CHAPTER 4

Scientific Traditions and Enlightenment Expeditions in Eighteenth-century Hispanic America

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During the eighteenth century, a great number of European expeditions traveled all over Hispanic America.¹ The numerous studies of the subject during the 1990s have considerably improved our knowledge of the Enlightenment and of the role science and technology played in the economic and social development of the Spanish colonies, although there are signs of exhaustion among researchers. It has become trite to reiterate the geostategic dimension, neomercantilist profits, or the tendency toward emancipation that marked eighteenth-century scientific expeditions. A new effort is needed to find new points of view within studies of European expansion. It is therefore worth remembering that there were bureaucratic organizations besides European crowns that were capable of substantial and sustained reconnaissance efforts in the territories.

The most recent literature focuses on expeditions such as Cook’s, Bougainville’s, Malaspina’s, or Humboldt’s and seems to have forgotten about two other expeditionary traditions. Thus, we cannot understand the work of Sánchez Labrador and Martínez Compañón or the work in New Spain of engineers like Constanço and sailors like Ulloa. This trend has been reinforced by classifying all the exploratory projects carried out in the eighteenth century into a single category. This seems to us to diminish the varied motives and actions of those involved in the study and exploration of Hispanic America.

Our thesis is that ecclesiastical and viceregal administrations were not mere appendixes of the home country’s power but were organizations with enough political and economic autonomy to promote their own expeditionary efforts according to specific objectives and cultural projects—which might have been different from those of the Spanish Crown. In general, most published materials are marked by an emphasis on the ratification
of Hispanic culture when compared to so-called European and North Atlantic customs. Naturally, this diverts attention to the arrival of European scholars and seems to enliven the pessimism that has characterized studies of Latin American culture. Although scholars do not ignore the presence of significant pockets of modernity within the Spanish colonial system by the end of the eighteenth century, the general trend is to see the low levels of institutionalization, the scarcity of agents of change, and the poor viceroyalty or home country and to capitalize on the endless studies of the territory and its mineral and botanical wealth.

These symptoms of exhaustion are also evident in researchers' inability to question the universality-of-the-Enlightenment thesis, which is implicit in most of these studies. Many facts that are difficult to account for are overlooked, for instance, in Mexico, Hidalgo's uprising against the Crown and his shouts of "Viva la Virgen de Guadalupe" (Long live the Virgin of Guadalupe), or when Unamuno stopped speaking until San Martin came to Lima's gates. And how do we explain the high percentage of reformers dressed in cassocks in Hispanic America if we continue to insist on the contradiction between the Enlightenment and religion? This contemporary ratification of Hispanic America (and Spain) by using inventories of books in private libraries or texts with references to European authors always faces an insurmountable obstacle: the number of renowned scholars, innovative experiments, and deeds crucial for the advancement of science will always be as small as the effort is great to find them.

In order to overcome this situation, it might be useful to place the study of expeditions and their cultural impact on colonial Hispanic America within the notions of the Catholic Enlightenment and socioprofessional roles. By using these frameworks, we shall posit the existence of a differentiated ideological context that we consider crucial to the function of the three administrations fighting over income and work within the context of the orientation of scientific practice. Using these two pillars as a basis—plus one that we will not consider here, cultural regionalization—we shall discuss what was untranslatable and international in Hispanic America with regard to the process of globalizing modern science. This process explains not only the mechanisms of the international transmission of ideas and institutions but also those of idiosyncratic recreation and habitation to the local climate. Seen from the receptor center, the preexisting cultural substrate was fertilized (and distorted) by the different and foreign elements, generating a tradition that started a dialogue with the new but without necessarily perceiving change as a struggle between tradition and modernity, for the former would be a condition for the latter.

One of the main problems posed by the studies of the globalization of science is the identification of the components of the aforementioned cultural substratum. Hence our objective is to demonstrate (or to remind readers of) the existence in Hispanic America of three scientific traditions that, throughout the eighteenth century, generated different expeditionary strategies for exploring and arranging the vast colonial territories. These are related to the three main structures of political, administrative, and economic power during the colony: the clergy, the home country, and the viceroyalty government.

The Expeditionary Tradition of the Church

All through the colonial period, the influence of the church on Spanish America was extraordinary. Its actions were not limited to missionary tasks; it pervaded all economic, judicial, educational, and health-related organizations. As the key structure of the colonial system, it was historically able to administer vast territories and to manage an immense economic and financial fortune. It therefore enjoyed broad autonomy. Such vast power demanded a permanent interest in incorporating the language of modern economics, politics, and science into the characteristic conceptual framework of Catholic intellectuality. The church, aware of its material power and always a jealous defender of its prerogatives and privileges, did not spare any effort to control the educational system and create an intelligentsia that adored closely to its interests.

Since many religious acted, from the moment they arrived in the colonies, from messianic—and sometimes messianic—conviction, a belief in the uniqueness of Hispanic America and its inhabitants did not take long to spread. Those first missionaries had many reasons to be fascinated with Hispanic American nature and excited by the magnitude of the colonization enterprise. It is therefore not strange that recording the continent's wonders and claiming for it the privilege of being unique thrived. It is within this tradition that the continent's roots were enhanced and the main ingredients for a Creole identity slowly matured, as David Brading notes: "The American clergy acted as the moral and intellectual leaders of colonial society." This was a culture of religious, patriotic, idiosyncratic, eclectic characteristics and therefore original, critical, and modern.
At the end of the seventeenth century, the clerical elite of the Hispanic world and of other countries involved in the Counter-Reformation started to incorporate new knowledge that allowed the development of the Catholic Enlightenment. This was not merely a cosmetic operation, or aggiornamento, as evidenced by the violent debates aroused by Jansenism and Cartesianism; it was the revival of, among many intellectual traditions, political Suavism, Erasmian humanism, Jesuitical pragmatism, and Cartesian Malebranchean. No work expresses better the difficulties of this transition than one published by the Benedictine Benito Jerónimo Feijoo. His arguments for the experimental method and against accepted religious superstitions gained him great popularity and remarkable authority among Hispanic intellectuals who favored change. Nothing demonstrates this better than the wide distribution of his writings before his death, between four hundred thousand and five hundred thousand copies of his works had been sold, a spectacular number even today.

