the needs brought about by such development in Spanish American colonies.

Second, the secularization of education laid solid foundation of the dissemination and popularization of scientific and technical knowledge.

Economic progress was followed by social development typified by the economic societies established in almost all of the Americas. The educational reforms were characterized by the end of the monopoly of scholasticism and Roman Catholic Church. Before independence, Schools were created to provide scientific and technical instruction for mine owners, metallurgists, engravers, draftsmen, engineers, architects, farmers, druggists, seamen, artists, and other artisans. For example, In Mexico, at the urging of and with the support of mine owners and merchants, schools of mining, schools of botany and the schools of arts were created respectively in 1792, 1788 and 1785. In Guatemala, the Botanical Garden was established in 1796, and the drawing and mathematics schools were created in 1797. All of these were set up by the Economic Society of Friends of the Country. In Caracas, the Mathematics Academy, founded in 1760, was supported by the business consulate. In Lima, the Chemico-metallurgical Laboratory, 1792, was sponsored by the Mining Tribunal. In Buenos Aires, the School of Geometry, Architecture, and Drawing was created by the business consulate in 1799, and the Nautical School was created by the same organization, at Manuel Belgrano's urging.

All of these institutions were established in accordance with the spirit of the century, that is, Enlightenment ideals, which focused on social reforms in science, education, and the useful arts. Universities created in Latin American colonies also set the foundation for the new generation of intellectuals in the pursuit of rationality and science. For example, in Bogotá, the curriculum created by Francisco Moreno y Escandón for the public university established in 1774 initiated interest in Enlightenment ideals and modern science. Another good example is José Celestino Mutis, he was a physician and taught the first modern mathematics and physics courses at the Colegio de Nuestra Señora del Rosario. Some students of Mutis such as Zea, Nariño and Caldas

used science, by institutionalizing it, as a source of political power for the Creoles to head up the revolutionary road. Until the late 18th century, Iberian-American universities have been incorporated into the curriculum content of science and philosophy, and students are learning to change the view of the world. This new educational and training idea have played an important role in the independence movement, almost all the leaders of the Latin American Revolution have received the education of colonial culture. ^①

Third, the publications of scientific newspapers, magazines, journals and the establishment of printing houses in the colonies helped to disseminate and popularize scientific knowledge, with the double purpose of creating a culture of science and awakening national consciousness, which acted as a preparation of independent thoughts.

In the 18th century, Periodicals and journals were created as a vehicle for the dissemination and discussion of enlightened science. Although the printing press, the importation of books, and pedagogy in general were subjected to Inquisitorial censorship, this was not an obstacle for the exceptional or heterodox cultivation of science. For instance, the first properly scientific magazine of the American Enlightenment, *Literary Magazine of Mexico*, established in 1768, was published by José Antonio Alzate y Ramírez. This intellectually curious scientist and Creole writer took on the enormous task of popularizing science over the next thirty years by publishing the *Miscellaneous Science and Art Subjects, Observations on Physics, Natural History*, and the *Useful Arts*, and *Mexican Literary Gazettes*. Alzate's scientific and popularizing works had great repercussions in Mexico as well as in other places in the Americas and Europe. ^②

The new scientific publications were encouraged by the Enlightenment philosophy to modernize scientific and technical areas. ^③ Hispanic American scientific magazines also helped broaden the Creole Enlightenment's influence on sectors of the population. As a result, in the areas of education, culture, agriculture, mining, and industry, diverse reforms were introduced, for example, the gradual abandonment of Scholasticism in teaching; the rescue and dissemination of languages and other aspects of native culture; measures to improve indigo, mulberry, cotton, and tobacco crops, among others; and innovations in mining and other industrial areas.

Texts and magazines written in the vernacular made the new science accessible to anyone, helped constitute markets of readers sharing common print vernaculars and common conceptions of science. News about new theories and technical applications as well as results of research on Latin America's natural resources, geography, industry, economy, and population were printed in these publications. This was one of the factors that greatly contributed to science's internationalization. In summary, publications and scientific newspapers disseminated scientific news with the double purpose of creating a culture of science and advancing scientists socially. Hispanic American scientists' greatest success lay in creating a leading role in society for science. ^④

Fourth, some private scientific libraries played great roles in the formation of colonial science.

