REMEDIES FOR THE EMPIRE: THE EIGHTEENTH CENTURY SPANISH BOTANICAL EXPEDITIONS TO THE NEW WORLD

by

Mauricio Nieto Olarte, B.A., M.Sc.

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ABSTRACT

Under the reign of Carlos III the Spanish government set up ambitious expeditions to the New World in order to investigate the medical virtues of the tropical vegetation.

The explorers remained in America for several years collecting numerous new species, and they brought back to Europe large collections of dried plants, botanical drawings, samples and descriptions of useful plants. The case of quinine (Cinchona) is an outstanding instance of the medical, scientific and commercial issues involved in the exploration of the New World, and is one of the several discussed in detail in the dissertation.

The investigation shows how colonial mercantile policies motivated the development of pharmacy during the eighteenth century and how knowledge in particular areas of natural history such as medicine and botany was shaped by economic, political and religious interests.

Scientific exploration and natural history are described as forms of appropriation. Classifying and naming plants were essential practices for the displacement and accumulation of natural objects. The elaboration and central role of visual representations as well as the publication of floras are also examined

in detail.

The legitimation of botanical and medical knowledge involved a process of translation from folk experience into enlightened science. In this process of certification Linnaean taxonomy and eighteenth century pharmacy had central roles. My investigation provides an analysis of these practices and of the social and political interests which made them possible.

Finally, my research is concerned with the influence of scientific exploration upon the nations in which the expeditions took place. The creation of scientific traditions in the Spanish America and the practice of European science by an elite of creoles had an important effect on the history of Latin America.

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What men want to learn from nature is how to use it in order to dominate it and other men.

Theodor Adorno and Max Horkheimer

Dialectic of Enlightenment

Once knowledge can be analyzed in terms of region, domain, implantation, displacement, transportation, one is able to capture the processes by which knowledge functions as a form of power and disseminates the effects of power.

Michel Foucault

Knowledge/Power

INTRODUCTION

During the eighteenth century, voyages of exploration became the focus of intense public interest which united the intellectual, commercial and political elites of Europe. Major international and national projects of exploration to distant countries became a common endeavour of the European empires. Natural history, it will be shown, was a form of appropriation and a key function of state policy; through the skills of naturalists would come understanding and eventual mastery not only of nature but also of other cultures.

A number of scholars have written about and recognized the importance of such voyages for both the history of Western science and for the cultural and political history of Europe. In recent years an increasing number of historians have addressed issues of imperialism and European expansion in relation to natural history and exploration.[1] They have illustrated how the relationship between political ideology and science became especially acute during the eighteenth century. It was a period when Europeans experienced an expansive sense of power over nature, mastering not only universal physical laws governing the cosmos but also conquering the earth.

After the arrival of Europeans in America in the

fifteenth century, Spain controlled the largest colonial empire in the world. During the reign of Charles III a number of political reforms, which I shall describe below, took place in Spain. The hope of the Spaniards, using the ideas of the French Enlightenment, was that the procurement and application of useful knowledge would improve their political and economic power. The King and his ministers' endeavour to strengthen the monarchy was seen in a new light: the clue for Spanish prosperity lay in a better exploitation of her American colonies' natural riches.

During the second half of the eighteenth century the Spanish government set up a number of ambitious expeditions carried out by botanists who undertook research on the virtues and characteristics of the tropical vegetation. The projects of exploration were dominated by physicians and promoted by medical institutions. In Spain, more than in any other country, acquaintance with medically useful plants and the promotion of a national pharmaceutical industry became a central commitment of the state. The long-standing marriage of medicine and plants, among other reasons, allowed botany to have a vital imperial economic function.

Supported by the Crown, the explorers remained in America for several years collecting numerous new species, bringing back to Europe large collections of dried plants, botanical drawings, samples and

descriptions of plants deemed useful. The reports and diaries of the different Spanish explorers contain hundreds of references to medicinal plants, several of which had an important impact on the European pharmaceutical industry. The case of quinine (Cinchona) is, among many others, an outstanding example of the intersection between medical, scientific and commercial factors.

I do not attempt to review, in this short introduction, all the literature available on the Spanish exploration of America. However, a brief discussion of the different approaches to eighteenth-century botany, medicine and exploration in Spain and their historiographical problems is helpful in situating my own investigation. The case of Spain and its ambitious projects of exploration in America, have been largely ignored by English-speaking historians. The English explorers James Cook and Joseph Banks, the Prussian Alexander von Humboldt, or the French Aimé Bonpland and Charles-Marie de La Condamine, are all familiar figures among European historians of science, but eighteenth-century Spanish naturalists and physicians are scarcely known by scholars outside Spain or Latin America. This omission has been partly due to the exclusion of Spain from the conventional notion of Europe's "Age of the Enlightenment" in which Catholic

nations are considered to have had no real participation. It is revealing that publications such as The Enlightenment in National Context, edited by Roy Porter and Mikulás Teich, does not mention Spain.

Some of the literature available in English on the Spanish botanical expeditions, Arthur R. Steele's Flowers to the king. The expedition of Ruiz and Pavon and the Flora of Peru (1964), or Iris Engstrand's Spanish scientists in the New World (1981), offers detailed and helpful accounts of the events, dates and actors involved, but for the purposes of the present research, their analysis is limited. Issues concerning natural history and imperialism, the actual practices of the explorers in the mobilization and classification of natural objects, or the influence of the expeditions upon the history of America, are treated superficially.

The themes of travel writing, imperialism and the encounter of Europeans and "others", which have been taken up by scholars such as Mary Louise Pratt or Anthony Pagden have also included studies of some aspects of the Spanish exploration of America, but a systematic study of the role of natural history in Spanish imperial history has never been undertaken.[2]

However, eighteenth-century botany, pharmacy, medicine and voyages of exploration have aroused increasing interest among Spanish and Latin American historians interested in colonial science. The secondary literature published in Spanish is extensive.

Particularly in the last few years, and partly due to the celebration of the fifth centenary of the "discovery of America", the scholarship on the Spanish Royal Botanical Expeditions has received growing support, and the number of scholars interested on the subject has increased enormously. Some of their contributions have been, in many ways, helpful and stimulating. Undoubtedly, historians of science in Spain have made valuable contributions towards a better understanding of the political, economic and cultural factors involved in natural history and voyages of exploration.[3] Unfortunately, their publications remain confined to their own circles and have rarely been translated into other languages. However, we should also point out that despite a number of revealing case studies on the institutions, actors and state policies involved in the exploration of America, the writings of Spanish-speaking historians of science are not thoroughly detached from the celebration of their fellow country-men and their achievements. Often devoted to revealing the Spanish contributions to the history of science, their analyses tend to be documentary and uncritical.

A group of Latin American scholars have also published a substantial amount of material on the eighteenth-century Spanish explorers, particularly on their influence upon the American nations.[4] For both Spaniards and Latin Americans, the naturalists of the eighteenth century constitute important national figures

who have been the subject of a long tradition of monotonous and reinforced veneration. Some of the Spanish naturalists and physicians who travelled to the New World were involved in the teaching of medicine and natural philosophy. They were responsible for reforms at the universities, and became leading figures in the establishment of institutions such as botanical gardens, museums of natural history and astronomical observatories. They have been regarded as heroic figures who brought to the colonies not only enlightenment, progress, and the benefits of modern science but also ideals of political independence. Recently, a more critical vein of scholarship has developed among some Spanish and Latin American scholars devoted to problems of imperialism and science. However the history of science in Latin America is still dominated by a conventional historiography of endless beatification of science and its practitioners.[5]

Even though my investigation has considerably benefited from their contributions, my research goes in a different direction. My investigation aims to examine the actual practices involved in botanical exploration: the elaboration of visual records, the mobilization and classification of plants and the actual making and certification of botanical and pharmaceutical knowledge. Unlike the Spanish-speaking historians studying the eighteenth-century natural sciences, I have found some of the recent discussions in the sociology of scientific

knowledge (SSK) relevant and sometimes indispensable for a historical revision of natural history and exploration.

Some of the current discussions in SSK, the works of Michel Foucault, Augustine Brannigan, Joseph Rouse, Barry Barnes, Bruno Latour and Michel Callon, among others, have been of central importance for the elaboration of a new and more critical study of natural history, exploration and imperialism.

Conventional notions such as "discovery", a distinction between "internal" and "external" factors in the history of science, and the consequent idea that knowledge about nature is necessarily progressive and politically neutral, are still common assumptions in the secondary literature on the Spanish expeditions. These are, in my opinion, problematic premises that have trapped historians in a celebratory and sterile description of natural history.

In the following chapters I seek to illustrate that knowledge, in areas of natural history such as medicine and botany, is inseparable from economic, political and religious interests; that colonial economic policies and career opportunities motivated the development of pharmacy during the eighteenth century; and that such practices constituted important forms of control and domination of both nature and people. Issues concerning appropriation and control, cannot be isolated from the actual commitments, practices and skills of European

naturalists. The pursuit of knowledge was hardly isolated from national and commercial profit. In fact, the dichotomy between knowledge and power and the very distinction between science and politics, can be misleading. Therefore, natural history and political ideology shall be regarded as two faces of the same structure of power, though not necessarily distinguishable. It is seriously misleading to imagine that knowledge of nature is not part of the social order, and for the present investigation we cannot accept the standard contrast between notions like "society", "power" or "politics" on the one hand, and "knowledge" on the other.[6]

Knowledge, discovery, appropriation and power, these are all key concepts that I shall explore and relate in the following chapters. "Power", as suggested by Barry Barnes, can be understood as "possession". Possession of territory, of goods, of finance, of weapons, of skill, and so forth.[7] I shall illustrate that the idea of "discovery" involves an act of possession. "Discovery" has been traditionally understood as finding something of which there was no prior knowledge and consequently something without an owner, but something that suddenly presents itself as a gift. To discover, traditionally means, to uncover, to reveal something that had had an existence prior to and independent to any viewer. I shall argue that in order to be "seen", "discovered" and "possessed", natural

objects had to become familiar, conformed to a pre-ordained set of rules, and to a large extent, the objects "discovered" had to be created throug a process of scientific work.

The European naturalist assumed that his mere presence, his alleged priority of sight, his skills in classifying and naming, could be transformed into appropriation.[8] He who first recognized a new land, plant or medicine, claimed the right of possession. However, the act of appropriation that we equate with the making of knowledge is a complex process. First, it is important to bear in mind that natural history was not the inspired endeavour of a few great individuals. Rather, it was, a practice of co-operation among many, a process of translation that required things to be mobilized, gathered, coded, displayed and sometimes sold.[9]

Voyagers and naturalists regarded themselves as agents of both God and the state, and their acts of possession, although claimed individually, were made in the name of the King and justified on religious gronds. The achievements of exploration were evidence of sovereignty, and, consequently, botanical gardens and museums became public galleries where the European empires could show off their power and display God's beneficent creation. Large collections of specimens of a botanical, zoological or mineralogical nature were set up in the most important cultural centres of Europe.

National museums of natural history were established in London (1753) and Paris (1745), and a growing number of new botanical gardens were set up after the mid eighteenth century: Vienna (1751), Madrid (1755), Lyons and Nancy (1758), Cambridge (1762), Versailles (1765). All of these institutions became important symbols of power. Aristocratic collectors began to satisfy their acquisitive interests not only with objects of art but also with fossils, shells, minerals, stuffed animals, and butterflies, often purchased at high prices. The natural world - as Peter Bowler put it - was incorporated into the world of property.[10] Natural history like map-making, mining, and the production of large floras and herbaria, was an expression of the European commitment to extending and maintaining control over the world with the support of God himself.

In order to explain these processes we must take into account the roles of actors who belonged to different places and social groups. Charles III and his ministers, the indigenous inhabitants of America, botanists, dealers, physicians and the chemists of the court, were all key actors in the construction of botanical and pharmaceutical knowledge in Spain during the eighteenth and early nineteenth centuries.

Classifying, drawing, naming and moving objects of nature, the legitimation of botanical and medical knowledge, the means by which folk experience (the first source of information the explorers had) was translated

into enlightened science, as well as the social and political interests and negotiations which made these processes possible: these are all topics of central importance for my investigation.

Next I shall give a brief description of the different chapters and specific topics explored in my work. In the first chapter my research focuses on the background to the expeditions, including the role of botany, medicine, and natural history in Europe during the second half of the eighteenth century. I also investigate the political and social history of Spain, paying special attention to its imperial and colonial policies and their relation to natural history; here I deal with Spanish institutions such as the Royal Botanical Garden and the Protomedicato, where Spain's new colonial policies took shape. This chapter also includes a brief outline of the different Spanish expeditions, focusing on their promoters and aims. The main purpose of this section is, then, to locate the scientific expeditions in a particular social and political context without which botany, medicine and exploration cannot be successfully explained.

The main subject of the second chapter is the manufacture of the botanical illustrations which unquestionably embody the major material outcome of the expeditions. Here I illustrate the key function of visual representation in scientific exploration,

particularly in botanical classification, where the artist played an active and central role. I also explain the importance and influence of Linnaeus on the Spanish botanists and offer examples of how the botanist-artist simplified and schematized his objects of study in order to accomplish the appropriation and displacement of natural objects. Following the naturalists from the field to the printing house, I discuss concrete instances of the process of appropriation suggested previously, and also introduce ideas which are reinforced in following chapters, i.e., that taxonomy can be understood as a process of invention related to social concerns rather than to disinterested discoveries, and that classifications (species and genera) were made rather than found.

In the third chapter I deal with a number of medicinal and commercial plants that raised interest among dealers, pharmacists and the crown: an American species of cinnamon, a tea from Santa Fe, and a number of plants with alleged anti-venereal, anti-rheumatic or febrifuge properties: the root of "Calaguala", Polypodium calaguala; the "Star-reed", Aristolochia fragantissima; "Ratanhia", Krameria triandra; the root "Yallohoy", Monnina polystachya; and others.

Here I argue that the concept of "discovery" - an achievement by a heroic individual finding for the first time something existing but unknown - is inappropriate

for understanding the work of the explorers. I shall rather describe a process of translation and legitimation in which natives, voyagers, taxonomists, chemists and physicians were all involved.

Because the botanists were trained and eager to recognize useful and commercial species but did not have the time nor the means for testing the virtues of every single specimen, their acquaintance with these new useful plants was generally dependent on local traditions and on the current and already established trade in some species which had had recognition and commercial value. Therefore I stress the importance of folk experience and examine the process of legitimation and translation of the native pharmaceutical traditions into enlightened science. Finally I deal with the Spanish reception of these drugs, examining the role of Spanish pharmaceutical and medical institutions in the approval and commercialization of the tropical remedies.

Here I describe three stages in the process of appropriation and certification of knowledge: a first stage in which discovery stories and folk experience are used to raise interest in new valuable plants; a subsequent stage in which the botanists' classification of plants becomes a second and indispensable practice for the certification of genuine remedies; and finally, a stage in which the plants are not only located into a particular Linnaean category, drawn and re-named, but also taken to the laboratories of the Court and reduced

to their chemical components.

The fourth chapter is devoted to the most important and controversial of all American plants in the history of medicine, the genus Cinchona (Quinine). This chapter is of central importance for the thesis, for it offers an extensive and detailed case study which reinforces the main points raised in the previous chapters. Here I make clear that the recognition of different species and the establishment of their medical uses involved interests common to botany, commerce, colonialism and medicine. Moreover, as I explain, the knowledge of the "fever tree" was constructed by human agents free to negotiate the information. American collectors, European dealers, botanists, physicians and chemists as well as the King and his ministers made all possible the making of pharmaceutical knowledge. I present a critical review of the history of quinine and its discovery stories, arguing that the "discovery" of new therapeutical plants such as quinine cannot be isolated from local traditions.

Then I focus my research on a dispute over Cinchona classification between the botanists of the expedition to Peru, Ruiz and Pavón, and José Celestino Mutis in Santa Fe de Bogotá; a controversy in which commercial and local interests were clearly involved with the actual work of the botanists.

I also give further evidence to support some of the claims made in chapter two, stressing the negotiability

of taxonomy and the importance of visual representation for the making of botanical knowledge.

So far I have been describing natural history and exploration as enterprises closely linked to a particular colonial policy that had as its main goals the appropriation and control of nature and the development of a more efficient exploitation of the Spanish colonies. However, I have said little about the nations in which the expeditions took place. The fifth and last chapter includes an analysis of the influence of Spanish botanists and physicians upon the culture and history of South America.

In order to achieve the appropriation and control of the New World, a scientific tradition had to be implanted in America. Eighteenth-century European scientists brought and disseminated new medical practices, introduced reforms to the universities, and founded botanical gardens and astronomical observatories. The Spanish expeditions succeeded in training South Americans in natural history, botanical drawing, taxonomy and medicine.

Contrary to Spain's expectations, by the beginning of the nineteenth century the vast majority of all Spanish possessions fought for and declared their independence.*

A study of the diffusion of the sciences, particularly botany, medicine and geography, offers new

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* In history textbooks we are taught that Colombia declared its independence in 1810, Argentina in 1816, Chile in 1818, Peru and Mexico in 1821.

insights for our understanding of cultural imperialism and its relationship with South American independence movements.

During the early nineteenth century natural history, geography, medicine and in general the Enlightenment's commitment to domination were in the hands not only of voyagers from distant empires but also of Americans. However, scientific practice was not necessarily a progressive historical force nor an instrument of liberation. In Latin America, science and its practitioners remained strongly attached to a class and to a culture largely dependent on European values and after the revolution the structure of power remained largely untouched.

NOTES

Complete references to the authors listed in notes 1, 3 and 4 are provided in the bibliography.

1. See for example: Lucile H. Brockway, James E. McClelan III, David Mackay, Mary Louise Pratt, Anthony Pagden, Dirk Stemerding and the different contributors to the volume Visions of Empire (Cambridge: Cambridge University Press, forthcoming).

2. Mary Louis Pratt, Imperial eyes: Travel writing and transculturation, (London and New York: Routledge, 1992); Anthony Pagden, The fall of natural man: The American indian and the origins of comparative ethnology, (Cambridge: Cambridge University Press, 1982); idem, Spanish Imperialism and the political imagination, (New Haven: Yale University Press, 1990); idem, European encounters with the New World: from Renaissance to Romanticism, (New Haven: Yale University Press, 1993).

3. To mention just a few of the most relevant writers: Javier Puerto Sarmiento, Antonio Lafuente, Antonio Gonzalez Bueno, Jose Luis Peset and Miguel Angel Puigh-Samper.

4. See for example, Emilio Quevedo, Luis Carlos

Arboleda, Patricia Aceves, Olga Restrepo, and Eduardo Estrella.

5. For a review of the recent scholarly work in the history and sociology of science in Latin America see Hebe M.C. Vessuri, "The social study of science in Latin America", Social studies of science, 17 (1987): 516-54.

6. See Barry Barnes, The nature of power, (Cambridge: Polity Press, 1988); Joseph Rouse, Knowledge and power: toward a political philosophy of science, (London: Cornell University Press, 1987); and Stanley Aronowitz, Science as power: discourse and ideology in modern society, (London: Macmillan Press, 1988).

7. Barnes, The nature of power, p. X

8. The idea of discovery as possession is nicely illustrated by Anthony Pagden, European encounters with the New World. and also by Stephen Greenblatt, Marvelous possessions: the wonder of the New World, (Oxford: Clarendon Press, 1991).

For a comprehensive sociological study of the idea of "discovery" see Augustine Brannigan, The social basis of scientific discoveries, (Cambridge: Cambridge University Press, 1981).

9. See Bruno Latour, Science in action, (Milton Keynes: Open University Press, 1987), p. 227.

10. Peter Bowler, The Fontana history of the environmental sciences, (London: Fontana Press, 1992), p. 114.

CHAPTER I

SPANISH IMPERIAL POLICIES, NATURAL HISTORY AND THE APPROPRIATION OF THE NEW WORLD

"Our economy, is nothing else but knowledge about nature adapted for man's needs"

Carl von Linne.[1]

I. Spain and the Enlightenment

The French government under Anne-Robert-Jaques Turgot's ministry and most of the monarchs of Europe during the second half of the eighteenth century were embarked on a number of reforms which, in one way or another, were influenced by the ideas of the Enlightenment. The governments of the King of Prussia, Frederick the Great (1740-86); the Habsburg Emperor, Joseph II (1765-90); the Russian Empress, Catherine the Great (1762-96); the Swedish ruler Gustave III (1771-92) and the Spanish monarch Charles III (1759-88), have been described as making systematic and rational attempts to apply the best recent knowledge to the task of ruling.[2] Needless to say, the precise policies adopted varied from country to country, but common reforms included the

modernisation of education, attempts to improve agriculture, moves to gain state control of the Catholic church, and the search for a better knowledge of natural resources.

For a proper understanding of Spain's enlightened policies of the eighteenth century, we must assess its particular economic and political situation, Spain's royal and imperial interests, as well as the government's relationship with the church.

The Spanish reception of new European ideologies and economic policies is a complex process which was not confined to Charles III's reign nor to the few individuals that we shall mention. However, some general aspects are particularly relevant for understanding the political function of scientific exploration. The Enlightenment provided the Spanish rulers with a new ideology for the centralization of power. Throughout the monarchy officials, from the American Viceroy downward, as well as members of the clergy, often eluded full control from Madrid. For many reformers, this lack of integration - especially obvious in the relationship between Madrid and the overseas empire - seemed particularly threatening.[3]

It is first necessary to understand the magnitude and nature of the power of the Spanish clergy. For centuries the Catholic church remained a dominant institution in Spain, and by the end of the eighteenth century no other country in Europe matched Spain's

numbers of churchmen and women. The census of 1768 showed that out of a population of 9.3 million, Spain had more than 150,000 clergy. France, with a population perhaps two and a half times that of Spain, had a similar number of clergymen.[4] The clergy formed a large, wealthy and powerful community with a vast landed property. By the end of the century their lands comprised one-fifth of Spanish territory, and the profits of the Church oscillated between one-sixth and one-fifth of the gross national product.[5]

Clerical control over education and the church's moral authority constituted an even more significant domain of social control. In 1784 and 1785 over one-third of the books and pamphlets published in Spain (about 160 of some 469) were on religious subjects: collections of sermons, saints' lives, prayer books and works on theology.[6] The parish priest was often the only person in a rural community who could read and write, so that he was the village lawyer, physician and religious leader.

Despite the obvious mutual support of the clergy and the Crown, the Catholic church was the only institution powerful enough to rival the king's authority. As we shall suggest, the new economic policies, the encouragement of scientific research and the reforms in education in Spain during the second half of the eighteenth century, can be partly explained as a struggle for power in which the Crown aimed to enhance

royal authority over the Church, to regain and centralize power. Charles III was determined to stifle all ecclesiastical challenges to his royal authority; the expulsion of the Jesuits, the abolition of all university chairs associated with Jesuit doctrine, the prohibition of their texts, were all measures to protect royal supremacy. To almost all the Caroline reformers, the Order of Jesus appeared to be the monarchy's worst enemy. The expulsion of the Jesuits from Spain began on 2 April 1767, and a few weeks later they were banned from Spanish America.

The policies of the ministers, Pedro Rodriguez de Campomanes and the Count of Floridablanca, sought to transform Spanish society by the introduction of useful education, which for them meant removing members of the Church from the universities. Campomanes (1723-1803), one of the most influential proponents of the new political economy, published his Tratado de la regalia de amortización (1765) in which he attacked clerical property as a barrier to the generation and circulation of wealth.[7]

However, the commonly accepted picture of a progressive lay government fighting the reactionary church is far from accurate. First, a number of influential church men constituted the major conduit for the introduction of European science and philosophy into Spain. A Benedictine monk and great admirer of Francis Bacon, Benito Gerónimo Feijóo (1678-1764) strongly

attacked Aristotelianism which was still regarded and protected by many as the indispensable foundation of Catholicism. As he put it: "It is imponderable the damage philosophy suffered for being under the yoke of ignorant authority for so long."[8] He also defended the study of French as much more useful than that of Greek or Latin, and promoted the study of natural history, indicating its economic benefits. He argued that Spanish science and the national economy had stagnated partly because Bacon and Newton were viewed as heretics. Feijóo was convinced that there could be no conflict between modern science and the Catholic faith. On the contrary, he was of the opinion that science would give a "clear idea of the power and wisdom of the supreme craftsman".[9] In his Teatro Crítico, Feijóo wrote: "If the Gospel and experience were opposed, I would deny my eyes and my hands to assent the Gospel".[10] Although he referred to Ptolemy's system as "absolutely indefensible", in his Cartas Eruditas he wrote about Copernicus: "I profess that if there were only philosophical and mathematical reasons concerning this issue, I would be the finest Copernican in the world... but against Copernicus there lies a superior argument to those that have been and are invoked in his favour. What is this argument? The one taken from the authority of the Gospel from which it is clear that the earth is motionless and that the sun turns around it."[11]

Another influential Benedictine monk who promoted

natural history and supported Feijóo, was Martín Sarmiento (1695-1772). His passion for natural history also had economic incentives. "How could it be doubted that this [natural history] would advance the wealth of the people, stimulate commerce and overcome the constant shortages? Above all, many doubloons would no longer leave Spain to bring from abroad what we have here."[12] Sarmiento insisted on the importance of reform in the Spanish education system, in which, with the help of the secular and regular clergy, children would be introduced to the knowledge of nature.

This is not to say that there was no ecclesiastical opposition to the reforms that aimed to bring foreign philosophy into Spain, nor that the Inquisition was impotent. The Inquisition was still feared, and persecuted individuals well into the nineteenth century. It continued to issue indexes and edicts, formally condemning the Encyclopédie; Voltaire's Lettres philosophiques (in 1756), Voltaire's works (in 1762); Diderot's Pensees philosophiques (in 1756); all Diderot's works (in 1807); Robinet's De la nature (in 1771); and La Mettrie's works (in 1771). Charles Bonnet, Oeuvres d'histoire naturelle et de philosophie, the two first volumes, Contemplation de la nature (1764-65) appeared in the index of 1791.[13] The index as edited in 1790 contained 350 quarto pages with double columns and small type. Labels such as atheistic, heretic or "afrancesado" (French-like), occurred throughout and

almost any influential thinker from the sixteenth century onward is likely to be found in the list. The Encyclopédie, except for a few copies, was successfully kept out of Spain.[14]

Despite Buffon's controversial arguments in "Epoques de la Nature", which clearly conflicted with the Gospel, his Histoire Naturelle escaped censorship from the Inquisition. We cannot assume that all the works that were not condemned were known in Spain; on the contrary, we could argue that the foreign publications and authors that escaped censorship did not have a major influence in Spain. However, Buffon was read, praised and translated into Spanish, and the reception of his work is worth discussing briefly as an example of assimilation of new ideas in Spain. It seems significant that Feijóo, commonly regarded as one of the leading figures in spreading the new sciences in Spain, did not mention Buffon in his influential Cartas Eruditas, the last of which was published in 1760. The first public appearance of Buffon's writings in Spain was in 1773 when the "Sociedad Vascogonda de Amigos del Pais" published a number of texts for the teaching of natural sciences which included extracts of Buffon's writings.[15] Some copies of Histoire Naturelle circulated in Spain before José Clavijo Fajardo began the publication of a Spanish version of the work in 1785. Buffon was repeatedly praised by naturalists in Spain. Valenti Foronda referred to the author of

Histoire Naturelle as "sublime" and "divine",[16] William Bowles wrote about the "immortal Buffon"[17], but the Spanish reception of the French naturalist, as well as of any other writer of the Enlightenment, was mediated by Spanish intellectuals. J. M. Alea, secretary of the "Real Gabinete de Historia Natural", and another Spanish admirer of Buffon, translated a French text about Buffon whith the Spanish title Vida del Conde de Buffon. In the preface to the text Alea says that the French naturalist should be read and enjoyed by everybody, "including the fair sex". Alea finished with the following advice for Spanish youth: "... get to know the Natural History of the count Buffon and read it day and night."[18] However, it is also important to note that Alea portrayed Buffon as a devoted religious person who represented no threat to the Catholic faith. "Buffon's theory of the earth", wrote Alea, "in my opinion must be considered as an ingenious novel in which the author combines observations and experiments and explains not the actual formation of our globe and the planets, but the laws with which could have been formed under the will and action of the creator."[19]

The Church was both a source for and a filter of the publications of the European Enlightenment, and we find a significant number of members of the Church and the government advocating new ideas concerning scientific progress, educational reforms, economic changes and so

on. But one would have to search hard to find the few who questioned their Catholic faith, and it is clear that neither Catholicism nor the monarchy were under serious threat. The Enlightenment in Spain accepted not only the political orthodoxy of absolutist government and social hierarchy, but the clerical orthodoxy of Catholicism as well.[20] Charles III and his collaborators wanted to retain the clergy as the pillar of society, but a clergy trained to accept both royal authority and the importance of economic development. As David Goodman points out, this had been one of the main reasons for the reform at the universities.[21]

The first plan sponsored by the government concerned the University of Seville, with the idea that the recommendations were to become a model for all universities. The plan was originally designed in 1768 by Pablo Olavide. Originally from Peru, Olavide had lived in France for eight years, fraternized with the philosophes and formed a large library. His plan, which we shall look at in some detail in chapter five, would become the model for university reforms taking place in Spanish America. In the name of the new science, Olavide's aim was to remove scolasticism and to ban the regular clergy from universities. Olavide was arrested by the inquisition for his support of French philosophes, and after a long trial he was sentenced to eight years in a monastery. Olavide, Campomanes, Roda and others, invested much energy on the reforms at the

universities. Decrees were issued repeatedly in the 1770s and 80s requiring extensive administrative and curricular changes, particularly in the natural sciences, medicine and law.[22] However renewal was slow and not always successful. It was virtually impossible in the Spain of the eighteenth century to imagine a society capable of establishing any kind of secularized system of education. The alternative to monks and nuns was not lay men or women, but non-monastic clergy.[23]

Another attempt to promote the new economic policies of the state, was the establishment of "Economic Societies of friends of the country". From 1765 onwards patriotic societies (Sociedades Económicas de Amigos del Pais) were organized with government encouragement in order to provide Spaniards with European advances in technology and agriculture. One of the aims of Charles III's government (1759-1788) was to stimulate the Spanish bourgeoisie into the pursuit of private profit. The patriotic societies aimed to create an educated, skilled elite that would promote regional prosperity by the development of agriculture, manufacturing and commerce, but their success was again just partial. The bourgeoisie was limited to the coastal towns, Barcelona and Cadiz in particular. The land was kept in the hands of a few, mainly nobles and clergy, who had no real interest in or need for improving their agricultural production. As we shall see, similar projects would

take place in America.

Scientific activity was not only promoted by universities and economic societies. Government policies to fight Spanish isolation from the rest of Europe included hiring foreign scientists and technicians to teach and research in Spain. The French chemist Joseph Louis Proust, the Irish mineralogist William Bowles and the Swedish botanist Pehr Löefling are just a few examples.

Charles III's government offered new grants for scientific studies outside Spain. Moreover, the Crown encouraged the creation of new learned institutions, some of which we shall examine in more detail. The Botanical Garden of Madrid, the Royal Academy of Sciences and Arts of Barcelona, the Cabinet of Natural History; radical reforms of medical and pharmaceutical institutions; observatories and technical mining colleges, were all examples of the monarchy's efforts to promote useful science and a new source of authority and control distinct from the church.

Perhaps the major medium for the dissemination of contemporary thought was a series of journals and newspapers which flourished in Madrid during the last years of the reign of Charles III. The rest of the Spanish press, the non-periodical publications, were less affected by the new trends. As already mentioned, a significant proportion of books in Spain were on

religious matters. Only 7% were on the sciences, while 3% were on industry, the arts and commerce. Medicine - it is worth noting - was a more popular subject, with 9% of all publications.[24] Journals, on the contrary, constituted an important channel for the spread of foreign thought. El correo de Madrid with a circulation ranging between 216 and 303, made its main contribution with a series of portraits of leading modern philosophers; El Pensador founded in 1761 by Joseph Clavijo y Fajardo - future translator of Buffon - did not hesitate to stigmatize both the "idle nobility" and the "ignorant clergy of Spain". El Censor was founded in 1781 by Luis Cañuelo, who criticized the Spanish attitude towards the modern philosophy. It insisted that the Spaniards, on the grounds of protecting their Catholic faith, were actually damaging it by calling atheists such men as Descartes, "who laboured so hard to prove the existence of God", and Newton, "whose philosophy without belief in God would be totally absurd".[25] The papers El Duende de Madrid, El Apologista Universal, El Semanario Erudito, were among other publications with a similar attitude and criticism towards the state of Spain.

The event which generated more discussion about Spain's cultural deficiencies was the article "Espa gne" by Nicolas Masson, which appeared in 1782 in the Encyclopédie methodique. For Masson Spain typified everything the philosophes were struggling against, and

he strongly emphasized the backwardness of the country. "Mais que doit-on a l'Espaigne? Et depuis deux siécles, depuis quatre, depuis dix, que at-elle fait pour L'Europe?"[26] The Masson "affaire" provided a good pretext for airing the controversy in the public press. A large number of reactions and replies from all sorts of indignant Spaniards were published, and Charles III himself officially protested to the French government.

It seems that we are facing a contradictory situation in which the government called for reforms with direct attacks on the Church, and at the same time needed to conserve its alliance with the Church and the Inquisition. The rhetoric of the Enlightenment, which helped to legitimize new policies and strengthen the monarchy's power, was at the same time prudently filtered. It might be true that the fight for royal absolutism and the attempts to subordinate the clergy and the Inquisition to the Crown opened new channels between Spain and European philosophy, but it is important to bear in mind that the monarchy and its power cannot be fully appreciated outside of a wider structure of power based on religion. The king existed on Earth by God's will. He was for the Spanish Church, the protector of religion and, for the people an image of both divine and social authority. The Inquisition kept the spirit of a "holy war" where the enemies of religion and the enemies of the king were the same.

The controversies and reforms of the late eighteenth

century did not involve a dispute over fundamental forms of government or religion. On the contrary, the innovations should be seen as an attempt to fortify the monarchy as a central government both in Spain and America. The monarchy and the church maintained an intense mutual support which, as we shall illustrate, was particularly visible in the colonies.

The new policies would have a vast impact on the New World. There too, universities were reformed following identical or similar plans, local economic societies were established, and Americans also were encouraged to be educated in Europe. The aim, again, was to simplify and strengthen royal control of the Americas and facilitate the exploitation of natural wealth. European naturalists and natural philosophers, before and after independence, were hired to take teaching positions at the universities and to assume leading roles in the new "national" scientific institutions. New periodicals devoted to the dissemination of science would flourish, and the message of material progress through the application of enlightened European science and technology was spread.

Next we shall analyse the political climate and framework of the second half of the eighteenth century in which Spanish science and in particular the expeditions took place.

In Spain and Portugal, the Enlightenment coincided with the struggle of an old power trying to be great again by adapting self-consciously the techniques they believed other nations had used to surpass them.[27] The economic and political decline of Spain in the seventeenth century was certainly affected by war; however it remained the largest imperial power in the world. Not surprisingly, to the government the key to prosperity lay in the Americas, for a prosperous Spain demanded an efficiently administered colonial market. The American colonies were to provide the crown with increased revenues and with a closed market for the exports of an expanding economy.[28]

During the sixteenth and seventeenth centuries, despite valuable importations of cacao, hides, dyewoods and tobacco, Spain's main interest focused upon gold and silver, the pearls and emeralds, the "riches of the New World". The Crown was obsessed with the exploitation of the mineral wealth of the colonies as a means of financing its costly European wars, and the promotion of agriculture and industry in the colonies was deliberately ignored. Spanish economic policies tended to stress the dependence of America on the mother country. It was thus hoped to stimulate mining in America with a corresponding expansion of agriculture and industry in Spain which would, in turn, find a colonial market. Yet in practice this monopoly was little more than an illusion. Spanish industries had

never been large enough nor sufficiently developed to provide manufactured goods for both home and colonial markets; consequently the smuggling of foreign products became a common practice. In the first half of the eighteenth century Spanish trade with her American colonies was overwhelmingly in foreign hands and the profits went to the French and the British rather than to the Spanish. By the end of the seventeenth century only one-eighth of the goods shipped from Spain to America had been of Spanish origin. Spain was not able to supply the needs of Spanish America; instead France and England dominated the colonial trade. Moreover, primary and craft industries began to develop in the colonies in a way which was contrary to the policy of the crown.[29] By the 1740s some ministers and economic writers pointed out the need for drastic reforms for an improved trading system. José de Carvajal, foreign minister of Ferdinand VI from 1746 to 1759, and his Nuevo sistema de gobierno económico para la América (New system of American economy)[30] was an important example. By the 1760s it seemed clear to the reformers that America's resources and markets represented a great opportunity for Spain's recovery.[31]

Ideas of progress related to English mercantilism, the doctrines of French physiocrats and especially the European assumption that the key to prosperity lay in modern science and technology. These became the basis for the new policies of the King's ministers,

Campomanes, Floridablanca, Aranda and Roda. The King, or rather his ministerial elite, introduced the administrative reforms which would give political priority to natural history, medicine and exploration. Botany and medicine, as we shall see, began to have a central role in a major project of mercantile import substitution.

Knowledge of natural history in both Spain and its colonies was the key to improvements in commerce and manufactures. As the minister Pedro Rodriguez de Campomanes would put it in his Discurso sobre el fomento de la industria popular (1774):

> While there is in any province a tree, herb, fruit, mineral or anything living whose use is unknown, it must be admitted that the inhabitants do not have the essentials for a well-established industry. It is very negligent to import what can be taken from within at slight cost and without prejudicing the balance of trade.[32]

The Indies, according to Campomanes's vision, would have to play the major role in Spain's economic and political resurgence. In his Discurso sobre la educación popular (1775) Campomanes examined the problems of trans-atlantic trade. The ideas expressed here would take shape three years later with the Reglamento de comercio libre that ended Cadiz's monopoly

and opened an expanded number of Spanish ports with direct colonial contact.