A particular vision of the nature and reality of the economic empire built by the church in Hispanic America demanded a permanent research endeavor that comprised numerous works by members of diverse religious orders and by the secular clergy: botanical, zoological, astronomical, cartographic, philological, and historiographic studies. Undoubtedly, the Jesuits were most remarkable, but the scientific program was not the work of a single order; it was shared by all orders that performed missionary activities on the frontiers of the empire. Among their less-controversial results is the cartography of the hydrographic basins of the Río de la Plata and the Paraguay River, of the Orinoco and the Amazon, and of Patagonia, Araucania, and the Californias, that is, the northern and southern limits of Spanish America. These cartographers included not only personal observations but also those of missionaries who preceded them, thereby showing a capability for capitalizing on experience accumulated over time.

In few regions was the exploratory labor of the religious as decisive as in Paraguay. The example of José Sánchez Labrado contains many of the elements that can be found throughout Hispanic America. A member of the Society of Jesus, he dedicated more than thirty years to exploring the Río de la Plata and reopened direct communication between Paraguay and Corrientes through Santa Cruz de la Sierra, with the double purpose of finding an alternative to the route that followed the Chaco River (through Tucumán) and breaking the isolation of the missionary province of Chiquitos (by using the Paraguay River). He left a record of these endeavors in a journal, *Diario o relación fragmentaria de los viajes desde la Reducción de Nuestra Señora de Belén hasta las misiones de los Chiquitos* (Diary or Fragmentary Account of the Voyages from the Reducción de Nuestra Señora de Belén to the Chiquitos Missions, 1766–1767), which includes a map of the Paraguay River and its natural waterways between latitudes 15° and 25°. Later, in Italy, he completed the monumental *Enciclopedia rioplatense* (Encyclopedia of the Río de la Plata), divided into three parts: Paraguay natural (Natural Paraguay, six volumes of natural history), Paraguay cultivado (Agricultural Paraguay, four volumes on agronomy), and Paraguay occidental (Catholic Paraguay, one volume on human geography).

The wide knowledge of nature and ethnography the Jesuits acquired was organized according to a plan that combined the three realms of nature and the culture of the human societies that inhabited each region in America. These "natural" and "moral" histories, written according to a pattern that had been used since the seventeenth century, placed all created beings on a vital continuum in which every piece had a meaning and interacted with all of the rest (we might say they were in communion). The Jesuits’ vision was encyclopedic and aimed at a historiography of totality; therefore, all territories in which they were active, regardless of the magnitude of their resources or their inhabitants’ talent, were deserving of such a work, of a literature that would integrate them into history, hence the order’s interest in building a heroic native tradition through literature and linking it to the great chain of being (as shown by the Jesuits’ first astronomical and naturalist studies). As a whole, they created a genre we can still follow through the writings of authors such as Altazzara, Gamarra, León y Gama, Caldas, Espejo, and Flores. This was the implicit objective of *Orínoco ilustrado y defendido* (Enlightened and Defended Orinoco, 1741), a book in which Valencian José Gumilla displays the natural, civil, and geographic history of the river and its waterways and gives an account of the government and of customs of the river natives. The book provides novel and useful news about the animals, trees, fruits, oils, resins, and medicinal herbs and roots of the area’s flora and fauna. *Orínoco ilustrado* also includes in the first part a general treatise on the geography, natural history, and ethnography of those Amazonian territories. Around the same time, Italian Pablo Maroni wrote the *Noticias auténticas del famoso Río Marañón* (Authentic News of the Famous Marañón River), an account of the hundred years of Jesuit activity in the Province of Quito, in the upper and mid-Amazon, from their posts in Borja and the upper Napo.

As previously stated, this intellectual effort was not limited to the Jesuits; French Dominican Jean-Baptiste Labat, after living for twelve
years in Guadeloupe and other parts of the West Indies, published a simi-
lar study entitled *Nouveau voyage aux Iles de l'Amérique* (New Voyage to
the Islands of America, Paris, 1722). These cases illustrate the international and diverse nature of the expeditionary program promoted by the church, which, in turn, explains, for instance, the early arrival of Carabao and the Kingdom
of Quito. The presence of the Italian Jean Magnin there is a significant
yet modest example, if we consider the work done in Italy by Jesuits after
they were expelled from the Americas. At this point, the cumulative
nature of the scientific and humanistic work these professors, missionaries,
and expeditionaries carried out must be stressed. Filippo Salvatore Gili,
for instance, corrected and completed Gymilla's text in his *Saggio di storia
americana* (Rome, 1780–1784). His pro-Spanish position in the debates
about the New World was the exception among the expelled Jesuits, for
this argument was his opportunity to project his Creole nostalgia onto a
vast historiographic program that allowed the order to claim the lus
ness of American nature, to praise the past grandeur of their distant homeland, and to demonstrate the existence of an erudite tradition there. This
would be the case of Ecuadorian Juan de Velasco, Chilean Juan Ignacio
Molina, and Mexican Francisco Clavigero.

There were areas of Hispanic America in which other religious orders
stood out, for instance, the Franciscans of Santa Rosa de Ocopa, who explored the Amazon. Multiple trips by Antonio Abad, José Amich,
Manuel Sobrevida, and Narcís Girbal helped warn Peru's viceroy about
Portuguese incursions and explain their contacts with Maimas Province
and its governor, Francisco Requena, but such trips were also used by
Peru's explorers—Hispánico Ruiz and José Pavón—and would be published in *Mercanario Peruano*.