At the turn of the 18th century, primarily from 1760 on, private libraries were the main

^① Luis Leal, "Felix Varela and Liberal Thought." In *The Ibero-American Enlightenment*, pp. 236-237.

^② Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html, P.63.

^③ Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html, P.66.

^④ Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html, P.58.

indicator of the ever-wider circulation of books, especially banned scientific books. We know that in the seventeenth century there were private scientific libraries in New Spain and Peru containing scientific works. In Mexico, for example, the libraries of physicians Melchor Pérez de Soto and Alfonso Núñez were famous at the beginning of the century. In the second half of the century, Carlos de Sigüenza y Góngora and Sor Juana Inés de la Cruz possessed thousands of volumes, some of which were hermetic scientific texts, others, modern. Sigüenza's library contained an important collection of advanced mathematical, astrological, and astronomical texts, as well as some on physics.^①

Another example, New Spain physician and mathematician José Ignacio Bartolache left a library consisting of 487 works published in 712 volumes. He owned books written in Latin, Greek, Hebrew, Nahuatl, English, and French. His collection included 80 literature books, 75 on medicine, 60 on religion, 50 on law, 25 on mining, 21 on chemistry, 20 on history, 20 on physics, 15 on mathematics, 16 on botany and the natural sciences; the remainder were dictionaries or about geography, travel, music, philosophy, indigenous and European languages. His library boasted 177 books on science, including Mathematics.^②

Fifth, various scientific communities dedicated to the fostering and teaching of science were established.

An important revolutionary feature of scientific revolution is the rise of the scientific communities, various scientific organizations and institutions. Some scholars pointed out that toward the beginning of the 19th century no city of the New World – not even in the USA – had scientific institutions as important as Mexico-City. At the end of the eighteenth century, individual and erudite cultivation of knowledge was replaced by an interest in the community search of “useful arts.” At the beginning of the nineteenth century there was a movement for science and the “useful arts” in practically every region of Spanish America. A significant number of scientists formed a community in each country, and modern institutions especially dedicated to the fostering and teaching of science were established, such as economic and “friends of the country” societies.

The alliances scientists established with several social sectors, such as mine owners, tradesmen, etc., allowed for a quite successful institutionalization process of science. Among the new institutions that fostered practical physics, chemistry, astronomy, botany, mineralogy, medicine, and surgery were the Mining College established in 1792, the Botanical Garden and Department created in 1788 in Mexico; the Bogotá observatory set up in 1803 by the famous physician Mutis, and the College of Surgery and Medicine created in Lima in 1815. Valuable results were achieved in fields such as chemistry, natural history, mineralogy, and astronomy. These scientific communities disseminated science in the newspapers created by the scientists themselves.

The institutionalization of modern science and technology began to produce results. The first generations of scientists and technicians, who were fully aware of the value of science to them and their society, were trained. Research that had practical applications for Latin America's natural resources, industry, geography, economy, and population was carried out. Such studies had an immediate impact on sectors such as mining, agriculture, and textiles but, above all, contributed to demonstrating the strength of the Spanish colonies as independent nations.

^① Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html

^② Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html

Sixth, owing to the Inquisitorial censorship, science spread sometimes through secret (namely illegal at that time) ways in Spanish America.

In essence, the secret organizations linked up almost every actor of independent movement, for they were both intellectual centers and revolution organizations. Secret societies played an indispensable role in the revolutionary colonies.

The most significant society was the freemasons. Some scholar said that, one of the earliest and most significant innovations of the Spanish American was the establishment in America of the secretive Order of Freemasons, whose organization they viewed as a useful means for the dissemination of independence ideas and whose purpose was to establish independent governments in colonial Latin America. Miranda founded the specifically Spanish American lodge *Gran Reunión Americana*. Very quickly, Masonic lodges began to sprout in all major Spanish American urban centers; Alvear, San Martín and O'Higgins set up the best-known, the Lautaro Lodge,^① with branches in Chile and Buenos Aires.^② The masonic order was crucial to the process of Spanish American independence; not only did it link the patriots by means of signs, symbols and organizational structure, it also gave organizational and idealistic cohesion during the early years of the independence movement.^③ It is said that while the Army formed the military wing of the liberation movement, Lautaro's Lodges constituted its political wing.