However, the new projects of exploration and exploitation of the Americas' resources were put in practice by the director of the Botanical Garden, Casimiro Gomez Ortega. As he explained:

> A dozen naturalists and some chemists scattered in Spain's dominions by means of their travels will offer an incomparably larger utility to the state than a hundred thousand men fighting for the enlargement of the Spanish empire with new lands which productions would be concealed and forgotten just as the major part of Spain's natural products remain today.[33]

II. The Spanish expeditions to the New World

Since the arrival of Europeans in the "New World" in the fifteenth century, expeditions had been a common practice of the Spanish empire as they sought to maintain and expand control over their possessions. Imperial voyagers had been busy making maps, charts of navigation, fixing limits or searching for silver and gold. The Spanish possessions in America were constantly threatened by the interference of other empires, the Portuguese in South America, the English in

the Pacific, the Russians in Alaska and so on. Spain sent numerous ships on geopolitical missions devoted to the demarcation of limits or military protection of its territories.[34]

However, during the eighteenth century not only did voyages of exploration receive increasing support from the government, but we can also see the emergence of a new kind of exploration dominated by natural history and medicine. This time the explorers were engaged in a major project of global appropriation that included not only coast lines, rivers, gold and silver, but also the systematization of every object on the planet.[35]

Before the apogee of exploration in the Enlightenment, Spain had made lesser attempts to seize and exploit the vegetable wealth and pharmaceutical potential of its colonies. One early expedition, that of Francisco Hernandez to New Spain (1571-1577), is worth mentioning. Many of the eighteenth century botanists regarded Hernandez's expedition and publications as an unfinished enterprise to be completed. Hernandez had received instructions to investigate medical plants and to interrogate physicians, herbalists, indians, or anybody who might know anything about herbs, trees and plants with any possible medical use. For the eighteenth-century explorers, as we shall see, medicine was also of central importance, but now the process of appropriation was

reinforced by the introduction of global projects and systems of classification.

Subsequent chapters focus on the Royal Botanical Expeditions to South America, notably José Celestino Mutis's expedition to the Kingdom of New Granada and Hpólito Ruiz and José Pavon's expedition to the kingdoms of Peru and Chile. But first I shall give a brief account of the major Spanish voyages of exploration during the eighteenth century.

A. Jorge Juan, Antonio de Ulloa and the expedition to measure the shape of the earth

French initiative and influence became a landmark of Spain's scientific projects, and the first voyage that interests us is La Condamine's expedition to the equator.[36]

After Cassini's measurements of the meridians seemed to show that the Earth was elongated at the poles, in clear opposition to Newton's conclusions, the controversy between the Academy of Paris (Cassini) and the English (Newton and Huygens) about the shape of the earth had not found a final arbiter. French cartesians opposed Newton's ideas and the debate involved two scientific communities identified with national ideals.

In order to end the dispute, the French Academy proposed that two measurements of one degree of an arc of a meridian should be made, one near the North Pole,

the other near the equator. The most convenient place to undertake the latter measurement seemed to be South America. The project was not only too expensive to be undertaken by the French Academy alone but it also required the permission and protection of the Spanish authorities. This first expedition was conceived and planned outside Spain, and as we shall see, foreign initiative would be a common feature of most Spanish expeditions.

The French presented a petition to the Spanish government asking it to undertake and join the expedition. The King, Philip V, approved the project but not without imposing some conditions. On the grounds that the enterprise might conceal other interests such as those of commerce or espionage, the Spaniards asked in exchange that the methods, instruments and results of the voyage would be shared with Spain.

Aware of the fact that precise knowledge of the shape of the Earth, and the development of map-making using measurements of longitudes was a key element for navigation, the exploitation of resources and the fixing of frontiers, Spain hoped to get benefits from the French project. Therefore two young members of the Spanish navy, Jorge Juan and Antonio de Ulloa, were appointed by Philip V to take their place on the expedition on behalf of Spain, to assist and learn from their French companions. Some of the French members of

the expedition included La Condamine, Godin, Bouguer and the botanist Joseph de Jussieu.

The resulting measurements were used by many to support the Newtonian prediction of a world with flattened poles.[37] The two Spanish scientists published the results of the expedition in a complete report, Relación Histórica del viaje a la America Meridional. The book not only dealt with the problem of the shape of the Earth but also with observations on natural history and geography made in more than ten years of travel. Particularly important for our interests are the botanical investigations made by La Condamine and Jussieu on the Peruvian Cinchona, which are discussed in chapter four.

Juan and Ulloa's book was printed in a expensive edition distributed among noble gentlemen and scientific institutions throughout Europe. Copies were sent to Pierre Bouger, Charles de La Condamine and Joseph Nicolas de l'isle at the Academy of Sciences in Paris; to Pierre Louis Maupertuis, president of the Academy of Sciences in Berlin; to Martin Folkes at the Royal Society of London; to the Academy of Petersburg; and to many other gentlemen and institutions in Spain and Europe. Despite the limited diffusion of the work in Spain, it had three French editions, four English editions, one German edition and one more in America.[38]

B. The expedition to the Orinoco: Loefling and Spanish botany

Historians have often related the awakening of botany in Spain to a controversy raised by Linnaeus' comment: "The Spanish flora is totally unknown to us and in very fertile places of Spain there are many plants which have not been discovered. It is distressing that in the most cultivated places of our time in Europe there exists such barbarism in botany."[39] Naturally, Linnaeus' words caused indignation among Spaniards, including the King himself. We shall see that the imperial role of botany and natural history was the result of much more than the indignation of a king, but Linnaeus' opinion and the reaction of Spanish officials is indicative of Spain's attitude towards European science.

Fernando VI, who ascended the throne in 1746, invited Linnaeus himself to study the flora and organize botanical research in Spain in 1751. Coincidentally, Linnaeus was planning to send one of his disciples to explore the "unknown" Spanish flora. The man chosen was Pehr Löefling (1729-1756) who remained in Spain until 1753. Loefling was surprised to find a group of dedicated botanists already at work; among them were Juan Minuat, José Quer, Miguel Barnades, Christobal Velez and José Hortega.[40] However, as Loefling pointed out in one of his letters to Linnaeus, they were

convinced followers of Tournefort's system and therefore not always receptive to the new Linnaean ideas. Nevertheless, in 1751 Loefling wrote to Linnaeus and said: "You will not believe how well your works, which they had no notice of whatsoever before my arrival, have been received here. The brief description of the characters in the system has pleased them very much, such that I, for this innovation alone, would have been welcome."[41]

In 1754 Löefling sailed for the Spanish territories in northern South America as a botanist in a expedition whose main purpose was to make clear the problem of limits between Portuguese and Spanish colonies. The Spaniards decided to include a botanical section which would first study plants in the Orinoco region, and then would go to Bogotá, Lima, Buenos Aires, and Patagonia. (Men familiar only with the confines of Europe did not realize the difficulties and distances of the journeys between South American cities; needless to say, the original plan was beyond the possibilities of a single explorer.)

Löefling's task was to find out all about various medical herbs used in South America and to study any plant of possible economic value, as well as the means to exploit them. Before departing, Löefling revealed to Linnaeus his interest in writing a <u>materia medica</u> based on the drugs of the New World. Linnaeus himself had requested Löefling to do research on Quinine and the

possibility of its cultivation in Europe. The project ended when Loefling died on 22 February 1756 after fighting with recurrent fevers, thereby upsetting all the expectations for the expedition.

However, Löefling collected about 600 species of plants including 30 new genera and 250 species not mentioned previously by Linnaeus. Spain allowed Linnaeus to have a copy of the notes and manuscripts on botanical subjects. Together with Löefling's letters to his master, these formed the basis for Linnaeus' Inter Hispanicum of 1758.*

Even more important than Loefling's botanical investigation was his role as disseminator of the Linnaean philosophy among Spanish botanists. Thanks to Loefling, and to the fact that Linnaeus' system of classification had already been accepted by too many people all around Europe to be ignored, we might well say that since the Botanical Garden was established in Madrid in 1755, Linnaeus began to be accepted by Spanish botanists.[42] However, the general and official recognition of the Linnaean classification system in Spain did not take place until 1772 and 1773 when Gomez Ortega and Antonio Palau took their chairs as professors at the Royal Botanical Garden.[43]

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* Some 1.700 folio pages of Löefling's notes and manuscripts including his description of the quinine from Guayana are preserved today at the archives in the Botanical Garden of Madrid, II 4,2/4,3).

C. The Royal Botanical Expeditions

Three major projects with direct supervision from the Royal Botanical Garden under the direction of Gomez Ortega would be supported by the government with explicit instructions to concentrate on botany and medicine. Hipólito Ruiz and José Pavón were sent to Peru and Chile; Jose Celestino Mutis was appointed to lead the expedition to the Kingdom of New Granada; and another group of naturalists were sent to New Spain (see figure 1).

The aim of the expeditions as stated by the Spanish crown was:

> ...the methodical examination and identification of the products of nature of my American dominions, not only to promote the knowledge of the physical sciences, but also to banish doubts and falsifications which exist in medicine, painting and other important arts, and to foster nature, describing and making drawings of the plants found in these, my fertile dominions, in order to enrich my museum of natural history and the botanical garden of the court.[44]

Next I shall give a brief account of the three Royal Botanical expeditions, introducing their protagonists and aims..[45] It seems that Spain had had no concrete

plans for hunting plants in Peruvian territories until the French came with a proposal. Anne Robert Jacques Turgot, a leading encyclopedist who became Louis XVI's chief minister, persuaded the Spanish government to send botanists to explore the natural resources of South America. Joseph Dombey (1742-1794), a physician who had been involved in plant collecting in the Pyrenees, became known to naturalists at the Jardin du Roi and was recommended by Antoine de Jussieu for the expedition. Turgot's proposal had made a favourable impression in Spain, but again, Spain's assent was conditional. Two Spanish botanists would have to accompany Dombey and he should leave in Spain a duplicate of all his finds. The two Spanish botanists were Hipólito Ruiz and José Pavón. Both had little experience in botany but practical knowledge of pharmacy.

On 4 November 1777 the expedition set sail for America and after a five-month journey it arrived in Lima. Abundant consignments of plants and other natural objects were sent back to Europe. Dombey returned to Europe in 1785, three years earlier than his Spanish companions. His arrival began an international dispute over the materials of the expedition and a battle for priority of publication between France and Spain. He and his collections were retained in Cadiz for more than four months, and the Spanish authorities requested a division of the materials as well as a copy of Dombey's writings. In 1787 the king ordered Ruiz and Pavón to

return to Spain. The following year they finally departed for Europe but left two young botanists to complete their work, particularly the investigation of the different species of Peruvian bark.

The Spanish physician José Celestino Mutis had been in New Granada since 1760, twenty-three years before the expedition to that part of the continent was officially sponsored by the Spanish Crown. Through the intervention of the Viceroy Caballero y Gongora, Mutis was named "first botanist" and received official support for the Royal Expedition to New Granada in 1783. Mutis never returned to Europe and died in Santa Fe de Bogotá in 1808. His manuscripts, collections and the immense iconographic production of the expedition were shipped to Spain in 1815.

The Spanish exploration of its North American territories (New Spain) was the result of two main expeditions. The Royal Expedition (1787-1800) was organized under the direction of the physician Martin de Sesse. This not only established a botanical garden in Mexico city where professional courses in botany were offered, but also provided scientists to explore Mexico, California, the Pacific Northwest, Puerto Rico, Cuba and Central America. Secondly, the expedition of Alessandro Malaspina (1789-1794) joined Sesse and visited not only Mexico but also Alaska, the Pacific Northwest, California, the Philipines, Australia and certain

Pacific islands.

With the collaboration of Casimiro Gomez Ortega in the Botanical Garden of Madrid, Sesse's project was approved by Charles III in 1787. Sesse was working as a physician to the Spanish Army in Cuba, but his interests in plants with medical properties led him to plan a botanical expedition focused on New Spain. His projects included founding a botanical garden, setting up a chair of botany at the University of Mexico and establishing an academy of pharmacy and medicine. Sesse hoped that upon his return from Mexico the Botanical Garden of Madrid would be enriched with medicinal plants. He was also aware that the Aztecs had a knowledge of botany and medicine which was worth studying. The major portion of the herbarium collected by Sesse in New Spain was incorporated into the herbarium of the Botanical Garden of Madrid in 1820. Part of it was sold to the English botanist Aylmer Lambert, together with a large number of dried plants belonging to the herbarium of Ruiz and Pavón. These are today preserved in the British Museum and in the Kew Herbarium.

The Italian Alessandro Malaspina, conceived the idea of a large-scale expedition not only to the Americas but all around the world. Antonio Pineda and his assistant, the French born Luis Nee, were in charge of natural history in all its branches. In July 1789 the ships Descubierta and Atrevida departed for the Canary Islands. In November they sailed for the Patagonia,

visited the Falkland Islands (Malvinas), rounded Cape Horn and arrived in the Port of Valparaiso of Chile in February 1790. Once in Guayaquil, Pineda and Nee decided to explore the cordilleran mountains and volcanos and travel along the Chimborazo mountain range. They would also go to Panama, Mexico and later on to the Pacific islands. Pineda, like all botanists, was confident that the American forests contained many precious drugs and vegetable products. He hoped that all the newly-discovered plants would increase the inventory of the vegetable kingdom by at least one-third. He believed that more than seven thousand distinct plants had been collected, over five hundred species of animals described and at least four hundred fossils examined.

Finally, on 21 September 1794, the expedition set its course for Cadiz after sixty-two months of constant travel. Materials were transported to Madrid for cataloguing and editing. The reports were so extensive, and had so many illustrations that the estimated cost of the seven volumes project accompanied by seventy maps and seventy plates was calculated as two million reales.[46]

Spain's extensive territories in the late eighteenth century provided an unparalleled opportunity for exploration. As we have seen, the projects of botanical exploration aimed to cover the entire extent of Spanish possessions. The expeditions during the reign of

Charles III constituted the most ambitious and expensive European project of botanical exploration in the Enlightenment. The explorers collected and made drawings of a vast number of plants, they recorded everything they thought significant about indigenous medical practices, and as they remained in America for several years they constituted an important means for the dissemination of scientific practices.

However, as shall be seen, policies of secrecy, the political crisis after 1792, the Napoleonic invasion, and the wars of independence, were all factors that prevented the results of such an ambitious enterprise from becoming available to the European intellectual communities of the early nineteenth century.

Unlike other European projects of exploration, the Spanish expeditions' dominant interest lay in the medicinal virtues of tropical plants. Let us now have a closer examination of the relationship between botany and medicine, and their importance for the Spanish state.

III. Botany, medicine, religion and the empire

During the eighteenth century botany was the branch of science which had the largest support from the Spanish state. As Alexander von Humboldt recognized, "No other European government had invested so much money

for the improvement of knowledge of plants."[47] But botany, we have to remember, was hardly isolated from medicine. The number of patent medicines was increasing and the range of substances used in them was also growing, most of which had a vegetable origin. Botanists in general, including Linnaeus, had medical training, and eighteenth-century plant gatherers were trained to recognize medicinal plants.

For the leading figures at the botanical garden in Madrid, pharmacy was the first beneficiary from the study of plants. From its creation, the botanical garden depended on both the "Protomedicato" and the "Real Botica" and was dominated by medical and pharmaceutical interests.[48]

French physiocrats, with their interest in new agricultural products from the colonies and the possibilities of naturalizing useful plants, may have contributed to making botany more fashionable in Spain's ministerial circles; but botany was largely in the hands of physicians and pharmacists in medical institutions, with little interest in manual occupations such as agriculture.

As we shall see in some detail in chapter three, the Bourbons' centralist policies affected medical practices directly. The "Protomedicato" as a single official institution gained control over physicians, surgeons and pharmacists. Botany in turn, was largely regarded as a branch of the medical sciences.

Pharmacists and physicians gradually gained higher social status and official recognition as providers of health care. The editing of official national pharmacopoeias, for example, became symbols of government involvement in the protection of public health. In many respects, the power that the government was trying to take out of the clerical hands, was now given to the physicians.

Botany, of course, had acquired some independence and the project of classification of natural objects was seen to have major significance in itself. For Enlightenment science Linnaeus was a crucial figure and in many ways his philosophy mirrors the aims and assumptions of eighteenth-century natural history as a whole, epitomizing the European assumptions and aspirations of global control.

Extending some ideas expressed by Lisbet Koerner in her work "Nature and Nation in Linnaean Travel",[49] we shall argue that Linnaeus himself understood natural history and voyages of discovery as economic tools enabling a mercantilist policy of import substitution, that taxonomy itself was a form of appropriation, and that Linnaeus, his disciples and collaborators, especially the Spanish explorers, believed that the success of that enterprise was possible because of the way God had constituted nature.

Let us begin with Linnaeus' conviction that natural history was essential for all economics, commerce and

manufactures, that natural history is the means without which no economy can survive. "An economist without knowledge about nature", said Linnaeus, "is like a physicist without knowledge of mathematics".[50] In a passage read in front of the Swedish royal family at Upsala University in 1759, the taxonomist succinctly stated his views on the unity of politics, progress and science: "Our lesser knowledge of science causes our medicinal herbs to be bought from foreigners, tea, quinine, cochineal to be bought yearly for a great amount of money.... Without science our herring would still be fished by foreigners, our mines mined by foreigners and our libraries totter under the works of foreigners." And as if addressing his words to the six-year-old princes Sofia Albertina, Linnaeus continued: "Without science the demons of the forest would hide in every bush, spectres haunt every dark corner. Imps, gnomes, river spirits, and the others in Lucifer's gang would live with us as if grey cats, and superstition, witch-craft, black magic, swarm around us like mosquitoes."[51]

In this set of ideas runs the message that voyages of discovery were essential, for Linnaean natural history would enable Sweden to produce previously imported agricultural products and manufactured goods. The Swedish government as well as many other European nations - notably Spain - assumed that the scientific exploration of nature would enable the economic reform

of society. By promoting knowledge the crown was stimulating commercial expansion and systematic exploitation of the empire and the periphery.

Behind this utilitarian and commercial view lies a teleological and theological view of nature which was essential for Linnaeus as well as for eighteenth-century natural history. All the traveller naturalists belonged to intellectual cultures which were convinced that everything in the world conformed to a pre-ordained set of laws. Genera and species, as Linnaeus conceived them, were the most important categories within his system and they represented eternal models of the realization of God's work. The order of nature, for Linnaeus, celebrated the infinite wisdom and kindness of the creator. The earth was thus nothing else but a "natural history cabinet of the all wise creator's masterpieces"[52] and man was the creature for whom everything else was created. In this case "man" probably means white male European and sometimes Swedish.

Botany and Linnaean taxonomy, by then officially recognized by Spanish institutions, were seen as useful for apologetic purposes, posing no real threat to the Catholic church. No doubt, this was another good reason for the state's support of botany. Other areas such as chemistry, astronomy or natural philosophy were probably more demanding, but above all, were in frequent conflict

with religion. It is important to bear in mind that the monarchy and the church were inseparable. Despite some differences, church and monarchy had an intense mutual support, and were, so to speak, two parts of a single web of authority. Religion played a major role in shaping man's attitude to nature in the eighteenth century. God had created a world which appeared rationally ordered for someone's material benefit. White, male, Europeans had the right and the duty to exploit "nature's economy". As a divine agent, the King was a temporal interpreter of natural law. The knowable world's order provided the foundation of the monarchy's imperial interests.

The person responsible for organizing Spain's projects of botanical exploration was Casimiro Gomez Ortega. Educated in Bologna, Gomez Ortega's professional background was in the field of medicine and pharmacy. Politically he identified himself with the reforms and policies of Charles III's ministers Campomanes and Floridablanca. He was a central figure in planning and controlling the Royal Expeditions. In 1775, when the Botanical Garden was moved from Soto de Migas Calientes to the Paseo del Prado in Madrid, Gomez Ortega was sent to visit a number of European gardens in order to bring back ideas for a proper design of the new Royal Botanical Garden. He went to Paris where he spent six months at the Jardin du Roi. He attended Joseph de Jussieu's lectures and made contact with other

naturalists. In February 1776 he moved to England and visited Kew Gardens, Chelsea and Oxford making contact with influential figures such as William Ayton, James Gordon, Reinhold Forster, Joseph Banks and Daniel Solander. He also visited the gardens in Amsterdam, Leyden and Montpellier. By the time he returned to Madrid he was already a member of a number of distinguished European scientific societies and had become a leading figure in Spanish botany.

In 1777 the Secretary of Indies put Gomez Ortega in charge of the scientific expeditions and named him representative of the Ministry of Indies for the development of botanical exploration. His control over the organization of the expeditions of Peru and Chile, Philipines and New Spain was absolute. He selected the members, wrote the instructions, chose the texts and carefully controlled their results.

The case of Mutis and the expedition of New Granada was slightly different. Mutis kept his expedition out of Gomez Ortega's severe control, and as we shall see, it would generate rivalry between the two botanists.

After the death of Charles III, Ortega began to have political problems and disputes with Antonio Cavanilles and Mutis (some related to the Cinchona affair and discussed in chapter four) and in 1801 was replaced by Cavanilles.

Ortega published a number of important works. First of all, his Instruccion sobre el modo mas seguro y

económico de transportar plantas vivas (1779).[53] (Instructions on the method for a safe and economic transportation of plants) constituted the basic instructions for the botanical travellers. The text is the result of his reading of John Ellis, Directions for bringing over seeds and plants from the East Indies and other distant countries.... (1770) and a similar manual by the French Duhamel de Monceau (1752). The book was planned for the instruction of explorers and correspondents of the Botanical Garden. It was sent to the Viceroys of New Spain, Santa Fe, Peru, governors of Puerto Rico, Santo Domingo and La Havana.

The introduction to Ortega's text emphasised the political and economic significance of botanical exploration. He relates how all the great empires, from the Romans to the French, English or Dutch, had succeeded in appropriating and naturalizing plants from remote places which provided them with commercial and medical benefits and power.

The text is divided into three articles, the first one dealing with the instructions for extracting and transporting trees, shrubs and other plants. Here we find an exposition of the different modes of extracting plants without damaging its roots, packing, finding a correct place in the ship, protecting it from insects, mice, and so on.[54] The second article deals with the "description of the boxes in which trees and delicate plants can be brought into Europe from distant

places...." (see figures 2a and 2b).[55]

Finally, the third article is a detailed list of "some of the plants, that with preference deserve to be brought into Spain from different places of America...." This constitutes a particularly interesting document in which Ortega mentions more than thirty-five distinct American plants, explaining their possible uses and regions where they ought to be found. They are listed in order of commercial priority, and it is not surprising that the first plant to be mentioned was Cinchona, both from Peru and New Granada. Next, Ortega recommends the study of cinnamon, and other medical plants with which we shall deal with in chapter three. The text also includes an appendix "On the method of collecting, drying, and arranging plants in the herbarium".[56]

Gomez Ortega also published a book for the dissemination of Linnaean botany, Curso elemental de botánica (Madrid 1785 and 1795) which became the standard text not only for Spanish botany, but also for botanists in the colonies. The text has a section in which "we are committed", as Ortega put it, "to embrace the totality of Linnaeus' publications".[57] This section includes definitions of all the structures of the plant, and an appendix with instructions on the methods of collecting and arranging plants in a herbarium, and also instructions for the shipment of live specimens. The practical section of the text is nothing more than a

literal translation of Linnaeus' Systema Naturae.

Having described some of the political and religious issues involved in the design of the Royal Botanical expeditions, we are now in a better position to understand not only why botany was the branch of science with the largest support from the Spanish crown, but also how natural history museums and botanical gardens were important as symbols of imperial domination and prosperity among the European empires of the eighteenth century. The achievements of exploration were evidence of sovereignty. Botanical gardens and museums were public galleries where the empires could show off their powers and wealth. This idea was clearly expressed by the Spanish ambassador to England in a letter addressed to Grimaldi in 1776: "It will be very useful", he says, "to publish, as soon as possible, the reports of our voyages and discoveries in those places; and to print the maps which have been promised, since for this nation [England] there are no greater acts of possession than these publicities...."[58]

We still have to describe the actual practices involved in botanical exploration and to explain how the appropriation of nature and knowledge took place. Systems of classification, artistic skills in visual representation, printing techniques, all contributed to the mobilization of natural objects.

The totalizing enterprise of cataloguing the world included the difficult task of extracting natural objects from their particular surroundings. Objects had to be stable and mobile, seeds had to be protected against desiccation, plants had to be safeguarded from deterioration and so on. Efficient means of classifying, transporting, displaying and documenting specimens were necessary.

The accumulation of natural objects was possible because problems of space and preservation were worked out, so that things that were faraway and invisible would become accessible and manageable. The task of the naturalists was to convert and transform the incommensurable into commensurable, to make the unfamiliar familiar, to create attachment and ultimately to possess the foreign.[59] The variety and complexity of nature was, as Daubenton wrote in the Encyclopédie, "abbreviated" and "flattened".[60]

We also have to explain how a process of translation from local to global knowledge took place. The knowledge that the explorers were looking for did not only belong to distant continents but also often belonged to different cultures.

Institutions such as the Jardin du Roi in Paris, Kew Gardens in London or the Royal Botanical Garden in Madrid, became what Bruno Latour would call "centres of calculation". Such institutions comprised elaborated networks of collaborators throughout the world, places

where a small group of naturalists were able to compare plants and animals on scale totally different from that of the natives. Botanists in such centres became stronger than the local inhabitants, indeed became familiar with more specimens than anyone else as more and more objects from distant places were domesticated.

In the following chapters we shall follow the naturalists in action, and we shall witness the actual practices which constituted natural history as a form of appropriation.

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24. Herr, Eighteenth century revolution, p. 194

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CHAPTER II

DRAWING, ASSEMBLING AND NAMING SPECIES: THE DISPLACEMENT OF NATURE IN BOTANICAL EXPLORATION

If we consider the outcomes of the Spanish royal botanical expeditions of the late eighteenth century, and list the materials brought into Europe, we immediately think of living and dried plants, seeds, samples of minerals, stuffed animals, written reports, maps, drawings of animals, people and landscapes. But above all, the Spanish explorers were engaged in the production of large and elaborate collections of botanical illustrations which, with their accompanying descriptions, would be published in Spain.

The plates and their descriptions were intended to constitute luxurious and expensive publications, a visible image of the achievements of the expeditions and Spain's sovereignty. Certainly, all great sovereigns, from the Medici and Habsburgs to the Bourbons, assembled iconographical collections of natural objects.

Both the realism and beauty associated with the art of botanical illustration made the drawings objects to be admired as much as studied. The final product had to

please a demanding audience which included the King, his court, an aristocratic market, and the leading naturalists of Europe. It may seem that we are dealing with a heterogeneous group of different people with diverse interests, but they all shared a single commitment, namely, the accumulation of possessions.

Botanical illustration, a genre usually classified separately due to its documentary character, nevertheless often converged with flower painting. It is difficult if not impossible to draw the line between a scientific illustration and a decorative painting. As we shall see, artists working for naturalists in herbaria, botanical gardens or expeditions usually came from schools of art trained according to the trends and fashions of painting. Each plate demanded time and hard work. The illustrator required not only special training, but also the supervision of a competent botanist. To put it in Mutis's own words, each plate would offer "the beauty and cleanness which a royal work demands, over the merit of the details which will be perceived by the great masters of the science only".[1]

The elaboration of a good botanical illustration involved a complex process which required a substantial amount of knowledge and special skills. The final product had to fit in the established market of flower books as well as provide an appropriate source of data for the classification of the objects represented and recognition of their genera and species.

Commentators on botanical illustrations have limited their analyses to the finished and most praised plates.[2] Some scholars have investigated the artists, their backgrounds and contributions,[3] but very little has been said about the actual complex process of manufacturing the drawings.

So far, the analysis of the illustrations has overlooked the importance of understanding the active role of the illustrator in botanical science. The role of visual representation in the Spanish expeditions has been either missed altogether or reduced to a virtually decorative function.

Natural history illustrations have been the subject of numerous investigations concerned with the aesthetics of visual representation of nature.[4] The study of botanical drawing, and in general of visual records of naturalists in the light of art history has been very helpful for understanding natural history and its social function during the eighteenth century. Barbara Stafford, Sveltana Alpers, David Knight and Martin Kemp, among others, have made valuable contributions to the field. They have analyzed the religious and social climates within which illustrators practised their craft and they have raised important issues concerning style and symbolism.

However, if one aims to explain the role of illustrations in the transformation of nature into distinct species which could be presented as discoveries

and possessions, one needs to go further. My concern here is not so much the representation of nature in the history of painting but rather the artist's active role in the classification of plants and in the making of botanical "discoveries".[5]

For the traveller-botanist of the eighteenth century, visual representation was the means by which nature was made transportable to and accessible in European centres of research. Once plants were moved away from their habitats, either dried or drawn, they became separate types easily examined, compared and most significantly, re-arranged. The specimens had to be "packed" and "stabilized", not only to remain unchanged during the journey from South America but also to be presented in Europe as newly discovered species.

The New World's wilds were places where plants and animals, but not knowledge, could grow. Knowledge was produced and secured in European laboratories, museums, gardens and prints. The objects of nature had to be removed and accumulated inside those institutions where the naturalist was able to work in a familiar environment.

Inside the cabinet, herbarium or museum, the botanist assumed a central and privileged position which enabled him to have "direct experience" of a number of objects that no one could have examined in the field. Moreover, as I shall illustrate, the actual objects

provided information that could not be seen in the field.

The naturalistic representation of landscape, animals or plants, presupposes the portrayal of existing objects, just as they are, as opposed to the imaginary works of art and fantasy. The visual account of nature ("Nature" or "natural" as a thing which the artifice of man had not altered) had to be presented as reality without intervention. An extract from Gomez Ortega's instructions to the artists in the expeditions goes like this: "In their works, they should confine themselves to copy nature with accuracy, specially the plants, without trying to adorn, nor to add anything from their imagination...."[6]

Despite these realist guiding principles and claims, the final results were carefully engineered and should be explained as actively constructed assemblages. Further in the same instructions by Gomez Ortega we read: "[the artists] must only draw what has been precisely determined by the botanists, work always under their supervision, obediently following their instructions, and take special care in drawing those parts that the botanists may consider important for the knowledge and recognition of plants; and sometimes, if necesary, represent separately and enlarge those parts."[7]

The drawings were never done in the field, and were always made from a collected specimen already

disassociated from its natural habitat. That is to say that a botanical illustrator neither had to see the specimens in their natural surroundings nor the complete plant, but only a branch of it collected by a different person. Moreover, the conditions in which the travelling artist-botanist had to work, as he constantly moved from one place to another, with too many specimens to draw at the same time, made it impossible to finish the plates during the journeys. Therefore, the artist traced the main lines of the plants, marked the colours, and sketched those features of the plant thought to be essential. Then, once at home a more elaborated version of the species could be concluded in a cabinet or print.

It was important for the naturalist to retain as far as possible the illusion of the immediate personal contact with the objects. Direct sight constituted a form of possession; to be an "eye witness" assured the authority and uniqueness of written or visual reports.[8]

In the following pages I shall examine the skills that allowed naturalists to appropriate natural objects. We shall study the training of artists and the manufacture of the plates in South America, we shall study the processes of engraving and printing taking place in Madrid, and also explain the importance of the Linnaean system of classification in the "discovery" and possession of plants.

I. Drawing

The Spanish authorities and explorers were particularly cautious in the selection of the accompanying artists as essential members of the expeditions.

On 12 February 1777, Jose de Galvez asked Ignacio Hermosilla, head of the "Real Academia de Bellas Artes de San Fernando" to recommend talented artists for the expedition to Peru and Chile. Four of the best pupils were told to make drawings of flowers, fruits and herbs in the presence of witnesses. The examiners included professors of art and the minister of Indies. Joseph Brunete was appointed first draughtsman of the expedition and Isidro Galvez assumed the second position. As suggested by Hermosilla, it was agreed to pay the illustrators the same salary as the botanists.[9]

In his search for illustrators for the New Spain expedition, Sesse had interviewed the director of the Royal Art Academy of San Carlos in Mexico. The latter suggested two of the best young students, Vicente de la Cerda and Atanasio Echeverria. Sesse incorporated the two men in the expedition at an annual salary of 1.000 pesos each while travelling and 500 pesos while in the capital. He also employed two other men as assistants.[10]

Now we shall concentrate on the elaboration of plates

for the Flora of New Granada by Mutis's collaborators. Mutis in New Granada, as I shall explain, not only requested artists from Spain but also founded his own school of botanical drawing in Santa Fe de Bogotá.

One of the botanists' and the Crown's main interests focused on the production of floras. Two-thirds of the official members of Mutis's expedition were artists, thirty-eight different painters made contributions to the Flora of New Granada[11] and indeed, the major outcome of thirty-three years of exploration was its iconographic production. The number of plates of the Flora del Nuevo Reino de Granada conserved at the Botanical Garden in Madrid amounts to 5393, 2945 of which are coloured and 2448 in ink. There were 2696 species represented, with 26 varieties (24 belonging to the genus Cinchona). From those species 1292 were represented in coloured plates, 262 in ink and the rest, 1142, were done in duplicates of colour and ink. The size of the great majority of the illustrations is 53 x 34 cm.(folio); a few of them, 72, are double size, and 75 are smaller.[12] The numbers given above do not include numerous plates which Mutis had sent to other naturalists in Europe. More than a hundred of the best illustrations were given to Humboldt, and some others were lost. Neither have we mentioned 735 small drawings of "anatomies" of the flower and its organs, nor 88 engravings representing the germination of the various plants.

In 1783 Pablo Antonio Garcia, already known in the field of religious painting and portraits, was appointed as the first official artist of the expedition. Francisco Javier Matis, in Humboldt's opinion "the best flower painter on earth"[13] and the most prolific draughtsman of Mutis's painters, was incorporated the same year.

Salvador Rizo, the closest of Mutis's collaborators and later director of the school of painting, joined the expedition in 1784. However, the increasing demands of the work overwhelmed the artists available in Santa Fe and Mutis appealed to a well-known school of painting in Quito from which five artists were hired in 1786.

From the foundation of the expedition Mutis asked the Viceroy "To beg His Majesty to send me from the court, another or others artists of recognized talent...the number of new plants being so abundant, that many artists would not be idle for many years."[14] But not until October 1788, were two painters from the "Real Academia de Bellas Artes de San Fernando" sent from Madrid. The presence of these two Spanish artists was a total failure. One of them died without making a single contribution, the other, Sebastian Mendez who worked with Mutis for one year and a half (1788-1790) produced only eight plates of questionable quality. Mutis had a preference for young and easily-led artists whom he could teach and train. "I do not want or need great officials, it has been easier for me to deal with docile

people, though not so skilful, because I supply the ability by instruction...."[15] The new artists were to be between twenty and thirty years old, and to work eight hours a day for a salary of eight to twelve Reales a day.[16]

In 1790, Mutis was ordered to move the expedition from the town of Mariquita, where the botanist and his collaborators had been working since July 1783, to the capital of the Kingdom of New Granada, Santa Fe de Bogotá. The reasons for the relocation was the impatience and fear that the promised Flora of New Granada would never be concluded. Mutis was already fifty-eight and continually ill. "I was ordered", wrote Mutis, "to move as soon as possible to the capital with my office and assistants, in order to avoid distractions with other business different from the conclusion of the Flora of Bogotá."[17]

Once the expedition was established in Santa Fe de Bogotá, Mutis not only increased the number of its artists to nineteen but also founded a drawing school in order to train future botanical illustrators. The school, under the direction of Salvador Rizo offered free training for young artists with the sole purpose of supplying the expedition with more qualified illustrators.

Besides the finished plates, the Botanical Garden of Madrid also kept samples of drawings and sketches of leaves, flowers and other specific structures, as well

as annotations which were to be followed for the proper representation of plants. These sketches of anatomies with annotated corrections are the only graphical records available from the school and training of artists. Presumably the large majority of those anatomies and drafts intended for the instruction of new illustrators were lost, but the few kept in Madrid give us a good idea of the precise and demanding skills required for botanical drawing and the sort of training which the young artists had to go through before being prepared to draw a plate.

To begin with, I want to make clear that the new artists initiated their training by copying sketches or illustrations rather than the plants themselves.

Figures 3 and 5 correspond to series of anatomies under the heading of "Sinenterologias" (studies on the family Compositae). Here we can see sketches of different types of both leaves and organs of fructification belonging to different genera of the family Compositae. There are also annotations made by the instructor Matis which approve or correct the drawings. In figure 3, top right hand side, we read: "N. 4 el vilano un poco más largo, lo demás bueno". (No. 4 the thistledown slightly longer, the rest good). One of the sketches kept among Mutis's papers in Madrid, figure 4, illustrates 12 different kinds of thistledown (vilanos) which again provided the artists with specific types of structures to be drawn. In figure 5, left hand

side, we also find a similar correction: "N.1...esos filamentos representing anteras. Alli no hay sino unos filamentos llamados (palabra ilegible) y que son comunes en muchas plantas de esta clase. Los demas buenos." (No. 1...those filaments representing anthers, are not anthers. They are nothing but some threads common to the class. The rest good).

In figures 6, 7, 8 and 9 we see some of the unfinished plates and anatomies which allow us to appreciate the selection of characteristics in the process of making a botanical illustration. In sketches of the family Malvacea, figures 6 and 7, we see that the work of the artist initially focused on the shape of the leaves and the structure of the flower. Some of the colours were marked and a written explanation was also common. In figures 8 and 9, we see more elaborated plates, but again, only some essential features for a proper Linnaean classification were elaborated.

Equally interesting are a number of anatomies and sketches of leaves and flowers, figures 10 and 11, in which the plants are reduced to their Linnaean features providing essential information for a succesful visual representation of a species.

It may be right to say that the artists drew what they saw, but only after they had learnt to see. The illustrator, we may assume, had to learn to distinguish the different botanical structures of the plants. The botanists, paraphrasing Bruno Latour, start seeing

something once they stop looking at nature and look obsessively at two-dimensional paper prints.[18]

After Mutis's collaborators returned from their collecting excursions with new material, a representative specimen was selected, usually a flowered branch. The drawing was to be done while the plant was still fresh, therefore the work had to be completed in less than two days working from dawn to sunset; however, it was common that for the manufacture of a single plate to use several fresh specimens.[19]

The whole plant was delineated, the anatomy of the fructification was done, and the leaves drawn on both sides. Mutis also gave instructions to the artists to draw, in the bottom of the plate, details of the different structures of the flower, fruit and seeds for a better characterization of the specimen.

From the Diary of the expedition kept by Eloy Valenzuala,[20] and particularly from Mutis's own diary,[21] it is clear that the drawings were continually improved by adding information missing from the first collected specimen. Fruits and flowers were brought in later and the plate completed or mended.