Exploration was not carried out exclusively by the Jesuits, the regu-
lar clergy, or in border areas. Frequently, pastoral visits were used as an
opportunity for geographic explorations, to look for resources to allow
the development of the diocese. Such is the case of the chorographic
description of plants and animals in the Bishopric of Trujillo in the
nine volumes of *Colección de plantas, estatuas y estampas, relativas a la historia
general de este obispado* (Collection of Plants, Statues, and Aspects Regarding
the General History of This Diocese), written by Bishop Martínez
Compañón between 1782 and 1785 and including varied information on
the geography, social history, folklore, natural history, and archaeology
of northern Peru.

The Viceregal Expeditionary Tradition

From the early days in Hispanic America, there was a remarkable con-
centration of technicians solving the challenges posed by urbanization,
defense, communications, and exploitation of the colonies. From Mex-
ico City to Lima—the first metropolitan in the New World, joined by
Bogotá, Havana, and Buenos Aires in the eighteenth century—the vicer-
roys organized a broad plan of activity intended to ensure the control
and communication with the territories under their jurisdiction. The viceregal bureaucracy thereby attained remarkable autonomy. On the
whole, the technician groups at the service of the viceroy were efficient
support for two different but complementary tasks. First, they served as
counselors and directors of the projects related to the improvement of
urban infrastructure and sanitation, cartographic exploration, the open-
ning and working of mines, the design and construction of fortifications,
the definition of law pertaining to metals or the minting of money. Sec-
ond was activity for controlling and creating public opinion, supporting
educational reform, and engaging in publishing by collaborating with the
*Mercanario in Lima, the Papel Perú tắca* (Newspaper) of Santa Fe de Bogotá,
or the *Telegrafo Mercantil* (Mercantile Telegraph) of Buenos Aires.

Although there was a trend to make professional positions stable,
technicians did not have quite the status of specialized viceregal func-
tionaries. Yet they moved in the circles of influence and power in the
capital and they were co-opted for missions and other tasks. Aware of their
own importance, they tended to adopt a utilitarian ideology as a mark of
identity, thereby creating a capital-based technocracy that gained wide
autonomy in decision making. The specialized nature of their knowledge
contributes to their autonomy, as did their extraordinary mobility and
professional versatility.

Undoubtedly, their social prestige was increasing, as shown by the nu-
merous appointments some of them received. Ambrosio O'Higgins, for
instance, was captain general of Chile before he became Peru's viceroy.
Miguel del Pino was captain general of Rio de la Plata. Miguel del Corral was governor and intendent of Verrazano, and Agustín Crane was
governor of Havana.

Although the literature on these technicians is not very abundant and
is quite scattered, we can state that the exploration of the territories was
entrusted to engineers and sailors. Their activity grew substantially be-
ginning in 1768, at the beginning of the political and administrative
reorganization of the colonial system to increase the security of the Atlantic front after the conflicts with the British during the Seven Years' War (1754–1763). Thus, between 1768 and 1800, two hundred Spanish military engineers were sent to the colonies to explore and fortify the empire's vulnerable areas, draw maps, and write reports about the geography of both which made them fierce guardians of the cartographic patrimony, and construct civil engineering works for the territorial coordination of the empire, such as bridges, roads, canals, lighthouses, factories, jails, warehouses, courthouses, hospitals, mines, bullrings, and churches.

The sailors in Hispanic America's fleets also served the viceroys. Within the framework of policies designed to maintain territorial integrity, numerous hydrographic expeditions were organized, some of which were directly promoted by the viceroys. The works of Engr. José de Elía stand out in New Spain. He worked between 1783 and 1786 in Mexico and produced remarkable charts of the territory between Florida and Veracruz. As a reward for his efforts, he was appointed captain of the New Orleans harbor and commander of the Louisiana Guard. His labor was completed by Lt. José Antonio del Río, who, in 1787, traveled over the east coast of Florida in order to find a location for a port and ship enterprise to supply the Havana arsenal. Several explorations to the North Pacific were organized from the northwest coast during the second half of the eighteenth century in order to contain Russian expansion. Several expeditions that included naturalists were launched to encourage the colonization of the Californias, for example in 1792. Mexican physician and botanist José Mariano Mociño, José Maldonado, and draftsman Anastasio Echeverría were commissioned, on the viceroy's order, to join Adm. Juan Francisco Bodega y Quadra on an expedition to Nootka Island to study the animal, mineral, and plant wealth of the area and anything that could facilitate their commercialization.

Francisco de Viedma explored the Patagonian coastline in the Viceroyalty of Río de la Plata, traveled the Chico and Chulín rivers, and explored the lake that today is named after him. In Peru, Viceroy Manuel Amat organized four journeys to the South Pacific in order to limit French and English expansion. The south of Chile was explored several times by expeditions sent from Chiloé. In the 1790s, ensign and head pilot of the Royal Armada, José Moraleda y Montero, charted the archipelago on orders from Peru's viceroy, Teodoro Croix, and the governor intendant of the Chiloé islands, Francisco Hurtado.

It is worth noting briefly that the activities we are summarizing here were not carried out by individuals or isolated. Because being part of the viceroyalty's inner circle was the engineers' goal, they collaborated whenever possible with Sociedades Económicas y Patrióticas (Economic and Patriotic Societies) on the coast, with the help of consulates (consulados), the development policy advisory body for the last viceroy's, viceroy's encouraged the founding of nautical schools, institutions that had an educational function and served as true hydrographic depositories.

No less important was the contribution these technicians made to the consolidation and coordination of geographic questionnaires, a method whereby they obtained massive amounts of information about the region. These questionnaires were administered during the eighteenth century with the collaboration of engineers and sailors. In 1743, the Consejo de Indias (Council of the Indies) urged the viceroy of New Spain, Pedro Cebrián, entrusted Mexico City chronicler Juan Francisco Sahagún de Arévalo (publisher of the Gaceta de México and the Mercado de México) and the quicksilver accountant, Antonio de Villaseñor y Sánchez (author of a 1751 map of New Spain and of Matemática cómputo de los astros [Mathematical Computation of the Stars]) to draft the necessary questionnaires and to collect the reports to enable a better understanding of each jurisdiction in the viceroyalty. The questionnaires were about the location and distance between urban centers and their social and economic development. Antonio Ulloa, for example, as a commander of New Spain's fleet, in 1777 designed a plan for Viceroy Antonio María Bucaré to collect the scientific, historical, and statistic data missing from the 1743 geographical questionnaires.