Historically, freemasonry is a knowledge monopoly organization in its nature.^④ And in Spanish America it was influenced greatly by French Enlightenment thoughts, such as independence and liberty, but in Iberian-America one more thought was promoted, that was the principals of religion. The Freemasonry had an immense hold on the educated classes and actually formed the basis for a political club in Iberian-America. Especially in Argentina, Established after the name of "Logia Independencia" in 1795, this Masonic organization was in fact a center of young intellectuals mostly with higher European degrees. Some of the most prominent members were Juan José Castelli, Manuel Belgrano, Juan José Paso, Feliciano Chiclana, Matías Irigoyen, Nicolás Rodríguez Peña, Hipólito Vieytes, Juan Larrea, Domingo Matheu and Antonio Luis Berutti. Some were scientists themselves and others were greatly influenced by scientific thoughts of that time. It is interesting to note that the First Triumvirate in 1811, the Second in 1812, the General Constituent Assembly and the Declaration of Independence in Tucumán in 1816 were mostly formed by Masons.

Books smuggling was another secret way to spread scientific thoughts. For example, in Peru, the smuggling of forbidden books, especially from France, was so uncontrollable that in 1704 Viceroy Manuel Oms de Santa Pau was appointed and charged with allowing the French to traffic secretly in books because it was considered impossible to stop sales to Lima's residents.

^① The Lautarian Lodges, or Lautaro's Lodges, were named after Mapuche leader during the War of Arauco Lautaro, struggle against the Spanish Conquest in sixteenth-century Chile, a town and municipality in southern Chile's Araucafa Region Lautaro (volcano). Some historians thought that it were created in Buenos Aires in 1812 by members of the Freemasonry, but others insisted that it been founded in 1797 in London by Venezuelan revolutionary Francisco de Miranda, some thought the Lautaro Lodge was founded in Cadix, Spain.

^② Oliver Marshall, *English-speaking communities in Latin America*, MacMillan Press LTD., St. Martin's Press, LLC., 2000, p.6.

^③ Oliver Marshall, *English-speaking communities in Latin America*, MacMillan Press LTD., St. Martin's Press, LLC., 2000, p.6.

^④ Freemasons are always linked up with Seven Liberal Arts and Sciences, which are grammar, rhetoric, logic, arithmetic, geometry, music, and astronomy. And in history, freemasonry is a guild-like technical monopoly organizations.

Censorship continued, however, and in 1708, Fray Nicolás Muñoz requested the intervention of the Inquisitor and pointed out the clandestine manner in which forbidden books were being introduced: “They have printed whole books of false doctrines, with titles belonging to Catholic authors of well-known authority. They have removed from the books of the Church Doctors what is most opposed to their perverse dogmas. They have mixed in among the works of Catholic writers great errors, which being (as they are) poison, take away the sense of the ignoramuses, and perhaps of the experts, either because of the bad inclination toward evil or because it hides under the disguise of good.”^① In Mexico, Bookstores, however, proliferated and undoubtedly were a good business, thanks to a real demand for books. In 1768, in Mexico City, there were fifteen bookstores around the city. Other businesses that combined the sale of goods and books also existed.

New Features of Modern Scientific Paradigms in Spanish America

Some historians of science, including J.D.Bernal, thought that Spanish and Iberian-American science was always underdeveloped compared to the Anglo-Saxon science. In his well-known work, *The Social Function of Science*, J.D.Bernal concluded that unlike other European countries, Spain for many centuries had been dominated in the intellectual fields by the clergies and never had the opportunity to develop science. The science of Latin America followed the same difficult way.^② Some researchers even thought that there was absolute opposition between science and religion in Iberian-American colonies. However, recent researchers took an opposite point of view. They argued that Iberian-American science and technology were of great historical value. These contributions have been excluded only because of the background of the Protestant Reformation and the Enlightenment under which the Scientific Revolution broke out.^③ Different from the scientific development in other European countries, Spain and Iberian-American science reflected some new features.