A few examples from Mutis's annotations during the period spent in the town of Mariquita can give us a good idea of the sort of day-to-day activities in which the director of the expedition and his collaborators were involved. On Friday 30 April 1784, Mutis wrote: "Today

I spent a considerable time in the recognition of the flowers and fruits of the aquatic 'Boymia', I also ordered the herbalists (herbolarios) to bring several specimens with their flowers."[22] Almost two weeks later, on Thursday, 13 May, we read in Mutis's diary: "At three o'clock in the afternoon Rizo concluded the 'Boymia', but the corolla remains to be done; it was impossible to finish it because the flower was already closed."[23] Some other typical entries go like this: "This afternoon, the herbalists Pedro and Esteban brought in the flowers of the tree that few days ago had brought Roque...." or "I received today flowers and leaves of the Menyanthes indica, which I could examine with more attention to discover some differences from the Linnaean genus...."[24]

The director of the expedition's task was to coordinate and instruct the illustrators and to make the best possible use of the materials brought by the collectors (herbalistas). Mutis was also occupied with the identification of the specimens, comparing them with established species and genera. The Spanish botanist collected a considerable number of expensive illustrated floras which he used as models for his own project. In particular we find references to the works of Linnaeus and Jacquin.

"Each plate costs me a thousand sighs", wrote Mutis, "...every plate which comes out of my hands will not need new retouching.... and any botanist in Europe will

find all the sharp characters of fructification (or floral characters), so that he will not need to travel to their native soil to recognize them".[25] In a letter to the Viceroy (1783) Mutis explains the form in which the flora should be published: "each volume will contain a hundred plants with their natural colours with an explication of the plate on the left; and preceding in the beginning, with citation to the plate, the complete scientific description of the plant."[26]

The method of presentation remained fairly constant during the eighteenth and nineteenth centuries. One plant to a page, with the plant rarely seen in its entirety. Flowers were usually given priority, each individual flower was carefully positioned to show off, according to Linnaean concepts, its most characteristic features.

Let us examine a finished plate and indicate some of the data both included as well as excluded in the plates. If we look at one of Mutis's illustrations of the genus Cinchona, which represents the species Cinchona cordifolia (figure 12), the first thing to be pointed out is the fact that the plate does not represent anything like a tree of Cinchona (usually from ten to twenty ft high). What we can see in the plate is the very end of a single branch which happens to be extraordinarily loaded with flowers and fruits. The drawing is visibly schematic and almost geometrical in its composition. The flowered branches which look

almost identical in both sides allows us to see fruits and flowers in different stages of development, the calix, number of petals, as well as the relative position of the stems.

However, the most evident feature of the drawing is the leaves whose shape and position are essential for the proper diagnosis of the species. In fact the shape of the leaves provides the name of the species, (Cordifolia = heart shaped leaves). "Leaves afford the most elegant and the most natural differences", wrote Linnaeus, "differences taken from the leaves are the easiest, the most obvious, the most abundant and the most certain."[27]

Faithful to Linnaeus' recommendations, Mutis took the shape of the leaves as a distinctive character of many of his specimens. In the case of Cinchona, Mutis argued that there were four distinct species which, as illustrated in figure 13, were classified according to the shape of the leaves. Cinchona lanceifolia (leaves armed with a little lance or point, narrowly elliptic); Cinchona oblongifolia (broadly shaped leaves); and Cinchona ovalifolia (oval, elliptic, broadest at the middle); see also figures 12, 14, 15 and 16. These four species were also supposed to be distinguishable by the colour of their barks (orange, yellow, red and white). The colour of the barks was a common criterion for the classification of quinine among local collectors and dealers. By means of Linnaean concepts Mutis managed to

translate local knowledge into a "universal" classification which, needless to say, was never definitive.

It is also worth noticing the missing parts of some of the leaves. David Knight makes the following comment on one of the illustrations of the Flora of Mutis (Miconia prasina, plate 37 vol. XXX, figure 17). "Some of the flowers are diseased (showing little sticks) here the artist has painted what he saw, rather than idealized".[28] However, a large number of Mutis's illustrations present broken leaves. These were neither accidental inperfections nor direct representation of what the artist saw, but a deliberate and common practice that saved work and allowed a clearer depiction of the diagnostic features of the species.

A number of faults in duplicating a plant might pass unnoticed, but not errors such as an abnormal number of stamens or the presence of an inferior ovary when it should have a superior one, or any other mistake in a characteristic important in Linnaean taxonomy.

The colour, so clearly presented and almost exaggerated, is another interesting element of the illustrations, not only because makes the works more attractive and beautiful but also because functions as a cosmetic that idealizes the plant. However colour was not crucial for identification, and in the opinion of some botanists, the high price and demanding work of printing coloured plates were unnecessary.

Probably the most interesting parts of the plate are the dissections on the bottom. In the light of eighteenth century botany, there we find "real" and "natural" features, the essential clues for the classification of the plant. We can see details and dissections of the sexual (Linnaean) organs of the plant. The calix and the flower are shown with the total of petals visible. A dissection of the flower with its male organs (stamens) appear clearly countable (five) from which we know that the species was classified in the class "Pentandria"; and then the one and only female organ, the pistil, which indicated that the species belong to the order "Monogynia".

Looking at some dried specimens kept in the herbarium of the Royal Botanical Garden in Madrid, also collected by Mutis, we can see the numerous advantages of a drawn plant, the amount of information that it gathers together as well as the sharpness with which the features are shown. (See figure 18, a dried specimen of Cinchona cordifolia and compare with figure 12, the drawing of the same species.) We can see, for example, how the heart-shaped leaves become more obvious in the drawing than in the specimen itself.

Royal patrons and botanists in Madrid were always impatient to welcome the long-promised and much-praised works. However, Mutis constantly increased the number of plates and improved them but died in 1808 without

finishing their descriptions. Some historians have suggested that the descriptions were done but somehow lost; however, the evidence seems to corroborate that they were never finished. Mutis's collaborators Sinforoso Mutis, Salvador Rizo and Francisco José de Caldas were interrogated by the Spanish authorities about the scientific works left by Mutis. They all agreed in saying that he did not finish any of them except his treatise on quinine, but that he had left many drafts and unfinished descriptions.

By the end of 1810, six months after the first declaration of independence, the house of the expedition was closed because of lack of funds; however, Sinforoso Mutis (José Celestino's nephew and successor) kept organizing and classifying icons and specimens. Until 1817 there were six painters still at work, but on 22 November their salaries were suspended indefinitely. In 1815 the Spanish government had sent a military expedition in charge of Pablo Morillo with the purpose of recovering Spanish hegemony in New Granada. Among his tasks as "pacificador" (peace-maker) Morillo had orders - significantly enough - to recover and send to Spain the manuscripts and collections of the expedition which were said to have cost one and a half million pesos to the Crown. The materials were packed and sent to Madrid aboard La Diana in 1817. Sinforoso Mutis, then in prison, was requested to pack all the materials collected in more than thirty years in only six days

with the consequence that some of the objects were inevitably just thrown away. The shipment included 104 boxes which were catalogued in Madrid as follows: " 14 boxes with 5190 plates and 711 sketches; one with manuscripts; 38 with anatomies of plants and quinine; 15 with minerals; 9 with seeds; 6 with various curiosities; 8 with samples of woods; 1 with samples of cinnamon; 2 with drawings of animals and other paintings.[29] The King himself supervised the arrival of the materials giving orders to place the zoological and mineralogical objects at his Museum of Natural History, and the botanical collections to be kept at the Botanical Garden.[30] He also ordered the then first professor of the botanical garden to publish not only Mutis's treatise on quinine but also the materials concerned with the Flora of New Granada.

Mutis's Historia de los arboles de quina was published in 1828 but not one single page of the Flora was ever printed in Spain. Not until 1954 did the governments of Colombia and Spain joined efforts to publish fifty-two volumes of which only eighteen have appeared so far.

However, some of the drawings from the expedition to Peru and Chile were published in Madrid. In order to study this process we shall now follow the botanists Ruiz and Pavón during the elaboration of the first volumes of the Flora Peruviana et Chilensis.

II. Engraving and publishing

I have partly described the process of manufacturing illustrations in America, but we still have to examine the actual publication, its costs, patrons and audience; that is to say, the history of the main outcome of the Spanish botanical expeditions. The capacity of image-making and reproduction, constituted the final stage of a process of appropriation that I aim to describe in some detail.

The first books with coloured illustrations began to be produced about 1700, with hand-coloured copper engraving as the medium for illustration. In the late eighteenth century the main medium available for the illustration of works in natural history was still copper engraving. The whole process required highly skilled labour.[31]

A large majority of the images made by the Spanish botanists were coloured and large, the paper and binding of the books were expected to be of the best quality, worthy of works of fine arts; therefore money was another essential requirement for their existence. These works of natural history were generally too expensive for the majority of men of science to buy. Hence, such publications, when completed, always had a limited distribution among nobles, institutions and few wealthy amateurs.[32] The wealthy and cultured European patrons had furnished an aristocratic market for flower

books from which botanical drawing was never independent, but the political significance of such imperial achievements constituted the main reason for the publication of these expensive floras.

To follow the botanists and artists in the process of engraving and printing, we shall look at the works of Ruiz and Pavon and examine the production of a few volumes that reached print in the early nineteenth century.

By the time Dombey, the French companion of Ruiz and Pavon, returned to Europe, Charles Lois L'Héritier (a wealthy member of the Académie de Sciences) had been permitted by the French authorities to secure drawings and to have engravings made of the plants. The first plates began to appear as a part of a publication dealing with "plants newly discovered." Needless to say, priority of publication meant a great deal for both governments. L'Heritier decided to ignore Spanish complaints, packed up the plants and travelled to London to verify Dombey's classifications by comparing them with specimens in Banks's herbarium. After a heated international dispute, the French authorities had to advise Dombey to halt L'Heritier's publication of his plates. Final publication had to wait more than ten years.[33]

Ruiz and Pavon had brought back from Peru and Chile

2,980 dried plants and 2,264 illustrations with descriptions. The publication of such a gigantic work (twelve folio volumes) was never completed. Moreover, the government also planned to publish the works of Mutis in New Granada and of Sesse in New Spain where similar or larger collections had been gathered. The project was planned to be carried out by the best available artists, the most competent engravers and the printer with the highest reputation. Isidro Galvez and José Rubio were selected as engravers and illuminators to work in Gabriel de Sacha's print.[34]

The King, once more, looked to the Americas to solve Spain's financial problems. He asked the viceroys, archbishops, deans, universities, and others, for contributions for the execution of the publication. The donations in Chile totalled 4,160 pesos while in Peru 19,067; but money was not the only obstacle delaying the publication. Endless mending of the images, disputes over taxonomy and the criteria to define new genera were far from simple and involved problems of priority of discovery and prestige for the botanists and Spain.[35]

By the time Ruiz and Pavon returned to Spain, the Crown was seeking a botanist to enter the Peruvian forests to establish an official monopoly and improve the quality, yield and processing methods of quinine trade. On February 1789 Pavon asked for the post, but the minister denied his request, as he would be needed soon to work on the prompt publication of the Flora.

Soon the botanists were provided with the necessary staff and materials, but as we already know, the return of the botanists with their collections, drawings and descriptions did not initiate immediate publication. It took more than ten years for the first volume to be published.

Among the manuscripts kept in the Botanical Garden of Madrid, there is a diary kept by the botanists during the elaboration of the first volumes of the Flora after 1793.[36] From that daily account it is evident that during the production of the Flora Peruviana the botanists were occupied with a laborious and endless correcting, completing and retouching of every single plate. The monotonous entries of the diary repeat statements like: "The botanists are still working on the corrections of the genus Magallonia"; "The botanists keep fixing the organs of fructification of the genus"; "The draughtsmen augmented some parts"; The botanists completed the description"; "The botanist assisted the artists for the reduction and unloading of the plates."[37] Most of the work was focused on perfecting the organs of fructification, but it is also clear that the illustrations were improved not only by adding information but also by eliminating unessential parts of the plant. In so doing the botanists not only simplified the relevant information but also reduced costs and work.

In order to be able to do the proper rectifications,

to guarantee recognition, and to ensure the originality of their findings, the naturalists required not only their own drafts and collections of dried specimens, but also demanded a large quantity of current botanical literature and published floras. In a letter dated the 26 July 1792, signed by Ruiz and Pavon, a number of texts were requested and an explaination of the reason for their petition was included. "In order to perfect our drafts, formalise and present to the public our work we need to consult, read and compare other publications with ours.... Therefore we need to have access to botanical descriptions and drawings so that we can, at the same time, compare and revise the drawings with the different herbaria and publications."[38] *

Among the duties assigned to the draughtsmen during the elaboration and publication of the icons were: making corrections suggested by the botanists; adding parts of the fructification at the foot or side of each drawing so as to show them more clearly; indicating what parts of the foliage could be omitted in the engravings so as to avoid confusion and save time and money; adding flowers and fruits to some illustrations which had originally been made at the wrong season; adding other fructification not seen by the expedition but found and illustrated by other botanists; drawing from the herbaria other plants not previously done for lack of

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* For a complete list of the major works used by Ruiz and Pavon for the publication of the Flora Peruviana, see appendix 1.

time.

As we see, the "discovery" of a new species or genus, far from being an event easily located in space and time, something occurring in the wilds of distant lands, was instead a prolonged process of fabrication presupposing negotiations and agreements taking place many years later and miles away from the first encounter with the object. Then, and only then, the legitimation of the object and its discoverer could be recognized.

The first volume of the Flora would be a "Prodromus" to introduce new genera, 136 in all. Subsequent volumes would undertake the systematic coverage of all plants found in Peru and Chile arranged according to Linnaeus' classes. After a long bureaucratic and scientific struggle, the illustrations for the "Prodromus" were ready for distribution in September 1794. Those illustrations were not in colour and did not include the complete plant but only the essential organs for a generic recognition with its accompanying description, namely, calix, corolla, stamen, pistilum, pericarpum and semina (figures 19 and 20).

The accompanying text (figure 20) which was presented both in Spanish and Latin, included a "Character Differentialis" which was supposed to be a brief and particularly distinct feature of the genus. It always contained a comment on the structure of the calix. Finally the text included a "Explication Icons", an

identification of the different figures (structures) drawn.

The book sold poorly; as Ruiz rightly said, "these vast and costly works are in truth only for the great and powerful, and for schools, gardens and libraries." The cost of a single volume was over one-third of Ruiz's monthly salary.[39] Seven hundred copies of the Prodromus were printed; six hundred on "regular" paper to be sold at 120 reales each, and another hundred, printed on a better paper "fino" to be sold at 140 reales. Despite Ruiz's and Pavon's decision to exclude from the drawings all the unneeded branches as well as to put three or four designs on one plate; the engraving and printing of this volume cost 29.000 reales. Six hundred copies of the "Prodromus" were printed on "regular" paper, to be sold at 120 reales each. Another hundred copies were printed on "fine" paper priced at 140 reales. In 40 years only 65 copies were sold.[40]

However, for a fair measure of its distribution we have to take into account gift copies which were distributed as follows: the King and various ministers, 20; Ruiz and Pavon, 12; Isidro Galvez, 2; Tafalla, 2; French institutions, 6; Spanish libraries, 2; German ambassador, 1; University of Padua, 1; Prince of Parma, 1; Martin Sesse, 2; "to bind with illuminated plates (for unspecified recipients), 8. Gift copies were also distributed among major contributors to the fund in America.[41]

Volume I of the Flora Peruviana did not appear until mid-1798. For its engraving, the botanists decided to replace Rubio. He was advised to accept another job at the Royal Porcelain Factory, where he was thought better suited, "because the tasks of that establishment do not demand such exactitude and subordination as the drawing of scientific objects."[42] Galvez, who was given the authority to revise Rubio's work, was charged by Rubio of having made alterations on his drawings "against the rules of the art." Once more we find evidence to conclude that the "direct and exact copy of nature" required more intervention than the botanists were ready to admit.

Volume I contained a systematic coverage of 277 species with 106 plates corresponding to the first four classes of Linnaeus. The botanists also named four new genera (Jovellana, Alonsoa, Anthodon, and Ohigginsia). By the end of the same year another volume without plates made its appearance. Volume II was published in the summer of 1799 with 116 plates covering 251 more species belonging to the fifth class of Linnaeus. In this volume the botanists included ten species of Cinchona and two more genera. Volume III did not appear until 1802. The book contained 223 descriptions of species belonging to classes V through VII of Linnaeus and 104 plates. This time they reported seven new genera and four new species of quinine. During this

time Ruiz kept receiving materials from his collaborators still working in South America; in 1804-5 they concentrated on quinine and by the end of 1805 they found 38 new species to add to the 12 already known to Ruiz and Pavon. These so long awaited species were not sent until early 1809 and had lain for four years in the archives of the Indies in Seville.

Although volumes IV and V were well advanced they were never printed. Charles IV abdicated on 18 March 1808 and hopes for publication collapsed. Apart from the Flora and his works on quinine, Ruiz also wrote and published a number of "Memorias" on medicinal plants (see chapter three) and the number of manuscripts which failed to reach print is also extensive.

After Ruiz's death in 1816 at the age of sixty-two, Pavon became the first botanist of the project of the Flora Peruviana and had the opportunity to recover some of the credit that he thought had been monopolized by Ruiz. Pavon sold collections to the British botanist Aylmer Bourke Lambert and also remitted to England the drawings of the unpublished volumes IV and V of the Flora.

It was clear that the completion of the Flora was impossible, yet in February 1824, Pavon was appointed to a committee with three other botanists to prepare the publication of the vast collections of Mutis made in thirty-three years in New Granada. Unsurprisingly the project was a failure and not another page of the Flora

Peruviana was published until a small edition of volume IV was printed in 1957.

Illustrations alone were not sufficient. Drawing natural specimens required assumptions and techniques which made the artist's representation of nature successful, legible and convincing. The visual representation of a plant embodied a set of rules that we shall examine below.

The Linnaean system and the art of naming

Together with the process of representation we described above, and directly related to it, there was another task of undeniable importance: naming the genus and the species.

We still have to examine the guiding principles for the representation of plants and what was the "filter" through which the explorers were looking at nature. We have already explained how the Spanish botanists had become followers of the Linnaean philosophy of classification and we have also discussed some of the implications and assumptions involved in the practice of Linnaean botany.

In the Instructions for the botanists written by Casimiro Gomez Ortega, we read: "The definition and description of each plant will follow the already widely accepted Linnaean rules and principles."[43] As Ruiz and

Pavon recognized in the first volume of the Flora Peruviana et Chilensis "In all we have punctually followed the sexual system of Linnaeus; not only because in our days it is generally recognized by almost any botanist, but also because it is more useful for the distinction of plants and because it embraces a higher number of them."[44] Thus that Linnaeus and his predecessors provided the basis of the observational language that made possible the translocation of New World specimens into Europe; they developed a theoretical framework for the production of floras, identification and naming of plants and their classification into species, genera, orders and classes. Ruiz and Pavon were known as the "sexualistas" for being the first botanists in classifying and naming the Peruvian plants according to the Linnaean system.

I shall explain briefly the structure and assumptions of the dominant philosophy of botanical classification, which is to be found and compiled in the works of Carl von Linné.

John Ray's Historia plantarum (1686-88), Nehemiah Grew's Anatomy of vegetables (1672), Marcello Malpighi's Anatome plantarum (1675-79), and Rudolf Jacob Camerius's De sexu plantarum epistola (1694) are, among others, representative botanical publications of the seventeenth century which have in common a marked interest in floral structures which began to receive attention in greater detail. It was partly due to the development of

magnifying glasses which made unnoticed structures appear bigger and meaningful. Therefore, theories about the functions of the floral parts and the consequent provision of terms for them were developed in the seventeenth and eighteenth centuries. Grew, Ray and others, recognized the sexual function of the inner parts of the flower; but it was Camerarius who in his De sexu plantarum provided experimental data and came to the following conclusion: "Hence it appears wholly reasonable to assign to the apices (anthers) a nobler name and the function of the genital parts of the male sex, as their capsules are vessels and containers, in which the semen itself, that powder, the most subtle part of the plant, is produced, collected and from here afterwards given out.... Plants exhibit equally these apices as the factory of the male semen and the seed vessel with its little feather or style as genital parts proper to the feminine sex."[45] This focusing of attention onto floral organs, which could be examined in detail by means of lenses, provided Linnaeus with the material for the production of a system of classification based on their differentiation and designation. More and more, the flower came to be regarded as the most important organ of classification. Linnaeus and his contemporaries did not only point out the essential importance of flowers as sexual organs, "these [stamens and pistils] were claiming attention by their function, since the whole generation of plants

depended on them alone", but also came to the conclusion that reproduction contained the "secret working plan of the creator".[46]

A new and standard terminology was then needed. Linnaeus in his Hortus Cliffotianus (1738) made an important effort to establish standard names for distinct and well defined parts of the plant. By the mid-eighteenth century, botanical Latin had thus acquired a vocabulary based on the seventeenth century legacies of Ray and Tournefort and enlarged and elaborated by Linnaeus; establishing a medium for the publication and European assimilation of new plants.[47]

Linnaeus' "sexual system" constituted the observational language and "filter" through which the explorers approached nature providing the travellers with a concise and convenient strategy for the portrayal, appropriation and translocation of natural objects.

It has to be clear that in Linnaeus' system of classification, plants are described not according to their particular features but according to the features common to them as a class. In other words, the success of the identification of a new specimen does not depend so much on an exhaustive examination of it, but rather on the verification of already known and familiar features recognisable in new unknown objects. The Linnaean botanist was able to transform the alien vegetation into something familiar because he was

convinced that every plant in the world naturally conformed to a pre-ordained set of rules. Attaching familiar names to unfamiliar vegetation, the European explorer was conquering natural objects. Like drawings, names too, were symbolic units which could easily be transported.[48]

Linnaeus divided all flowering plants (angiosperms) into twenty-three classes based on the male organs, i.e., according to the number of stamens (figure 21). In this order, following Linnaean classes, the Spanish explorers arranged and presented their collections. These classes were in turn divided into orders based on the number of female organs. So far, the system was basically arithmetical and clearly artificial. However, Linnaeus next groupings (i.e., genus and species) were seen as natural; they were regarded as units formed by nature and consequently the ones eligible to be found or discovered.

Genera and species were particularly important in Linnaean philosophy and consequently for exploration as well. Discoveries and success were measured in terms of the number of distinct and new genera and species collected, so that the explorers had to make efforts in grouping unknown plants into these categories.

A genus of plants, as stated by Linnaeus in his Philosophia botanica (1751), is a group of species possessing similarly constructed organs of

fructification (flowers and fruits) and hence distinguished from other genera. That is to say that genera were defined in terms of the overall similarity of the species; however it was common to define a new genus upon a single specimen. Moreover, any new species required a generic name, and every new specimen, however unique, had to be located in a genus.

Needless to say, the discoverer of a new genus could only be someone trained to see them as such. In other words, a plant already known and used by a group of people foreign to the rules of the Linnaean game of classification could readily be discovered and re-named after many years of usage. As a matter of fact, the Spanish explorers found communities and traditions among which there was a rather sophisticated knowledge of plants. Among the indigenous American communities, plants were distinguished on the basis of their culinary, medicinal, decorative or supposed supernatural properties; but from the explorers' point of view, there was something illegitimate about this local grouping and vernacular names, so that a translation had to be made.

In Linnaeus' Critica botanica we read "He who establishes a new genus should give it a name.... It is certain that no one ought to name a plant unless he is a botanist, and it is not allowable for anyone to bestow a generic name if he does not understand the existing genera. But none of us can doubt that a man who recognizes that a plant is of a genus absolutely

distinct from all others, should also know how to bestow on it a distinct name".[49]

The Linnaean explorer's procedure was: firstly to make a visual representation and a description - in this context two inseparable tasks - of the flower and fruit of a "representative" specimen, which usually was the most complete specimen and sometimes the only one known; and secondly give it a generic name. In so doing the botanist could claim the "discovery" of a new genus .

Names, the actual words used to distinguish a genus or a species, have important functions which are worth looking at with some care. Names serve as a short, distinctive and easily memorable label in order to codify the largest possible number of specimens assuring greater control for those who mastered the new systematics.

The language used was Latin, a language which presented an essential advantage; the botanists made their works immediately available to the whole learned world of their time. It is important to remember that Latin was the common language of a number of practices related to power, a symbol of culture. It was used not only in natural history but for diplomatic, legal and ecclesiastical matters as well.

The name of a genus is a noun and begins with a capital letter; it is singular and may be taken from any source, so that it may be composed in an absolutely arbitrary manner: for example, Cinchona, Bonapartea,

Pavonia, Ruizia, and so forth.

The name of a species is a binary combination of the generic name followed by a specific epithet. (e.g. Cinchona officinalis). The epithet can have a descriptive purpose, but a large number of them commemorate a person (kings, patrons, politicians, botanists etc.) This practice of commemorating individuals was encouraged by Linnaeus, and was a common practice among the Spanish botanists. In Linnaeus' Critica botanica we read: "Generic names ... given to preserve the memory of a botanist who has deserved well of the science, I retain as a religious duty". And "names of kings and names of those who have advanced the study of botany" are also legitimate.[50] In their prologue to their Florae peruvianae et chilensis Ruiz and Pavon wrote the following comment on the matter:

> Concerning the nomenclature of our new genus, there will be those who might disapprove our procedure of applying to the plants the names of illustrious botanists or protectors of botany both Spaniards and foreigners; but they will probably be only those who ignore that the discoverers and publishers of new genus have this faculty.... approved by the very respectable authority of Linnaeus.... however, if anyone would feel offended because his name was unintentionally omitted, he would be satisfied when we publish the rest of the genus which we keep continually receiving from our

disciples in Peru.[51]

For the publication of the Prodromus, a first volume of the Florae peruvianae et chilensis of Ruiz and Pavon, the botanists had the duty of making a complete list of all the patrons directly or indirectly related with the expedition. As we read in the diary kept by the botanists during the elaboration of this volume, there were special meetings supervised by Gomez Ortega - then director of the Botanical Garden in Madrid - with the express purpose of discussing which names should be given to the new genera.[52]

In the description of each genus we also find a footnote reference to the name, explaining who is the person honoured. From the 149 new genera presented in the Prodromus, 116 of the names conveniently corresponded to influential people.

Let us look at some of the names and personalities chosen by the naturalists. To begin with, we have the genus "Carludovica" which stands for the king Carlos III and his wife Ludovica (the only female character honoured in the Prodromus); the genera "Monnina" and "Floridablanca", corresponding to José Monino, Count of Floridablanca; the genus "Godoya" to Manuel Godoy. Floridablanca and Godoy were two of the most influential ministers and functionaries of Carlos III' government. Apart from Spanish political figures, the botanists themselves could not be missed. Naturally, Casimiro Gomez Ortega's name was present in two new genera:

"Gomortega" and "Casimira". The genera "Ruizia" and "Pavonia" honoured the explorers themselves. Equally some of their collaborators in America such as Juan José Tafalla received their own genera. A substantial number of names correspond to people linked to the Botanical Garden, its most select correspondents as well as almost all the members of previous expeditions. These included botanists of the Malaspina expedition, i.e., Tadeo Haenke, Luis Nee and Antonio Pineda; while the Spanish members of La Condamine's expedition Jorge Juan and Antonio de Ulloa provided the names for the genus "Juanulloa". Other important sources of names were classic authors or recognized European naturalists (e.g. Humboldt and Bonpland), which in turn gave the Spaniards a touch of erudition as well as affiliation to a community of recognized naturalists. Even the success of Napoleon made it politically advisable to create the genus "Bonapartea".

In sum, we could say that the 116 genera of the Prodromus dedicated to concrete individuals constitute a complete guide to the history of Spanish botany as well as to the political history of Spain.[53] The historian Gonzalez Bueno has pointed out how after 1802 the criteria for the selection of names shifted from one group of patrons to another following changes in the political history of Spain. New ministers like Jovellanos and the direct support of Zenon Alonso and E.A. Leon appear in the genera "Jovellana", "Alonsoa"

and "Leonia".[54]

This practice gave to the floras another political and social dimension which reinforced the role of natural history as a tool of sovereignty and as a source of national pride.

After Mutis's death, the botanists, artists and other members of the expedition (all of them born in America) continued their works. It is significant that the newly-discovered plants began to have names that no longer honoured Spanish ministers or European naturalists but South American botanists. In 1810, the year of the first declaration of independence in New Granada, Sinforoso Mutis published the Continuación del semanario del Nuevo Reino de Granada in which six new species were presented, i.e., amaria, pombea, lozania, valenzualla, and consuegra, all of them honouring South American members of the expedition.[55]

It is also worth remembering that a complete scientific name must be followed by the third element, the name of the person or persons who formally described the plant, that is to say, the names of those who published a description for the first time. Even today the nomenclature of a taxonomic group is based upon the priority of publication and a majority of the descriptions published after May 1753, when the first edition of Linnaeus' Species plantarum appeared, retain their priority.

It was accepted that each species and sometimes

genera were founded upon a single "type specimen". The "type specimen" is not a particularly representative individual, it is just the first to have been described and named. Hence the significance of herbaria, botanical gardens and prints, as the spaces where command and ownership of nature was assured.

The interests were no longer the local recognition of useful plants but rather to docket, catalogue and make explicit the ownership of natural objects from any part of the world. The names of plants known in America were not only replaced but the new names had nothing to do with local affairs. Locality is actually denied by Linnaeus himself whose instructions for naming species explicitly states: "Native locality does not make a specific difference. Locality neither canonizes nor changes anyone; as the proverb goes, not even a pig is changed by being taken to Rome."[56]

Conclusion

Even the most recent and sophisticated commentators have failed to extend their interests in visual representation of expeditions to their principal product, actual botanical drawings. Despite the increasing interest on expeditions, historians have ignored the actual skills and practices that made possible the recognition and appropriation of unknown natural objects.

So far I have introduced two fundamental aspects of the process of knowing and possessing the plants of the New World: the roles of visual representation and naming of plants. There is no need to go deeply into philosophical or psychological arguments to realize that the visual representation of nature is never a straightforward process. Mutis, Ruiz, Pavón and almost any botanist of the time, as well as historians and commentators, seem to agree that botanical illustrators were, or ought to be, good copyists, that they were trained to depict a faithful copy of reality and that they were drawing from nature itself. That might be the case in so far as we share the whole network of assumptions that made such claims sustainable. As we have been arguing, botanical illustrators were trained to see and pick up the features which made possible the diagnosis of the specimens. The artist-scientist had been provided with a filter which ordered and selected information in terms of his own project and interests.

As we have seen, the final result was a collection of illustrations where the selection of information represented by the botanist-artist was not only inevitable but also deliberate; and the "exactitude" of each illustration demanded a great deal of intervention.

In a single plate one can not only see "more" than looking at numerous living specimens, but there are also a number of different advantages. First, plants are

fragile objects easily torn or ruined which present serious problems of transportation as well as difficulties of acclimatization. A living specimen is not always mobile, while the drawing is not only easily transported and stored but also immutable. The plant once drawn, remains an ideal realization which does not change or deteriorates even during long overseas journeys.[57] Besides, on a flat piece of paper the botanical artist was able to gather time and space in a single ideal picture where one can see not only the whole plant in a convenient size but also all the essential features (flower, fruit, leaves, seeds, and so forth) for a proper Linnaean classification. Some of the essential organs for an accurate diagnosis only appear in short periods of time and not simultaneously in a single specimen. The meticulous illustration of the flower, the calix, corolla, stamens and pistils (always countable) usually presupposed an enlargement of them, so that the identification of a genus or a species was simple.

Most significantly, the icons could be, and were thought to be reproduced and published. In so doing the botanists and their patrons were able to multiply and present their data, discoveries and possessions in an identical form to people otherwise divided by cultural or geographical frontiers. Making use of a common language, not only visual but also a Latin text and Linnaean terminology, the botanists ensured

communication with a community of European naturalists.

We ought to bear in mind that the verb "to illustrate" retains something of its ancient Latin meaning "to illuminate" explain or clarify. Learning to draw a plant was, in a sense, learning to see it. Through the process of being drawn, a plant acquired an identity, a name and a family. The diagnosis, to know or distinguish one specimen from the other, and its consequent naming and classification was the procedure by means of which botanists and naturalists conquered the unknown objects of nature.

The plants, once drawn, and removed from their natural habitats, became attached to and part of the European world. Moreover, the icons could be published and reproduced in an identical form, so that the botanists and their patrons could replicate their discoveries and possessions.

This chapter has also discussed the use of a particular body of words and rules for naming and classifying plants. European travellers had repeatedly pointed out the inadequacy of indigenous languages. For the Spanish naturalist Antonio Ulloa the Quechua language of the Incas "approximated most closely to the speech of children."[58] The natives seemed to lack understanding and words for concepts proper of any "civilized" society. "God", "Trinity", "virginity", "inmaculate conception" and so forth. Amerindians had

innumerable names for trees but no a single word which could translate the term "tree".[59] Cultures whose survival (nutrition, medicine and religion) was largely dependent on the use of plants, knew a vast number of distinct plants, their uses and specific descriptive names. "Quino-quino"*, "Punctu-punctu", "Yallohoy", "Calaguala" are just few examples discussed in the next chapter. But, needless to say, native Americans had no understanding or interest whatsoever in concepts such as "genus", "species" or "class".

In order to conquer foreign plants, the botanists had to remove local contingencies[60] and fabricate ideal types conformable to a system under European command.

Spanish imperial interests before the eighteenth century had been focused on gold and silver, commodities easily transported, stored, and interchanged. Plants, however, are delicate objects easily damaged. Their appropriation did not require so much physical violence but rather special skills. Plants were not always transportable, but they could be replaced by drawings and names.

As I have explained above, the search for new medicinal plants was of central importance for the Royal Botanical Expeditions. In the two following chapters I shall follow the explorers and their remedies from the field to the pharmaceutical laboratories of Madrid, and

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* In the Quechua language, the repetition of the same sound in a single name, e.g., "Quino-quino" usually means some utility of the plant.

explore some concrete instances in the process of "discovery" and appropriation of useful plants.

NOTES

1. José Celestino Mutis, "Informe sobre los pintores", in Flora de la Real Expedición Botánica del Nuevo Reino de Granada, vol.I, (Madrid: Ediciones Cultura Hispánica, 1954) p. 126.

2. In the particular case of the Spanish botanical expeditions, see Carmen Soto Serrano, "Aspectos artisticos de la Expedición Botánica de Nueva Granada", in Mutis y la Real Expedición Botánica del Nuevo Reino de Granada, (Bogotá: Villegas Editores, 1992).

3. See Lorenzo Uribe Uribe, "La expedición Botánica del Nuevo Reino de Granada: su obra y sus pintores.", Revista de la Academia Colombiana de Ciencias Eexactas, Físicas y Naturales, 19 (1953): 1-13.

4. See for example, Barbara M. Stafford, Voyage into substance: Art, science and nature and the illustrated travel account, 1760-1840, (Cambridge Mass.: M.I.T. Press, 1984); Martin Kemp, "Taking it on trust: form and meaning in naturalistic representation", Archives of Natural History, 17 (1990): 127-188; Sveltana Alpers, The art of describing: Dutch art in the seventeenth century, (London: John Murray, 1983).

5. Recent publications on scientific representation give for the first time the analytical framework for a better understanding of the essential function of visual modes of comunication in scientific practice. See for example:

Bruno Latour, "Drawing things together", in Michael Lynch and Steeve Woolgar, (Eds), Representation in scientific practice, (Cambridge, Mass.: M.I.T. Press 1990), pp. 19-68; Martin J.S. Rudwick, "The emergence of a visual language for geological sciences", in History of Science, 14 (1976): 149-195; L.J. Jordanova, "Gender generation and science: William Hunter's obstretical atlas", in: W.F. Bynum and Roy Porter, (Eds) William Hunter and the eighteenth century medical world, (Cambridge: Cambridge University Press, 1985); Ludwig Fleck, "To look, to see, to know" in: R.S. Cohen and T. Schnelle (Eds.) Cognition and fact, (Dordrecht: D. Reidel, 1986).

6. Casimiro Gomez Ortega, "Instrucciones que deberan observar los dibujantes que pasan al Peru de orden de S.M. para servir con el ejercicio de su profesión en la expedición botánica. Abril de 1777.", in: Jaime Jaramillo Arango (Ed.) Relación histórica del viage de Hipólito Ruiz a los Reinos del Peru y Chile, (Madrid, 1952), p. 416.

7. Ibid.

8. Anthony Pagden, European encounters with the New World from Renaissance to Romanticism, (New Haven and London: Yale University Press, 1993), p. 76.

9. Arthur R. Steele, Flowers for the king: the expedition of Ruiz and Pavon and the Flora of Peru, (Durham, North Carolina: Duke University Press, 1964), p. 55.

10. Iris H. W. Engstrand, Spanish scientists in the New World: the eighteenth century expeditions, (Seattle and London: University of Washington Press, 1981), p. 25.

11. Uribe, "La expedición y sus pintores", p. 12. A complete list of the artists, their signed works and their salaries appears in appendix I.

12. Ibid., p. 6.

13. Humboldt to Willdenow, 1803 "Matis, le prémier peintre de fleurs du monde et un excellent botanist..." Ibid., p. 8.

14. Mutis, Flora del Nuevo Reino de Granada, vol. I, p. 31.

15. Mutis to Juan José Villaluenga, Mariquita, 10 July 1786, in: Archivo Epistolar del Sabio naturalista Don José C. Mutis, Vol. I, (Bogotá: Instituto Colombiano de Cultura Hispánica, 1983), p. 313.

16. Soto Serrano, "Aspectos artisticos de la expedición", p. 146.

17. Mutis to the viceroy José de Ezpeleta, Mariquita, 24 February 1790, in Archivo epistolar, vol. II, p. 17.

18. See Latour, "Drawing things together".

19. Gomez Ortega, "Instrucciones que deben observar los dibujantes", art. 11; see also Soto Serrano, "Aspectos artisticos de la expedición", p. 154.

20. Eloy Valenzuela, Primer diario de la Expedicion Botánica del Nuevo Reino de Granada, (Bogotá: Instituto Colombiano de Cultura Hispánica, 1983).

21. José Celestino Mutis, Diario de observaciones de José Celestino Mutis (1760-1790) transcription and prologue by Guillermo Hernández de Alba, (Bogotá: Instituto Colombiano de Cultura Hispánica, 1883).

22. Ibid., p. 161.

23. Ibid., p. 202.

24. Ibid., pp. 175 and 245.

25. Mutis, Flora del Nuevo Reino de Granada, Vol.I, p. 102.

26. Mutis to Antonio Caballero, 3 June, 1783, in: Archivo Epistolar, vol.I, p. 122.

27. Carl Linnaeus, The Critica botanica of Linnaeus, (London: Ray Society, 1938), Art. 277.

28. David Knight, "Scientific theory and visual language", in: Allan Ellenius (Ed.) The natural sciences and the arts: Aspects of interaction from the Renaissance to the 20th century: an international symposium. (Upssala: Almqvist and Wiksell International, 1985) p. 109.