With questionnaire answers in hand, Villaseñor wrote Teatro americano (American Theater, 1748–1749), considered to be the first regional geography of Mexico. His contemporaries appreciated it greatly, and for a long time it was the compulsory starting point for new expeditions. The constancy of expeditions of this kind throughout the colonial period, even after Spain started sending its own scientific expeditions, seems only proven. Other examples from the Viceroyalty of Peru can be added to those we have mentioned from New Spain. The Consulado de Lima, between 1803 and 1805, sent questionnaires to its delegates and representatives in the provinces. The royal ordinance of August 25, 1802, was applied, which ordered the carrying out of geographic-economic surveys in all Spanish domains. All the knowledge about nature and American culture the cosmographers and viceregal commissioners acquired was periodically reviewed and represented the core of works that synthesized the information, such as the Diccionario geográfico-histórico de las Indias occidentales o América (Geographical-Historical Dictionary of the West Indies or America), in the
Collaboration between Lima’s cultural elite and the viceroy was decisive in founding the Antifteatro Anatómico (Anatomical Amphitheater, 1792) and the San Fernando Colegio de Medicina (School of Medicine, 1808). The medical school was established only a few months after the publication of Unýme’s most remarkable text, Observaciones sobre el clima de Lima y sus influencias en los seres organizados, en especial el hombre (Observations on the Climate of Lima and Its Influence on Organized Beings, Especially Man, 1805), and after Viceroy Abascal had appointed him director of the Protoemecátor (Board of Medical Examiners) in November 1807.

During this period, New Granada enjoyed the services of an outstanding figure, José Celestino Mutis, the most important intellectual in the viceroyalty, who collaborated in all of its projects. He arrived in 1760 as the viceroy’s physician, and it did not take long for him to establish links with Bogotá’s institutions. Thus, by 1762, he held the Mathematics Chair at the Colegio de Nuestra Señora del Rosario. From then on, his desire to lead and administer would scarcely wane. Always attuned to the viceroy of the moment, his social ascent was tied to reform projects or reports that he wrote at the regional authority’s request. There were few projects on which he did not work from the moment Viceroy and Archbishop Antonio Caballero y Gonzaga decided, in 1781, to create the Expedición Botánica and appointed Mutis director. Although the expedition would ultimately be formally incorporated into the expeditionary program promoted by the Jardín Botánico of Madrid, Mutis counted on an autonomy that was legitimized by the viceroyal decision that botanical slides were not to leave Santa Fé de Bogotá and that the manuscripts were to remain with the viceroyal secretary to later become part of the holdings of the Real Biblioteca (Royal Library) of the viceroyal capital.

In fact, the hypothesis that Mutis occasionally considered the expedition to be his personal property is well justified. Not only did he try to promote numerous businesses using his position, but he also made his three nephews his only assistants and obfuscated reports of the work under his command. Among the numerous commissions he carried out for the viceroyal authority were his endeavors to work gold deposits in Mariquita, his diverse projects to reform university education, and his participation in efforts to improve health care and in the fight against smallpox.

In the Viceroyalty of Río de la Plata, the most outstanding character was army engineer Félix de Azara. In 1781, he arrived at Río de la Plata as a member of the boundary commission, which was charged with correcting
the American boundaries of Spain and Portugal after the Treaty of San Ildefonso was signed (1777). For over a decade, he participated in the geographic demarcation of Brazil and in the definition of the boundaries between the Paraná River and Matto Grosso. In the 1790s, he was in Buenos Aires and was placed in charge of the detailed exploration of all the southern borders. Later he visited the Spanish possessions south of Río de la Plata and Paraná. As a result of those commissions, Azara produced numerous maps of the City of Corrientes, the Provinces of Misiones and Paraguay, and the course of the Paraguay River, for example. He also wrote several reports for the viceroy of Buenos Aires, including Memorias sobre el estado rural del Río de la Plata (Report on the Rural State of Río de la Plata), in which he analyzes the economic situation and the property patterns of agriculture in the province.

The Expeditionary Tradition of the Home Country

The discovery of America had extraordinary scientific and cultural consequences. The firm belief that there remained no territories to be discovered made the world less mysterious and no longer a boundless space; it came to be seen as complete and therefore susceptible to order and measurement. This expectation immediately affected cartographic, botanical, and astronomical knowledge. After exploration and inventories were completed, it became necessary to systematize all data according to criteria that allowed encompassing the great diversity of phenomena and natural beings. It was an effort that required observations made according to a routine that improved over time and that became a specialized language.

At the same time, another factor became necessary for the worldwide spread of the scientific method: international research and, as a consequence, the strengthening of bonds between scientists and the seat of political power. Thus, Renaissance cosmopolitanism became scientific internationalism, which was institutionalized in centers that could coordinate a worldwide net of scholars and experts and that developed an innovative communication model using another language, new agents, different methods, and different legitimating procedures. Within such (scientific) communication systems, all participants historically tend to polarize around a center and a (paradigmatic) research program.

It is widely acknowledged that, during the seventeenth century, Spain lagged in the process that led to the Scientific Revolution. This circumstance pushed all scientific activities developed in the empire toward the periphery. Along with the internal processes of cultural renovation (among which those related to population and defense stand out) Spain's participation in international cooperative observation projects had a catalyzing effect on the reforms devised by the new Bourbon bureaucracy. The integration of peninsular people and institutions into the international scientific network was particularly significant to those programs that related to scientific expeditions to America.

The magnitude of these projects required diplomacy in addition to significant economic investment, all of which meant advancing the increasingly crucial relationships between the state and science. Furthermore, the geopolitical and economics aspects—philanthropy and business—were hopelessly entangled. As a consequence, some Spaniards and Hispanic Americans who espoused Enlightenment ideals had the opportunity to meet renowned European scientists and learn the accepted methods of observation and instrumentation.