First, science in Spanish America didn't develop under the Protestant Reformation and French Enlightenment circumstances. It was actually a mixture of modern science, rationality and Catholic Enlightenment^④, a mixture of European science and native one, and a mixture of tradition thoughts and modern ones.

Until the 19th century, the Catholic Church was an arm not only of the Spanish conquest but of the colonial government as well. Its power was too strong to ignore. Therefore, In Spanish America, the scientific revolution was not and could not be an anti-religious movement. Actually, the interest in the dissemination of scientific knowledge characteristic of that cultural movement which originated in Europe in the 18th century was embraced by priests and monks in Spanish America. The many examples of Catholic clergy involved in scientific endeavors in Spanish America between 1700 and 1808 suggest that the Catholic Church did not oppose the scientific knowledge promoted by the Enlightenment. Contrary to popular opinion, the Catholic Church did

^① Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html

^② J.D.Bernal, *The Social Function of Science*, George Routledge & Sons Ltd. London, 1944, p.290.

^③ Jorge, Cañizares-Esguerra, Iberian Science in the Renaissance: Ignored How Much Longer? *Perspectives on Science*, Volume 12, Number 1, Spring 2004, pp. 86-124 (Review), Published by The MIT Press, <http://muse.jhu.edu/journals/posc/summary/v012/12.1esguerra.html>

^④ Mariano Picón Salas, *A Cultural History of Spanish America*, Berkeley, 1962.

not (or could not) prevent the ideas and concerns of the Enlightenment from entering the Spanish speaking world, and that many Roman Catholic clergymen actually did much to spread and support this ideological movement in Spanish America. For example, in New Spain, the most outstanding scientist of the century of the Enlightenment was Father José Antonio Alzate (1737-1799).^① Father Alzate disseminated scientific knowledge in the various scientific publications that he edited between 1769 and 1795.^②

Another example is Father Jose Celestino Mutis. He placed in the development of Spanish American science the same fervor that other Spanish priests had given to the conversion of non-Christians in the 16th and the 17th centuries. He was a secularist and a man of the Enlightenment. He was also a Catholic in good standing in as much as he did not harbor theological opinions contrary to Catholic teachings, but his heart was in scientific observation, and he was a modern scientist, because his observations were not motivated solely by a desire to understand God's creation, but by a desire to understand the laws of nature and to disseminate that knowledge and its applications.^③ The complex and unpredictable relations between science and religion in the Spanish American Enlightenment reflected that many of those who made the Scientific Revolution saw themselves as students of God's handiwork.^④ For example, Elías Trabulse once surveyed astronomy and religion and declared that they were "indivisible, since focusing on only one aspect...would mutilate what should be considered as a whole."^⑤ Spanish America Enlightenment, according to Lewis White Beck, is a mixture of pietism, French classicism, and scholasticism. In the 18th century, the Spanish speaking world was not the only place where the Enlightenment co-existed with a deeply Catholic feeling. That was also true in Austria.^⑥ Just as Paulino Castañeda Delgado pointed out that by the second half of the 18th century modernizing Jesuits had already produced a synthesis of Catholic doctrine and modern philosophy equivalent to a Catholic Enlightenment.^⑦ And Mariano Picón Salas called the Iberian-American Enlightenment as "Jesuit humanism"—that is, the Christian humanism taught by the Jesuits—was one of the bridges that joined in Spanish America the scholastic thought of the 17th century to that of the 18th century.^⑧

There were numerous metaphysical treatises, philosophy courses, and physics texts written by Spanish Americans trying to reconcile theology, metaphysics, and science. This was, for example, the effect attached to devotion to the Guadalupana (the "brown Virgin") by Creoles in New Spain who believed in Enlightenment ideals. In Mexico, devotion to the Guadalupana constituted a truly nationalist ideology with broad social acceptance in the religious and cultural spheres. In order to avoid Inquisitorial censorship and protect themselves against charges of non-religiosity or heresy because of their commitment to modernity, their study of the

^① Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html

^② Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html

^③ Miguel Angel Martínez, *Contribuciones americanas al mundo*, Madrid: Anaya, 1988, p. 62.