29. See the following documents: number 72, "1817, Marzo 14. El General Pascual Enrile, Jefe del Estado Mmayor del Ejercito Pacificador, da cuenta...del las gestiones realizadas para poner a salvo el patrimonio científico de la expedición botánica"; number 79, "1817, Noviembre 11, Razón sacada del catalogo original ... para la entrega de veinte cajones con destino al Real Gabinete de Historia Natural..."; number 79, "1817, Noviembre 17, Inventario general de los dibujos, manuscritos, herbario

y demas objetos pertenecientes a la Real Expedición...." in Guillermo Hernandez de Alba, (Ed.) Historia documental de la Real Expedición Botánica del Nuevo Reino de Granada despues de la muerte de su director J.C.M. 1808-1952, (Bogota: Instituto colombiano de Cultura Hispánica, 1986), pp. 551, 399, and 403.

30. See Enrique Perréz Arbeláez, José Celestino Mutis y la Real Expedicion Botánica del Nuevo Reino de Granada, (Bogotá: Istituto Colombiano de Cultura Hispánica, 1983), pp. 198-9.

31. See Buchanan, Nature into art, appendix on printing techniques.

32. David Knight, "A note on sumptuous natural histories", Annals of science, 34 (1977): 311-14.

33. For an account of the international dispute over priority of publication see Steele, Flowers for the king, pp. 176-186.

34. Ibid., pp. 225-235.

35. Ibid., pp. 212-224.

36. Hipóplito Ruiz, "Diario de los trabajos que van haciendo los botánicos y dibujantes de la expedición del Peru a fin de publicar la Flora Peruviana y Chilense desde el dia 21 de febrero de 1793", Archivo Real Jardin Botánico de Madrid, Div. IV, Legs. 7, 4, 11 and 7, 4, 12.

37. Ibid., entries numbered: 15, 12, 18, 20, 21, and 28.

38. Hipólito Ruiz and Josef Pavón, "Solicitud de libros,

Madrid Julio 26 de 1792", Archivo Real Jardin Botánico de Madrid, Div. IV, Leg. 7, 4, 4.

39. Hipólito Ruiz, cited by Steele, Flowers for the king, p. 246.

40. For details on the costs and sales of the Flora Peruviana et Chilensis, see Steele, Ibid., pp. 246-265.

41. Ibid., p. 246.

42. Ibid., p. 252

43. Casimiro Gomez Ortega, "Instrucción a que deberan arreglarse los sujetos destinados por S.M. para pasar a la America Meridional en compañia del medico Josef Dombey a fin de reconocer las plantas y yerbas y de hacer observaciones botánicas en aquellos paises", 1779, Archivo Real Jardin Botánico de Madrid, Div.III, Leg. 2, 6, 17. art. 6.

44. Hipólito Ruiz and Joseph Pavon, Flora Peruvianae et Chilensis. Prodromus., (Madrid: Imprenta de Sacha, 1794), p. 21.

45. R.J. Camerarius, cited by William T. Stearn, Botanical Latin, see ch. 3, "Development of botanical Latin terminology".

46. Carl Linnaeus, Systema Naturae, 1735, trans. Engel, p. 23.

47. See Stern, Botanical Latin, ch. 3. See also Philip Sloan, "John Locke, John Ray, and the problem of the natural system", Journal of the History of Biology, 5 (1972): 1-53.

48. Pagden, European encounters, p. 27.

49. Carl Linnaeus, The Critica botanica of Linnaeus, Art.218, p. 15.

50. Ibid., Art. 237.

51. Ruiz and Pavon, Florae peruvianae et chilensis, Prodromus, 1794. Prologue.

52. "Diario de los trabajos que van haciendo los botanicos y dibujantes de la expedicion peruana a fin de publicar la Flora Peruviana y Chilense desde el dia dos de junio de 1793", Archivo Real Jardin Botanico de Madrid, Div. IV, Leg. 7, 4, 11. Days 22-27.

53. A. Gonzalez Bueno, E. Gonzalez Alonso, P. Sánchez Sánchez, and R. Rodriguez Noval, "La expedición botánica a los reinos del Peru y Chile (1777-1831): un analisis de sus resultados", in Alejandro R. Diez Torre, et al. (Eds) La ciencia española en ultramar, (Madrid: Doce Calles, 1991).

54. For a complete list of the generic names in the Prodrumus see Gonzalez Bueno et al., Ibid.

55. Sinforoso Mutis, "Continuación del semanario del Nuevo Reino de Granada", 1810, in Hernández de Alba, Historia documental, pp. 144-47.

56. Carl Linnaeus, Critica botanica, art. 264, p. 130.

57. Bruno Latour, "Visualization and cognition: Thinking with eyes and hands", in: Knowledge and society: studies in the sociology of culture past and present, 6 (1986): 1-40.

58. Antonio Ulloa, Relación Historica del viaje a la

America Meridional, 1772, p. 386, cited by Pagden, European encounters, p. 132.

59. Pagden, ibid., p. 132.

60. See Susan L. Starr and James R. Griesemer, "Institutional Ecology, 'Translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39", Social Studies of Science, 19 (1989): 387-420.

CHAPTER III

HEALING THE SPANISH ECONOMY: THE SEARCH FOR MEDICINAL PLANTS

"Traduttore-traditore"*

"Translation", to bear, convey or remove from one person, culture, place or condition to another, is the process we want to illustrate in the following pages. As Michael Callon has pointed out, "To translate is to displace....but to translate is also to express in one's own language what others say or do.... It is to establish oneself as a spokesman." "The result", concludes Callon, "is a situation in which certain entities control others."[1]

In order to understand the process of translation and certification involved in the exploration of tropical

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* The present chapter is not only about "translation", but also involved a great deal of translation of eighteenth century Spanish into English. "From translation to treason there is only a short step." It applies equally both to the actors in this story and myself.

vegetation we shall follow the explorers in the field, make explicit their permanent contact with folk and local practices, illustrate the importance of taxonomy as the primary source of certification, and describe how the botanists became indispensable for the appropriation and legitimation of medical knowledge. Finally we shall study the European reception of these substances, their analyses and approval by the King's pharmacists.

We shall neither try to be exhaustive nor to list all the possible useful species mentioned by the Spanish explorers; we shall rather focus on a few examples which raised sufficient interest among dealers and scientific institutions to become, if not always universally recognized, at least known and sold in Spanish and European markets. The case of the Peruvian bark, Cinchona, shall be studied in detail in the next chapter.

For a proper understanding of the process of appropriation and legitimation of botanical and medical knowledge, we have to leave behind any attempts to identify a single specific discovered by an individual wandering in the tropical wilds. Instead, we shall explain the achievements of the Spanish botanists in terms of a translation from traditional and indigenous experience into a different style more in accordance with the European culture of the late eighteenth and early nineteenth centuries.

As the botanists were trained and eager to recognize

useful and commercial plants but did not have time nor the means for testing the virtues of every single specimen, their first source of information was not, as they repeatedly claimed, direct observation of nature; their acquaintance with new useful specimens was generally dependent on local traditions and on the established trade in some species which had had some recognition and commercial value.

There is no need to stress the utilitarian character of science and exploration during the Enlightenment but it is important to remember that taxonomy was regarded by the Spanish explorers more as a necessary tool for the recognition and distinction of useful plants than as an enterprise in itself. "Little advantage can be derived from the knowledge and distinction of plants", wrote Ruiz, "if we neglect the study of their uses and virtues. Nor can any great benefits arise from the knowledge of the uses and virtues of plants without previously obtaining a clear and distinct idea of the plants themselves...."[2] The 'viret et usus' accompanying the descriptions of the Flora Peruviana was more than a complement to the botanical work, it was the very reason of the enterprise.[3] Taxonomy was a condition for the appropriation and exploitation of nature, which was - as we shall see - embedded in commercial interests.

As we shall illustrate with the following examples, the research of the explorers was focused on plants that

could replace other medical products often brought into Europe from the East Indies, a market which was dominated by other European countries. The Spanish interest in medical plants during the eighteenth century clearly reflects a mercantile policy of import substitution.

The Spanish government promoted the incorporation of American medical substances long before the eighteenth century. Since 1570, when Felipe II named the "Protomedicos" for the Indies, they were supposed to give reports about the local physicians and herbalists, and to take note of every herb, tree or medical seeds to be found, and to send them to Spain if unknown. A Royal schedule signed by Felipe II in 1570 makes explicit the state's interest in medicinal plants: "...all the herbs, trees, plants or seeds with any medical value that may be in those places shall be sent to this kingdom...."[4] But the first systematic attempt to collect direct information from the indigenous people about medicinal plants began on 25 May 1574, when a Royal schedule ordered the collection and translation of reports about indigenous medical practices. They were published in 1577 under the title La instruccion y memorias de la descripcion de las indias que su magestad manda hazer para el buen govierno y enoblecimiento dellas. (Instruction and memoirs for the description of the Indies that Your Majesty orders for their proper

government). For this purpose the "Caciques" (Chief), herbalists and healers' knowledge was translated and reinterpreted. The humoral conception of diseases was dominant so that indigenous knowledge was read in the light of Hippocratic and Galenic ideas.[5] Very little attention was paid to the indians' own beliefs and religious practices which were regarded as worthless and superstitious. Nevertheless, these reports probably gave the least distorted testimony about the Inca's customs and practices. Apart from them we only have the chronicles of conquistadors and later explorers, botanists and physicians who visited the new world. The most important writers of reports about American medical plants before the expeditions of the late eighteenth century included: Nicolas Bautista Monardes (1493-1588) whose Dos libros, el uno que trata de todas las cosas que traen de nuestras indias occidentales que sirven al uso de la medicina.... was translated into Latin, Italian, French, German, Dutch and English, published in 1572 with the title Joyful Newes out of the Newe Founde Worlde; the priest Jose de Acosta (1540-1600) who published his Historia natural de las indias.... in 1590; Garcilaso de la Vega (1539-1616); Bernabe Cobo (1582-1657); Louis Feuillee (1660-1732) and his work Histoire des plantes medicinales qui sont le plus en usage aux Royaumes du Perou and Chily dans L'Amerique Meridionale.... of 1714 ; Jorge Juan and Antonio de Ulloa and their Relacion historica del viage a la

America meridional... of 1748. A typical European account of the medical practices of native Americans is to be found in the works of the Jesuit father Bernabe Cobo.[6] A fragment of his text is worth quoting here:

> ... the treatments done by these Peruvian indians were accompanied by superstitions and magic.... they were barbarous people with little knowledge.... This ignorance is so general among all the indians that not one of them, unless he is well versed in Spanish, knows how to inform the doctor about his ailment and what could have caused it. Nevertheless ... they have many herbs to cure those illnesses. For all of their remedies they use simple herbs, and among them there are great herbalists to be found; from them we have learned the healing powers of many plants that we use now in our healing....they were never aware of the four humors, except for blood because they did not study their nature and properties. They had no knowledge of the veins, and still they used bloodletting in their own way....[7]

The assessment of local traditions and the clear recognition of the communities in which the explorers found medicinal plants present a number of problems. Despite an extensive secondary literature on pre-

columbian cultures,[8] our knowledge of the religious and medical practices of the native peoples of the Americas, before the arrival of Spaniards, is limited. Because of the absence of written records among the Incas or other dominant cultures in the regions concerning the present research, knowledge of their medical-religious practices is derived from archaeological studies or from written records of the Spanish conquerors, which, in the light of modern anthropology, are clearly insensitive to the natives' own forms of life.

After the arrival of the Spaniards, the rule of the Inca, and other aboriginal cultural traditions were suppressed. But the Catholic Church was never able to root out the traditional beliefs of the Andean peoples. Despite centuries of effort, Christianity did not succeed in eradicating "pagan" elements and we find adaptations of the earlier beliefs and practices in the new imposed christian tradition.[9] Therefore, by the time the enlightened Spanish expeditions arrived in America, the explorers were confronted with traditions which had elements of both Catholic and indian customs and beliefs.

Before the eighteenth century, European physicians had had little impact in the colonies, and the native "quacks", herbalists, midwives, and so forth, constituted the most important health agents for the American population, whether they might be indians,

mestizos or Spaniards. With the eighteenth century, enlightened medicine began to take shape in the colonies but aboriginal medicine and folk traditions maintained an important role, particularly in rural settlements.

It is impossible to identify a unified folk tradition in the Spanish colonies, and equally difficult to find genuine and untouched Inca traditions during the eighteenth century. However, some general points can be noted and it is worth giving a brief description of the indigenous conception of "medicine" and its influence upon local communities and upon European explorers interested in pharmaceutical plants.

One of the essential features of the medical practices of the Incas before the arrival of Europeans was a unity between organic and spiritual or psychological, a dichotomy non-existent for them, at least in the same way that we or enlightenment physicians understood it. The physician was often a priest and the meaning of illness was generally linked with religious and spiritual concerns foreign to the European. Remedies were usually against "malign spirits"; their illnesses were thought to be a consequence of "sins", sorrows or other psychological disorder. In order to heal these ailments it was necessary to purify the patient through special ceremonies in places called "Cayan". After the patient had told the truth,"confessed his sins", after he declared that he had given them to the Sun, he asked the

rivers to take them away to the sea. Among their practices and rituals there was an unshakeable faith in natural remedies with curative powers, many of which were vegetable species. There were different kinds of "doctors", the ones who collected and prescribed natural medications were known as "Ccamiles" (herbalists) or "Callahualas" (travelling physicians).[10] There is no need to go deeply into anthropological discussions or problems of "commensurability" and "rationality" in order to see that we are confronting two very distinctive traditions, and that the incorporation of native remedies into the European pharmaceutical industry required a process of legitimation that is important to explain.

We already indicated that medicine and pharmacy constituted a major interest for the Spanish government during the Bourbon period, and it was during the late eighteenth century that the state undertook major projects primarily devoted to the exploitation of pharmaceutical substances. The Royal Botanical Garden can be seen as a sanitary institution and the expeditions were designed with a central objective, i.e., the investigation, recognition and eventual commercialization of therapeutic plants. France and other European nations searched for plants to be used in agriculture, industry or dyeing. This seems to have been of secondary importance in Spain. The reports,

diaries and correspondence of the different Spanish explorers who visited the New World contain hundreds of references to supposed medicinal plants which caught their attention either because they were used by natives or because of their similitude to one or another of the already known and useful species. In Ruiz's Relación historica del viaje a los reinos del Peru y Chile there is an index of folk and scientific names of medicinal plants which includes 170 items.[11] These include a new sort of tea, a species of cinnamon similar to the one cultivated in Ceylon and sold in European markets, new species of barks which were supposed to belong to the same genus as the Peruvian bark (quinine) which had been in commerce for many years, and many other "new" plants which were used by indians or other communities established in America.

Among the useful plants recorded by the explorers of Peru and Chile, 50% had medical uses. From these, it is also worth noting, almost 30% were deployed against either venereal diseases or had febrifuge properties.[12] It is well to remember that epidemic fevers affected large sectors of the population and constituted the major medical concern of Spain during the eighteenth century.[13] To give an idea of the severity of these epidemics we might mention some medical reports. Dr. Antonio Ased gave the following account of an epidemic in the town of Barbastro: "... in three months 60

persons out of a population of 180 died...."[14] In the town of Cartagena, as reported by Martin Rondon, 2267 people died in 1767 due to tertian fevers, 2481 in 1768, and similar epidemics followed in the years 1771, 1772, 1781, 1782 and 1785.[15]

Before turning to the plants and remedies themselves, it is worth describing the institutions by which pharmacy was both controlled and promoted.

The Bourbon reforms and the government's efforts to have direct control of the empire's economy had a visible impact on Spanish pharmacy. Not only because of the increasing number of therapeutic products brought into Spain by the explorers but also because of the internal reforms that aimed to provide the state with absolute control over pharmacy. The government sought to centralize the management of medicine and pharmacy by means of a single entity, the "Protomedicato".[16]
In a Royal schedule of 1780, Charles III ordered that the faculties of medicine, surgery and pharmacy were to be governed by the Protomedicato. Pharmacy was run by the "Protofarmaceutico", who was the pharmacist to the king; and three examiners, two of whom were also pharmacists of the court, and the third one being from the Botanical Garden.

Another official document issued by the first secretary of state, the Count of Floridablanca, specifies the norms for the election of the "Board for

the enquiry on the virtues of plants, and specially for the chemical observations undertaken in the Royal Pharmacy". Here the secretary of state stated that "the Protomedicato shall not admit for examination candidates without accredited studies in botany", which meant that they had to have attended the courses at the Botanical Garden.[17] That is to say that the management and control of pharmacy was in the hands of a closed circle centered around the King himself.

During the reign of Charles III the prerogatives of the pharmaceutical colleges were suspended, physicians were prohibited from exercising the profession of pharmacy, no woman or relative of a practising physician could run a pharmacy and a list of physicians who ought to be consulted before issuing a prescription was published. The commercialization of unauthorized specifics remained a common practice and another Royal schedule was issued in 1788 to prevent speculation and abuses in pharmacy. The schedule was also meant to give legal protection to genuine pharmaceutical innovations. The document specified that any new remedy should include its composition, which would be kept secret during the life of its author and up to ten years after his death in favour of his inheritors.

The function of the Real Botica (Royal Pharmacy) was to examine plants, undertake chemical analyses and issue official reports on the therapeutical efficiency of medical substances and provide the court and the nation

with reliable remedies. As the single institution in which medical products were officially recognized and approved, the Real Botica was of central importance for the new state policies. As with any position so close to the King, all its members were supposed to give proof not only of scientific competence but also of political suitability. The Real Botica's main responsibility was to guarantee proper health care for the King and his family, therefore it was not a place for experiments or innovation and it remained a very conservative institution concerned with the approval of medical substances but with little interest in new theoretical trends in modern chemistry. As we shall explain, the Spanish chemists involved in pharmacy, and particularly the Royal Pharmacists, adopted an eclectic amd almost passive attitude towards the theoretical discussion in contemporary chemistry in Europe.[18] The examination of medical substances undertaken by the pharmacists of the court aimed to provide a comparative and quantitative analyses of the "chemical" or "active principles" present in plants or substances wich already had medical and commercial recognition.

From 1785 to 1796, when the outcomes of the Royal Botanical Expeditions were arriving in Spain, the number of specimens was particularly large.[19] The reports and materials sent by the explorers inevitably had to pass through the Royal Pharmacy for examination and approval, and as we shall illustrate with some examples, this was

the means by which the state administration sought to control and expand the commerce of pharmaceutical products.

The government's efforts to improve the pharmaceutical industry by means of official central control, can also be seen in some of the publications of the period. First we ought to examine Francisco Brihuega's Examen Farmaceutico (1761, 1776, and 1796) which constituted a basic text for the teaching and spread of pharmaceutical knowledge. This work, whose title can be translated as Pharmaceutic Exam, Galenic-chemical, theoretical-practical.... was a small text of instructions meant to facilitate the learning of modern pharmacy. In the form of a dialogue, it contains a number of basic definitions often taken from Linnaeus' Systema Naturae (1735). Beginning with the question "What is pharmacy?" Brihuega explains: "[it] is the art that teaches us the method and the reasons for the election, preparation and composition of medications". Next the Exam introduces definitions of odour, colour, taste and so on. The textbook, particularly the second and third editions, stresses the importance of knowledge about botany and natural history. It particularly recommends the study of the following texts: Curso elemental de botánica.... (1795) by Gomez Ortega, Principios de Botánica.... (1767) by Miguel Barnades, and Antonio Palau's translation (1778) of Linnaeus' Philosophia Botanica. Brihuega's text tends to

emphasise practical modes of drug preparation, including a list of the most common remedies and their appropriate doses, but with no real concern for chemical analysis or theoretical explanations of the principles at work. However it refers to books such as Macquer's chemistry* and Boerhaave's texts[20] for further information.[21]

The chemical concepts in Brihuega's Exam relied on Felix Palacios's Palestra pharmaceutica which was largely limited to the preparation of remedies.[22] And if we examine the chemical texts often mentioned by the Spanish pharmacists such as Nicolás Lemery's Cours de chymie (1675), Maquer's Elemens de chymie theorique (1749) and his Dictionaire de chymie (1766), or Boerhaave's Elementa chemia (1732), they might not concide in their theoretical assumptions but all had a central didactic and pragmatic function.

The other essential publications are the different editions of the "Pharmacopoeias" that appeared in Spain from 1739 to 1860. A "Pharmacopoeia" is no more than a list of all the drugs and medications with legal recognition, used as a means to control the practice of pharmacy and medicine. The first Pharmacopoeia Matritensis was published in 1739 by the College of pharmacists in Madrid. It had to be approved by the

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* Pierre Joseph Macquer (1718-1784) Best known as the author of a widely read textbook, Elemens de chymie theorique (1749) and of the first chemical dictionary Dictionnaire de chymie (1766)

"Real Tribunal del Protomedicato" and by the King himself. The text main purpose was to fill and make all prescriptions, "Galenic as well as chemical" according to a set of formulas in all pharmacies in Spain.[23] In other words, it was an official text imposed by the state to be followed by physicians and pharmacists. Written in Latin it consisted of 383 pages with the "modus operandi" of simple formulas and "modus faciendi" of chemical remedies. It described the doses, uses and virtues of the different substances, and included a description of techniques and pharmaceutical instruments.

This first edition already contained American remedies such as quinine. A second edition with similar content was published in 1762. In 1794 the first Pharmacopoeia Hispana was edited, this time by the Protomedicato. It was a smaller volume in which the number of remedies was substantially reduced. The following editions of 1797, 1803 and 1817 presented a similar structure with an increasing number of products. The fifth edition, and the first to be published in Spanish, was not printed until 1860.[24] The development of a Spanish pharmacopoeia clearly illustrates the consistent endeavour of the state to regulate the drug business, both in Spain and in the Americas.[25]

Gomez Ortega thought that the results of the expeditions would be reflected in the Pharmacopoeia, which in turn would serve the European dissemination of

American drugs. The explorers would contribute to the pharmacopoeias with a better taxonomic knowledge of some of the sources of medications, an improved knowledge of the geographic distribution of medicinal plants, and with new remedies.

As we have been arguing, one of the main interests of the botanical expeditions was the taxonomic determination of those plants already used in medicine and referred to by their vulgar names and descriptions. In the opinion of contemporary naturalists, these were incomplete and frequently presented confusion, imitation and falsifications. A clear example is, of course, the case of Cinchona. The first two Hispanic editions included quinine with the "vague" denomination of "Cortex Peruvianus" accompanied by a short description. With multiple varieties of quinine available for trade the need for a more precise taxonomic knowledge of the plant seemed evident. In the Pharmacopoeia Hispana of 1817 the works of Ruiz and Pavón made a visible contribution. In this edition three different species of Cinchona are described: Calisaya (C. lanceolata, Ruiz and Pavon); quina de Loja, (C. officinalis, L./ C. condaminea, Humb. and Bompl.); and the quina Peruviana (C.nitida, Ruiz and Pavon). Other examples of this kind of contribution to the taxonomic definition of medicines already in use were, among others, Ruiz's work on the root of China (Similax china, L.), Calaguala (Polypodium calaguala), Quinoquino (Myroxilum peruviferum),

Canchalagua (Gentina canchalagua, Flor. Per. et Chil.), the works of Mutis and others on Cinnamon, and so on.

However, it is revealing that relatively few new American drugs were introduced into the Spanish pharmacopoeias during this period. Only two were added in the 1803 and 1817 editions: the root of Agave (Agave americana L.) and the root of Ratahia (Krameria triandra, Ruiz and Pavon).

But Spain was not the only recipient of the expeditions' achievements and it is interesting to note that the introduction of new American drugs in Spanish pharmacopoeias would come later, after their appearance in foreign publications. Needless to say, the networks and power relations embedded in the pharmaceutical industry as well as the process of appropriation did not end in Spain. The introduction of the leaves of coca (Erythroxylon coca, Lam.) as a medicine, which Hipolito Ruiz had qualified as "a corroborated remedy", was not considered by the editors of the Spanish pharmacopoeias before they had read French studies on the issue. "Matico" (Piper agustifolium, Ruiz and Pavon) an anti-venereal remedy was included in the fifth edition of 1860, following North American publications.[26] These examples, as well as others, suggest that despite Spain's efforts to lead the business of pharmacy, the American remedies did not cure the Spanish empire's maladies. Spanish science, medicine and commerce was still dependent on foreign criteria.

As we already argued, the process of "discovery" and the legitimation of unknown specifics involved a number of negotiations and translations that we aim to illustrate with some examples.

The explorers could not and did not find specific medications in the wilds. Instead they contributed to the appropriation and legitimation of medical commodities and made themselves indispensable to a process of translation from folk practices into enlightened science and commerce. They were also necessary for the actual displacement of both natural objects and their use into Europe, but the common attribution of discoveries to individuals gives us a distorted picture of voyages of exploration.

All the specific cases discussed below follow similar patterns that reflect the commercial interests of the state. They all illustrate the importance of indigenous knowledge for botanical exploration, and show the significance of taxonomy and chemistry in the process of translation and appropriation of medicinal plants. However, I have divided the discussion into two main sections that show two important points. A first group of plants, including a South American Cinnamon, the tea from New Granada, Star-reed, and the Chinese root, constitute clear instances of a commercial policy of import substitution. Here I illustrate the role not only of botanists but also of chemists in the search for new commercial plants. In the second section, including

the plants Calaguala, Ratanhia, Yallhoy, and others, I concentrate on the role of folk knowledge, and on the botanists' claims of discovery. Finally, the chapter ends with some general conclusions on the process of translation.

I. Botany, chemistry and a commercial policy of mercantile substitution

The commerce in plant species with the East did not present major obstacles for Spain until the separation of Portugal from Spain, the independence of the low countries and the Dutch commercial monopoly with the east. But with this new political scene, Spain had to pay high prices for eastern products, and the exploitation of American species, particularly of plants such as cinnamon or tea, became a major target of the imperial government during the eighteenth century.

A. The American cinnamon

From Gomez Ortega's Instructions we know that two plants had priority: the trees of quinine, to which we shall devote the next chapter, and the "Canelos" or American cinnamon. The Spanish interest in cinnamon has a history that is worth reviewing briefly. During the late fifteenth century Cinnamon constituted an important commodity imported by the Portuguese and later by the

Dutch from the island of Ceylon (Sri Lanka). As early as 1536 there had been reports of an American species of cinnamon that, as was then argued, could replace the one from Ceylon.[27]

Nicolás Bautista Monardes (1493-1588) Historia medicinal de las cosas que se traen de nuestras indias occidentales (1574) attributed several medical properties to the American species. Monardes argued that the American cinnamon "Comforts the stomach, prevents bad breath, is an important remedy for stomach pains...." He also noted that that the only difference between the two plants was their geographical location and that the American plant had culinary uses and all the other properties of the cinnamon from Ceylon.[28]

Jorge Juan and Antonio de Ulloa, the Spanish members of La Condamine's expedition, criticized the negligent attitude of Spain in ignoring "the richness that the Peruvian forests offers to us", and explicitly refered to cinnamon, that "in the opinion of the most capable naturalists that have visited those places, and examined the plant, it is as good as the one from the East."[29]

However, the person directly responsible for the promotion and planning of research on these trees was the director of the Botanical Garden and the designer of the Royal expeditions, Casimiro Gomez Ortega. Ortega's project was to make the cultivation of American cinnamon a national industry that would free Spain from the Dutch monopoly. In his Instructions to the botanists of the

Royal expeditions he ordered them "to pay special attention to the cinnamon trees and to observe and study carefully the American specimens in order to find the means to sweeten them and if possible to make them as good as the cinnamon brought into Europe by the Dutch."[30] Equally, Dombey, the French companion of Ruiz and Pavon, had instructions from Paris to collect samples and study the plant. Mutis in Santa Fe and Cuellar in Philippines, as we shall see, had all been requested to do research on the "canelos". From Ruiz's account in his Relacion Historica del viaje hecho a los Reinos del Peru.... we know that the plant had various uses among indians and that the trees constituted an important element of religious ceremonies.[31]

In 1763 Mutis wrote to the King Charles III: "The American mountains and specially around the Peruvian provinces of Macas and Quijos, are inhabited by some trees which smell, colour and taste have made people believe that they deserve the name of "Canelos". He also points out that even though the trees belong to a different species than the cinnamon from Ceylon, his investigations on these American trees "would not be useless nor despicable."[32]

José Lopez Ruiz, another physician in New Granada and an eternal rival of Mutis, was also doing research on the trees and in 1780, Lopez Ruiz's presented his Memoria que podra servir de auxilio para el cultivo y beneficio de los arboles de Canela que se producen en

las montañas del Virreinato de Nueva Granada. Following procedures already at work in Ceylon, Lopez Ruiz paper consisted of forty one articles or rules for the successful growth and use of the American cinnamon trees.[33]

Meanwhile, the government put Pedro Fernández de Cevallos* in charge of a larger project for the exploitation of American cinnamon, this time in Peru. From documents gathered by Cevallos[34] and sent to Mutis in 1793, we know about the complexities and obstacles of such an enterprise.

First of all, the region in which the trees were found was by no means easy to reach. "There are plenty," explained Cevallos, "but with the problem that they are scattered through the mountains and intertwined with various species...." In order to reach the area of "Canelos",[35] one had to travel two days by land from Quito, a day downstream the Bobanaza river, and another day by land to the port of Canelos in the Copataza river.[36] Another problem was the lack of people for the collection of the bark. As Cevallos pointed out, "there was no knowledge of specimens on the same chain of mountains...." "Its fruit is so hard", he also pointed

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* Fernández de Ceballos was in charge of several militar comissions in Peru. In 1777 he was named "Intendente" of the provinces of Jaén de Bracamolos, Luya and Chillaos for a militar expedition of the Marañon River.

out, "that neither birds nor monkeys can extract the seeds, consequently its propagation does not take place in the way that many other species are known to multiply...."[37]

As a consequence the project for cinnamon exploitation included not only the construction of better means of access but also required the establishment of settlements which would provide Spaniards with the work force required.[38] Cevallos was always drawing parallels with the Dutch success in Ceylon and arguing that there was no reason for Spain not to have a similar industry. He argued, for example, that the latitude of the province of Canelos and that of Ceylon were almost the same, and that all the disadvantages that the American trees might present could be solved by means of proper cultivation.

The establishment of the identity of the tree and its uses was a major issue that concerned the King, the state, the physicians and the botanists. The viceroy of New Granada, Caballero y Gongora, had great hopes for the American plants and requested samples in order for them to be examined by Mutis. Mutis's answer of 1783 was categorical on the identity of the trees, demonstrating that they were far from being cinnamon and that they belonged to a different genus:

> Indeed, this tree belongs to a new genus that I had recognized and discovered in 1772....
>
> In the year 1773, after training a skilful

> artist I sent it to Linnaeus who made it known in Europe in his Systema Naturae. The structure of their flowers and specially the abundant number of their stamens that frequently reach twelve, make them part of a separate and distinct class from the Laurel (Laurus).[39]

However Mutis also argued that the "cinnamon" from Santa Fe had valuable medical properties. Moreover, Mutis became involved in a major project to transplant some trees and to cultivate them in Mariquita where the expedition was then settled. In 1786 Mutis received thirty seeds to be planted in the Botanical Garden of the Expedition. As the Spanish botanist explained, the aim was "to make the trees grow in a less barbarous province and in a place more accessible for the government's foresight and interest in its propagation."[40]

Mutis's consignments of his plant were welcomed in Madrid and approved by the Royal Pharmacy. In 1792 the viceroy of New Granada received a Royal schedule in which he was asked to do everything in his capability to promote the cultivation of Mutis's cinnamon, whose good quality had been corroborated by the Royal Pharmacists experiments.[41]

The other source of cinnamon that the Spanish

authorities had considered was on the Island of Manila, now part of the Philippines, where Francisco Javier Salgado had been cultivating it. In 1778 Gomez Ortega received samples from Philippines. His verdict was encouraging and optimistic. The director of the Botanical Garden was of the opinion that the cinnamon from the Philippines was of identical quality as the one from Ceylon, and that it could completely end the Dutch monopoly. The King gave orders to the governor in Philippines to investigate the plantations and to endeavour to improve its quality. He also requested specimens to be sent to the Royal Pharmacy to be analyzed.

The final step in the process of "discovery" and possession had to take place miles away from the actual sources of cinnamon. Now we have to move from the New World's forests into Madrid, more precisely into the pharmaceutical laboratory at the Royal Palace. The Royal Pharmacy constituted a space where new techniques and criteria for the recognition of remedies were counted as competent, where the ambiguities of botany and taxonomy could be removed by means of chemical analyses.

In 1786 the Royal Pharmacy received cinnamon from Manila. The report issued by the King's pharmacists, once again, stated that the new cinnamon was indeed as good as the one cultivated by the Dutch. Moreover, with

proper cultivation it could even surpass the virtues of the species already in commerce.[42]

A report, dated 24 November 1786, signed by Juan Diaz[43] and kept in the archive of the Royal Pharmacy, illustrates these points. "Even though we lack the organs of fructification", concluded the King's pharmacist, "there is no doubt that this cinnamon is the same cultivated in Ceylon.... With authority, reason and experience it is manifest that the cinnamon called (de China) or from Philippines, is of the same species than the one from Ceylon... that it can and ought to be equal and may be preferable to the latter."[44] The report also describes the plant already known and characterized by Linnaeus Laurus cinnamomun.

The bark, its colour, smell and the "essential oil" extracted from it seemed to offer enough evidence to convince the pharmacists of the efficacy of the plant:

> Chemistry, being the science by means of which we can recognize the properties of natural products through analysis, compositions, de-compositions and combinations, we have submitted to these proofs the different species of cinnamon, separating their principles and essential oils by distillation; stratifying their viscous humours and extracting their saline parts by means of different operations and making precise comparisons in order to reaffirm their

> qualities.... Our operations have been done in complete agreement with and following the methods of the most competent chemists.[45]

The report gives the results of a comparative chemical analysis that allowed the pharmacists to conclude: "the small difference in the quality of their products, suggests that they belong to one single species and that they can be used indiscriminately". Those differences were, in their opinion, due to the age of the trees, to the possibility that the samples the barks might have been taken from different parts of the plant, to different modes of cultivation, or "some other accidents".

Juan de Cuellar was sent by the Botanical Garden to the Philippines in order to join the botanists of the Malaspina Expedition, to supervise the cultivation of cinnamon trees and to prepare some for transportation to Spain. In 1787, Juan de Cuellar reported that he had found the genuine Laurus cinnamon in excellent quality and abundance.[46] The King had ordered Cuellar and the governor of the Phillipines to supervise the systematic cultivation of the plant and to send consignments of the product to Spain. In 1789 Cuellar sent back materials accompanied by a report on the topography and mode of cultivation. The Royal Pharmacy reaffirmed the quality of the trees but pointed out that the trees presented excessive "mucilaginous substances" and recommended that

incisions on the trees should be made.

In 1791 a new consignment was sent to Spain and included different by-products of cinnamon. This time the royal pharmacists expressed disappointment and qualified the new remittance as inferior to the one received in 1789. "The cinnamon from Philippines", wrote the pharmacists, "was found deprived of those active principles and essential oils that ought to possess in order to be useful".[47] The first pharmacist, Juan Diaz, thought that the loss of the essential oil characteristic of the most valuable cinnamon, had been caused by the incisions recommended previously, and that after suspending such treatment the trees would exhibit their virtues again.

Despite all the effort, time and money invested in the commercialization of American cinnamon, it would never threaten the Dutch monopoly. The Spanish attempts to substitute the products imported from other countries - as we shall see - was a complete failure. It was partly due to the differences between the plant cultivated in Ceylon, Cinnamomum zeylandicum and the American trees. But principally, Spain's failure was a direct consequence of a worsening economic and political situation that led to the wars of independence and the collapse of all Spanish imperial aspirations.

B. Mutis and the tea from New Granada.

Mutis's most important and polemical works were those on the genus Cinchona, with which we deal separately. But he also wrote essays, memoirs and kept an extensive correspondence in which he dealt with many other medicinal, useful and commercially profitable species. One interesting example is his research on the leaves of a plant from which, he argued, a new kind of tea could be obtained. The tea from Santa Fe was not only an "exquisite" drink that could replace the tea from the East but also a valuable medical product, "...improving the digestion, keeping a free transpiration and preserving a balanced circulation of all humours without visible alteration", explained the Spanish physician, "for nobody ignores that all diseases are caused by the disturbance of those functions."[48]

Mutis's writings on medical plants are always revealing of the political and religious assumptions of the naturalists. In the first paragraph of his paper "Te de Bogotá" we read: "The natural productions with which the Divine Providence has enriched this new Kingdom of New Granada are countless" and further on in the same paper he explains, "Everything has been created by the author of nature, with relation to the utility and welfare of man."[49]

The interest raised by this plant, as in the case of cinnamon, and many of the other medical products

appropriated by the Spaniards, was marked by its mercantile possibilities, as a substitute for an already valuable product brought from the East into Europe by other nations.

On 3 November 1785, Mutis sent to the archbishop and viceroy Don Antonio Caballero y Gongora an essay, Te de Bogotá: sus preciosas virtudes, in which Mutis presented this new tea as one of his most "precious discoveries". Unlike other useful plants, Mutis claimed that this tea was completely unknown in Bogota and that it was discovered "only by means of scientific principles and due to repeated experiments."[50] He explained in a different letter to the Conde de Floridablanca that the new plant, which he named Alstonia theoformis, presented characteristics similar to the Chinese tea. Mutis also insisted thet it was of undeniable importance for Spain to exploit this new species, not only for its exquisite taste but also for its medical virtues which could not only compete with but surpass the quality of the Chinese tea.[51]

In March 1786, the Viceroy of Santa Fe notified the king of Mutis's discovery of a plant called "Tea of Bogota" which - in Mutis opinion - was as good as the tea from the East. A quantity of the new remedy was sent to Madrid to be examined by the Royal Pharmacy. The report issued by the court pharmacists, in August 1786, stated that they could not identify the species for they had only received the leaves. "The leaves", we read in

the report, "are very different from the leaves of Chinese tea, lead us to the conclusion that we are dealing with two different plants."[52] They were certain that the Chinese and the American plants were different species, but "without organs of fructification it was impossible to conclude whether or not they belong to the same genus". However, the pharmacists of the court undertook a comparative chemical analysis from which they concluded that the virtues of the newly discovered plant could equal those of the tea from China. "If the two plants coincide in their chemical principles", explains the report, "they should serve for the same uses and consequently can be replaced in commerce."[53] The manuscript concerning the analysis of the tea from Bogotá kept in the Archive of the Royal Pharmacy in Madrid, Disertación phisico, chimica, botanica del the de Bogota comparado con el de Levante, signed by Juan Diaz, provides us with a complete account of the actual procedures involved in the chemical analysis of the new tea. The pharmacist took two "dracmas" (one-eighth of an ounce) of each plant to which they added three ounces of spirit of wine and waited twenty-four hours in order to "extract their resinous parts". Once filtered, the resulting tinctures appeared different. The tea from the East presented a dark colour, while the American product a clearer colour. "In order to know with certainty the substances in the tinctures" they took half ounce of each sample and "added two drops of

"Spirit of Vitrol". "After few minutes the mixture turned turbid producing a coagulum originated by the union of acid and the resinous parts".[54] This time the tea from Bogotá generated a greater quantity of the saturation mentioned.