Our purpose is not to describe the activities of these expeditions, for this has been done by other scholars. Our interest here is to point out the legitimating character of these expeditions for the values and knowledge that would become decisive identifiers of outstanding representatives of the local elite, both in Spain and in Hispanic America. One of the cultural expressions of this fact was the reappraisal of the continent’s economic possibilities after its natural resources were explored. Thus, along with the reasons why scientists were sent, we find observations and suggestions inviting the government into profitable business ventures and new sources for local prosperity, such as harvesting cinnamon in Venezuela, cinchona in Loja, cochineal in California, or wood in Guayaquil.

This consideration can be extended to all botanical expeditions sent from Madrid to Peru, New Granada, and New Spain between 1777 and 1787. Planned for the purpose of inventorying American flora, transplanting vegetable resources useful for the pharmacopoeia and gardening to Madrid's Jardín Botánico, and spreading the Linnaean classification model of nature, the intellectual concerns and political interests of the different power groups active in Hispanic America became intertwined insofar as organization, development, and results. We have already mentioned the circumstances that led to expeditions to Peru, New Granada, and New Spain; another factor emerged with the creation of new institutions intended to promote the knowledge, methods, and values that met the home country's criteria, as happened with the establishment of the Cátedra de Botánica (Botany Department) entrusted to Cervantes, or
with the introduction of the new chemical nomenclature in México, 48 two examples that historians recall to show the vigor of scientific Creolization in New Spain. In Lima, the presence of Creole scientists was rather small, and it was difficult for agents of the home country to institutionalize the new knowledge; in fact, they failed to impose new metallurgical knowledge in the 'Tribunal de Minería' (Mining Tribunal) and to establish a botany department at the Universidad de San Marcos, in spite of the efforts made by religious and corresponding member of Madrid's Jardín Botánico, Francisco González Laguna, and by the military pharmaceutical attached to the viceregal expedition to Peru, Juan José Talavera. 49

The expedition classifications that have been published and that follow disciplinary, administrative, and geospatial criteria do not account for all the activities carried out on those expeditions. 50 In order to do that, we must first take into account the variety of responsibilities taken on by the participants and also the synchronicity of their work in America.

All the activities could be grouped according to three criteria, the functionality of which is determined by their power to distinguish between the most institutional, taxing, and home country-oriented behavior of these agents of the homeland, and service on some other commission by viceregal order, or, alternatively, cooperation, proselytism, and reintegration to the local elite. 51

By looking at the expeditionary program, we can verify that the home country and institutional aspect of each was important but not the only thing. It is not enough to observe just one expeditionary function to understand the key elements of expeditionary actions and to evaluate their results. We must, according to criterion, see the totality of the work they did in order to understand their numerous effects and the reasons for the sincere support or the severe criticism of local groups, or how those attitudes might have changed in the local elites through the years.

It is also interesting to note the synchronicity of much of the expeditionary movement and the simultaneity of the activities of different expeditions. This is an issue of great importance, since most activity—except in Mexico— took place in areas where the population was small and where, obviously, the presence of a dozen persons endowed with great political and scientific authority must have had a great impact. If we emphasize this point, the feedback and continuous nature of expeditionary policy is apparent, since the arrival of successive, overlapping waves of scientists and technicians made possible the transfer of science and technology between social groups. This becomes clearer if we remember that several explorers, among them, Cervantes, Longinos, Mutis, Bustamante, and Haeckel, remained in America after finishing their missions, or that several Creoles, for instance, Mosén and Zena, traveled to Spain, where they held important positions.

Whatever the importance of such expeditions to scientific development in Europe, what we want to highlight here is their participation in the processes of regional integration and differentiation in the colonies. It is well known that they did not always have their operational quarters in the viceregal capitals but in more remote places, where the richest flora were found. Such places and their areas of influence were economically appraised. This happened in the central Andes, where plants had been collected by members of the botanical expedition to Peru since 1780, the year the Huánuco base of operations was established. Although far from Lima, Huánuco’s location was privileged. 52 The area became much more important after Manuel Alcaraz—who had already visited the cichona production zone in the Loja mountain range—discovered near Huánuco an abundance of that valuable tree. Several trained workers were brought from Loja to teach the natives how to gather the bark so that a profitable business could be set up in Lima. The arrival of Spanish botanists had an immediate effect on the development of the trade in cichona as they helped differentiate the species and obtain the quinine extract. 53

While staying in the Andes, Spanish botanists also took an interest in agriculture, particularly in Andean coca, since the miners of Cerro de Pasco were supplied from Huánuco. Their knowledge of the role of this plant in the religion, diet, and economy of the natives would change their European prejudices regarding this so-called vice plant: “The experience made me change,” Ruiz writes, “showing me, with positive facts, the wonderful effects of those leaves, seemingly tasteless, odorless, and inert.” 54

European botanists therefore began all kinds of assignments in several parts of the viceregency. In early 1779, Viceroy Manuel Guirior entrusted French naturalist Dombey with an analysis of Chauchin's mineral waters, near the source of the Huaura River. 55 Dombey was also commissioned by the president of the Audiencia in 1773, during the naturalist’s stay in Chile, to study the mercury mines in the north of that country. Pavón was very interested in carrying out the commissions entrusted to him to study the woods of the Chilean forests. And Talavera would start a similar task in the Ecuadorian forest at the mouth of the Guayas River and in the Intag Mountains, where he would meet with Caldas. 56

During the Malaspina expedition’s stay in Lima (May—September 1790 and July—October 1793), both expeditions cooperated closely. Thus, Viceroy Gil y Lemos accepted Malaspina’s suggestion that naturalist Juan
Tafalla and painter Francisco Pulgar participate as experienced guides in the scientific expeditions that Haenke, Née, and Pineda were to carry out in the Andean region. This kind of collaboration also existed among renowned members of the local elite: clergy who cared for the dying González Laguna participated in natural history projects, and Father Francisco Romero helped with astronomical and geodetic tasks. González Laguna and Romero were suggested by Malaspina to work with Manuel Lavarden in Buenos Aires, Joaquín Tocca in Santiago de Chile, and others from the new patriotic society in Quito to create a meteorological correspondence network among the different Hispanic American cities and the Academia de Guarniamarinas (Coast Guard Academy) in Cádiz.