^④ Rodney Stark, *For the Glory of God. How Monotheism Led to Reformations, Science, Witch-Hunts, and the End of Slavery*, Princeton: Princeton University Press, 2003, pp. 166-172.

^⑤ E. Trabulse, *Ciencia y religión en el siglo XVII*, in Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006.

^⑥ Nicholas Till, *Mozart and the Enlightenment: Truth, Virtue, and Beauty in Mozart's Operas*, New York: W. W. Norton, 1993.

^⑦ Mariano Picón Salas, *a Cultural History of Spanish America*, Berkeley, 1962.

^⑧ Rafael E. Tarragó, Science and Religion in the Spanish American Enlightenment, *the Catholic Social Science Review* 10 (2005):pp.181-196.

Guadalupana helped them show that religion and science were not incompatible. The scientific works of this period contain elements of both the modern and the traditional. All these conditions led the Enlightenment science of New Spain to acquire its own characteristics, different from the European scientific mold. Clear examples include the most developed Amerindian science and technology such as herbalism, astronomy, agricultural techniques, medicine, and natural history such as botany, zoology, paleontology, mineralogy as well as experimental physics, chemistry, and physiology from the seventeenth to the nineteenth centuries.

Second, the Iberian-American science is Utilitarian in nature, which influenced by the doctrine of Bentham.

Some scholars pointed out that, it is Iberians who first created a culture of empirical, experimental, and utilitarian knowledge-gathering of massive proportions that did not get its cues from the classics or the learned, but from merchants, enterprising settlers, and bureaucrats. As a matter of fact, Iberian-American science is Utilitarian during the whole developing process in history. Creoles that supported Enlightenment ideals usually used science and the useful arts to propose or introduce the reforms they deemed appropriate for their interests and power. In so doing, several times they had to oppose the Spanish government's authoritarian initiatives and show that their viewpoints were correct or even superior in the name of science.

In Mexico, for instance, Alzate presented suggestions in his magazines for improving the extraction of minerals and water from mines, for ventilating mines, for ginning cotton, for cultivating and processing cochineal. In Peru, Unánue published statistical data on public health and his botanical studies of Peruvian plants. In New Granada, Caldas wrote about how to cultivate cochineal, the relationship between the geography of Santa Fe and economy and trade. In Buenos Aires, Vieytes proposed reforms to the agriculture of Río de la Plata and the use of chemistry in agriculture and industry. In Guatemala, a Mexican botanist, Mariano Mociño, proposed measures for improving the cultivation of indigo, and Tomás Zelaya and others presented suggestions regarding linen and cotton.^①

For Spanish American scientific development focused mainly on applied sciences and technology. And it devoted to wedding commercial pursuits with scientific research. A convincing example is botany. The outstanding science in the Spanish colonial possessions was botany, and it too was developed chiefly for practical reasons: to find medicinal and industrial products. Such examples abound and allow us to appreciate one of the essential characteristics of Hispanic American Enlightenment science, namely, its pragmatic orientation.^② This type of empirical information gathering, codification, and utilitarianism was important to the development of Spanish American science.

The Role of Science in Latin American Independent Revolution

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^① Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html, p.68.

^② Juan José Saldaña, ed., *Science in Latin America: A History*, Austin, University of Texas Press, 2006. www.utexas.edu/utpress/about/bpermission.html, p.68.

was intellectual in nature and led to the conception of the full sovereignty of nations.

At the end of the eighteenth century and the beginning of the nineteenth, science took on a leading role in social transformation of the region, and it became one of the cultural and material agents of change. In their way, Latin American scientists also struggled for freedom and independence, the only framework in which science could develop and fulfill a social function. Latin American scientific Enlightenment was, therefore, the achievement of societies in the process of transformation and in search of their identity. The theories and concepts of this new philosophy were aimed at opposing Scholastic thought by explaining reality through observation and experience. They were also an attempt to promote a different vision of the world in new generations by teaching modern physics in nontraditional ways.