Another half of the same tincture was mixed with two grammes of "Alkali del Tartaro"* and both samples gained colour. To the remaining ounces were added a double quantity of water in order to "weaken the spirit of wine and precipitate, separate and recognize the nature of the resinous parts." As a result, "the tincture from the tea of Bogotá became lacteous and after twelve hours presented a precipitate of thirteen grammes of a well characterised white resin", a product that was not obtained from the Chinese tea which only took a "light white colour and no precipitate at all."[55] The pharmacists also made tests with boiling water, observing that the tea from Bogotá presented a golden colour while the Eastern tea became greenish. The sample from China presented a stronger smell.

Despite all the differences noted above, the court pharmacists' conclusions were optimistic. As already noted, they recognised that the two plants were not of the same species, and that without the organs of fructification it was impossible to determine the genus. However, they also concluded that there were no reasons

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* A saline substance obtained from calcined ashes of tartar (potassium acid).

to doubt "that the virtues of the tea from Bogotá is or could be as good as the already known virtues of the Chinese tea".[56] The report was signed by Juan Diaz and dated 15 August 1786.

Another revealing document in Mutis's papers, Examen del the de Bogotá, Gomez Ortega and dated 24 September of the same year, 1786.[57] Here the Spanish botanist describes the tree and explains the mode of its preparation "by toasting its leaves as practised in the East." Following Mutis's information, Gomez Ortega argues that despite some differences in taste and smell with the Asiatic tea, the one sent by Mutis "not only has stimulant effects of the sort of spirituous licours, but also cheers the soul, promotes transpiration and sweat, that can be of valuable use for voyagers as purificator of water," and so on. Gomez Ortega also argues that the Asiatic tea, when consumed in large quantities, as is the case in places like England, can be harmful for the health - another reason to consider the new plant as a convenient replacement.

In February 1790, two pounds of the tea from Bogotá, collected in Mariquita, were sent by its discoverer to the Royal Pharmacy for further examination. The experiments were repeated and once more, the pharmacists of the King concluded that the plant was different from the Chinese plant, but they pointed out that the "resinous principle found in these leaves, as manifested by Mutis, might well have an active virtue." Juan Diaz

concluded this second report with the following remark: "It is very convenient for the economy to continue with the consignments in order to replace the expensive Chinese tea."[58]

Once again, Mutis's and Spain's efforts had limited results and the world's greatest tea monopolies, such as the English India Company, were never threatened by the Spanish empire. However, it is worth mentioning, that a small industry of the tea of Santa Fe survives in Colombia.

C. Star-reed

A large number of the works and manuscripts of the Spanish explorers did not reach print in Spain but some of their writings and collections were bought by foreigners who used and sometimes translated and published these materials.

The English botanist Aymer Bourke Lambert managed to buy from the Spaniards a substantial number of specimens and works on medicinal plants. Lambert, in his An illustration of the genus Cinchona (1821) included the translation of a collection of papers by Ruiz on different useful plants. Some of them had already been published in Madrid in 1805.

A work by Ruiz, published in Madrid in 1805 and translated and published in England in 1821 by Lambert,

was his Memoir on the virtues and uses of the plant called in Peru the Star-reed (Bejuco de la Estrella) in which the Spanish botanist presents another notable species. As Ruiz put it "...the Star-reed is a drug of greater interest to Spain, growing abundantly in her American possessions and it will constitute a new branch of national commerce."[59] And in a footnote he explains the reasons why it should be exploited, "in order to contravene the exclusive trade of the English in Virginia Snake-root, or at least to save Spain the annual sum drawn from her by them for this article." A substantial part of Ruiz's Memoir is an extended defence of his Star-reed as a drug preferable to the Snake-root.

The first source of information about the remedy seems to come from indigenous people, who, as Ruiz explains, used the plant for medical purposes." The great estimation in which the Star-reed is held by the indians ... exited in me the most lively wish to make myself acquainted with the plant." And he goes on to say that the indians used the Star-reed "as a remedy for dysenteries, malignant inflammatory fevers, colds, rheumatic pains, and the various diseases arising from fatigue."[60]

As we have already suggested, it was common among botanists to assign similar properties to related species, so that the "discovery" of a new species of a plant belonging to a genus in demand was always significant. That is why taxonomic disputes were more

than simple problems of classification. Because they were often embedded in commercial interests, such controversies involved bitter disputes over priority of discovery.

Once more we find a related species already used in commerce and known by physicians as a reliable tonic, i.e., Virginia snake-root.[61] Ruiz concluded that the Peruvian Star-reed belonged to the genus "Aristolochia" of Linnaeus, "so that the resemblance of the properties and virtues of the two plants, as belonging to the same genus, cannot be doubted"[62] and that the Peruvian species could be used instead of the Aristolochia serpentaria (Virginia snake-root) against nervous, intermittent and putrid fevers.

However, taxonomy was not the end of the story. As we have shown earlier, the analysis of the plants' chemical components was also important for the recognition of new remedies. Ruiz's Memoir includes a chemical analysis of the Star-reed. The botanist recognizes that "no method has been hitherto devised for exactly and completely analyzing vegetable substances" However, he explains, that by means of "fire or fermentation" and various alterations the constituent principles of plants can be exposed. Making solutions in alcohol, distilled water, acetic acid or distilled vinegar, hot and boiling water... he was able to draw the following conclusions: "... it must be inferred that the virtues of the Star-reed reside in the extractive

resinous and aromatic-camphorous* properties...."[63]

From such results, Ruiz suggested simple preparations that the physicians could adopt in order to make use of the plant. These included : Powder of Star-reed, infusions, decoctions. essential water, vinegar of Star-reed, and so on. Finally, Ruiz provides us with a visual representation of the plant. (see illustration 22) and gives a "Descriptio Botanica" which locates the vegetable in the Linnaean system : Classis XX, Gynandria Hexandria, Aristolochia fragrantissima.

D. The Chinese root

The "Raiz china" or Chinese root was an anti-venereal remedy, also brought into Europe from the East. In his Memoria sobre la Raiz China descubierta en el Peru.... Ruiz claims to have discovered in America the genuine Similax china described by Linnaeus and brought into Europe from Asia. In his entry of the 23th of July 1784, Ruiz noted:

> ...I have discovered the special Chinese root, which we import from China and Japan to Europe and America as a very important anti-rheumatic and sudorific. This plant, known among the indians with the name of Purampui and Palo santo, and by Linnaeus with the name

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* A bitter and aromatic taste and a strong characteristic smell proper of camphor.

> of Similax China... is so common in these mountains... that it is possible to collect infinite quantities of its roots... and in so doing our nation will find a new branch of commerce, without the need of begging it to the Chinese, as we do nowadays.[64]

His publication, once again, aimed to persuade dealers, pharmacists and physicians that the plant discovered by him in Peru was the same species as the one that Spain had to buy from other nations. Not surprisingly, Ruiz also reported the medical uses that the plant had among the indians Panatahuas.

It is clear that in the second half of the eighteenth century the Spanish government and Spanish scientific institutions were committed to finding substitutes for products that Spain had to buy from other countries. As a result we find an army of naturalists all around the Spanish empire looking for and trying to cultivate, transport and legitimize species from its own colonies. In the following section we want to make clear that the botanist's "discoveries" were not only responding to concrete commercial interests but also that they were, to a large extent, dependent on indigenous medical practices.

II. Indigenous knowledge and European "discoveries"

From the diaries and writings of the explorers it is clear that they had a very poor opinion of the local population's habits and knowledge. Hipólito Ruiz refered to the native Americans as "bellicose", "lazy", "thieving", "evil", "superstitious" and "declared enemies of the Europeans".[65] However, the Inca civilization as well as other native cultures of America were largely dependent on the cultivation and collection of useful plants, and as is shown by several instances, the natives' own practices were a major source of European medical and botanical knowledge.

A. Calaguala

The Pharmacopea Matritensis of 1762, long before Ruiz departed for America in 1777, included Calaguala as a solvent and a sudorific. Besides it also appeared in Gomez Ortega's Instructions as one of the plants to be investigated by the explorers.

Hipólito Ruiz's Memoria sobre la legitima Calaguala y otras raices que con el mismo nombre nos vienen de la America meridional (Memoir on the genuine Calaguala; and other roots which are sent under the same name from South America), as well as other botanical writings of the explorers, was an attempt to distinguish a single species as the genuine specific from a group of plants

sold under the same name. As he explains, "...there have been and are current in commerce many roots of different 'Cryptogamous' plants of little or no virtue, to the disparagement of the efficacious and genuine Calaguala, which casually though rarely reaches Spain; and if it comes to the hands of druggists and dealers, they unjustly decry it, preferring the roots of a plant of a distinct genus and of no virtue, as equivalent to the Calaguala...."[66]

"The dealers, druggists, and professors of medicine," wrote Ruiz, "include under the name of Calaguala, three species of roots brought from Peru; but the indians and natives of that kingdom distinguish these three species by very different names, derived, with sufficient property, from their respective plants. They call the first and genuine Calaguala, callahuala; the second, Puntupuntu; and the third species Huacsaro."[67]

Ruiz also explains how the term Calaguala was extended to all roots of the family "Felices" or ferns. He notes that they passed in commerce as genuine species of the Calaguala, and how collectors were accustomed to procure and mix up with roots of the first species of Calaguala the roots of other species of polypodium, which are very similar at first sight and which Ruiz distinguished as two distinct species. "My sole object in this memoir" - explains the Spanish botanist - "is to remove the doubts and ambiguities which exist on this matter; to illustrate by means of the subjoined

descriptions, and exact definitions of the genuine Calaguala...."[68]

But what does "genuine" mean for Ruiz and on which grounds did he argue that the root he described is the only authentic Calaguala? Ruiz put forward an argument common among the botanists, i.e., that the genuine species is the one he thought was originally used by indians in Peru, who "already used the Calaguala as a sudorific, solvent, deobstuent and anti-rheumatic remedy before the Spaniards entered those countries"[69]

Needless to say, South American aborigines did not share with eighteenth century Linnaeans the notions of "genus" or "species"; nor did they understand concepts such as anti-rheumatic, sudorific, solvent, deobstruent and so forth. The Spaniards, however, did not have any problems in borrowing and distorting folk stories as the ground for their own "discoveries".

Ruiz also argued that, the roots of the "genuine" Calaguala, used in Peru, scarcely ever occurred in European commerce. Therefore, those roots most commonly sold by the druggists and dealers in Cadiz were of the second and the third species (Puntupuntu and Huacsaro), and the Calaguala remedy had been discredited. Perhaps for the same reasons the Calaguala was excluded from the "Materia Medica" of Linnaeus and from that of Peter Jonas Bergius.

By the end of his paper, "Of the difference between the genuine Calaguala and the other roots with which it

is confounded..." Ruiz insists once more that the Polypodium calaguala is a distinct species (the genuine) and explaines that this Peruvian plant is a very different species from any of the Polypodia mentioned by Linnaeus in his "Species plantarum", neither Polypodium lanceoratum nor Polypodium phylilitidis. Next he gives a detailed Linnaean description of the three plants sold in commerce under the name of Calaguala. He included some illustrations and "an accurate engraving from the original drawing" (see figure 23) arguing that the Polypodium Calaguala is the only one which ought to be used in medicine clearly protecting and promoting the trade of his Peruvian species.

While explaining the virtues and uses of the plant, Ruiz seems to rely on what he calls "the aboriginal experience":

> The indians and other natives of Peru are convinced that it possesses really great deobstruent, sudorific, anti-venereal, and febrifuge virtues, and to call them in question would be unjust, since they have been proved by the experience of so many years.... At the present day not only not only those indians who have very little communication and dealing with the Spaniards, but also Spaniards themselves, and most of the indians from Peru and people of other castes, make use

of the Calaguala for the same purposes.[70]

Even though Ruiz's main argument in favour of the medical virtues of the plant seems to rest on folk knowledge, which is presented as time tested and somehow reliable, his reference to the natives' experience can be read as a mere anecdote. The legitimation of "his discovery" cannot be based on the medical knowledge of "savages", which were very often regarded as superstitious and useless.

Therefore a process of translation and appropriation was required, and Ruiz had to find arguments more in accordance with the style and authority in natural history prevalent among enlightened Europeans.

An important principle which guided the rhetoric of the explorers, as already indicated above, was the assumption that related species had similar virtues. Consequently, already profitable plants were often re-discovered or similar suitable replacements were found. Ruiz pointed out that many other species of the family of the Ferns (Felices) had medical uses. "The the anti-rheumatic and emmegogical virtue of the root of the fern, Polypodium filix, Linn; the emollient and pectoral virtue of the Polypodium vulgare, Linn; the astringent virtue of the Spleenwort, Asplenium caeterach, Linn; and the aperient virtue of the Maiden hair, Adranthum capillus veneris; these like the Calaguala grow in airy, pure and salubrious situations."[71]

The translation of folk experience into an enlightened language consists of a whole series of actions: referring to plants with Latin names, classifying them in the light of Linnaeus' system, providing a suitable visual representation of the species, describing the specimens according to contemporary knowledge of botany, explaining their virtues in terms of known European diseases or illnesses, and indicating how to prepare drugs using the methods of eighteenth century pharmacy.

B. Ratanhia

The root of Ratanhia was one of the few remedies that were added to the Pharmacopea Hispanica because of the work of the botanists of the Royal Expeditions. It was included in the fourth edition of 1817 as an astringent.*

In his Relación de viaje... Hipólito Ruiz presents the medicine with the following description:

> The root of Ratanhia possesses the most efficient stiptic virtue, which restrains any flow of blood; taken as an infusion of half an ounce of dried root; or one "dracma" (one-eighth of an ounce) of its extract dissolved

* An agent that produces contraction or shrinkage of organic tissues or that arrests hemorrhages, diarrhea or other discharges.

> in water the roots are useful for cleaning and reaffirming the teeth, purpose for which it was already used in Peru when I discovered its efficiency against haemorrhages....[72]

Ruiz also published in Madrid a longer account of his discovery, a description and an account of the uses of the plant in his Disertación de la Ratanhia, específico singular contra los fluxos de sangre... in 1799. The paper starts with a description of the places and topography where the plant was found and with an account of the different local names it had in America. "Ratanhia" (plant lying on earth) was the name chosen by Ruiz as the most "adequate description of the plant and the most common in Peru."

Ruiz explains that he did not know of the root's properties until he saw some women brushing their teeth with a straw which happened to be the root of the same Ratanhia Krameria triandra that he had discovered in 1780. Its stiptic [austere or acid] taste made him suppose that, as with other substances with similar characteristics, Ratanhia should have astringent properties.

By means of repeated cooking in boiling water Ruiz extracted a substance from the root and sent it to the physician Cosme Bueno in Peru. Bueno did not give any report on the effects of the new remedy, but Ruiz recounts incidents in which the medicine was

successfully tested. By chance he visited a silversmith whose son sufferrd from a nasal haemorrhage that no remedy had stopped. He also met a female slave with continuous menstruation and a few other cases for whom the botanist's extracts successfully arrested the bleeding of different patients.

In his Memoria sobre la Ratanhia, Ruiz explains that:

> the major contributions to the discovery of new medicines have taken place in barbarian lands, and that few professors of medicine are devoted to the discovery of new medications, but rather to its propagation.... The first virtues and uses of the root Ratanhia, should be counted among the discoveries made in barbarian lands and by people without culture for the indians of Peru had been using the root as a remedy since immemorial times. Their practices were then extended to Spaniards and Creoles who still use the plant for cleaning and reaffirming their teeth and as a cure for sores of the mouth.[73]

However, Ruiz claimed the discovery of the roots astringent properties as his own: "In 1784 I discovered", claimed Ruiz, "its efficient stiptic virtues."[74]

Ruiz's Memoria sobre la Ratanhia also deals with the different techniques of collection and desiccation,

adequate packing and transport. Then he offers a complete account of the different modes of preparation (drinks, pills, powders) and their doses both as a remedy for haemorrhages and as a dentifrice. Finally he gives a botanical description of the plant Krameria triandra and provides a large illustration (see figure 24).

C. Yallhoy

In Ruiz's Memoir on the virtues and uses of the root of the plant called "Yallhoy" in Peru, once more, it seems to be clear that acknowledgment by European physicians of this plant goes back to a custom common among natives. Let us quote Ruiz again:

> ...The Faculty in Huanuco, finding that none of the remedies in medical use were adequate to arrest the fatal progress of an epidemic dysentery which prevailed in this city in the years 1788 and 1789, prescribed clysters of the decoction of barks of the roots of Yallhoy. They were induced to this by observing that the natives already used the bark with success for evacuating the intestines when affected with irritating diarrhoea. Observing the good effects resulting from these clysters, the faculty took a further step and administered

internally the infusion of a small quantity of the barks made in hot water.[75]

In so doing - Ruiz points out - the physicians succeeded in curing the epidemic. In a footnote he mentions that the drug had also been tested in Europe by the doctor Thomas Garcia Suelto, who had been commissioned by the Royal Medical Academy of Madrid to make experiments with this new anti-dysenteric remedy in the general hospital of that city. Suelto reported he had cured two patients afflicted with dysentery, and that he had followed the method described by Ruiz in his essay. Two other successful cases of the use of the new anti-dysenteric drug by European doctors are mentioned.[76]

Ruiz's papers are always accompanied by a detailed botanical description of the plant (Descriptio Botanica) which locates the specimen in the Linnaean system and which includes the Latin names of its Class, Genus and species, followed by a latin botanical description of the plant's diagnostic characters - Class XVII, Diadelphia Octandria, Monnina polystachya - and is usually accompanied by beautiful illustrations (see figure 25). A chemical analysis similar to the one done on Calaguala and a description of the modes of preparing the infusions, powders, pills, or clysters are also included.

Conclusion

The publications, manuscripts and diaries from the eighteenth-century explorers suggest some common patterns in the introduction and certification of American vegetable remedies into European medical practice. First it is clear that Spanish botanists took part in a major economic project for the mercantile substitution of foreign commodities. With few exceptions, all the important plants under investigation were - or were presented as - suitable replacements for, or even improvements of, already used medications. The botanists commonly inferred that related species ought to have similar virtues. Consequently, taxonomy and particularly the Linnaean method of classification, served as an essential tool of legitimation.

It is also evident that the indigenous medical practices had a central function for the European exploration of the New World. The natives' knowledge was never recognized as such, and was often scorned and regarded as irrational, but a translation and re-interpretation of their practices took place; an enterprise in which not only voyagers and botanists made crucial contributions but also in which the pharmacists, chemists and physicians back in Europe played their parts.

The case of coca is particularly helpful for illustrating the ambivalent approach and uses of

indigenous traditions by European explorers.[77] The coca plant, so prized by the natives, and regarded as a divine plant among the Incas, was generally looked upon by Europeans merely as a savage means of intoxication, or at best, a mere source of idle indulgence among a race. However, Hipólito Ruiz, in his Relacion Historica del Viaje, wrote: "The leaves of coca have well corroborated medicinal properties against diarrhoea, stimulates the menstruation after giving birth, and taken in infusion or powder is a remedy for acidity and also fortifies the teeth"[78]

When Mutis wrote about the medical uses of the "Aceite de Canime" he noted: "from the effects observed among the Brazilian indians it is known that this remedy is a powerful cure for kidney and bladder diseases". However, he insists in distinguishing "popular-empirical knowledge" from "observation governed by reason" and seems to move from the former to the latter just by translating a unfounded belief into a more "reliable" and "rational" style. A few lines later Mutis describes the remedy again: "It is known by corroborated and constant observation that there is an affinity between this balsam and the glands which separate the urine in the kidneys...", and he adds, "it is the strongest and most reliable diuretic known in nature...."[79]

The language used to describe the virtues of the plants, the use of concepts such as "febrifuge", "astringent", "tonic", "diuretic", and so forth, made

the European explorers spokesmen and put them in possession and control of new remedies which matched the interests of eighteenth century medical practice.[80]

In the process of certification of new remedies there was a fundamental transition from botany to chemistry, from the field to the laboratory. Pharmacy and botany were never fully independent from the work of botanists, but the chemical analyses taking place in the King's Pharmacy provided new criteria for the legitimation of vegetable remedies. As we have explained and illustrated, those analyses consisted of a comparative study of the chemical properties of plants. Even plants that belonged to different species or genera could serve similar purposes and could be seen to have the same or similar "active principles".

The Royal Pharmacy, situated inside the King's Palace, represented a space where Europeans gained full command and possession of overseas plants. Inside the laboratory walls the complexity and variety of vegetable species was subjected to a final reduction into quantifiable principles.

To sum up, we can identify three main stages in the process of translation. The first stage is one in which folk traditions and discovery stories are reported by the explorers. In so doing they raise interests and give credibility to their own claims. In a second stage the botanist provides a taxonomic identification of the

plant, a process of appropriation described in chapter two, which in the case of medical plants functioned as an indispensable practice for the certification of genuine species. Finally the third stage is one in which the plants are not only located in a particular Linnaean category, drawn and named, but are also reduced and analyzed to their chemical components.

The result of the practices described above was that medical knowledge, medicinal substances and their commerce became exclusive property of a comunity whose interests and power remained centralized in Europe. Within Spain, the control of pharmacy and medical practice was gradually moving towards a central location, Madrid. Needless to say, Spain's pharmaceutical and commercial interests were in turn shaped by major networks of political and scientific power that remain beyond the focus of the present research.

Some of the ideas suggested above shall be examined in a detailed study of the most controversial of all American remedies, the case of quinine, with which we shall deal next.

NOTES

1. Michael Callon, "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay", in John Law (Ed.) Power, action and belief, (London: Routledge and Kegan Paul, 1986), pp. 196-233.

2. Hipólito Ruiz, Flora Peruviana et Chilensis. Prodromus, descripciones y láminas de los nuevos generos de plantas de la Flora del Peru y Chile (Madrid: Imprenta de Sacha, 1794), prologue.

3. See A. Gonzalez Bueno, "Hipolito Ruiz Lopez (1754-1816): Ensayo bio-bibliografico", in Ruiz, Disertaciones sobre la raíz de la ratánhia.... (Madrid: Biblioteca de Clásicos de la Farmacia Española, 1992).

4. Frances Maria del Carmen Causape, "Estudio de la especialidad farmaceutica en España", Boletin de la Sociedad Española la Farmacia, 94 (1973): 49.

5. W.F. Bynum and V. Nutton (Eds) Theories of fever from antiquity to the Enlightenment (London: Wellcome Institute for the History of Medicine, 1981). For a general exposition of the European medical practice during the eighteenth century see Lester S. King, The philosophy of medicine: the early eighteenth century (Cambridge: Harvard University Press, 1978); Guenter B. Risse, "Principles of eighteenth century therapeutics" and "The use of drugs", in Hospital life in

Enlightenment Scotland, pp. 177-82 and 189-202 (Cambridge: Cambridge University Press, 1986); Andrew Cunningham and Roger French,(Eds.) The medical enlightenment of the eighteenth century (Cambridge: Cambridge University Press, 1990). For the particular case of medical practice in Spain during the Enlightenment see Juan Riera, José Masdevall y la medicina española ilustrada: enseñanza epidemias y guerra a finales del siglo XVIII (Valladolid: Universidad de Valladolid ed., 1980).

6. Bernabe Cobo's writings are considered one of the main sources on the history of the Incas; his publications include: History of the Inca Empire, an account of the indians customs...., trans. Ronald Hamilton, (Austin: University of Texas Press, 1979); and Inca religion and customs..., trans. Ronald Hamilton (Austin: University of Texas Press, 1979).

7. Bernabe Cobo, "Of their knowledge and practice of medicine", in Inca religion and customs, pp. 220-22.

8. See for example Francisco Guerra, The pre-columbian mind (London: Seminar Press, 1971); Geoffrey W. Conrad and Arthur A. Demarest, Religion and Empire: the dynamics of Aztec and Inca expansions (Cambridge: Cambridge University Press, 1984).

9. See Nancy A. Chavez, La materia medica del Incanato (Lima: 1977).

10. Ibid.

11. Hipolito Ruiz, Relación histórica del viaje, que hizo a los reinos del Peru y Chile enl botánico D. Hipólito Ruiz en el año 1777 hasta él de 1788, en cuya época regresó a Madrid. ed. Jaime Jaramillo Arango, (Madrid: Real Academia de Ciencias exactas Físicas y Naturales, 1952) pp. 475-6.

12. See Antonio Gonzalez Bueno et al, "La expedición botanica a los reinos del Peru y Chile (1777-1831): Un analisis de sus resultados", in La ciencia Española en Ultramar (Madrid: Ateneo de Madrid, 1991).

13. See Juan Riera Palermo, "La medicina Hipanoamericana del siglo XVIII", in Anales de las II Jornadas de Hiatoria de la medicina Hispanoamericana (Cadiz: Universidad de Cadiz, 1989), p.55.

14. Antonio Ased y Latorre, Historia de la epidemia acaecida en la ciudad de Barbastro en el año de 1784... cited by Juan Riera, "La medicina Hispanoamericana....", p. 51.

15. Martin Rondon y Bell, Relación de las epidemias que han afligido a la ciudad de Cartagena, sus causas y metodo curativo, Cartagena, 1787, cited by Juan Riera, "La medicina Hispanoamericana...." , p. 53.

16. For a comprehensive historical study of the Spanish "Protomedicato" see John Tate Lanning, The Royal Protomedicato: the regulation of the medical professions in the Spanish Empire (Durham: Duke University Press, 1985).

17. "Sumministro de medicinas y varios, 1782-1787", Archivo de Farmacia. Palacio Real de Madrid. Signatura C-3-3.

18. See A. Gonzalez Bueno and F.J. Puerto Sarmiento, "Ciencia y farmacia durante la ilustracion" in: Manuel Sellés et al., (Eds.) Carlos III y la ciencia de la Ilustración (Madrid: Alianza Editorial, 1988).

19. Maria Esther Alegre Perez, "La Real Botica y las especies Americanas", Boletin de la Sociedad Española de Historia de la Farmacia (siglo XVIII), 140 (December 1984): 225-244.

20. For a comprehensive account of Boerhaave's chemical and botanical works see: F.W. Gibbs, "Boerhave's chemical writings", Ambix 6 (1958): 117-135; and "Boerhaave and the botanists", Annals of science 13 (1957): 47-61.

21. Antonio Gonzalez Bueno and M.C. Frances Causape, "Divulgación científica en la farmacia española ilustrada :El exámen farmaceutico ... de Francisco Brihuega" LLULL, 14 (1991): 495-505.

22. F.J. Puerto and L. Sanz Diaz, "Las idea científicas de Felix palacios", Boletin Sociedad Española Historia de la Ciencia, 32 (1982): 237-247.

23. Pharmacopea Matritensis Regii, ac sipremi Hiapaniarum Protomedicatus auctorite, jussu atque auspiciis elaborata, (Madrid, 1739). See also John Tate Lanning, The Royal Protomedicato, op. cit., p. 233.

24. Rodriguez Noval et al., "La influencia de las expediciones botanicas ilustradas en las farmacopeas españolas", in La ciencia española en ultramar (Madrid: Ateneo de Madrid 1991), pp. 235-247.

25. John Tate Lanning, The Royal Protomedicato, p. 233.

26. Rodriguez Noval et al., "La influencia de las expediciones botánicas", p. 243-245.

27. See Marcelo Frias and Andres Galera, (Eds.) Pedro Fernandez de Cevallos: La ruta de la canela americana (Madrid: Historia 16, 1992), p. 11.

28. Nicolás Monardes, Herbolario de Indias, E. Denot and N. Satanowsky, Eds. (Mexico: Turner, 1990), cited by Frias and Galera, Pedro Fernandez de Ceballos, p. 13.

29. See Jorge Juan and Antonio Ulloa, Noticias secretas de America, in L.J. Ramos ed., 1991, cited by Frias and Galera, Pedro Fernandez de Ceballos, p. 16.

30. Casimiro Gomez Ortega, "Suplemento a las instrucciones" in Ruiz, Relacion historica del viaje, p. 402.

31. Ruiz, Relacion Historica del Viaje, p. 166-7.

32. José Celestino Mutis, "Correspondencia y oficios de Mutis". Archivo Real Jardin Botánico de Madrid, Div. III. Transcription in: Hernandez de Alba (Ed.) Archivo Epistolar del sabio naturalista J.C.M., (Bogotá: Instituto Colombiano de Cultura Hispánica, 1983) p. 40.

33. See Frias and Galera (Ed.) Pedro Fernandez de Ceballos, p. 34.

34. This colection of documents are among Mutis papers in the Archive of the Botanical Garden in Madrid. They have been edited by Marcelo Firias and Andres Galera . Pedro Fernandez de Cevallos. La ruta de la canela Americana. op.cit.

35. "Canelos" was also the name given to the region where the trees of "canela" were found.

36. Frias and Galera (Eds.) Pedro Fernandez de Ceballos, p. 112.

37. Ibid., p. 125.

38. Ibid., pp. 127 and 206.

39. José Celestino Mutis, "Letter to the Viceroy Caballero y Gongora", in Hernandez de Alba (Ed.) Archivo Epistolar del Sabio Naturalista J.C.M., p. 148.

40. Frias and Galera (Eds.) Pedro Fernandez Ceballos, p. 48.

41. Archivo Real Jardin Botánico de Madrid, Div. III, 2, 3, 4.

42. "Informe de Juan de Cuellar, botanico del Rey en Filipinas sobre la canela...", Archivo de Farmacia, Palacio Real de Oriente. Madrid. Expediente sobre canela, Legajo 4650.

43. Juan Diaz was appointed first assistant at the Royal Pharmacy in March 1783. Due to the death of the chief pharmacist, Martinez Toledo, Diaz was named chief royal pharmacist three months later.

44. "Suministro de medicinas y varios 1782-1787",

Archivo de Farmacia, Palacio Real de Oriente. Madrid. Signatura C-3-3.

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52. "Disertación phisico chimica botanica del the de Bogota comparado con el de Levante", Archivo General, Palacio Real de Oriente. Madrid. Leg. 4650.

53. Ibid., p. 2.

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55. Ibid., p. 4.

56. Ibid., p. 6.

57. Casimiro Gomez Ortega, "Exámen del The de Bogotá", Archivo del Real Jardin Botanico de Madrid, Div. III, 2, 5, 32.

58. "Analisis quimico del te de Bogotá", Archivo de Farmacia, Palacio Real Real de Oriente. Madrid. Suministro de drogas y varios, 1790.

59. Hipólito Ruiz, "Memoir on the virtues and uses of the plant called in Peru the Star-reed (Bejuco de la Estrella)" in: Aymer Lambert (Ed.), An illustration of the genus Cinchona, (London, 1821) p. 149.

60. Ibid., p. 150.

61. See Guenter B. Risse, Hospital life in Enlightened Scotland (Cambridge: Cambridge University Press,1986) p. 197.

62. Ibid., p. 154.

63. Ibid., p. 165.

64. Hipólito Ruiz, "Memoria sobre la Raiz China descubierta en el Peru por Don Hipólito Ruiz" in Disertaciones, p. 67.

65. See Ruiz, Relación historica del viaje , pp. 215-225.

66. Hipolito Ruiz, "Memoir on the genuine Calaguala and two other roots which are sent under the same name from South America", in Aymer Lambert, An illustration of the genus Cinchona, pp. 98-9.

67. Ibid., p. 110.

68. Ibid., p. 112.

69. Ibid., p. 101.

70. Hipólito Ruiz, "Memoria sobre la legitima y otras dos raices que con el mismo nombre nos vienen de la America meridional", in Disertaciones, p. 31.

71. Ibid., p. 113.

72. See Hipolito Ruiz, Relacion de Viaje, p. 230.

73. Hipólito Ruiz, "Memoria sobre la Ratanhia", in Disertaciones, p. 10.

74. Ruiz, Relación del viaje, p. 230.

75. Hipolito Ruiz, "Memoir on the virtues and uses of the root of the plant called Yallhoy in Peru" in Aymer Lambert (Ed.), An illustration of the genus Cinchona, p. 134.

76. Ibid., p. 138.

77. Ibid.

78. Hipólito Ruiz, Relacion historica del viaje, p. 154.

79. José Celestino Mutis, "Aceite de canime", in Escritos cientificos, p. 167.

80. For a general appraisal of medical practices during the Enlightenment see Lester S. King, The medical world of the eighteenth century (New York: Robert E. Krieger, 1971); see also works cited in note 5.

CHAPTER IV

THE COUNTESS, THE JESUITS, THE CARDINAL, THE DEVIL, LINNAEUS AND THEIR POWDERS

> I am foolish and rabid against species mongers or rather against their vanity. It is an useful and necessary work which must be done, but they act as if they had made the species, and if they were their own property.
>
> Charles Darwin[1]

The following case study consists of a detailed illustration of three stages in the process of translation and appropriation, described in the previous chapter. We shall see how the displacement ocurred, and how knowledge moved from one group of spokesmen to another. First we shall deal with some discovery stories that helped to raise interest in quinine and constituted a first step of legitimation. Then we shall study the works of botanists involved in a dispute over Cinchona classification where Linnaean taxonomy became

indispensable for the certification of the medical uses of the trees. Finally we shall focus our attention on the chemical analysis undertaken at the Royal pharmaceutical laboratories in Madrid.

Despite the extensive secondary literature available on the history and medical uses of Cinchona, there is no satisfactory account of the practices, actors and interests that made the Peruvian bark one of the most important remedies in the history of medicine. This chapter questions and explains traditional accounts of the "discovery" of quinine and offers an analysis of central episodes in the medical and commercial history of the trees of quinine during the late eighteenth and early nineteenth centuries.[2]

I. Discovery stories, raising interests

Probably the most important plant in the history of medicine, quinine is said to have benefitted more people than any other drug, and has been regarded by some as the greatest medical discovery of the seventeenth century. However, the history of its "discovery" is far from clear. We shall argue that earlier attempts to addess questions such as when and by whom quinine was first discovered, pose misleading problems. As suggested in previous chapters, the very idea of "scientific discovery" is inappropriate for

understanding the work of the explorers; it leads us to reconstruct stories that tend to ignore the context which preceded, motivated and made possible the certification of new remedies. Any attempt to isolate a genuine discovery moment and a single author ends up with a distorted reconstruction of the actual practices involved in exploration.[3]

Let us begin with the question of whether the aboriginal Americans knew about the curative properties of quinine or not, and whether "malaria" was known in America before 1492. The problem has interested historians representing a diversity of views; some of them have argued, with documents and elaborated data, that malaria was completely unknown in America before the arrival of the Spaniards, and that it was brought to the New World either by Europeans or by African slaves. Alexander von Humboldt, for instance, doubted that the discovery of the medicinal power of the Cinchona belonged to what he saw as the primitive nations of America.[4] Others, also with reasonable evidence, maintain that "malaria" has existed in America from pre-columbian times and that "quinine" was successfully used to treat intermittent fevers by some tribes who administered the bark macerated in "chicha" (a kind of fermented corn beer).

We do not have to go too deeply into this argument to realize that we have to beware of anachronisms. "Malaria" is an Italian word from the nineteenth

century, about which, needless to say, pre-columbian aborigines knew nothing. Moreover, the natives' knowledge of "botany" or "medicine"- though sophisticated - had nothing to do with the medical reasoning of modern Europeans.

If we turn our attention to the question of how either indigenous Americans or Europeans knew about the medical properties of the fever bark, we shall find that the idea of "discovery" has been nourished and justified by a number of fanciful folk legends, most of them of western origin. It is said that the indians saw how mountain lions, suffering from fever chewed the bark of a particular tree, which turned out to be the fever tree.[5]

An folk story often quoted by historians goes like this:

> Some trees in the Peruvian wilds were blown into a pool by the wind, and thereby the water became very bitter, in fact so bitter that the natives refused to drink it. One day a native was seized with violent fever, and finding no other water to quench his thirst, he was forced to drink the water from this pool, with the result that he was cured. He then related his wonderful discovery to the other inhabitants of the district and thus the fame of the febrifuge qualities of Cinchona became known.[6]

The issue of European conception of the fever tree and its properties, though more accessible, is a question by no means easier than the former, and once more our first source of information is based on charming tales, some of them from folk tradition, others much more academic but not necessarily more reliable. There is, for instance, exactly the same story about the trees and the pool quoted above, but with a Spanish soldier instead of an indian.

The following story, if not exactly accurate, is of undeniable historical interest. It is said, that sometime between 1632 and 1638 in Lima, Francisca Fernandez de Ribera, wife of the fourth count of Chinchon, the viceroy Luis Geronimo Fernandez, was attacked with intermittent fever. On hearing this news, the "corregidor" of the viceroyalty of Peru, Juan Lopez de Cañizarra, sent a portion of the bark and informed the count that the corregidor himself had suffered from similar fever and that was cured by the bark of quina, which he had been informed was a successful remedy for fevers among the native indians. As a result, the countess recovered quickly and was completely cured. Soon she ordered a large quantity of the bark to be sent to her to relieve the sufferings of the citizens who often suffered from the fever. This is why the bark was called "Los polvos de la condesa" (the countess's powders).[7]

Jaime Jaramillo Arango, A. W. Haggis and other

scholars have found good evidence to discredit this story; the dates and the names involved do not fit, and the official diary of the Count of Chinchon does not mention that episode.[8] These details however, and whether or not the Countess of Chinchon was actually cured, are not our main interest. What is relevant about the story is, firstly, it indicates that the countess episode constituted a succesful certification of the remedy with European aristocratic patrons rather than indians. Secondly, it shows that the story was widespread in Europe where the bark was known as the countess' powders, and Linnaeus himself, wishing to immortalize the name of the countess gave to the genus of the tree the name of Cinchona.