It seems clear that these Spanish explorers were active participants in the cultural life of the region. Botanist Pavón, for instance, was praised by the local authorities for having directed the construction of a public boulevard in Huánuco. They frequently had contact with the Franciscans from the Oconpa monastery; it is also possible that artists from the Gálvez and Brunete expedition collaborated in Martínez Compasón's iconographic album. Years later, Tafalla was the link between Lima and the Quechua philological work of clergyman Joseph Manuel Bermúdez of Huánuco; González Laguna encouraged this work, since Europe was interested in American languages.

We can say much the same about the activities of members of boundary-mapping expeditions or about Malaspina and his travels through Buenos Aires. Many of these explorers settled in Río de la Plata, for example, frigate captain Francisco Javier de Viana; a sailor, Joaquín Antonio Gutiérrez de la Concha, who explored the San Jorge Gulf and governed Córdoba de Tucumán; and the chief of Río de la Plata's naval station, but based in Montevideo, José de Bustamante y Guerra. Bohemian naturalist Tadeo Haenke settled in Upper Peru (Cochabamba), from where he sent articles to the Río de la Plata press and Caballero's Telegram Mercantil, to Vieytes and Cerviño's Semanario de Agricultura (Agriculture Weekly), and to Manuel Belgrano's Correo de Comercio (Business Mail).

The members of the boundary commissions also participated in local life. Diego de Alvear, married to Josefa Barbastro (an important name among Buenos Aires merchants), handed in the instruments of his expedition to the consulate. Pedro Cerviño, an engineer and member of the third boundary commission expedition, founded the Escuela de Náutica of Buenos Aires, where a select group of technicians was trained, for example, Bernardino Rivadavia, Francisco de la Cruz, Lucio Manzana, and Benito Goyenea, and where pilot and geographer Andrés de Oyarzúa, member of the second boundary commission expedition, was also an advisor.

The expeditions to New Spain were different from the rest that were sent to Hispanic America. In Mexico, a group of Creole intellectuals thought they were competent enough to be in charge and direct all projects charged with learning about the reality of New Spain. Sessé's instructions were to found a botanical garden and to create at the university in the viceregal capital a botany department wherein the Linnaean classification system would be taught. Both endeavors were part of a plan to reform the medicine curriculum and to ensure, as in Spain, that physicians' power on the Protomedicato would diminish. The controversies aroused by these initiatives have been recounted many times, and it could be said that they intensified debate and deepened the Creole elite's discontent after the expulsion of the Jesuits in 1767. Church elder Alzate, for instance, was accused of calling the Linnaean system nonsense and childish things, and urged botanists trained in Madrid to imitate ancient Mexicans.

When their stay in Mexico came to an end, the expeditionaries had accepted Alzate's opinion of the Linnaean system to a certain extent; Sessé, Mocíto, and Montañá started a vast experimentation program to define the therapeutic properties of plants and to elaborate a Mexican materia medica. Ten years later, the alliances had been modified: the university, which had been a Creole bastion, and not only the Spanish commissioners' crudest demanding was corrected but a more cooperative attitude had emerged. The aforementioned subterfuge might represent what also happened during the mineralogical expedition of the Señores Ellsöyr, as Alzate called them, which gave rise to initially bitter debates brought about, according to Pest, by the encounter of great European science and great New Spain technique.

We also find examples of the catalyzing capacity the expeditions had on Creoles in New Granada, the heart of the spread of modern science. Independently from his commissions for the viceroy, Mutis collected and classified flora. It is no accident that his expedition is still described...
as botanical. In fact, he even imagined the possibility of correcting Linnaeus and, whether he was qualified or not for such an intellectual adventure, the truth is that all of his work was oriented toward a theoretical objective.

As a consequence, two crucial aspects of the expedition were neglected, one relating to methodology and the other to its objectives. The task of collecting plants, because of the sedentary character with which Mutis had endowed the expedition, was entrusted to envys with almost no scientific education, hence the importance painters had in this expedition. Mutis's plan (unlike what happened in New Spain) also was unable to accomplish the utilization aims of the study of the flora. Both failures were strongly criticized by Creoles once Mutis lost some of his viceregal support. Caldas criticized Mutis's excessive iconicity. "Such grandiosity... such literary luxury, contributes little, and, truly speaking, it delays the progress of the sciences." Expedition zoologist Tadeo Lozano complained that Mutis's theoretical insistence "tied [his, Lozano's] hands and prevented [him] from publishing as he went along."96 Zea summed up all this criticism in Proyecto de reorganización de la expedición botánica (Botanical Expedition Reorganization Project, 1802) by stating that his objectives had been "purely botanical, with no relation whatsoever to agriculture, economics, or the arts."97 These well-justified observations do not express any reality other than the one derived from the newly achieved maturity of New Granada's elite, which had not existed twenty years before and which had been able to take advantage of the contact with European science provided by the simultaneous presence of Mutis, Elizalde, and Humboldt.98

The collaboration was mutual,99 as shown by consulting the Mercado Peruano, a journal that devoted a great many pages to learning about the country (33.8 percent) and to the spread of science (25.5 percent).100 Ruiz, for instance, came to be considered the Peruvian Linnaeus. and González Laguna expressed pride in the new intellectual atmosphere in Lima: "Before this time we knew only the native [plants] of this country, very few from Spain. Today, we have [plants] from very remote parts of our continent."101 Mocino acknowledged the benefit of his contacts with the New Spain expedition as he declared their studies on materia medica to have been carried out "not only as mere compilers but as exact observers."102 The Lima press paid great attention to the labor of the mineralogists and members of the Nordenflecht expedition sent by the home country to study Andean mineral deposits and to introduce a new amalgamation method to replace the traditional patio process.103 This simultaneity of scientific intervention in Peruvian territory made it possible for the members of the viceregal's local elite to foster the illusion that it was possible to restore Peru, thanks to the cultivation and development of modern science.