First of all, in the 18th century, science became an important political tool for the revolution and independent war in Europe and European colonies, including Spanish America.

Since 17th century, especially from the 18th century on, scientists and historians of science started to use the concept of revolution to describe the progress of science. ^① Joseph Priestley pointed out that the 18th century was both a time of a philosophy or scientific revolution and also a national revolution age. Occurred in the late 18th and early 19th century, American War of Independence, the French Revolution and the independence of Iberian-America's revolutionary war was precisely accompanied by a second scientific revolution.

The relationship between science and political order is by no means secondary, because it has had a direct effect on the conditions that made Latin American scientific development possible. Even before the independence, the process of scientific politicization began. Several colonies attempt to form technological elites in 18th and 19th century. Many scientific and technological elites took part in the independent movement, which successfully transformed science into a powerful political tool. From then on, Science became thoroughly intertwined with the political interests of the colonies. For instance, Thomas F. Glick has shown that Creole scientists spearheaded the patriotic wars of independence against Spain from 1810 to 1824 and developed separate national identities much earlier than other sectors of the population. These naturalists participated in the wars in a number disproportionate to their small population.

Second, scientific research in the Spanish American colonies also helped to form national identities which were indispensable for the independent movement of Latin American colonies.

With the development of science, a Creole nationalist consciousness and revolutionary movements emerged in Spanish America. Creoles and, to a lesser extent, mestizos gradually created their own Latin American identity by “Indianizing” the natives and through Creolization. And simultaneously, the “domestication” of science by integrating it into and adapting it to the Spanish American context took place. During this process, science became more pragmatic, and scientific knowledge became more localized in terms of education and ideology.

Some researcher said that, Spanish American Creoles created the first modular form of a nation. ^② The role of the late colonial Creole intelligentsia is very crucial in the invention of Latin American nations. Many historians of Latin American science have already noticed the connections between the development of communities of Creole scientists and the rise of a discourse of national identity in the late colonial period.

These social and cultural facts were expressed in the science that developed in the region. For

^① Bernard Cohen, *Revolution in Science*, the Belknap Press of Harvard University Press, 1985.

^② Benedict Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism*, London: Verso, 1991.

example, in the case of New Spain, the existence of ideological nationalism and a “Creole” scientific tradition shows that in this colony there was an appropriate foundation for introducing scientific theories, institutions, and policies at the end of the eighteenth century. During the process of scientific research, almost all the scientists of the Spanish American colonies embodied strong national identities. For example, the Mexican José Antonio de Alzate, editor of several periodicals and an expert astronomer and naturalist, helped to create and form the peculiar form of ‘national’ science; Benedictine Friar Benito Jerónimo Feijóo said that neither the indigenous peoples nor the descendants of Spaniards in America were inferior to Europeans.

In this process of seeking to develop separate identities from Spain they also created “patriotic” sciences, explored the connection between late colonial science and nationalism.^① The development of a patriotic science was headed by naturalists Francisco Zea and Francisco José de Caldas in New Granada at the end of the 17th century. For example, the naturalist Francisco José de Caldas offered a similar providential, utopian, and patriotic view of Colombia’s commercial destiny based on the uniqueness of Colombia’s space before independence. According to Caldas, Colombia was uniquely situated “in the center of the New World and enjoyed all the climates of the world. As a microcosm of the earth, Colombia was capable of supplying the world with all it needed. Caldas also viewed the Andes as a microcosm of the globe, a place around which all the racial varieties of the world had developed, thus, a privileged space to study plants and peoples.”^② Caldas sought to create a patriotic science based on the particularities of Colombia’s nature. He encouraged local scientists to benefit from such comparative advantage and study the causes of human racial variations without having to leave Nueva Granada. In 1812, he called on his Creole compatriots to create at last a national science. “If we have shaken off the political yoke of Europe,” Caldas admonished them, “let us also shake off the scientific dependence that degrades us and that maintains us in a literary infancy more ignominious than slavery.” Some local scientists such as Velasco also contested European histories of the origin of some of the most valuable dyes, spices, and fruits in international markets. For instance, he insisted that indigo, pepper, and coconut palms had not originated in the East Indies as it had traditionally been assumed but in America’s equatorial areas; nor had the bananas and plantain of Quito come from Africa; Creole lawyer Pedro Fermín de Vargas presented Nueva Granada as a land of unparalleled commercial potential.