Linnaeus' spelling "Cinchona" is not accurate and the mistake was pointed out by botanists, such as Ruiz in 1792, but it has been officially recognized as the proper name for the genus of the quina tree.* However, Linnaeus' spelling mistake was neither the first nor the last of a series of ambiguities in which botanists, dealers, physicians and governments were involved with the fever bark.

Next, we shall seek to explain how particular

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* The omission of the "h" seems to be originally found in an Italian version of the story. As in Italian language the sound "ch" before "i" is given by the letter "c" and not by the "ch" as in Spanish, it is very likely that an Italian (Ballus or Bado) who heard the name "Chinchon" ingenuously wrote "Cinchon" and in so doing gave an original name to the genus of the tree of quinine.

communities and interests were involved in the fabrication of the quinine business and its relationship with botanical classification and medical knowledge. To begin with, the word "quina" or "quinaquina", was originally given by the natives to the Peruvian balsam tree Myroxylon peruviferum and not to the fever tree Cinchona, but later these words were transferred from the balsam to the fever tree; and even today we understand "quinine" or "quina" as the popular name for the genus Cinchona. As it was argued by later naturalists - Ruiz and Mutis - the majority of naturalists and commentators who dealt with the matter in Europe confused and mistook the actual Cinchona genus for the Myroxylon peruviferum or Peruvian balsam. The two plants not only had botanical similarities, but also both were supposed to have medical properties. Ruiz published in 1821 a work titled "Description of the tree known in the kingdom of Peru under the name of quinoquino and of its bark called quinaquina, which is distinct from the quina or cascarilla".

However, the confusion was not entirely gratuitous and is worth explaining. A regular trade of the balsam tree - then called quinaquina - was carried out between Europe and South America before the advent of Cinchona. A rumour of the curative properties of the "Peruvian bark" began to spread in Europe and not surprisingly the merchants took the opportunity to increase the sales and prices of their old stock which was previously declining

in popularity. So they continued to refer to the new with the same name as the Balsam, that is to say by the name of "quinaquina". This is not to mention that native collectors of the product, who faced with the unexpectedly great demand for the fever bark, took advantage of the similarities and did not have any problem in mixing up the two barks according to their own convenience.

Around 1630-1640, a chance traveller may have brought samples or even a cargo of the fever bark with him to Spain or Italy, but it is generally accepted that the Jesuits were the ones who first deliberately sent or brought it to Rome, where the Spanish cardinal Juan de Lugo was a central figure in propagating news of the bark's uses and in marketing the drug. Then people began to talk about the "powders of the cardinal". The Jesuits, who had a closer contact with the native Americans, arranged the collection of the bark, powdered it and sold it for the benefit of the order. By 1650 quinine started to be identified with the Society of Jesus and began to be known as the "Jesuits' bark".

Besides the already-mentioned difficulties in identifying the genuine bark, there were other factors which made the commercialization and general recognition of the tropical remedy controversial. Some opposition to the new drug came from other countries and particularly from the protestants who refused the Jesuits' remedy and did not recognize any benefits of

the drug. An example is the case of Oliver Cromwell, who, sceptical about the virtues of the jesuits' bark, referred to the remedy as "the powders of the devil".

No doubt, political and religious rivalry was an important factor in a controversy which went on for many years, but there were other factors that we want to study in some detail.

By the time Cinchona bark made its debut in Europe the battle between Galenists and iatrochemists was being fought. Galenic physicians, who finding that the nature of the bark did not fit into the ancient theories, regarded with suspicion or rejected the new remedy. The ancient idea was that fevers could be relieved only by expelling corrupt "humours" from the body, but the new drug expelled nothing, hence it could not be a valid cure. The new drugs brought into Europe from the New World caused some discomfort to the conservative medical practitioners. Already in trouble by the inroads of iatrochemistry they were further disturbed when drugs that were not part of the traditional materia medica began arriving from distant parts of the world. Cinchona was characterized by some as an "impertinent innovation".[9]

However controversial, quinine posed social, economic and botanical issues that could not be ignored, and an intense struggle for its monopoly took place among the European empires. The adulteration of Cinchona bark by collectors in South America, the difficulties in

identifying a single genuine bark, the lack of knowledge on the part of physicians about the method of preparing the drug, the death of several people after taking it, the poor quality of much of the bark on the market, as well as the religious and medical controversies; all these factors made the search for and establishment of the botanical criteria for the identification of the genuine fever tree a burning issue of undeniable political and commercial interest.

The Spaniards controlled the sources of and the trade in the bark, consequently the problem of quinine was unavoidable for the Spanish explorers of the eighteenth century who undertook a great deal of research on the fever tree. The Crown had given specific instructions to the botanists to investigate the quina trees and make clear the ambiguities about their properties and origin. In the instructions given by Gomez Ortega to the explorers the trees of quinine had evident priority.[10]

It is worth keeping in mind that "intermitent", "putrid" and "malign fevers" constituted the major concern of Spanish medicine during the eighteenth century. The medical literature on fevers during the second half of the century included academic memoirs, monographies dealing with particular epidemics and a number of news and references about therapeutic methods often appeared in news papers such as the Gaceta de Madrid, or the Memorial Literario.[11] A common feature of such publications was the inclusion of a comment on the

febrifuge virtues of quinine.[12]

II. Taxonomy and certification

The first description of the tree by a man of science and sent to Europe, was by the French astronomer Charles Marie La Condamine who was asked by the botanist Joseph de Jussieu to make observations. La Condamine travelled to the region of Loxa, where he observed and collected some specimens, and a botanical description of the supposed genuine tree of quinine was for the first time published in 1738 in the Memoirs de L'Academie. La Condamine was of the opinion that the uses of quinine were known in America before the arrival of Europeans, and also suggested that it was very likely that the natives, who "still have an explicable antipathy for their conquerors" kept hidden the virtues of the specific for many years.[13]

La Condamine's paper included information on the geographical location of Loxa, giving its altitude, longitude and latitude. He also gave a physical description of the tree. However, the French astronomer recognized that he lacked proper botanical training and time for a better examination of the plant. "I could not examine by my self the differences in colour, nor the diversity of species and its virtues. For such examination one needs more time, and above all, the

inspection of a botanist...." "My intention", wrote the French explorer, "was to yield and conserve one of them (trees of quinine) for the Jardin des Plants in Paris, but despite all my efforts it was not possible."[14] La Condamine's text was translated into Spanish in 1778 by Sebastian Lopez Ruiz who published an extended version with his own comments on the Cinchonas from Santa Fe.[15]

Linnaeus classified and named the genus Cinchona based on the drawing of the leaves, flowers and fruit of the tree made by La Condamine in February 1737 (see figure 26) and on its accompanying description. It appeared in the second edition of Linnaeus' Genera Plantarum 1742; in his Species Plantarum 1753, Linnaeus presented a description of the species Cinchona officinalis for the first time, but his classification was by no means definitive. Linnaeus had never seen the plant and - as claimed by later botanists such as Ruiz, Humboldt and Mutis, more familiar with the number of varieties of the tree, or just familiar with different varieties - La Condomine's drawings lacked certain data needed for the establishment of all the characters of the genus. That is to say that, although "genus" in Linnaean taxonomy is a central category - natural and real - Linnaeus did not exactly "describe" a new genus but rather created one, and one which not everybody was ready to recognize as such.

In 1764 Mutis sent to Linnaeus a coloured drawing of the tree made by Miguel de Santiesteban (figure 27) as well as a dried specimen. Two extracts from the correspondence which passed between Mutis and Linnaeus show the importance of exchanging illustrations and specimens for the diagnosis and classification of plants. In a letter dated 24 September 1764, Mutis writes: "... I send you a drawing with some of the flowers of the Peruvian bark. I am not certain whether the celebrated Monsieur de La Condomine has given any drawing along with his description, nor whether you had an opportunity of examining a dried specimen as I find no mark indicative of this, in the generic description of Cinchona in your Stockholm edition of 1754...."[16] In his reply to Mutis, Linnaeus gratefully explains that his drawing, leaves and flowers "never seen by me until now, really have given me an idea of a very rare genus, and very different from that which I acquired through the figure of M. La Condomine."[17]

From the edition of 1767 of Systema Naturae Linnaeus included in his description of Cinchona officinalis both the plant drawn by La Condamine and the one sent by Mutis for his description. As Ruiz, Humboldt and Bompland, among others, showed later, Mutis's specimen was quite different from La Condomine's, consequently Linnaeus' description of the "species" which he had called Cinchona officinalis and which was supposed to be the genuine fever bark, was a composite based upon one

species from Loxa - which Humboldt named C. condaminea - and another species from New Granada - the C. cordifolia of Mutis.

Linnaeus' "mistake" arose because Mutis sent him a species he thought was the same as the one from Loja. However, in the opinion of Ruiz and Pavon, the plant from Mutis bore no resemblance to the plant drawn by La Condomine (figures 26 and 27).

> Even though M. La Condamine, in his Memoir... described and made drawings of a branch of the quinine trees he had observed in the Caxanuma mountains, it shall be noticed by comparing his drawings and description with ours, that he did not spend time enough for the proper botanical description of the species he saw in his travels, and which he registered as a single one .... as almost every single writer has been wrongly persuaded by this learned man.[18]

So that, in his description - as Humboldt also explained in his work on quinine - Linnaeus united, without knowing it, two different species, the yellow Cinchona from Santa Fe and the one originally drawn by La Condamine.[19]

As a result, Linnaeus' description of the genus, being based on two species so remote one from the other, was - as pointed out by Humboldt and Ruiz - too vague,

and loaded with many heterogeneous elements. A number of barks which passed in commerce as Cinchona were not Cinchona at all, although some of them might have possessed febrifuge properties.

The ambiguity remained but the business kept growing, and this apparent lack of taxonomic precision quickened manipulations by merchants, local interests or botanists looking for scientific prestige and recognition, who finding it convenient labelled their own specimens Cinchona officinalis. The trouble with and relevance of the term "officinalis" (used in medicine) is that it was both a classification and an evaluation.

Until 1780 the only reliable bark was derived from the area of Loja that was in demand and expensive. It was not farmed and the trees were being destroyed in the process. After gold and silver the most valuable commodity by weight was quinine bark and by the mid-eighteenth century the Spaniards desperately needed new sources of quinine. By 1782 Cinchona still was an exclusively Peruvian product; and virtually every vessel which entered Cadiz from Callao carried a consignment of it. The range of American products imported into Spain in the late eighteenth century was wide and varied, but the Peruvian bark alone represented 1.4% of all Spanish imports.[20]

It was not supposed that the trees grew north of the equator until Miguel de Santiesteban, Mutis and others

reported that the genus grew abundantly to the north in what was then known as the Kingdom of New Granada.

Santiesteban had recognized the Cinchona tree in Popayan - a small town in the south of Colombia - in 1752, he showed the specimen to Mutis who, although acknowledged Santiesteban's "discovery", claimed fifteen years later the finding for himself and thus started a bitter controversy about the priority of the discovery of the new trees and their medical utility.

Mutis's first observations were published in a local paper of Santa Fe de Bogota, The Diario in 1793 and reprinted in Madrid in 1828 with the title El Arcano de la Quina. In this work Mutis not only distinguished and described seven kinds of quinine but also explained their supposed particular medical properties. Four of them - in Mutis'opinion - had febrifuge properties and were classified under the label of Cinchona officinalis. They were the orange, the red, the yellow and the white. The other three were thought as genuine species of the genus Cinchona but with no febrifuge properties. As Mutis explained, the orange was the most effective but the red, the yellow and the white had not only indirect febrifuge properties but a large number of medical uses. In opposition to the idea that the only legitimate bark came from Loxa, all these quinines were supposed to grow in the surroundings of Santa Fe. Mutis's work, needles to say, was of great commercial importance, for as we said, the trees from Loxa were rapidly disappearing and

their existence in the north opened trade in New Granada.

The classification of quinine according to the colour of its barks was already a common practice among Peruvian collectors. Mutis's task was then to translate the local criteria into his own using Linnaean categories. It is not surprising that the shape of the leaves constituted the essential and distinctive feature of Mutis's four species. "The orange quinine", explained the botanist, "has spade like leaves, bitter and aromatic taste". However, he added, "it could be confused with the yellow and for a clear distinction the bark ought to be powdered and compared, if the colour increases its intensity, it is orange, if decreases is yellow". Similarly he defined the other species acording to their leaves. "The red has oblong leaves and bitter and austere taste.... The yellow has heart shaped leaves and a taste between bitter and sour.... The white has oval leaves and the same taste as the yellow"[21] (see figures 12-16).

As we discussed earlier, the Peruvian bark gained access to Spain more readily than that of Santa Fe, but interestingly enough, the latter, which the North Americans and English managed to import directly from Cartagena, enjoyed a pre-eminent reputation in England, France and Germany. This meant that after 1780 Europe received bark from both Loxa and New Granada; the bark went partly to Spain and partly (by smuggling) direct to

England and North America.

Prices varied depending on the places where the bark was collected. Often it was necessary for a good bark to be accompanied by a certificate of its origin sworn before a notary. However sometimes the same name "Loja bark" was used for Cinchona from other places, as it was thought to be the same species as the one from Loja.

A document sent by Mutis to the king explained the urgency of controlling the trade of quinine. The title of this work was Real proyecto del Estanco de la Quina (Royal project for the state monopoly of quinine). Here Mutis argues that it is indispensable to establish a central control of quina trade in order to prevent manipulations by particular interests. Not surprisingly he exposes a number of reasons to set up this control in Santa Fe and insists that the trade of quinine in the regions of Peru should be suspended. The document is not only an extensive defence of the quinines from Santa Fe but also shows that Mutis knew extremely well the details and figures of the commerce of the bark, for he gave a comprehensive account of the economic benefits of his proposal.[22]

Mutis himself and some of his collaborators were involved in the illegal exportation of quinine to other countries.[23] Mutis made a considerable fortune in America, and his own interest in the commercialization of the quinine from Santa Fe as well as the financial benefits he had from the exportation of quinine remain

to be explained.

Mutis never had the oportunity to travel to the district of Loja. However, Francisco José de Caldas, probably the most important of Mutis's collaborators, spent four years in Peru collecting specimens and doing research on the quinine trees from that part of the continent. The case of Caldas will be studied in the following chapter, but it is worth mentioning briefly his contributions to the knowledge of quinine barks. The result of his investigations can be seen in an unfortunately never published work, Memoria sobre el estado de las quinas en general y en particular sobre las de Loja (1805). Caldas, an admirer of Alexander von Humboldt with whom he shared his works in 1801, was more an astronomer and geographer than a botanist. His investigations were focused on the geographical and topographical distribution of the different species of quinine. Caldas's contributions were to enlarge the number of barks known, and to provide descriptions and drawings of new species that would later complement the works of Mutis's expedition. However, his conclusions were different from Mutis's. Caldas was of the opinion that "In all Meridional America, only in two hundred leagues around Loja was to be found the true Cinchona officinalis, the only species with full recognition in Madrid's Royal Pharmacy."[24] His solution to the problem was also different. From his geographical studies he

knew that in New Granada there were places in which the trees from Loja could be cultivated for the benefit of Spain.

Mutis and the members of the Royal Expedition to New Granada were neither the only Spanish physicians or botanists in South America nor the only ones who put forward a classification of quinines. There are also the works of the botanists in charge of the Royal expedition to the viceroy of Peru. In 1777 Hipólito Ruiz and José Pavón were appointed to lead an expedition to Peru and Chile; and as Ruiz pointed out: "... we were ordered by the ministry of Indias, as one of the most important tasks of our mission, to undertake the examination of the cascarillos or quinine trees, as well as of everything related with them."[25] In 1788, after ten years in the tropics, they arrived in Cadiz and settled in Spain. From 1789 to 1802 the two explorers were engaged in the composition and publication of their main work The Flora Peruviana et Chilensis. For a number of reasons (see chapter 2) the publication of the Flora was delayed and incomplete, however, in 1792 Ruiz published his Quinologia and there is no doubt that the relevance of quinine to the state contributed to the prompt publication of this small volume.

The work was dedicated to the Count of Floridablanca with the following words: "Your excellency knows better than I can explain how important it is for the state and even for the human race, to fix knowledge on the various

species of quinine, their virtues, uses and commerce...."[26] Ruiz, like Mutis, sought to lay the foundations of better botanical knowledge of the fever tree by announcing that he had observed, described and had drawings made of seven species, the first of which he named "officinalis" and was regarded by him as the genuine from Loxa and the one with the best febrifuge properties. "I devoted myself with particular care", wrote Ruiz, "to investigate, observe, collect, describe and make drawings of every species I found, the number of which reaches seven. The observation and description of such a considerable number of species made it easier to correct and improve more and more the description of the genus Cinchona made by the immortal Linnaeus."[27] Ruiz arranged his seven species as follows:

1. Cascarilla fina, (C. officinalis)
2. Cascarillo delgado, (C. tenuis)
3. Cascarillo lampiño, (C. glabra)
4. Cascarillo morado, (C. purpurea)
5. Cascarillo amarillo, (C. lutesces)
6. Cascarillo pálido , (C. paliesces)
7. Cascarillo pardo, (C. fusca)

Despite the fact that Mutis's and Ruiz's classifications were visibly different, Ruiz found, perhaps for the last time, friendly words for his colleague in Santa Fe, and commented on Mutis's manuscript: "...I see with much pleasure, corroborated

some of the observations and reflections in my own treatise...."[28] But, as we shall explain later, behind the taxonomic debate there was a more fundamental dispute involving local commercial interests and it would become more intense and hostile.

In 1800, an anonymous defence of Mutis's species appeared in the Diario de Madrid which included the name and address of a dealer from whom those barks could be bought. The dispute became public as a number of attacks on Mutis began to appear in the same publication. Mutis's protector assumed that the attacks on Mutis and the trees from Santa Fe were written by "...some merchant who wanted to sell the Peruvian bark at higher prices".[29] In the same journal the unidentified author of Mutis's apology answered with the following text:

> What reason is there in physics to persuade, that the quinines from the meridional part of the line - Equator - are preferable to those from Santa Fe? In the boreal part there are the same lands, the same expositions, the same heat, the same height, the same distance to the line, and the vegetals are all the same, and being true all this, how can you believe that only the quinines are different?[30]

Antonio Zea, a South American disciple of Mutis and later director of the Botanical Garden in Madrid, in his

Memoria sobre la quina, segun los principios del señor Mutis (Memoir on quinine following the principles of Mr Mutis) published in Madrid in 1800, not only strongly defended the barks from Santa Fe but also suggested that all the species of Ruiz and Pavón could be reduced to mere varieties of the orange, red or yellow quinines of Mutis,[31] and if this view gained acceptance it would imply equating the trees of New Granada with those of Peru. The policy of discrimination that had hitherto favoured the dealers in Peruvian Cinchona would then collapse. The botanists in Madrid seemed to be divided in two groups with confronting positions on the species of reliable quinine. Gomez Ortega supported Ruiz and Pavon, while Cavanilles was clearly on Mutis's side. Zea met a cold reception from the Ortega-Ruiz axis, but the new power in Spanish botany, Antonio Jose Cavanilles, who in 1801 ousted Gomez Ortega as head of the Royal Botanical garden, was a bitter opponent of Ruiz. Cavanilles had been on intimate terms with Mutis by correspondence since 1786; in 1803 Zea became his assistant in Madrid and took over the headship after Cavanilles' death in 1804.

In 1801 Ruiz and Pavón published their Suplemento a la Quinologia which included an extensive response to Zea's Memoria de las Quinas. In this work, Ruiz and Pavón described four new species discovered by Juan Tafalla, who had been asked by Ruiz and Pavon to remain in Peru when the two leaders of the expedition returned

to Spain in 1788. However, the publication was, above all, a direct attack to Mutis, Zea, and the quinines from Santa Fe. The botanists presented their work with the following statement: "It will be completely clear that the orange, red, yellow, and white quinines from Santa Fe, are notoriously inferior species than those from Loja and Peru recognized in medicine as the most efficient and exquisite.... It will be shown that the orange is the only one that can be counted among the average quinines; that the red and yellow belong to are of the inferior type and that the white is the least steemed of all."[32] The publication also contains a thorough description of Mutis's orange quinine, "...in order to illustrate the marked difference existing between this quinine and the species from our Flora Peruviana".[33]

Ruiz and Pavón's defense of the Peruvian species was accompanied by bitter remarks on the Royal Expedition to New Granada, questioning the botanical capabilities and reputation of Mutis and his collaborators as well as the results of an expedition which, despite its generous economic assistance and numerous members, had produced such limited results. When Mutis was named director of the expedition, Ruiz and Pavon pointed out that he already was an old man who did not travel further than the surroundings of Santa Fe de Bogota and Mariquita. They also suggested that Mutis should have received a copy of Ruiz's Quinologia before May 1793, when Mutis's

Arcano de la quina began to appear in a news paper of Santa Fe, and that he never even mentioned it. Mutis's silence - in Ruiz and Pavon's opinion - was due to "jealousy that someone else, who visited America seventeen years later than he did, would have anticipated him in publishing an original work such as Ruiz's Quinologia".[34] They claimed that the names Orange, Red, Yellow and White were originally given by the people raising quinine in Loja; that Mutis had applied those names to the quinines from Santa Fe, and that Mutis's Arcano was no more than quotes from a multitude of authors in medicine copying everything from La Condamine and others, and finally that Mutis project of a state monopoly of quinine based in Santa Fe was nonsense.[35]

The authors of the Suplemento also pointed out Zea's mistake of equating the orange quinine (C.lancifolia, Mutis) with the tree described by La Condamine, which Linnaeus named Cinchona officinalis. Interesting enough, in his Quinologia, 1792, nine years earlier, Ruiz had made a similar attempt to equate the C. officinalis of Linnaeus with his C. nitida, (see figures 28 and 29) claiming that it was the same Cinchona described by La Condamine (figure 26). This assertion was withdrawn in the Suplemento of 1801, but nevertheless, it shows that the name of Linnaeus, who had never seen a Cinchona tree, was for the Spanish botanists an important means for ensuring their

recognition. Linnaeus was the authority which would legitimize their work in Europe where the Swede's signature provided scientific support and universal recognition in natural history. Not only Spaniards regarded Linnaeus as Adam; in another important work on quinine written by the English botanist Aymer Bourke Lambert A description of the genus Cinchona, 1797, we find a similar reasoning. "Cinchona officinalis, wrote Lambert, "this is the species from which is taken the genuine Peruvian Bark, and is that which was first discovered: it is the species which has given the character of the genus, and is consequently that which Linnaeus mentions in the old editions of his Systema Naturae and in the sixth edition of his Genera Plantarum."[36] Totally distinct varieties were described by the name of C. officinalis: e.g. C. cordifolia, Mutis; C. macrocarpa, Vahl; C. nitida, Ruiz; and the one originally described by La Condamine, which Humboldt named C. condaminea. Acting as though the Linnaean word "officinalis" was giving medical power to the different barks and consequently higher prices as well as credit for its discoverer, the explorers were eager to borrow the name.

Both Ruiz and Mutis had their own local and individual interests which in turn were due to the commercial importance of the bark. These interests are factors that ought to be taken into account for the understanding of the Spaniards' attempts to classify

Cinchona barks. Such interests must also feature in our explanation of the construction of the knowledge of the bark's medical virtues. Moreover, more than once, botanists found good arguments to fabricate the only or most reliable species.

These circumstances, as described by Humboldt in 1821, gave rise to very singular prejudices in judging of Cinchona bark.

> Certain mercantile houses in Spain, which a half century since were in possession of the exclusive trade in Cinchona bark, endeavoured to throw disrepute on that from New Granada. They found complaisant botanists, who, by boldly exalting varieties to species, proved that all Peruvian Cinchonae were specifically different from those which grow about Santa Fe... Physicians like Popes draw lines of demarcation on the map. They insisted that beyond certain degree of latitude in the northern hemisphere no efficacious Cinchona could grow. The effect of mercantile cunning went so far, that at the royal command, a quantity of the best orange-coloured Cinchona bark from New Granada which Mr. Mutis had caused to be peeled at the expense of the king, was burned, as a decidedly inefficacious remedy, at a time when all the Spanish field hospitals were in the greatest want of this valuable product of South America. A part of the Cinchona bark condemned to destruction was secretly

bought by English merchants in Cadiz, and publicly sold in London at high prices.[37]

Humboldt, who was indebted to his friend Mutis, from whom he had received numerous specimens and botanical drawings, seemed to favour him on the whole issue of the barks. "Professor Zea", wrote Humboldt, "thinks, and, as it appears to me, with perfect propriety, that several species of the Flora Peruviana, denote merely different states of the quina naranjada, such as depend on the age, the climate, and the place of growth." [38]

We will now analyze the grounds on which the dispute was taking place, what were the criteria and observations counted as competent, and what were, in the botanists' opinion, the actual properties that made one plant preferable to another.

In 1792 Ruiz admitted: "Nobody so far, has demonstrated with certainty in which part or principle of the barks are their admirable virtues stored, nor do they know how it works in the human body". Similarly, in his Arcano de la Quina, Mutis had recognized the lack of knowledge on the nature of quinine's virtues "which no one has been able to determine". However, in the Suplemento we read: "The signals that so far we posses to prefer some experiences than others are: abundance of sticky substance in the bark; acid and sour aroma, distinct and pleasant; little stypticity and none or a

small number of whiskers; characters all present in the superior barks of Loja and Peru, which, during 160 years have produced prompter and more reliable effects".[39] What were those reliable effects? The barks, far from being regarded as a specific, a cure for a single and separate disease such as malaria - completely unknown at that time - Cinchona was presented rather as a multiple remedy for a large number of heterogeneous afflictions. Even if a particular species was thought to have no febrifuge properties, it might be useful as a digestive, antiputrid, stomachic, suppurative, absorbent, anti-spasmodic; it could prevent prevent tooth aches, head aches, abortion or rheumatism. In Ruiz's account we find two pages with more than twenty different medical uses of the bark.[40] Mutis, similarly, did not have problems in attributing a large variety of functions to the barks of quinine.

Physicians and botanists from other European countries became involved in the dispute, and as we shall see, contrary to the efforts of the Crown to increase imperial power by means of colonial exploitation, quinine monopoly would soon be taken out of Spanish hands.

The English botanist and vice-president of the Linnaean Society, Aymer Bourke Lambert, was able to buy an extensive herbarium, containing nearly the whole of the plants collected by the authors of the Flora

Peruviana, the number of which amounted to 5700 species. The collection also contained numerous specimens both in flower and fruit of the species of the genus Cinchona with accompanying descriptions. In 1821 Lambert published in London a major work on quinine, An illustration of the genus Cinchona, in which he lists and describes twenty-two species. The book included Alexander von Humboldt's On the cinchona forests of South America, a work - as Humboldt put it - "with a view to examine the Cinchona tree as an object of physical or botanical geography", and from which we have quoted several times. Humboldt himself arranged 18 species, but he adds six more species which deserve a closer investigation. Lambert's publication also contained a "Memoir on the different species of quinquina" by M. Laubert, who was then the chief physician to the Spanish Army. As we see the number of species was gradually growing, and as Laubert points out, "Botanists recognize about twenty barks of the genus Cinchona, but the number of those which are current in commerce is much more considerable."[41]

After Ruiz's death at the age of sixty-two in 1816, Pavon became the chief botanist of the project of the Flora Peruviana. Pavon was writing a new work on quinine Nueva Quinologia, finished in 1826, that included twelve species already described in the Flora and thirty-two new species which Tafalla had discovered. Some copies of this work circulated among European

botanists and was finally published in English by John Eliot Howard in London in 1862.

In 1858 Howard obtained fifty-four specimens of barks of Pavon's collection together with an original manuscript in Pavon's hand writing. Nine of Pavon's new species, as Howard pointed out in his publication of 1862, were excluded by present arrangements from the genus Cinchona. Howard also added a number of species which he thought were new. Howard's Illustration of the New Quinologia of Pavon with coloured plates by W. Fitch, and observations on the bark described, circulated in important European scientific circles and was translated into other languages. The volume also contained material from an unpublished manuscript by Ruiz, Compendio Historico medico comercial de las quinas.[42] Howard, unlike Humboldt, was by no means on Mutis's side, but he rather followed Ruiz and Pavon from whom he had received the material of his own publication. The red bark from Mutis, Cinchona oblongifolia, in the opinion of the English naturalist, was an "entirely worthless plant, that does not even belong to the genus Cinchona". He also insisted that the trees from Peru were different species than the those from Santa Fe.[43]

The disputes over classification were not the end of the process of translation, displacement and control. Besides the mercantile houses, dealers and botanists with different personal and local interests and

taxonomic opinions, chemical criteria were also taken into account, and the pharmacists of the Royal Pharmacy would have their own part in the dispute.

Now it is time to study a third stage in the legitimation of quinine, to move into the laboratories and see how the dispute shifted from the field to the laboratory, from the American wilds to Madrid, and, more precisely, into the Royal Palace itself. The plants were not only transported, dried, drawn and classified but now powdered and decomposed in their "constituent elements", their "active principles" were isolated, measured and evaluated. In so doing the crown gained closer control over Cinchona, that is to say, control over dealers, botanists and physicians.

III. The Royal Pharmacy

As has been shown, the disputes over Cinchona classification were central for the recognition and certification of the bark as a genuine remedy. However, not less important and probably with a more direct impact upon pharmacy, were the chemical analyses undertaken at the Royal Palace's chemical laboratories.

Every single consignment of Cinchona bark brought into Spain was supposed to go to the Royal Pharmacy where it was examined, classified, stored and then distributed. Once in Cadiz the cargos were located in

the "Casa de Contratación" waiting for transport that the Palace would provide in order to move the consignment to the Royal Pharmacy. In the court's laboratories, the first pharmacist and his assistants proceeded to open the boxes, recognize and classify the products.

The external appearance and particularly the place of origin were important criteria for an initial classification. The quinine from Loja, which had been in commerce for the longest time, was considered of excellent quality and classified according to the size and state of the canes. External features such as thickness, smell, colour, consistency and taste were taking into account. It was generally believed that the anti-febrifuge properties of the bark were due to its bitterness.

The quinine from Loja was then classified as belonging to the first, second or third class and accordingly distributed for the use of the King, hospitals or for other possible uses. The bark classified as "superior" was for restricted use of the Royal family and for the annual presents that the King sent to the Pope, the courts of Austria, Naples, Toscana and so on. The rest was used in hospitals, by the army or donated for charity.[44]

The barks brought from other places different from Peru received a different treatment. These barks were subject to a comparative chemical analysis. By means of

distillation and stratification their "gummous and resinous parts" and their "principles" were isolated in order to compare these results with the ones obtained by similar examination of the Peruvian Bark. If the results were similar, the report was favourable. If not, the bark could be considered of inferior quality and larger doses were recommended. Inferior barks were simply rejected and burnt or used for other non-medical purposes like dyeing.

Apart from the chemical analysis and the elaboration of the corresponding reports, samples of the barks were sent to a number of practising physicians in order to test their efficiency and possible secondary effects which might harm the patients. These clinical trials were undertaken at the hospitals with poor patients suffering from tertiary fevers. Once concluded, the experiments the physicians were ordered to report their results to the first pharmacist of the court.[45]
The archive of the "Real Botica" at the Royal Palace in Madrid keeps a vast collection of documents and manuscripts on quinine. They include accounts of the cargos received, distribution of the remedies, reports from the hospitals, and evaluations of the chemical virtues of the barks done in the laboratory of the Royal Pharmacy.

Particularly relevant are the reports of comparative chemical analyses and the consequent approval or rejection of barks original from Santa Fe or other

places distinct from Loja. As we have shown previously, the controversy about the quality of non-Peruvian Cinchona was a central political, commercial and scientific concern. The authority of the King's pharmacists was of central importance in these disputes.

In 1784 the Royal Pharmacy received the first consignment of quinine sent by the Viceroy of New Granada. In December of the same year a full report was issued by the pharmacists of the court. The thirteen page long manuscript contains valuable information that is worth examining in some detail. Once again, the source of the plant and its taxonomic identification is the first concern of the court pharmacists. "Following the botanists who methodically have identified the proper and true characters, and that provide the most precise knowledge for the determination of the species, and even though we do not have any of its parts of fructification required to find out whether or not this new quinine is the same brought from Quito, we do not doubt... that they are one and the same species".[46] The report begins with a brief exposition of the essential characters of the quinine from Loja, which "since its discovery has had the first place among all febrifuges and for a long time its efficiency have been corroborated". The pharmacists also point out that the newly-discovered quinine from Santa Fe possessed an "aromatic smell, a bitter taste, red or yellow coloured bark, roughness to the touch, and a skin of certain

mucous white matter, characters all proper and particular of the Peruvian Bark."[47]

From the evidence given so far and other reasons provided later, the pharmacists manifest their confidence that "the quinine from Santa Fe is the same species that Linnaeus called 'Cinchona officinalis' and that is brought from the mountains of Loja, Jaen y Cuenca in the Kingdom of Quito."[48]

The consignment from Santa Fe included three different kinds of barks, red, yellow and white and in order to avoid "false confusions" they appeal to La Condamine's publication in which the Frenchman says that the different colours appreciated in the barks should not lead to the distinction of those barks as belonging to different species. The pharmacists report extensively quotes La Condamine when the French astronomer concludes that "the yellow and the red do not present any visible difference in the flowers, leaves, fruits and not even in the barks" and that their differentiation is only possible by opening the barks that sometimes present different colours, and suggesting that those differences may be due to soil, temperature or other topographical accidents. It is worth remembering that La Condamine had also said that he had no time to examine such differences, and also that the distinction of the trees according to the colour of the barks was common among local colectors and dealers. As we have seen, it was adopted by botanists like Mutis who translated these

four kinds into Linnaean species.

The Spanish royal chemists provide further reasons to conclude that the different barks - red, yellow and white - and the trees growing both in Peru and New Granada might perfectly be one and the same species and that their apparent differences are nothing more than the result of different age of the trees, different exposition to the sun, altitude, and so on. They argued that even from the same tree it was possible to extract differently coloured barks.

So far, and already half-way through the pharmacists' report, they had been dealing with a problem of Cinchona classification. However, the second part of the document presents the results of their actual chemical experiments.

"The purpose of chemistry", says the report, "is to recognize the nature and properties of any object by means of analysis, compositions, de-compositions, and combinations... and we have put the different samples of quinine to these proofs, separating their principles by dry distillation, stratifying their resinous parts and then making combinations and measurements with those results...."[49]

In order to isolate its essential salts the chemists put five ounces of yellow bark in "cold digestion". The result after filtration and evaporation was five "dracmas" and twenty four grammes of a saline substance, as they maintained, "similar to the extract obtained by

the same method from the quinine officinal from Peru".[50]

Four ounces of powdered red quinine were dissolved in thirty-four ounces of "spirit of wine". After proper filtration and evaporation the result was: "Five dracmas and forty eight grammes of a resinous extract very similar to from the one obtained from quinine from Loja."[51] Dry distillation "an operation that, by means of fire, allows us to extract the component parts of natural objects" produced substances that were, in their opinion, similar to those obtained from the Quinine officinalis. "Other operations done with the three classes of the new quinine", concluded the report, "showed that their chemical components or elemental principles are the same, with no distinction from those obtained from the quinine from Loja."[52]

By the end of the paper the chemists recognised some differences in the quantities and weights, but these differences, as they interpreted them, "ought to be attributed to the freshness of the samples from Santa Fe."[53]

They also explained that their intention was neither to be in favour of, nor to write an apology for, the quinine from Santa Fe, but they wanted to make clear that the bad reputation of these trees was due to the commercial use of other barks that did not belong to the genus Cinchona and had been sold as new quinines.

A number of clinical reports issued by physicians during this period seemed to corroborate the reliability

of the quinine sent by Mutis and the Viceroy of New Granada. Among many others, the doctor Miguel Ambrosio Rivillo provided the Royal Pharmacy with a report, dated November 1784, in which the number of patients treated and cured with the new quinine was listed. "From the information above provided", concluded the Spanish physician, "I have observed that the quinine from Santa Fe has a febrifuge virtue as strong and efficatious as the Peruvian quinine."[54] Some other clinical reports of the same and following years contained similar conclusions, some of them, however, pointed out that larger doses were required.

Another revealing document, Extracto de los pareceres de los medicos que han observado la quina de Santa Fe, gathers together the data provided by twenty-two different physicians. Almost all believed that the effects of the new bark were either identical or slightly inferior to the effects of the Peruvian bark.[55]

During the government of the Viceroy Antonio Caballero y Gongora, the quinine from New Granada seemed to compete successfully with the Peruvian. Between 1785 and 1788, 27200 arrobas* of quinine from New Granada were embarked from Cartagena to Spain. In the same period a similar quantity of 27940 arrobas arrived in Spain from Callao, Peru.[56] However, the opposition to Mutis's trees was still strong and the controversy would go on for many more years.

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* Measure of weight = 25 pounds.

In 1788 the Royal Pharmacy received quinine from Santa Marta (a costal town in the north of New Granada) and the analysis concluded that it was the same quinine from Santa Fe. However, this time the report from the court pharmacy was different. The bark from Peru still dominated the market and the criteria were the same: "... as far as the constituent parts of the new quinine correspond to the ones characteristic of the bark from Peru, we can conclude that their uses are also the same".[57] But some differences pointed out by the pharmacists were enough to raise doubts about the quality of this consignment.

Apart from differences in the external appearance, the comparative chemical analysis also pointed out a lower proportion of salts in the quinine from Santa Fe. Further evidence against Mutis's Cinchona was also brought into account. A clinical trial at the General Hospital of Madrid undertaken in 1786, at a time when the Peruvian bark was scarce and the physicians had used quinine from Santa Fe stored since 1785, seemed to indicate that this quinine was notably inferior.[58] Another report of 1789, concluded that "no quinine from Santa Fe is of any use, and while there is Peruvian quinine available, the other barks should be prohibited."[59]

Repeated meetings of the "Protomedicos", (physicians of the court), and the first pharmacist of the Royal Pharmacy failed to produce definitive conclusions about

the quinine from New Granada. As a result the King himself made an attempt to solve the controversy and in February 1789 ordered the suspension of all consignments of quinine from New Granada.