American Mosaic

Having presented in outline form the three scientific traditions that developed on the Hispanic American scene (those of the home country, the viceregal, and the Creole elite), we would like to stress that their interaction grew deeper with the arrival—almost in waves—of expeditions sent from Europe at the end of the eighteenth century. The expeditions, therefore, represent an extraordinary catalyst for cultural life in Hispanic America. Endowed with great authority, both political and scientific, and after proving their competence during the assignments local authorities entrusted to them, the expeditionaries became magnets for a variety of controversies and debates.

Where the maturity of Creole and viceregal local elites was more noticeable, the interactions were more fruitful. It is within this environment that cultural differentiation solidified so acutely that it was decisive in the process of cultural regionalization of the Spanish colonial system in America. This differentiation spread through the four scientific and political activity centers: Mexico City, Lima, Bogotá, and Buenos Aires, that is, the capitals of the four vicerealdy into which the American portion of the Spanish Empire was divided in the eighteenth century.

The aforementioned cultural regionalization must not be seen as a by-product of the colonial armies' reform projects, the implementation of intendants, or the introduction and putting into practice of free trade. Such policies lasted only a short time and, on the whole, were fragmentary and unsuccessful. By cultural regionalization we mean the capacity of the local elite to find symbols that could replace reality and make it meaningful. Most significant at the end of the eighteenth century is the fact that such symbols were described, related, and idealized by incorporating the methods, language, and practices of modern science. This revealed the importance of science, as a substantial—and not merely instrumental—element in the Hispanic American elites' culture.

The regionalization process, therefore, expresses a dual maturity in Hispanic American culture. On the one hand, those who produced this maturity were able to invent a tradition and a portable symbology, with
their integrating potential. On the other, the local elite was able to change that tradition and integrate into it the concepts and key institutions of European culture.

We hope to describe the key points of that process in a future study. We believe that this will be possible for the four cases we have mentioned here, keeping in mind that the vitality and novelty of the process are not legitimated by the elite's capacity for reproducing emancipating formulas comparable to the French republicanism of that historical moment; rather, the locally created symbols are the cultural elements that had a more corrosive, disintegrating, and revolutionary effect. Thus, while the elite of New Spain agreed to make Mexico City a universal metropolis and a splendid synthesis of the viceroyalty, with the Virgin of Guadalupe as its most detailed symbol of integration, in Peru, it would be the mystery of its sky. With an atmosphere and climate that were capable of integrating the national being and of explaining all of its amazing peculiarities, if—as Galileo explained—religion taught one how to go to heaven and science taught how it was made up, the Peruvians wanted to risk the belief that the road to heaven followed the trace the movement of its stars left behind. If in New Granada the idea of America as a Promethean environment enlivened the patriotic aspirations of its elites, in Rio de la Plaza, the dream of taming the inner Mesopotamia took on the function of mobilizing public opinion.

We are speaking, though, of elites, not so much for their education or wealth as for their capacity to articulate legitimating discourses that were, conversely, legitimated by the structures of administrative, political, and economic power in the colony: church, home country, and the viceroyalty. It is in this sense that we believe it necessary to consider the assignment of intellectuals to specific roles and to introduce a third factor—political and cultural dynamization—besides the Creole (Spanish American) and the peninsular (European Spanish). We believe this approach has the advantage of not being obsessed with racial features and, at the same time, of acknowledging the three power sources' capacity for political and cultural action.