The creation of such kind of “patriotic” science was based on the assumption of Creole naturalists and intellectuals. They thought that America’s tropical nature, bodies, and diseases responded to radically different natural laws were different from those of Europe and American phenomena could only be studied by local Creole scientists. For example, José Antonio de Alzate insisted that Mexican nature could never be understood by European scholars, whose laws had been devised to explain their own natural phenomena, regarding the perspective of inventing national identity grounded on the perception of a unique Mexican space. New Spain, he argued, was full of botanical marvels that would always contradict the laws of nature devised by Europeans.

Third, the independent war of Spanish America was a movement basically led by both

^① Luis Carlos Arboleda, “Science and Nationalism in New Granada on the Eve of the Revolution of Independence,” in P. Petitjean and C. Jani eds., *Science and Empires. Historical Studies about Scientific Development and European Expansion*, Dordrecht: Kluwer Academic Publishers, 1992.

^② Jorge Cañizares Esguerra, *Nation And Nature: Natural History And The Fashioning of Creole National Identity in Late Colonial Spanish America*,

revolutionaries and scientists (intellectuals).

Scientists, probably because of their contact with modern thinking and their newly acquired knowledge about Latin American reality, were, from the start, sensitive to and supportive of the ideal of freedom that motivated the insurgents. Many of them participated actively in the wars of independence, lending their knowledge in the wars of emancipation. Such was the case of Caldas, who took part in the conspiracy that started the rebellion of July 20, 1810, and who, as a scientist, lent great services to the war of independence as a military engineer and as editor of the first newspaper of the republic, the *Political Daily*. Another example is a group of graduates of the Mining College in Mexico, made up of Casimiro Ramón Chovel, Isidro Vicente Valencia, José Mariano Jiménez and Rafael Dávalos, all of whom joined Miguel Hidalgo's troops in Guanajuato in 1810.

As a matter of fact, almost every leader of the independent war was influenced more or less by scientific thoughts and rationality. For example, Simón Bolívar believes that freedom relies heavily on science and the development of science will help people understand and fight for their rights. In his view, only scientists can truly understand the real situation of a country. Another example was the Argentine lawyer, journalist and politician Mariano Moreno, one of the leaders in the May Revolution, which led to the declaration of independence of Argentina from Spain, radically influenced by Montesquieu, Voltaire, Denis Diderot, Jean-Jacques Rousseau and other European philosophers of the time. Moreno was convinced that society could be changed by the power of intelligence and reason. Another good example is the famous scientists and revolutionary José Celestino Mutis, as I mentioned before. These materials demonstrate the aspiration among some intellectuals to combine a national science and a national identity for Creoles by revolutionary method.

Conclusion

In the twentieth century, especially toward the end, science and technology became omnipresent. They embraced everything, including economic, political, cultural, social and even international affairs. Science also became an important academic discipline, and "invisible" schools communicate more intensively now. The scientific development of Latin America can trace back as early as to the 16th century.

In summary, the scientific development was the result of various factors, both external and local. But the local factors were the vital elements in these changes. It is worth emphasizing that the spread of science did not take place in a cultural vacuum. The scientific modernization is the product of the social dynamics including economic, demographic, cultural, technical, and scientific dynamics, that the region underwent and also an answer to the needs brought about by such development in Spanish American colonies. The historical forms through which Enlightenment ideas were incorporated into Hispanic America were unique regarding the European model, and the science of Spanish America in fact came to be recognized as science in its own context rather than a part of European science according to the Euro-centralism. It is a mixture of modern science, rationality and Catholic Enlightenment^①, a mixture of European science and Indian science, and a mixture of tradition thoughts and modern ones. And the role science played in Latin American independence revolution can no longer be ignored.

^① Mariano Picón Salas, *A Cultural History of Spanish America*, Berkeley, 1962.

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