Later the same year, the Royal Pharmacy received two bottles containing extract of yellow quinine sent by the Viceroy of Santa Fe. The first pharmacist, Juan Diaz, said that it was impossible to test its febrifuge properties because there was not enough quantity of the product, but recommended that the barks from Santa Fe should not be used in medicine and that the consignments of that country should be cancelled. In August, September and December new samples arrived. The small quantities, once more, did not allow clinical experiments; but as reported by the pharmacy, their smell, colour, taste and consistency, indicated that the samples received were, in general of good quality but that they did not equal the strong taste and smell of the barks from Quito.

In 1789 fifty-two boxes containing red and yellow quinine from Santa Fe were sent by the Viceroy. The same frigate also carried sixty boxes of quinine from Loja. The two cargoes were initially confused. However the final decision from the Royal Pharmacy was that the bark from Santa Fe had few febrifuge virtues and that it should be better used for dyeing. From that report the crown gave orders to sell all the quinine from Santa Fe and also stipulated the suspension of collecting and

shipment of that useless bark.

The quinine from New Granada would not have a better reception in Spain until Cavanilles and Zea replaced Gomez Ortega in directing of the Botanical Garden in 1803. We have to remember that the botanists of Peru had a closer relation with Ortega, not only because Hipólito Ruiz married Ortega's niece but also because the explorers in Peru were directly chosen and led by Ortega. Cavanilles on the contrary was visibly on Mutis's side with whom had been in contact since 1786. Zea, as we already explained, was originally from Santa Fe, had been a member of the Mutis's expedition there, and in Spain became the major champion of Mutis's Cinchona.

Conclusion

For many years Loja in Peru had the benefit of a monopoly in quinine commerce under Spanish control. The trees originally from this region were regarded by many as the type (the first discovered and genuine species) of the genus Cinchona described by Linnaeus. The medicinal and commercial success of the Peruvian bark was repeatedly certified by botanists eager to give the scientific description and botanical determination of one single and genuine species, Cinchona officinalis, that would not only prevent falsifications but also

secure the monopoly. However, botanists and explorers in other parts of South America also claimed the discovery of equally efficient barks from other places. It gave rise to an endless botanical and chemical controversy with marked commercial interests.

The evidence is clear that by the mid-nineteenth century no one was in the position to stand as a final arbiter in the game of Cinchona identification. We are told that quinine was isolated from Cinchona bark for the first time in a laboratory at Paris on 11 September 1820, and by the mid-nineteenth century Cinchona trees were farmed in both India and Java by the English and the Dutch respectively, hence the monopoly of the bark was taken out of Spanish hands.[60]

Although modern taxonomists cannot be taken as final arbiters, it is worth saying that the number of varieties known at the present exceeds 150, and since the plant is heterostylous, a natural characteristic which conduces to hybridism, their number tends to increase. The genus Cinchona has been completely re-arranged and the majority of the species we have been talking about do not belong to the modern genus Cinchona.

Needless to say the taxonomic problem itself is beyond the scope of the present research. What should be clear by now is that in the business of Cinchona classification and its medical uses were involved factors and interests that neither allow us to

differentiate or draw lines between botany, natural history, commerce, medicine, colonialism and religion; and that the taxonomic complexity of the genus can be explained historically.

We cannot think of plant taxonomy and medicine as enterprises immune to political and commercial incentives, or alien to bigotry, spite and personal interests. On the contrary, as we have argued, ministers, naturalists and dealers were free to negotiate and construct the knowledge of the fever tree. Cinchona, for its economic and medical importance represents a special case, but it was not an exception, as demostrated by examples in previous chapters.

The demand for quinine was particularly strong in those nations with imperial interests in zones with endemic malaria, the English and the Dutch, for example. Under the leadership of Kew Gardens, Cinchona had important demographic and political effects through the control of tropical fevers it afforded. Scholars such as Lucile H. Brockway, have argued that the colonial penetration of Africa in the late nineteenth century was accomplished only after a cheap and reliable source of quinine was available.[61]

We have seen how the Spanish state was committed to find new products that would free Spain from the English, Dutch and French commercial monopolies. However, Spain's success in introducing alternative American products in European markets was limited.

Major South American products began to be cultivated in English and Dutch colonies. Kew Gardens, for example, gained control over rubber, sisal and Cinchona.[62]

As a result of these acts of appropriation, either by Spain or other European empires, the peoples and nations of Latin America were losing control over indigenous plants and native industries. It is time to turn our attention to those countries and investigate the consequences of the expeditions upon the Spanish colonies and the new nations of South America.

NOTES

1. Charles Darwin, quoted in Flora de la Real Expedición Botánica del Nuevo Reino de Granada, vol. 44, Madrid: 1957, p. 68.

2. Some good secondary sources on the history of Cinchona are works by: Jaime Jaramillo Arango, John Owen Evans, A. W. Haggis, Saul Jarcho, Norman Taylor, Clements R. Markham, J.A. Wikinski, and R.S. Desorwitz (see complete references in bibliography).

3. Augustine Brannigan, The social basis of scientific Discoveries (Cambridge: Cambridge University Press, 1981); and Simon Schaffer, "Scientific discoveries and the end of natural philosophy", Social Studies of science, 16 (1986): 387-420.

4. Alexander von Humboldt, "On the Cinchona forests of South America", in Aymer B. Lambert (Ed.) An illustration of the genus Cinchona, London, 1821).

5. Jaime Jaramillo Arango, "A critical review of the basic facts in the history of Cinchona", Journal of the Linnaean Society, 53 (1949): 272-311.

6. Ibid., p. 275.

7. The countess story appears in numerous different versions, e.g. La Condamine, Ruiz, Mutis, Humboldt and others.

8. See Jaramillo Arango, "A critical review"; or A.W. Haggis, "Fundamental errors in the early history of

Cinchona", Bulletin for the history of medicine, 10 (1941): 417-459.

9. See David L. Cowen , Pharmacy, an illustrated history (New York: 1990) pp. 64-5.

10. See Casimiro Gomez Ortega, Instruccion sobre el modo más seguro y económico de transportar plantas vivas (Madrid: Biblioteca de clasicos de la farmacia española, 1992), pp. 37-38.

11. The eighteenth-century Spanish medical literature on fevers is reviwed by Juan Riera, José Masdevall y la medicina española ilustrada: enseñanza, epidemias y guerra a finales del siglo XVIII (Valladolid: Universidad de Valladolid, 1980).

12. For a comprehensive source of information about the introduction and uses of quinine in Spain see: F. Arribaz Arraz, Papeles sobre la introducción y distribución de la quina en España (Valladolid, 1937).

13. Charles M. La Condamine, "Descripción del árbol de la quina...", (1737), trans. Sebastian Lopez Ruiz (1778), in: La Condamine, Viaje a la America Meridional por el río de las Amazonas, (Barcelona: Ed. Alta Fulla, 1986) pp. 156-222.

14. Ibid., p. 216.

15. Ibid., pp. 156-222.

16. "Mutis to Linnaeus, 24 September, 1764", in Archivo epistolar del sabio naturalista Don José Celestino Mutis (Bogotá: Instituto de cultura Hispana, 1983), vol.1, p.46.

17. Linnaeus to Mutis, in Archivo epistolar, pp. 22-3.

18. Hipólito Ruiz, Quinologia o tratado del arbol de la quina o cascarilla con su descripción y la de otras especies de quinos nuevamente descubiertos en el Peru. (Madrid, 1792).

19. Alexander von Humboldt, "On the Cinchona forests", p. 24.

20. See John Fisher, Commercial relations between Spain and Spanish America in the era of free trade 1778-1796, (Liverpool: Centre for Latin American Studies, University of Liverpool, 1985).

21. José Celestino Mutis, El Arcano de la quina: discurso que contiene la parte médica de las cuatro especies de quinas officinalis, sus virtudes eminentes y su legítima preoaración, (Madrid: Ibarra, Impresores de Cámara de S.M., 1828).

22. José Celestino Mutis, "Real Proyecto del estanco de la quina", in Flora de la Real Expedición Botánica del Nuevo Reino de Granada, vol. 44, (Madrid: Ediciones Cultura Hispánica, 1957).

23. See for example, "Don Salvador Rizo, Albacea del sabio Mutis y Mayordomo de la expedición botánica, explica las circunstancias del viaje a Cuba de Don Sinforoso Mutis y consecuencias del mismo", in Historia documental de la Real Expedicion Botánica del Nuevo Reino de Granada 1808-1952, (Bogotá: Instituto Colombiano de Cultura Hispánica, 1986) pp. 157-160.

24. Francisco José de Caldas, "Memoria sobre el estado de las quinas en general y en particular sobre la de Loja", in Obras completas, (Bogotá: Universidad Nacional de Colombia, 1966), pp. 241-260.

25. Ruiz, Quinologia, prologue.

26. Hipólito Ruiz, Quinologia, p. 2.

27. Ibid., prologue.

28. Ruiz, Quinologia, prologue.

29. Diario de Madrid, No. 315 "Martes, 11 de noviembre de 1800", in Flora de la real expedición botánica del Nuevo Reino de Granada, vol. 44, p. 41.

30. Ibid.

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CHAPTER V

THE EXPEDITIONS AND THE CREATION OF A SCIENTIFIC TRADITION IN AMERICA

> The issue here is no longer science in imperial history but science as imperial history.
>
> Roy Macleod[1]

So far we have analysed practices involved in the scientific exploration of America. We have examined natural history, botany and medicine and their function as forms of power embedded in imperial interests. Natural history and medicine operated as tools of appropriation, and we have pointed out the importance of these enterprises for European botanical gardens, natural history museums and, more generally, for the European empires of the Enlightenment. But little has been said so far about the impact of the expeditions upon the emerging American nations and their cultures.

This chapter examines some of the consequences of the implantation of scientific practices in the Spanish

colonies. In so doing, we shall offer new insights into topics such as colonialism, cultural imperialism, the frequently distorted relationship between science and the independence movements of Spanish America, and, above all, into the understanding of science as power.

One cannot legitimately talk about the "relationship" of knowledge and power as two different entities interacting with each other. As Joseph Rouse put it, "power is no longer external to knowledge or opposed to it, power itself becomes the mark of knowledge."[2]

Historians have frequently pointed out the links between state interests and the aims of science and exploration. Such analyses can be very helpful, but the point here is to understand knowledge as a form of power and to appreciate that the dissemination of disciplines such as natural history, taxonomy and medicine is the dissemination of power. From this perspective, we hope to offer some evidence to show that after the Latin American wars of independence - so often related to the progressive ideals of the Enlightenment brought by learned Europeans - the structure of power remained, to a great extent, untouched. The sovereignty of the Spanish crown was not formally recognized any more, but the colonies had adopted deeper forms of dependence; ones which were deep, but neither obscure nor hidden. We are talking about language, religion and science.

In the following pages I shall focus on the case of Mutis, his collaborators and the Royal Botanical

Expedition to the kingdom of New Granada. I shall describe the social identity of the director and other members of the expedition, and examine their roles in the political history of Colombia. It will be shown how Mutis's teaching of natural philosophy, and his influence as a leading physician and director of the botanical expedition, involved the introduction of an ideology which accorded with the Enlightenment's imperial commitments. The practitioners of medicine, botany and geography in New Granada constituted an elite of creoles who have been repeatedly related to the movements of independence and who have become national figures in the history of Colombia. This chapter questions traditional views of the role of medicine, natural philosophy, botany and geography, and of the Enlightenment generally, as sources of progress and independence in Latin America.

José Celestino Mutis, the first botanist of the Royal Expedition to the Vice-kingdom of New Granada, epitomizes what we shall call an "agent of power". Mutis personifies all the ideal features of the disseminator of order, i.e., male, white, European, physician, botanist and priest (figure 30). In this chapter we shall focus on his activities as a spokesman for the Enlightenment and as an emissary of imperial scientific policies in America.

Mutis was born in Cadiz in 1732, studied medicine in Seville, and was trained as a botanist at the garden of

Soto de Migas Calientes, with the botanist Miguel Barnades, where he became familiar with the Linnaean philosophy. Having been named physician for the Viceroy of New Granada, Pedro Messia de la Zerda, Mutis had the opportunity to travel to the New World. At the age of twenty-eight, with many more expectations than simply caring for the health of the Viceroy, Mutis arrived in Cartagena in October 1760. Soon he encountered people who were strange to him, alien customs and the richest and most impressive variety of natural specimens. After a few days in Cartagena, Mutis and the Viceroy travelled to Santa Fe along the Magdalena River. During this month of travel, Mutis was introduced to the riches of the tropical flora and fauna. On 28 January, they arrived in Honda, from where they had to travel by land to Santa Fe at 2,600 m. above sea level in the Andes (see figure 31). Mutis took daily notes of the journey. His main concerns were the exotic vegetation which he described following the Linnaean system; the medical practices among the natives, of which he kept a detailed record; and the state of the Catholic faith.

Passing through hot, temperate and cold climates and all sorts of vegetation and habitats, Mutis arrived in Santa Fe on 24 February 1761. Before leaving Europe, he had already planned to do research in natural history, including a trip to Loxa to investigate the quinine trees. However, once settled in Santa Fe and busy working as a physician, he complained of the lack of

time and resources for natural history.[3]

In the same year, 1761, Mutis wrote for the first time to the King asking for royal patronage for his botanical project. In 1763 and 1764, Mutis persisted and explained extensively the numerous advantages for Spain of exploring New Granada. In a letter of 20 July 1764 addressed to the King, he wrote: "...I am prepared to undertake such a great and useful commission, once Your Majesty agrees to send the salaries and means for the works of an enterprise whose only purpose is to honour the nation, help the public, expand trade, enrich the sciences, supply new funds for the Royal Treasury and give immortal glory to Your Majesty...."[4] However, obtaining royal approval would take more than twenty years and Mutis had to limit his ambitions in natural history to collecting plants in his spare time and noting the medical uses of plants among the local people around Santa Fe. He also began his correspondence with European naturalists, including Linnaeus to whom he sent specimens and descriptions of what he thought were new species.

The return of the Viceroy de la Zerda was imminent and Mutis had to find support for his vast project as a naturalist. The King had not yet approved the expedition and Mutis decided to become a priest on December 1772, probably to assure his stay in America.

Mutis won the admiration of the new Viceroy, the Archbishop Caballero y Gongora, through whose

intervention the expedition finally gained royal support. Carlos III, who six years previously had given permission to Ruiz and Pavon to undertake the expedition to the vice-kingdom of Peru, and who had been informed of Mutis's progress, gave his approval for the expedition to New Granada and named Mutis as its first botanist. The royal news did not arrive in Santa Fe until the following year when the explorers had already done a good deal of research under the auspices of Caballero y Gongora. On 1 April 1783, Mutis, Valenzuela and Garcia received from the Viceroy their first salaries as director and assistants to the expedition.

Soon the expedition moved to Mariquita, a small pleasant town selected by Mutis to be the central base of the expedition. Mariquita had a privileged location. At an altitude of 535 metres above the sea level, the town provided the naturalists with a good climate and easy access to a wide variety of floras and habitats. Its proximity both to important silver mines and to Honda (a terminal port of the Magdalena river) was also convenient. There Mutis founded a botanical garden and organized research on a number of different subjects. The explorers engaged in many activities including studying medicinal plants, quinine, cinnamon, tea from Santa Fe, domesticating bees, mining, collecting birds, insects and, of course, plants. However Mutis's main task, as we explained in chapter two, was the supervision of producing one of the largest

iconographical collections in the history of botany.

The Spanish government, eager to see results, feared that the priest, whose health was increasingly delicate, would never complete the long-awaited works. From Madrid, Mutis received orders to move the expedition to Santa Fe. In 1791 Mutis who was fifty-one years old, began another seventeen years of work centred in the capital. New American naturalists, artists and collaborators joined the expedition making important contribitions. These included Francisco Antonio Zea, later director of the botanical garden in Madrid; Jorge Tadeo Lozano, the zoologist of the expedition; Jose and Sinforoso Mutis, Jose Celestino's nephews; and the most important of all Mutis's collaborators, Francisco Jose de Caldas. All of these men became important figures both in the cultural life of New Granada and in the independence revolution. Caldas, Lozano, Rizo and Carbonel were executed by the Spaniards; Sinforoso Mutis survived probably because of his name.

The fact that some of the members of the expedition became activists and martyrs of the independence war allowed a number of scholars, eager to magnify the image of Mutis, to argue that the European naturalist himself should be regarded as a forerunner of the independence movements and as the "father of the nation".[5] It has been easy and probably convenient to see in Mutis, a priest, a scientist, a white aristocratic and peaceful man, the forerunner of a Catholic nation whose ruling-

class values still fit well with those of the eighteenth century Spanish priest. However, we have not found the least evidence to support those claims. On the contrary, Mutis was always faithful and servile to the Spanish crown, and his attitude towards America and its people was nothing more than paternal. Moreover, as we have been arguing, the whole enterprise of natural history and exploration was clearly directed to favour the Spanish empire. His role as a disseminator of the Enlightenment and of the new scientific ideas - which has also been also exaggerated - gives us an image of a progressive man fighting scholastic preachers.

The role of scientific practices in the colonies and their relation to the creation of the new nations demands a more critical analysis.

It is pertinent to mention briefly some of the historiographical problems one has to face when analysing the establishment of western science overseas and the emergence of figures like Mutis. The conventional depiction of Mutis as "the oracle of the New Granada", "the father of the nation", promoter of the new science and progress, can be traced back to the eighteenth century and to Mutis's own efforts to build such an image. This is a portrayal that we still find in the massive secondary literature which continues to promote his heroic stature.

It is important to remove distorted accounts of the role of Mutis himself and his relationship with

Americans. Despite his enormous influence, Mutis was far from being the only source of European science in New Granada; he was not alone - as some historians seem to suggest - in bringing the Enlightenment to New Granada. We have reasons to question the common notion of seeing Mutis as the master to whom the American naturalists, his "disciples", owe their education and even their revolutionary ideas. The number of people who received Mutis's instructions in mathematics, natural history, physics, botany or medicine in more than forty years, (as well as the influence that he might have had on the people who were in one way or another linked with his projects), is difficult to evaluate. But what seems to be certain is that Mutis was never willing to be replaced, nor to have any successor; moreover, he never thought it was possible. "After my death", wrote the Spanish physician, "the chair of the director of the royal expedition should be abolished."[6]

This is not the place to review the excesses of the historiography of colonial science, but it is worth surveying the interests promoting the celebratory tone in which the history of Spanish colonial science has been written.

To begin with, the common description of Mutis as "the oracle of the kingdom" was originally Mutis's own phrase.[7] Its literal meaning reveals much about the role of European scientists in the New World, for an oracle

was the agency or medium by which a god was supposed to speak or make known his will. Historians, in turn, seem to have been happy to perpetuate that god-like image of western science as a benevolent source of progress. From the very first historian of the botanical expedition, Florentino Vezga,[8] to some of the most recent publications, we can trace a common interest in justifying and legitimatising the patronizing role of science. To a great extent, historians themselves belong to a tradition of promoters of science holding leading positions in scientific institutions who are keen to present themselves as successors of Mutis. They seem to have found in the European priest a convenient model for a local elite of intellectuals attached to the Colombian ruling classes[9] (see figures 32a and 32b).

As has been often pointed out, science and medicine are often considered symbols of the cultural superiority of western countries over the so-called "New World".[10] That view takes for granted that science and medicine constitute wholly progressive historical forces, that the colonies are fortunate to have science and medicine transmitted to them and that such countries should be grateful. Historians have celebrated the success and magnified the benefits of such an inheritance, but the reasons and interests involved in the transmission and implantation of scientific and medical practices have not been thoroughly explored.

When we see knowledge and science as value-free and

neutral, morally unquestionable and almost sacred, we are prevented from realizing that scientific and medical practices carry with them relations of power, and that they constitute important tools of domination which determine superiority, underdevelopment and subsequent control.

Another obstacle to the understanding of science in a colonial context is - as David Wade Chambers and others have pointed out - the conventional periodization of Latin American political history, which for the most part is unrelated to the history of science in those countries. These periods have been delineated by historians whose analyses regard political hegemony exclusively from a marked Eurocentric point of view. Colonization or decolonization, for example, are episodes that correspond reasonably well to European political history but often fail to encompass the "peripheral" stories. If we include economic criteria and take into account historical forces such as science, it becomes necessary to extend the colonial period well into the twentieth century. In other words - as Henk Wesseling suggests - the end of the Empire is not the end of imperialism but the continuation of it by different, more diffuse means.[11]

I. José Celestino Mutis as an agent of the empire

We shall examine the figure of Mutis as a disseminator and promoter of natural history and medicine in the colonies, particularly in New Granada. But we want to approach his activities and the role of science in the Spanish colonies from a different point of view.

As we have seen, the activities of Mutis and his collaborators were numerous and varied, but we must focus our attention on the Spanish naturalist's role as a disseminator of knowledge/power, as an agent of imperial domination, who at the same time contributed to providing a younger generation of Americans with mechanisms of appropriation and control which encouraged some of the protagonists of the war of "independence".

The three intellectual heroes adopted by Mutis - Newton, Boerhaave and Linnaeus - represented the possibility of a systematic and rational understanding of the universe, the human body, and nature. They provided important symbols of the success of Europeans in knowing and controlling nature and hence other cultures.

A. The moral message of natural philosophy

To begin with, we shall examine Mutis's role as a teacher at the University Nuestra Señora del Rosario and

his private lessons in natural history. In a number of papers written for his lectures at the University of Nuestra Señora del Rosario, he gives us a complete account of his ideas on science, its methods and its utility. A good representative of the European Enlightenment, Mutis offered a number of lectures on the importance of mathematics, and on the true method of natural philosophy, which he identified with Newton, Descartes and Copernicus, and of course on Linnaeus.

One of the most interesting of Mutis's manuscripts, kept in the archives of the Botanical Garden in Madrid, is a Spanish version of Newton's Principia. Consisting of 300 pages in Mutis's hand-writing (except for a minor fragment) written between 1739 and 1742, this appears be his own translation of the Principia. Following the Latin edition by the Minim fathers Leseur and Jaquier, Mutis translated Books I and III. There is no translation of Book II which was probably never done. Even though it seems that the Spanish naturalist did not attempt to finish a formal translation for publication, the importance of such an early Spanish version of Newton's work in America is undeniable.[12]

However, Mutis's teaching about Newton seems to be limited to the rhetorical and methodological importance of the new mechanics, rather than the physico-mathematical content of the Principia.

One of the main thoughts permeating all Mutis's didactic work is that the correct method in natural

philosophy leads people both to progress and to God. In one of his works read at the University in Santa Fe de Bogotá, "Elementos de filosofía natural, que contienen los principios de la física demostrados por las matemáticas y confirmados con observaciones y experiencias: Dispuestos para instruir la juventud en la filosofía Newtoniana...." ("Elements of natural philosophy, containing the principles of physics, demonstrated by mathematics and confirmed by observations and experience: for the instruction of the youth in the Newtonian philosophy....") Here natural philosophy was presented as the foundation of religion and morals. "The main merit of natural philosophy, wrote Mutis, "consists in its use as a solid foundation for natural religion and moral philosophy. It leads man, in an agreeable way, to a knowledge of the author of nature and creator of the universe."[13] Insisting that ignoring the true method of science leads to atheism and barbarism,[14] and expressing his blind admiration for Newton, Mutis repeatedly contends: "...every discovery in natural philosophy is a new proof of divinity".[15]

At the same time, natural philosophy is a source of prosperity, order and civilization. This is the principal message of Mutis's "Plan provicional para la enseñanza de las matemáticas, 1787" (Plan for the teaching of mathematics):

> The teaching of mathematics aims to propagate amongst American youth the knowledge of some

> necessary sciences for the welfare of the state, which together with the other useful sciences, are highly prized in the learned world. In direct proportion either to its neglect and absolute ignorance, or to its culture and development, all the civilized nations have experienced backwardness or progress of their industries, agriculture, arts and commerce, which constitute the main branches of man's sustenance and comfort, and which should be seen as essential for any society which aspires to culture and growth.[16]

Needless to say, Mutis was not the only source of the new mechanics or modern philosophy. All through the eighteenth century the colonies received European publications which included the most representative works of the time. But it was not until 1820 when Felix Restrepo published his Lecciones de fisica para los jovenes, that the people of New Granada had access to a Spanish text for the study of Newtonian natural philosophy.

Now that we realise how Mutis conceived that education in natural philosophy would provide the basis for morality, civilization and progress, we can examine Mutis's activities as a physician and naturalist and offer more concrete instances of the roles of the

European man of science as an "agent of empire" in a colonial context.

B. The teaching and practice of medicine

First of all it is important to keep in mind the central role of medicine in the whole enterprise of exploring and controlling America, which in turn corresponds to the central political role of medicine in Spain (see chapter one). During the eighteenth century doctors developed a stronger role as moral authorities and state advisors in institutional management. Sometimes members of religious communities, physicians became the new key agents of state control.

As Foucault and others have pointed out, during the eighteenth century, the health of the population was one of the essential objectives of political power.[17] It was not just a matter of keeping a labour force at work or offering support to marginal sections of the population, but of raising the level of health of the empire as a whole. These goals were related to the maintenance of order, the imposition of values and the organization of enrichment and progress.

Mutis explains these issues in his essay of 1801, "Estado de la medicina y de la cirugía en el Nuevo Reino de Granada en el siglo XVIII y medios para remediar su lamentable atraso" ("The state of medicine and surgery in New Granada in the eighteenth century and the means

to repair its regrettable backwardness"). "Any barbarian society, even those lacking the enlightenment of the useful sciences, is aware of the necessity of empirical medicine, which they practice intuitively by helping their people; but in a civilized and educated society, to be satisfied with such practices, would be to move away from the agreed judgementof the rational world."[18] "A fairly opulent kingdom", writes Mutis of New Granada, "that through its native riches could be exceptionally opulent, walks in slow steps because of the endemic diseases, caused by the arbitrary election of the sites in which its population gathers together." A few lines later he concludes that "nutritional disorders, drinking and poor lifestyles...disable half of the population."[19] Most physicians of the time would have agreed with Mutis that diseases originate in the behaviour and customs of the people. Very often, diseases were explained as being due to lack of discipline and cleanliness, to putrefaction, corruption and decay.

In a similar manner to the role of priests christianizing the natives, civilizing the savages, and saving their souls; so the physicians perceived their mission as saving their bodies. In so doing, they imposed another, equally important, pattern of domination and power, i.e., European medical aims and methods. This process of re-educating the natives can be regarded as a new and systematic form of control and

cultural intervention, extremely well exemplified by Mutis in New Granada.

Eighteenth-century European physicians in the colonial context acquired an influential status with multiple social functions. Often occupying administrative roles, doctors and scientists, like priests, became increasingly trustworthy, seen as expert advisors and protectors of the people. Physicians had authority to instruct individuals and communities on the basic rules of hygiene, food, and behaviour, which people had to follow for the sake of their own health and that of the empire.

In chapters three and four we examined the influence and the incorporation of some aboriginal medical practices into the European medicine and pharmacy. Now we shall look at the encounter between Americans and Europeans from a different point of view, aiming to understand the effects of European medical practices upon the people and culture of America.

At first sight the answer seems to be simple: European methods were more succesful than indigenous practices, which were systematically supplanted and finally abolished with the institutionalization of medical training in the colonial universities during the late eighteenth and early nineteenth centuries.

Nevertheless, the process deserves further investigation. Local and folk medical practices, which

were used by indigenous, "mestizos" and whites, were never really abandoned. Indeed, some of these traditions survive even today among peripheral communities in South America. Folk medical practices did not disappear completely, they were partly tolerated or assimilated by white physicians. Some practices which the Church associated with the devil and heresy were always persecuted, but some others, which were "translated" and explained by the medical reasoning of the enlightened European, became common and in demand. They were, however, slowly transformed and systematically suppressed both by European physicians who imposed Galenic or Hippocratic notions as the only genuine methods, and by churchmen who similarly feared indigenous practices as threateningly pagan activities. For the European authorities indigenous medicine was a practice outside European control, and a source of superstition and witchcraft.

"The deplorable state of health and the high number of deaths", as repeatedly reported by physicians to the Crown, were presented as major obstacles for the proper economic development of the colonies. Pedro Fermín de Vargas, a contemporary commentator who wrote reports on the "regretably slow" increase of the population in America, explained: "in order to have the population that the colonies require we will need thousands of centuries and some control of the epidemics and illness that prevent its growth".[20]

In 1778 the physician Sebastian Lopez Ruiz wrote his Informe contra empiricos y curanderos which explained the problem as lack of trained physicians" that "leaves the population in the hands of empirics, quacks, and druggists, who sell medicaments without any certification.[21] Similarly, in 1796, José Antonio Burdallo sent a report to King Charles IV, Informe al Rey sobre el estado de la medicina en el Nuevo Reino de Granada, in which he explained the problem in similar terms.

Despite Charles III's prohibition of physicians without credentials, the situation did not change. His successor Charles IV took further action and issued a document in which leading physicians in New Granada were requested to give a detailed report of the state of health and medical practice in the New Kingdom. Lopez Ruiz and Vila shared the opinion that any practitioner without official credentials should be banned. The Castilian law would leave the kingdom without physicians at all. Lopez Ruiz's and Vila's only solution was to bring Spanish doctors to New Granada, not only to provide proper medical care but also to establish a chair of medicine in Santa Fe.

Mutis, who was also requested to provide a report, disagreed. As we have discussed, priority disputes over the discovery of cinchonas in Santa Fe, as well as disagreements on the medical uses of American cinnamon, had already created an endless rivalry between Lopez

Ruiz and Mutis. In his report of 1801, Mutis agreed with Ruiz and Vila on the poor state of medical care and on the need for a new chair of medicine in Santa Fe. But instead of seeing the solution in importing new Spanish doctors with official credentials, Mutis argued that the new chair of medicine could be run by physicians already in Santa Fe. Specifically, Mutis had in mind his disciple and friend Miguel de Isla. Despite having no titles, Mutis guaranteed de Isla's competence, for he had been trained by the priest himself.

As Emilio Quevedo has pointed out, the differences between these two groups of physicians - Lopez Ruiz and Vila on the one hand, and Mutis and Isla on the other - reflect a wider conflict between a new local elite and the traditional authority centred on Spain. "The problem of medicine and medical training in New Granada during the eighteenth and nineteenth centuries", writes Quevedo, "is part of a larger number of conflicts in which the legal and political structure of the colony does not respond to the needs and interests of a growing local bourgeoisie which seeks freedom for its commercial activities."[22]

Finally, in 1802, a royal schedule of Charles IV authorized Miguel de Isla to practice medicine and Mutis to reorganize the Protomedicato. As a result, Mutis had a central function in the implantation of enlightened medical practices in the kingdom of New Granada. He was a leading figure in the establishment of a new medical

curriculum at the University Nuestra Señora del Rosario. His efforts to update medical training in Santa Fe de Bogotá, which followed reforms taking place in Europe and Spain and were put to work at the University of el Rosario, are well defined in a document General Plan for the medical education of 1804.[23]

Before the nineteenth century, when Mutis's reforms began to take shape at the university in Santa Fe, the teaching of European medicine had had little success and had only a minor effect upon the local culture. From 1636 to 1802, only two physicians received their titles in Santa Fe.[24] The medical profession had a low social status and a small number of students. The state interest in improving medical training both in Spain and the colonies, came with the eighteenth century enlightened reforms.

Previous attempts to reform the university had included: Francisco Moreno's project in 1768 for the foundation of a public university in order to replace the peripatetic and religious domination of the colleges; and a plan elaborated in 1787 by Caballero y Gongora. The Viceroy's plan, in which Mutis's influence is clear, included the establishment of a new medical training program, teaching chemistry and botany, as well as the foundation of a new operating theatre for anatomical dissections. None of these projects had any success until 1801, when the King approved and ordered the re-establishment of the curriculum of medicine.

Finally, the plans for reform proposed by Mutis in 1802, 1804 and 1805 began to be realised in New Granada. Following almost literally Pablo de Olavide's plan of studies for the University of Seville of 1768, one of the main innovations was the introduction of complementary disciplines such as mathematics, natural philosophy, chemistry, natural history and botany. All of these subjects were regarded as fundamental for the formation of competent physicians. Mutis insisted that medical knowledge could not be isolated from the knowledge of nature, and "it would be impossible to call someone a doctor [medico] who lacks sufficient instruction in the sciences of mathematics, experimental physics, botany and chemistry."[25]

Another significant feature of the reform was the choice of treatises and authors following Hermann Boerhaave's doctrines. Boerhaave's success can be compared to that of Linnaeus. Both of them can be seen as systematizers whose attempts to build comprehensive taxonomic and medical doctrines allowed them to publish numerous editions of textbooks that travelled and were accepted all around the world. Boerhaave's lectures became the basis for several publications. Institutiones medicae (1708) and Aphorismi de cognoscendis et curandis (1709) became not only the new medical textbooks of Europe, but also convenient and comprehensible vehicles for the mobilization of medical European practices into other continents.

The new studies also included the teaching of "rational philosophy, which included logic and ethics" as well as languages such as Greek and Latin. But above all, explained Mutis, it was essential for the physician to command some of the European languages, "particularly French, in which the more recent medical advances are published."[26]

As we see, medical training, including the study of the classics and languages, aimed to provide physicians with a universal culture, a moral education and therefore social status and authority.

One of the prerequisites for entering the university and for being examined as a doctor was to prove purity of blood. In metropolitan Spain, purity of blood meant freedom from Moslem or Jewish ancestry. In America this meant that blacks, mulattoes or any kind of slaves or former slaves were added to those who could not get medical degrees. [27] Mutis explained that one of the reasons for the "pitiful" state of medicine in New Granada, "is that it is exercised by browns [pardos] and people of low extraction."[28] As we shall see later, access to colonial universities in general, not just for the medical professions, was an exclusive privilege of those who were able to prove the purity of their blood.

The reforms, both in universities and hospitals, reflected the policies of reinforcing the state administration to reduce administrative power of the clergy. The Jesuits had been expelled from America in

1767, but religious orders still had more control over education and health than the central government desired. To gain more direct state control, the funds of the hospitals were taken out of the hands of religious orders.

Mutis's influence as a physician and state advisor went further than university reforms. Both Mutis and his disciple Miguel de Isla were in charge of the Protomedicato of Santa Fe. The protomedicos in Spain supervised the preparation of candidates for practising in the medical professions and inspected apothecary shops. In the colonies, they were also assigned the tasks of collecting fees for inspecting pharmaceutical dispensaries, preserving the purity and integrity of drugs and suppressing false or dangerous medical information.[29] The physicians' responsibilities ranged from taking care of the noble and powerful, and prescribing treatments for seamen, soldiers, or even advising on the transportation of slaves. Mutis introduced vaccination programmes against smallpox,[30] was the official inspector of pharmacies,[31] gave directions and warnings upon matters such as the location and organization of towns, cemeteries and plantations.[32] His authority was also important for the publication or censorship of new texts.[33]

C. Botany

Undoubtedly, medicine was a form of colonial control, but it was not the only one. It is time to turn our attention to another political facet of European science in the Spanish America, i.e., natural history.

Botany, the other main interest of the Spanish scientists in the New World, was closely related to medicine. The utilitarian "Baconian" view of botany was particularly strong during the eighteenth century and this was mainly due to its intimate relationship with medicine. Particularly in Spain, as we have explained in previous chapters, medicine had a vital economic and political function. For both voyages of exploration and the development of botanical gardens, medicine acted as a major stimulus. During the sixteenth and seventeenth centuries, botanical gardens had been attached to hospitals; slowly, the function of these gardens expanded beyond their medical origins, but by the end of the eighteenth century medicine and botany were still inseparable. More significantly, most of the plant collectors were physicians or pharmacists.

Mutis repeatedly complained that his duties as a physician distracted him from his major interests: "my botanical excursions, the only reason for my travel to America."[34] The influence of his teachings and reforms at the university and his authority as government advisor are undeniable, but both Mutis's and the Crown's

major ambition was the production of the Flora of New Granada. As we suggested in chapter two, naming, drawing, classifying and transporting natural objects constituted the starting point of a gigantic project of the Enlightenment in which natural history, revealing the mysteries of the natural world, would offer methods for dealing with the economic and political interests of the empires. But again, little was said about the impact of such an enterprise upon the people and cultures inhabiting the territories being explored.

Botanical exploration was part of a major European project of reordering the world. Like many others, Mutis was - to use Mary Louise Pratt's terminology - an "ambassador of an empire" taking part in a global project of classification which is epitomized by Linnaeus' systematizing philosophy. We will just mention a few of the better-known students of Linnaeus who were sent faraway from their country of birth: Pehr Kalm, who went to North America, Frederik Hasselquist to the Middle East, Pehr Löefling to Spain and South America, and Daniel C. Solander travelled with Cook and Banks. Mutis was always proud and conscious of being one of Linnaeus's "soldiers". He - as well as his biographers - gratefully kept a record of Linnaeus' letters as a valuable treasure giving him status as a naturalist.

The process (described in chapter two) of making natural objects transportable, accessible, and

intelligible, entailed not only moving plants, animals or minerals into European centres, but also making things "closer" to a universal language of appropriation available to any trained person.

As Pratt suggests, the systematization of nature was a European project that followed the circumnavigation of the world as cartographers concentrated on the coast lines of the new continents. This new project of "planetary consciousness" was now focused on inland exploration, and was consequently accompanied by a stronger and reinforced imposition of values and culture.[35]

The mapping was not limited to coastlines, but included every single object on the planet: plants, birds, fish, insects, minerals and people. Not only was the local adequacy of medical practices replaced but the existing order among people, plants and animals was also denied.

This global project of ordering God's creation necessarily implied reincorporating nature into a Eurocentric and Christian-based pattern of unity and order. Europe's Christian view of nature never gave up the idea that the aim of creation and of every distinct species was the benefit of mankind. There was always, as exemplified particularly clearly by Linnaeus, a teleological and functional view of nature as created for European human beings.

Taxonomy is fundamental to the dissemination of

power; it is a science which delimits and demarcates objects, organizes domains, and designates purposes. As David Mackay explains, "in so far as collectors did penetrate other cultures they were agents of empire in a deeper sense. Their inventories, classifications and transplantations were the vanguard and in some cases were to be the instruments of European imposed order."[36] Ordering the world helped pave the way for the imperial commitment to controlling, and "ordering" other cultures.