Notes

1. The authors wish to thank the Dirección General de Investigación Científica y Técnica (Spain), grant no. PB91-0071. We also want to thank Juan Pimentel for his unfailing help and valuable advice.
2. Bauer, "The Church"; Tiberi, "The Peruvian Church."
22. Cook, Flora Típica.
23. Lanza, Plantas.
24. Exploraciones.
26. Lima’s Escuela de Náutica (Nautical School) was created in 1793, and
seaman Balseco excelled there. The Bueno Aires school (1799) was founded
at the request of the viceroy’s technical counselors connected to the consulate, such
as Belgrano and Azara. The school was headed by a geographer and cartogra-
pher, Pedro Cerviño; it closed in 1806 under pressure from the home country,
as it was considered to be a "mere viceregal luxury" (Babini, 1986, pp. 46–47).
In Cartagena de Indias, the Escuela de Náutica started in 1810. These insti-
tutions inherited the legacy of some viceregal functionaries who cultivated astron-omical and physical geography, as had happened in Peru with the Cosmógrafos
Mayores del Rey (Elder Cosmographers of the Realm), an adjunct position to
the Mathematics Department. Their work can be reconstructed, thanks partly
to the uninterrupted publication of the Conocimientos de las Tierras (Knowledge of
the Times) series in Lima. Some of these cosmographers, like Koenig, Peralta
Burmuro, or Godin, collaborated in the fortification of Lima; Coome Bueno also
handled the geographical descriptions that were sent by the magistrates from
several places to create comprehensive descriptions of Peru (Maccera, 1977).
27. Solano, Antonio de Ulloa, pp. 91–92.
29. The questionnaire’s answers were reported as geographic accounts, or
resultes circunstancias, in which the consulat’s power over Peruvian territory
was evident. The consulate maintained exceptionally well organized files, a per-
mannent source of information in its provincial delegates, and a group of counsellors
in the capital with whom technical, financial, and legal opinions were entrusted
30. Ibid., p. 182.
32. Moreno, Joaquín Velázquez de León, p. 63.
33. Trubülse, Francisco Xavier Gamboa.
36. Arboleda, "Mutis entre las matemáticas."
37. Penet, Ciencia, pp. 281 ff.
40. Amaya, La Real Expedición Botánica, p. 56
41. Quevedo y Záballa, 1988; Fras Núñez, Enfermedad.
43. Chavorrotte, La crítica laudativa, p. 58.
44. Amaya, Colección Musas.
45. Spanish participation in the expedition to the Kingdom of Quito intended
to determine the Earth’s shape (Lafuente and Mazuecos, Los caballeros), or in the
one headed by Abbe Charpe (Moreno, Joaquín Velázquez de León) to California
in order to observe Venus passing in front of the sun, had a similar origin: the de-
finition of a problem by the Academia Royale des Sciences (Royal Academy of
Sciences) and the Royal Society of London that required research that had to be
carried out on the other side of the world. Although their objectives differed,
the first expeditions to Hispano America in the eighteenth century were relat-
ed to problems of an international nature, as was the expedition to the Orinoco
to establish the borders between Portugal’s and Spain’s domains (Lacasa Cirallo,
Francisco de Remyana y otros). The botanical dimension of this expedition (entrusted
to Pedro Loefling, a pupil of Linnaeus)—as in the other cases mentioned—had
been decided outside Spain. The same applies to the expedition to the Viceroy-
alty of Peru, part of a French endeavor led by Joseph Dombey and to which botau-
nists Hipólito Ruiz and José Pavón were attached (Puerto Sarmiento, La historia
grabada). Previous expeditions were also international in nature, nevertheless,
as Spanish scientific institutions matured, expeditions began to be financed as
national enterprises to which scholars from other countries contributed.
46. Other contacts had already been established, such as the two trips Luis
Fueillé made at the beginning of the century to South America, leaving his mark
on the local scholars of Cartagena de Indias (Arias de Groiff, "Historia," p. 128)
and Peru (Steele, Flores, p. 22). Fueillé’s stays in Lima (in 1799) and, later, Frazier’s
(1712–1714) were different from others that would follow in terms of the capacity
colonial scientists to interact with European scholars. It is worthwhile to point
out Pedro Peralta’s frequent contacts with the Academia Royale des Sciences of
Paris, an institution of which he would later become a corresponding member and
so to which he would promptly send his observations of celestial events.
47. Puerto Sarmiento, La historia grabada, pp. 94–96.
48. Annees Pistrans, "La diffusion."
49. Notwithstanding what’s been said, the Linnaean method spread through-
out Peru thanks to the nearby missionary efforts of Ruiz and Pavón among Lima’s
scientific elite. Thus, during the early months of 1780, at the Universidad de San
Marcos, they had the opportunity to perform before some members of the uni-
versity an objective lesson and demonstration of their botanical and Linnaean skills.
Unanue’s introduction to the scientific description of Peru’s plants, published in
the Mercurio Peruano under the pseudonym Aristio, is also evidence of the enthusi-
astic reception of the Linnaean system.
50. Pino and Guairón, "Las expediciones Ilustradas"; Luena Salmoral, "Las
expediciones científicas."
51. By working through institutions, agents showed an ability to impose the
way scientific work should be organized, according to criteria from the home coun-
try. They made an effort to spread and reconcile European scientific practices. Thus
they achieved—frequently through authoritarian methods—the introduction of
the Linnaean System. By working through missionaries or cooperating with one an-
other, they gained some scholars’ participation. Thus, they fostered the construction,
strengthening, and expansion of information-exchange networks, which tended, by
their very nature, to be useful tools for the institutionalization of knowledge from
the home country. In addition, they built around a center that was no longer in the
home country but in the colony, which was its most characteristic and solid trait. In
performing commissions, the agents showed their ability to become part of viceregal projects and to be used as qualified technicians and sources of information by the local powers. Activities of this type were described in reports, judgments, accounts, that is, writings that increased the administrative literature generated by the colonial bureaucracy.

52. Huánuco had some six thousand inhabitants and was located five hundred kilometers northeast of Lima, on a forested slope of the eastern Andes, near the jungle. Nearby, the Huallaga River reaches the Marañón and the Amazon. Dombrey qualified its position as the "nec plus ultra de la Conquista española en el interior" [best of the Spanish domination in the countryside].

53. If, in 1779—the year before Ruiz and Pavón arrived in Huánuco—the annual raw bark harvested amounted to around two thousand or three thousand arrobas (1 arroba equals twenty-five pounds, so this was twenty-three thousand to thirty-five thousand kilos), in 1788, some forty thousand arrobas were estimated to have been sent to Lima (Steele, Flores, pp. 96–97). From 1779 to 1788, Ruiz and Pavón researched the chemistry of producing the quinine extract in order to improve the therapeutic virtues of the bark; this fact accounts for the increase in exports.

54. Ibid., p. 101.
55. Ibid., p. 89.
58. Ibid., p. 116.
59. Steele, Flores, p. 225.
60. Ratto, Alejandro Malaspina, pp. xxvii–xxix.
61. Tjarks, El Conquistado.
64. Tasch de Estrada, “Aspectos políticos.”
65. Locoy, Planta, p. 128.
70. Ibid.
71. Puig-Samper, “La ciencia metropolitan.”
72. On June 29, 1790, Malaspina sent the former and current trade consuls of Lima a list of the latitudes and longitudes the ships under his command had determined during their trip to Cape Horn (Higuera, *Catalglo crítico*, p. 129). During his second stay in Lima, Malaspina was received by the viceroy to send all the botanical works he no longer needed to botanists Juan Tafazz and Francisco Pulgar (Ibid., p. 199).

76. European mine owners’ efforts to improve the Peruvian mining situation and their various experiments at diverse mining sites to prove the superiority of their amalgamation method were published by Mariano Perenau (vol. 1, pp. 218–220, 228–289; vol. 2, pp. 30–32, 53–55, 149, 266–275; vol. 3, pp. 217–223, 225–279, 233–239, 241–253; vol. 5, pp. 35, 237–229; vol. 7, pp. 46, 49, 66–81). The support this modernization effort received was justified on humanitarian grounds, since the use of the patio process saved the repasados Indians’ feet from rough labor [repasados are the workers who trample the amalgam in the patio method].

Bibliography