Natural history's task was, to a large extent, the mobilization of natural objects into what Latour calls "centres of calculation"[37] where the information collected by voyages of exploration was recreated at key sites in Europe, in a form in which the imperial power of European nations could be extended. The de-contextualization of objects and their re-accommodation in those centres required a number of techniques. This included ways of stuffing animals, drying plants, classifying specimens, transporting them, drawing botanical illustrations, and so forth, which provided natural objects with a new context and a language that made them intelligible to Europeans.

The eighteenth-century European scientific institutions such as botanical gardens or natural history museums, Kew in London, the Jardin des Plantes in Paris, or the Royal Botanical Garden of Madrid, appear as great exchange houses which sought to make

each nation self-sufficient and independent from other imperial powers.

But what Pratt and the majority of commentators on eighteenth and nineteenth-century colonial science seem to forget, is that natural history was also beginning to flourish inside the continents and in the hands not just of voyagers but of local inhabitants. That the Eropean projects of exploration and the implantation of Western science in South America woud have been impossible without the collaboration of an American elite interested in adopting the methods and goals of European science.

Natural history, medicine and astronomy soon became the concern and profession of non-Europeans. What must be also taken into account and explained is that Mutis and many other European scientists remained in America for many years or even settled there. They not only trained natives in medicine or natural history but also created botanical gardens, museums, astronomical observatories and chairs at the universities. Once those scientific institutions had been created and supplied with trained naturalists, they became local symbols of power, organs of dissemination of the ideology of appropriation embedded in natural history. Therefore we have colonial or "sub-centres of calculation" under the control of a new elite of people born in America but of European ancestry. This new group of educated, aristocratic, American intellectuals

possessed feelings of national pride far from the European courts but nourished by the European scientific commitment to reveal the natural riches of their continent.[38]

II. Science and "independence": the appropriation of the New World from within

Around Mutis and the Royal expedition we find an elite of Americans who became practitioners and promoters of European scientific activities. The American members and collaborators of the expedition constituted a group of enlightened creoles in whose hands natural history, medicine, geography, astronomy and so on became the expression of their own political interests.

The process of appropriation embedded in the European exploration of the New World began to grow roots thousands of miles away from Madrid and to lose contact with the Spanish crown. The European project of appropriation of nature became a commitment not only of voyagers from a distant empire, but also of a local bourgeoisie. This group of native-born Americans shared with Europeans their education and their resolution to dominate nature, but had no empire to stand on. As we shall argue, there was a tight relationship between men of science, their social status and the power they exerted. They all became influential figures with high

official posts and considerable political control. Without exception, they were of Spanish ancestry and had access to European education. Some of them were executed by the Spanish authorities for their links with the independence revolution and were soon converted into models of national pride and into heroic images of the new ruling class. It is important to analyse critically the values upon which the new nation was being created.

In order to make sense of the relations between science, the independence revolution and the legitimation of a new political and social power, it is essential to describe briefly both the structure of imperial domination and the social setting and interests involved in the revolutionary movement.

The Spanish appreciation of the indigenous cultures of America has always been ambiguous. If the natives were considered irrational beings, then the European explorers had the right to their land, to their property and to their persons. But on the other hand, a declaration of irrationality made the Amerindians unfitted to recieve the Christian faith, thus leaving without foundation the spiritual aim of the conquest of the New World.

The right to conquest and the issue of the native's rationality were centred upon an Aristotelian thesis. In the Politicas (Book I, chapter 1, Nr.2), he proposed that "those with superior intelligence are by nature the rulers and lords of others... [while] those with

deficient judgement are by nature serfs...."[39]

Right from the first arrival of Spaniards in America, domination of its inhabitants had been justified on legal and religious grounds. Conquerors, as Christians, had the right and the duty to care for peoples who still were in a condition of "imbecility". The conquest of America could be legitimated only by demonstrating that the native population had forfeited domination by its own actions. This had to be done without endangering the claim that all rights were guaranteed by God's law. Sovereignty (imperium) and property rights (dominium) had, after all, been conferred upon Ferdinand directly by the papacy.[40] The word "indies" soon became the term to describe any environment in which people lived in ignorance of the Christian faith and the "proper" modes of human life. "Civil", "political" or "Christian" were all opposed to the barbarian, i.e., these men and women who failed to progress. Both science and religion constituted the symbols of superiority on which conquest was justified. Priests throughout the empire had always preached obedience to the monarchy as a divine commandment.

Soon after the conquest, the varied indigenous peoples with distinct ethnic and cultural characteristics were reduced to a common stratum of "indians". Their own castes were absorbed into an indistinct "plebe". Rather than a sense of common cause this homogenization and dispossession produced a sense

of disinheritance.[41]

Amerindians, mestizos, and American-born Spaniards - not to mention black slaves - were dispossessed of their own cultures and left only with the option of claiming or seeking European social recognition. Far from eliminating social tensions, the process of "mestizaje", the racial mixture of Europeans and natives, generated the need for new mechanisms of social distinction.

The creoles, eager to acquire the privileges of the European members of society, made all sorts of efforts to prove their Spanish ancestry. In order to guarantee their right to belong to the elite, rich creoles sought civil or ecclesiastic careers, avoided low, unworthy, manual occupations, and above all, tried to get a university title in law, theology or medicine. In other words, the "mestizo" used all possible sources to banish any trace of his non-European origin.

By taking a few concrete examples, we shall illustrate how scientific practices constituted a means for strengthening and legitimating a growing American gentry.

Francisco Jose de Caldas, probably the most important member of the expedition, the man who at one stage was considered to be Mutis's successor, has been often cited for his expressions of admiration and gratitude towards his "master". However, Caldas's criticisms and often bitter remarks about Mutis are rarely published. "He never introduced me in his

sanctuary", wrote Caldas, "He always kept me in ignorance of his affairs which I have only known superficially after his death."[42] In his Memorial del astronomo, as well as in many other writings,[43] Caldas accused Mutis not only of never finishing any work, but also of incompetence. Moreover, the American astronomer and botanist did not want his works to be confused with those of Mutis, fearing that, as he suspected in the case of Cinchona, Mutis might take all the credit for other people's work; he also believed that Mutis did not write anything worth publishing.

Caldas, exemplifies many of the obstacles and interests involved in the practice of science by Americans in Spanish America during the late eighteenth and early nineteenth centuries. He came from a typical family of the colonial elite. The privileged ruling class was constituted by a mixture of land owners and Spanish members of the government. Caldas's father was Spanish and occupied a number of administrative posts in the town of Popayan. His mother was born in America but was of Spanish ancestry.

Due to his privileged position, Caldas was one of the few Americans with access to the University. He received a grant for his studies in law, which was only offered to students in a position to prove their noble ancestry. The "Colegio de Nuestra Señora del Rosario", where Mutis gave his lessons on Newtonian natural philosophy, was an institution designed for the

education of Spaniards where - as stated by its founder - "only the most illustrious novelty of the town and of the kingdom" was admitted.[44] Caldas returned to his home town, Popayan, with his studies unfinished, and dedicated himself to commercial activities. He was obliged to travel across the kingdom through a variety of climates. Reading any book on science that he could get, Caldas developed an increasing interest in natural history and geography. Making his own maps, using his own instruments,[45] the young American would soon become a self-made and competent geographer and astronomer.

Taking advantage of his frequent travels as a merchant, Caldas measured altitude, temperature and determined the astronomical position of the different places he visited. Thus he gathered valuable topographical and astronomical data. His talent as astronomer and his passionate desire to become a proper member of the European-centered scientific community led him to embark on ambitious and original projects. By the end of 1798 he had planned the elaboration of an improved map of the Kingdom of New Granada.

Among his most celebrated achievements was the design of an instrument to measure altitude by means of temperature. His thermometric method for the measurement of heights and the construction of the corresponding instrument (now known as hypsometer) demanded undeniable ingenuity and originality, but he was never in a position to claim priority of discovery

or to be given proper recognition.[46] Even more interesting were Caldas's investigations into plant geography. Before his encounter with Humboldt and Bonpland in Quito, he had been gathering data on the geographical distribution of plants. Surely encouraged by the Prussian explorer, Caldas drew on his skills as a geographer and cartographer for his botanical investigations.

Caldas's Memoria sobre el estado de las quinas en general y sobre la de Loja en particular, opens with a remark reminiscent of the style of Spanish explorers of his time: "The trees of the different species of quinine that grow in the Andes can give Spain as much benefit as the cinnamon of Ceylon has given to the Dutch."[47] As we have seen, his Memoir was a comprehensive study of the geographical distribution of the different Cinchona trees, which, he argued, was of invaluable importance for their successful exploitation. Unlike Mutis, he did not think that the genuine Cinchona officinalis was to be found in New Granada, "... the truth is", wrote Caldas, "that in the whole extent of the kingdom, we do not have a single quinine tree from Loja."[48] His solution to the problem is significant. His geographical investigations led him to conclude that the best places for the cultivation of Cinchona were some regions in New Granada which shared the same latitude, altitude and temperature as Loja. "The transplantation of Cinchona trees to the equinoctial Andes and not to

Europe should be promoted."[49] "I do not believe", he added,

> that a plant which loves an atmospheric pressure of twenty-eight barometric inches, that dies in temperatures lower than two to four degrees Reaumur, that needs abundant rain for a period of nine months, etc., could, prosper, as Ruiz argued,[50] in Galicia, Cataluña, and Andalucia, with a pressure of twenty-seven inches and temperatures of twenty-eight to thirty degrees in summer, and five to zero degrees in winter....[51]

"It is neither the nomenclature, nor the dry descriptions which makes my work interesting for commerce, agriculture and medicine", wrote Caldas, "but the knowledge of the plant's relation to the globe, the geographical location, latitude, longitude of each species, temperature, atmospheric pressure, and so on...."[52] However, all his projects and dreams seemed to have ended in frustration, as he put it: "What a sad destiny it is to be American! After years of research, if we find anything new, we can only claim: it is not in my books."[53]

The isolation and limited access to European publications not only made it difficult to practice European sciences in the New World, but also underpinned faith in the magnitude and power of European scientific knowledge. Caldas and other Americans devoted to science shared the conviction sadly expressed by José

Arcadio Buendia in Garcia Marquez, One hundred years of solitude: "Incredible things are happening in the world. Right there across the river there are all kinds of magical instruments while we keep living like donkeys."[54]

Humboldt and Bonpland met Caldas in Quito in 1802 and praised the accuracy of Caldas's astronomical and geographical observations.[55] Caldas spent six months with the European travellers from whom he was willing to receive instruction. Caldas had planned to accompany Humboldt on the rest of his voyage, but the Prussian naturalist did not take the South American astronomer with him. Instead, another young aristocrat was chosen as Humboldt's companion. For Caldas, Humboldt represented the highest exemplar of the European Enlightenment and culture he passionately sought and admired. The fact that Humboldt rejected him as a companion caused profound frustration, and as he wrote to a friend, all his dreams of being a scientist with proper credentials were upset leaving him no option but to remain in "this land hostile to knowledge."[56]

Mutis needed a competent astronomer for his project of the observatory in Santa Fe, and he had been informed by Humboldt of Caldas's talent for astronomy. The Spanish priest quickly made Caldas a member of the Royal expedition, offered financial support for his (unrealised) travels with Humboldt, and commissioned him to collect plants, mainly Cinchonas, from the south of

New Granada. Disappointed and resigned to remaining in America, Caldas decided to devote his time to botany and to his new protector.

Travelling under the auspices of the Royal Expedition, Caldas collected plants and established the location of many places in the kingdom. The results of this period of his career appeared in three major publications: Ensayo de una memoria sobre un metodo de medir la altura de las montañas por medio del termómetro y agus hirviendo (1802), in which he explained his thermometric method for measuring altitude; Memoria sobre la nivelacion de las plantas del Ecuador (1803), a geographical study of the vegetation around Quito; and his Memoria sobre el estado de las quinas en general y en particular sobre las de Loja (1805), which collected together his geographic and taxonomic investigations into Cinchona.

Caldas was named geographer of the vice-royalty and director of the new astronomical observatory which had been completed in August 1803. Its design and construction, intended for high latitudes, followed European models and presented inconveniences for proper observation on the Equator.[57] Mutis did not bother to take advice about the construction of the observatory. Caldas was never consulted and the result was a clear example of an inadequate transference of technology. Nevertheless, one of Mutis's achievements often mentioned by his biographers, was the construction of

the first (obsolete) astronomical observatory ever built in Equatorial America.

Caldas gathered a complete set of modern astronomical equipment, a Dollond telescope, a John Bird quadrant, a Graham pendulum, a Hadley octant, a thermometer and a barometer;[58] and by the time he arrived in Santa Fe to take up his duties as astronomer of the Vice-kingdom, he was in full command of all the skills of European explorers.

Well-trained in the main techniques of appropriation of the eighteenth-century imperial science, Caldas settled in Santa Fe where he was soon engaged in scientific and political projects. From 1805 he began to work on an atlas of the Vice-kingdom, and three years later he began publishing the Semanario del Nuevo Reino de Granada which continued until 1812. The Semanario, a publication devoted to science, clearly demostrates the concern of an elite of native-born Americans to improve their local economic projects. "The subjects of the Semanario", as stated by Caldas in his New plan for the "Semanario" of 1810, "will be agriculture, industry, commerce, economy, roads, navigable rivers, natural products, exact sciences in all its branches, physics, eloquence, history, poetry, and everything that can contribute to the improvement, enlightenment and culture of the New Kingdom of New Granada."[59] "Those who have not enough enlightenment to understand these matters", Caldas explained, "should avoid subscription... and save

us from the annoyance of the criticisms that have bothered us so often during this year."[60] A typical publication, this time by Caldas himself, had the revealing title Which is the product that should be preferred in our climate, and which foreign product is the most convenient for us to acclimatize in our soil? The commitments of the European Enlightenment had begun to be appropriated and adapted for the needs of non-Europeans. In a different publication, Discourse on the rural calendar of the New Kingdom, Caldas wrote, "A lot has been written in Europe about agriculture... but the rules established for that part of the world are not adaptable for other regions... agriculture has diverse rules for the different zones of the globe...." [61] In many other writings Caldas reveals his interest in studying the land, nature and people of the country as well as the American climates and seasons to facilitate the exploitation of nature, e.g. On the influence of climate upon organized beings (1808) or State of the geography of the Vice Kingdom in relation with the economy and commerce.... of the same year. "Geographical knowledge", wrote Caldas, "is the thermometer with which one measures the enlightenment, commerce, agriculture and the prosperity of a country. Its stupidity and barbarism are always proportionate to its ignorance on this issue."[62]

However, Caldas's "patriotism" cannot be isolated from his own class and from the interests of a minority.

In Caldas' opinion, the native indians were "stupid", "barbarians who lack the knowledge to keep the natural equilibrium". As a solution he suggested that the protection of the American natural heritage should be put in the hands of "gentlemen landowners."[63]

When the province of Bogotá proclaimed its independence in 1810, Caldas was among the active rebels. He also published a revolutionary periodical Diario Político, was enlisted in the army of liberation as an engineer, directed the army's training school, and organized the arsenal for manufacturing rifles, gunpowder and ammunition.

The new government did not hesitate in resuming the projects of the Royal Expedition and soon provided Caldas with instruments and artists to complete the Atlas of New Granada.

With the counter-revolutionary attack led by the "peacemaker" Pablo Morillo, Caldas was imprisoned and, despite all his pleas for mercy and declarations of devotion to Spain, he was executed in 1816 (see figure 33). Caldas's letters include several petitions to the Spanish authorities written in prison and begging for forgiveness. In these documents Caldas asks for clemency and extensively lists all the services that as a scientist he had and could offer to the crown, again stressing the utility of astronomy and geography for the empire. "Your Majesty knows better than anyone that good

geography is the basis for good politics."[64] Perhaps the Spaniards understood that too well to let him live. In these last attempts to save his life, he also expressed his loyalty to the mother country and the king of Spain; unfortunately it was too late. Whatever his political convictions were, Caldas's career as a man of science put him in a position with too much power for a non-European.

The members of the creole elite involved in the revolution of independence were, to a great extent, struggling for the privileges of merchants, land owners, miners and slavers. More significantly, they were fighting for the rights of possession and control appropriate for any man of the Enlightenment. But it did not really matter much if the government was European or American in so far as their social status and economic advantages were not threatened.

The policies of the Bourbon rulers took for granted that the development of the colonial economy and the increase of public revenue were perfectly compatible, but in the eyes of Americans a contradiction began to emerge. In agriculture as in mining, it was imposible to reconcile the interests of Spain and those of an American elite. It was common for land owners to be simultaneously public officials, merchants and miners with large amount of local power. They sought greater export outlets than Spain would allow and demanded more trade with other countries.

The ideals of freedom and equality of the leaders of the independence were restricted to those who were both literate and solvent, a reduced minority of the inhabitants of the country. As Simón Bolivar proclaimed "Who are the agents of this revolution? Are not the whites the rich, titles of Castile...?"[65]

It is important to point out that in the movement of independence there were two main factions that clearly represent different local interests. The "federalistas", with whom Caldas was vehemently identified, sought local control of their lands, mines and slaves, and did not want intervention from Santa Fe in their business. Another faction of the revolution, "centralistas" (as opposed to "federalistas") led by Antonio Nariño, were interested in a centralized control of business and external commerce from Santa Fe; and for them the separation from Spain was of central importance.

All the other members of the Royal Expedition were aristocrats whose scientific and political interests involved them in the re-possession of America.

Jorge Tadeo Lozano, member of an illustrious family from Bogotá, studied chemistry, mineralogy and botany in Madrid. He replaced Mutis in the chair of mathematics at the University of el Rosario, became a volunteer member of the expedition and was asked by Mutis to translate Humboldt's Geography of Plants in 1803.[66] He also prepared an important work on zoology, Fauna de

Cundinamarca. Lozano, Caldas and the other American naturalists seemed to share the dream of building their own American empire, portrayed in Lozano's words as "...a vast empire which in a few centuries will rival the most powerful European nations."[67]

Francisco Antonio Zea, another born American of European ancestry, joined the expedition in 1792 when it moved to Santa Fe. He was sent to Spain and put on trial for his links with the revolution. Zea protested his faith to the crown and was declared innocent. In January 1803, recommended by Cavanilles, then the director of the Botanical Garden, he was named second botanist of the Garden and promoted to director in May 1804. Since he was in charge of the Garden's publications, as we saw in chapter three, he played an influential role in the disputes over Cinchona classification. After a period working for Joseph I in Spain, Zea was engaged in a number of scientific projects in America and was later named Vice-president of the Gran Colombia.

Sinforoso Mutis, José Celestino's nephew, also took part in the independence movement and contributed to removing a viceroy to whom only a few months before he had dedicated a new vegetable species.[68] As in the case of the other collaborators of the expedition, Sinforoso's attitude towards Spain was not entirely clear. Having established the new State, and without abandoning his duties as a botanist of the Royal

expedition, he joined the centralist party led by Antonio Nariño. After the Spanish re-conquest of New Granada by Pablo Morillo he was imprisoned and was ordered to organize and pack all the materials of the expedition. Unlike Caldas, Rizo and Carbonel, Sinforoso was not executed but was condemned to exile.

Both for the leaders of the new nations and for the Spanish authorities, the acquisition of knowledge and the practice of science constituted essential routes for claiming sovereignty over the American continent. Pascual Enrile, the general in charge of the Spanish army for the recovery of New Granada, reported to the secretary of state: "The insurgents were devoted geographers interested in the topography of the country... who undertook the project of mapping the Viceroyalty."[69] One of the central commitments of the Spanish army was the repossession of the materials, books and instruments of both the headquarters of the botanical expedition and the astronomical observatory. In 1818 the "Gaceta de Madrid" published an account of the "success" of the Spanish army not only in re-establishing order in various places of America, commenting that "not less important was the recovery of the innumerable objects of natural history collected by Mutis...."

As we have already seen, the materials were sent to Madrid and brought into the Palace, where the king himself formally took possession of the different

objects. He ordered the mineralogical and zoological specimens to be safeguarded in his Museum of Natural History, and the herbarium and the botanical illustrations to be saved in the Botanical Garden. He also ordered the prompt publication not only of Mutis's Quinologia but also of all the materials concerned with the Flora of New Granada. Similarly, books and instruments belonging to the observatory were confiscated and sent back to Spain in 1816.*

On the other hand, Americans were also committed to securing their sovereignty and to reappropriating the country. Throughout the nineteenth century, the history of science in Colombia can be seen as a single attempt to fulfil the Royal Expedition projects. As early as 1811, the constitution of Cundinamarca included the establishment of a Patriotic Society in which the Spanish policies of appropriation seemed to be transformed into a local policy. "A Patriotic Society should be established as soon as possible in order to promote and stimulate the sciences, agriculture, industry and commerce... The work that so far has been done in the Botanical Expedition should be considered and the Expedition objectives should be extended to the

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* The inventory of objects belonging to the observatory shows not only a complete set of geographical and astronomical instruments but also a large collection of books covering subjects such as geography, astronomy, natural history, travel, physics engineering, and so on. For a complete list see Historia documental de la Expedición... pp. 305-6

teachings of natural history...."[70]

During the first decades of the Republic (1822-1850) the government made all sorts of efforts to import science. In 1823 the new government of Colombia approved the employment of five French naturalists, hired by Zea, in Paris for the foundation of a Natural History Museum and a school of mines in Bogotá.[71] In this project the state ended up paying high salaries to foreign technicians and importing instruments and materials for financing research that seemed to benefit European scientific institutions rather than the needs of the new nation.[72]

It is also significant that the first major scientific enterprise founded by the state in Colombia was the "Comision Corografica"(1850-1859) for the investigation and elaboration of maps of the national territory.[73]

Conclusion

This chapter does not attempt to explain or give a complete account of the process of independence of the Spanish colonies; the numerous political, economic, ideological and social elements involved are beyond the scope of the present research. What is at issue is a series of scientific practices and a process of scientific dissemination that constituted important ways of exercising power.

Knowledge cannot be seen as an instrument of liberation, since a science which was supposedly universal remained in fact centralized and controlled by members of a particular class who never detached their interests from those of Europeans. Whether European or native the colonial scientist was educated at least in part abroad. If self-taught, he depended on European publications, equipment and scientific instruments. These intellectual traditions led the colonial practitioner of science to inmerse himself in the methods, techniques and problems of European sciences. Therefore he sought the recognition and success bestowed by European institutions, societies, academies and scientific journals. The colonial scientific elite had an important effect on the creation of the new nations but rather as instruments of appropriation and control, not as agents of independence. Moreover, the implantation of such practices and institutions in places like New Granada reduced the power of the indigenous people to control their own lives.

An elite of creoles (merchants, planters and miners), played a decisive role in the economic growth of the Bourbon epoch and the very success of this colonial oligarchy brought into question the value of the imperial link. But they were concerned to improve trade, navigation and agriculture rather than to refuse European supremacy. This elite of creoles had tasted power, discovered their own strength and acquired a new

sense of identity as a class, experiences which brought them into politics. Naturally, they wanted to get rid of their masters but not of their servants, so they rejected European intervention between master and slave. They were aware of social pressure from below and, strongly dependent on European values, strove to keep coloured people at a distance on the grounds of their class, and race. American revolutionary leaders and intellectuals sought to decolonize their commercial interests while retaining European values and white supremacy. And these were the social grounds in which science would flourish in Spanish America.

We cannot say that European scientists, even those, like Mutis, most devoted to America and its people, contributed to the liberation of America. Nevertheless they disseminated an ideology and instruments of appropriation which stimulated the repossession and control of America by a group of privileged creoles. The independence of the Spanish colonies was possible partly because European mechanisms of control were set up inside the continent, where they were run by a significant number of non-Europeans.

On a large scale, the revolution left untouched the structure of power which had been implanted by the imperial government and which in turn made possible the removal of Spain's control of the American continent. Early in the nineteenth century the sovereignty of the Spanish crown was no longer recognized, but deeper forms

of dependence were to remain among the population of the New World: European language, religion, and as we have indicated, science.

Practitioners of science in Colombia were never detached from an elite concerned with the preservation of their privileged social status. Their scientific activities were largely justified in an ideology of free trade: the study of nature would offer new sources of commerce.[74]

The image of scientific knowledge as a source of progress, civilization and social status remains a potent one, and continues to justify a structure of power based outside the nation.

NOTES

1. Roy Macleod, "On visiting the 'moving metropolis': reflexions on the architecture of imperial science", in Nathan Reingold and Marc Rothenberg (Eds.) Scientific Colonialism: a cross-cultural comparison, (Washington: Smithsonian Institute Press, 1981), p. 219.

2. Joseph Rouse, Knowledge and power, Toward a political philosophy of science, (Ithaca and London: Cornell University Press, 1987), p. 19.

3. Jose Celestino Mutis, "Martes 24 de febrero, viernes 17 de julio, 1761." Diario de observaciones Vol. 1, (Bogotá: Instituto Colombiano de Cultura Hispánica, 1983), p. 85.

4. José Celestino Mutis, "Mutis to the King Carlos III, Santa Fe, 26 June, 1764.", Archivo epistolar del sabio naturalista Don Jose Celestino Mutis, vol. 1, (Bogotá: Instituto Colombiano de Cultura Hispanica, 1983), p. 43.

"... me hallo pronto y preparado para el desempeño de una tan grande y útil comisión, luego que Vuestra Majestad se digne mandar que se me destinen los sueldos y medios proporcionados a los trabajos de una empresa que solo de dirige a producir honores a la nación, utilidad al publico, extención al comercio, ventajas a las ciencias, nuevos fondos al Erario Real, y gloria inmortal a Vuestra Majestad...."

5. See for example, Jose Luis Peset, Ciencia y libertad: El papel del científico ante la independencia americana, (Madrid: Consejo Superior de Investigaciones Científicas, 1987); Federico A. Gredilla, Jose Celestino Mutis, (Bogotá: Plaza & Janes, 1982).

6. Mutis, "Ultimas disposiciones del director de la expedición botánica relacionadas con el funcionamiento del instituto despues de su muerte, septiembre 19 de 1808" in Historia documental de la Real Expedición Botánica del Nuevo Reino de Granada después de la muerte de su director Don J.C.M. 1808-1952, (Bogotá: Instituto Colombiano de Cultura Hispánica,1986), p. 82.

7. Jose Celestino Mutis, "Mutis to Francisco Martinez, Mariquita, December 19, 1789", Archivo epistolar, p. 503.

8. Florentino Vezga (1833-1890) was a lawyer and physician who became the first director of the Escuela de Ciencias Naturales de la Universidad Nacional and professor of zoology, crystallography and mineralogy. He also taught in the faculty of medicine and at the school of jurisprudence. Throughout his career he held influential positions in the political life of Colombia.

9. For an illuminating exposition of the problem see Olga Restrepo, "Jose Celestino Mutis. El papel del saber en el Nuevo Reino", in Anuario Colombiano de Historia Social y de la Cultura, 18-19 (1991-1992): 47-99.

10. See for example Teresa Meade and Mark Walker (Eds.)

Science , medicine and cultural imperialism, (London: Mac Millan, 1991).

11. Henk Wesseling, "Overseas history", in Peter Burke, (Ed.) New perspectives on historical writing, (Cambridge: Polity Press, 1991).

12. Luis Carlos Arboleda, "Sobre una traducción inedita de los Principia al castellano hecha por Mutis en la Nueva Granada circa 1770", Quipu 4 (1987): 291-313.

13. Jose Celestino Mutis, "Elementos de la filosofía natural que contienen que contienen los principios de la física demostrados por las matemáticas y confirmados con observaciones y experiencias: dispuestas para instruir a la juventud en la doctrina de la filosofia newtoniana en el Real Colegio del Rosario de Santa Fe de Bogotá en el Nuevo Reino de Granada, año 1764", in Escritos Cientificos de don J.C.M. (Bogota: Instituto Colombiano de Cultura Hispánica, 1983), p. 51: "Su principal merito consiste en que sirve de fundamento sólidopara la religión natural y la filosofía moral conduciendo al hombre en modo muy agradable al alto conocimiento del autor de la naturaleza y creador del universo".

14. Ibid. p. 52. See also: "Discurso preliminar pronunciado en la apertura del curso de matemáticas, el dia 13 de marzo de 1762, en el Colegio Mayor del Rosario de Santa Fe de Bogota", p. 39.

15. Ibid., p.69 : "...cada descubrimiento en la filosofía natural es una nueva prueva de la divinidad."

16. Jose Celestino Mutis, "Plan provicional para la enseñanza de las matemáticas, 1778", in Escritos Científicos, p. 150 : "La enseñanza de las matemáticas ... se dirige a propagar entre la juventud americana los conocimientos de unas ciencias necesarias al bien del estado en el mismo grado supremo en que se cosideran por todo el mundo sabio las demas ciencias útiles. A proporcion de su abandono o absoluta ignorancia y de su cultura o adelantamiento han experimentado todas las naciones civilizadas al atraso y progreso de su industria, agricultura, artes y comercio, que formando los ramos principales del sustento y comodidad del hombre, deben mirarse como esencialisimo de cualquiera sociedad que aspire a su cultura y engrandecimiento".

17. Michel Foucault, "The politics of health in the eighteenth century", in Power/Knowledge: selected interviews and other writings 1972-1977, (London: The Harvester Press, 1980), pp. 166-182.

18. Jose Celestino Mutis, "Estado de la medicina y de la cirugia en el Nuevo Reino de Granada en el siglo XVIII y medios para remediar su lamentable atraso. Santa Fe, 3 de junio de 1801", in Escritos científicos, p. 33.

19. Ibid. p. 35.

20. Fermín de Vargas, Memoria sobre la población del Reino (Bogotá: Biblioteca popular de cultura, 1944), pp. 89-91; cited by Quevedo, "Antecedentes de las reformas médicas del siglo XVIII y XIX en el Nuevo Reino

de Granada. Una polémica entre médicos y cirujanos", Quipu, 3 (1986): 311-334.

21. Sebastian Lopez Ruiz, Informe contra empiricos y curanderos, Biblioteca Nacional, sección libros raros y curiosos, manuscript 169, folios 119-127. See Emilio Quevedo, "Antecedentes de las reformas médicas del sigo XVIII y XIX en el Nuevo Reino de Granada", Quipu, 3 (1986): 317.

22. Quevedo, "Antecedentes de las reformas médicas", p. 332.

23. Jose Celestino Mutis, "Plan general de los estudios medicos, arreglados segun las proporciones del pais a la enseñanza de todas sus profesiones subalternas, propuesto al gobierno, en caracter de regente de estudios para el Colegio Mayor de Nuestra Señora del Rosario, Santa Fe , mayo de 1804", In Escritos Científicos, pp. 63-95.

For a comprehensive analysis of the document see Emilio Quevedo, "La ilustación y la enseñanza de la medicina en Colombia", in La ciencia moderna y el Nuevo Mundo, (Madrid: Cosejo Superior de Investigaciones Científicas, 1985).

24. Emilio Quevedo, "Jose celestino Mutis y la medicina", in Mutis y la Real Expedición Botánica del Nuevo Reino de Granada. (Bogotá: Villegas ed., 1992), p. 53.

25. Jose Celestino Mutis, "Plan general de los estudios

médicos...Santa Fe, mayo de 1804", in Escritos Científicos, p. 67.

26. Ibid., p. 68.

27. "Auto del Real Protomedicato, Madrid 1678", see John Tate Lanning, The Royal Protomedicato: the regulation of the medical professions in the Spanish Empire, (Durham: Duke University Press, 1985), pp. 175-199.

28. Mutis, "Plan general de los estudios medicos...", p. 56.

29. Lanning, The Royal Protomedicato, pp. 245-51.

30. Jose Celestino Mutis, "Instrucciones sobre las precausiones que deben observarse en la práctica de la inoculación de las Viruelas, formada de orden del superior Gobierno (1782)", in Escritos cientificos, vol.1, p. 189.

31. Jose Celestino Mutis, "Presenta renuncia del cargo de visitador oficial de las boticas... Santa Fe, enero 16, 1808", in Escritos científicos, vol. 1, p. 264.

32. Mutis, "Sobre la necesidea de construir los cementerios en las afueras de las poblaciones. Santa Fe, noviembre 27 de 1798", pp. 255-63, and "Problema ecológico de los platanales sembrados a inmediaciones de villas y pueblos. Santa Fe, septiembre 26 de 1792" In Escritos científicos, pp. 255-63 and 247-54.

33. Mutis, "Censura a publicaciones realizadas en Santafé de Bogotá, 1791-1805", in Escritos científicos, Vol. 2, pp. 309-19.

34. Mutis, "Estado de la medicina y de la Cirugía en el Nuevo Reino de Granada en el siglo XVIII y medios para remediar su lamentable atraso. Santa Fe, 3 de junio de 1801", in Escritos científicos, vol. 1, p. 37.

35. Mary Louise Pratt, Imperial eyes. Travel writing and transculturation, (London and New York: Routledge, 1992), see chapter two, "Science, planetary consciouness, interiors", pp. 15-68.

36. David Mackay, "Agents of Empire : The Banksian collectors and evaluation of new lands", in Visions of Empire, (Cambridge: Cambridge University Press, forthcoming).

37. Bruno Latour, Science in action, (Milton Keynes: Open University Press, 1987), chapter 6.

38. For a comprehensive study of the social identity of creoles see D. A. Brading, The first America: the Spanish monarchy, creole patriots and the liberal state, 1492-1867. (Cambridge: Cambridge University Press, 1993), pp. 561-647.

39. Francisco Guerra, The Pre-Colombian mind, (London, New York: Seminar Press, 1971), pp. 2-3.

40. Antony Pagden, Spanish imperialism and the political imagination, (New Haven and London: Yale University Press, 1990), p.53.

41. Richard M. Morse, "Urban development", in: Leslie Bethell (Ed.) Colonial Spanish America, (Cambridge: Cambridge University Press, 1987), p. 189.

42. Francisco Jose de Caldas, "Memorial del astronomo don Francisco Jose de Caldas al secretario del Virreinato..., septiembre 30 de 1808", in Historia documental, p. 99.

43. See Historia documental, pp. 92, 96, 98 and 110.

44. Jeanne Chenu, Francisco Jose de Caldas: un peregrino de las ciencias, (Madrid: Historia 16, 1992), p. 15.

45. Jorge Arias de Greiff, "La historia de la Astronomia en Colombia", in Historia Social de la Ciencia en Colombia, (Bogotá: Colciencias, 1993), p. 214.

46. Victor S. Albis and Regino Martinez Chavanz, "Las investigaciones meteorológicas de Caldas", Quipu, 4 (1984): 413-32.

47. Francisco Jose de Caldas, "Memoria sobre el estado de las quinas en general y sobre la de Loja en particular", in Obras Completas, (Bogotá: Universidad Nacional de Colombia, 1966), pp. 241-60.

48. Ibid. p. 249.

49. Ibid. p. 250.

50. See Hipolito Ruiz, Quinologia o tratado del arbol de la quina, (Madrid: 1792), p. 21.

51. Caldas, "Memoria", p. 250

52. Caldas, "Informe al virrey del director del observatorio astronómico sobre los trabajos realizados bajo su dirección y respuesta del mandatario, julio 18, 1809", in Historia documental, p. 113.

53. Caldas, cited by Albis and Martinez, "Las investigaciones meteorológicas de Caldas", p. 425.

54. Gabriel Garcia Marquez, One hundred years of Solitude, (London: Picador, 1978), p. 14.

55. Arias de Greiff, "Historia de la astronomia en Colombia", p. 217.

56. "Caldas to Santiago Arroyo, Quito enero 21 de 1802", in Chenu (Ed.) Francisco Jose de Caldas, p. 144.

57. Arias de Greiff, "La historia de la astronomia en Colombia", pp. 218-220.

58. See Arias de Greiff, "La astronomia colonial durante el reinado de los Borbones", in Historia social de la Ciencia en Colombia, pp. 197-236.

59. Caldas, "Nuevo Plan del 'Semanario' para el año de 1810", in Obras completas, pp. 362-3.

60. Ibid., p. 361.

61. Caldas, "Discurso sobre el calendario rural del Nuevo Reino", in Obras completas, p.122.

62. Caldas, "Estado de la geografía de Santafé de Bogotá con Relación a la economia y al comercio", in Chenu (Ed.) Francisco Jose de Caldas, p. 269.

63. Caldas, "Memoria sobre la importancia de connaturalizar la vicuña del Peru y Chile", in Obras completas, p. 332.

64. Caldas, "Informe al Virrey", in Historia documental, p. 112.

65. Simón Bolivar, Obras, vol. III, pp. 647, cited by D.A. Brading, The first America, p. 607.

66. See "Papeles de Mutis", Archivo Real Jardín Botánico de Madrid, Div. III, 4, 11, 44.

67. Jorge Tadeo Lozano, Fauna de Cundinamarca, cited by Gonzalo Hernandez de Alba, Quinas Amargas: El sabio Mutis y la discusión naturalista del siglo XVIII, (Bogotá: Tercer Mundo Editores, 1991), p. 148.

68. See "Continuación del semanario del Nuevo Reino de Granada", in Historia documental, p. 147-148.

69. "El general Pascual Enrile, jefe del estado mayor del ejercito pacificador, da cuenta al secretario de estado... 1817", in Historia documental, p. 353.

70. "Constitución de Cundinamarca, titulo undecimo, de la instrucción pública, articulo 1, paragrafos 4 y 5", in Historia documental, p. 216.

71. "El senado y camara de representantes de Colombia aprueban las contratas celebradas en Paris entre el doctor Francisco Antonio Zea y los profesores Rivero, Boussingault, Roulin, Bourdon y Goudet, para establecer en Bogotá un museo de ciencias naturales y una escuela de minas, 1823", in Historia documental, p. 470.

72. Frank Safford, "Acerca de la incorporación de las ciencias naturales en la periferia: El caso de Colombia en el siglo XIX", Quipu, 2 (1985): 423-435.

73. See Olga Restrepo, La Comisión Corográfica: Permanente actualidad, in: Santiago Diaz (Ed.), Jose Triana, su vida, su obra y su epoca (Bogotá: Universidad Nacional de Colombia, 1991), pp. 95-127.

74. Diana Obregon, "Trade and the natural sciences in the United States of Colombia", in P. Petitjean et al.,

(Eds.) Science and Empire, (Boston: Kluwer Academic Publishers, 1991), pp. 147-52.

CONCLUSION

One of the most important results of the increasing interest in the social history of science, has been the appearance of studies that illustrate the relationship of power and knowledge, and more particularly the issues concerning science and imperialism. A large number of scholars, not only in Europe and North America but also on other continents, have recognized the central role of scientific practices in imperial history. These researchers have made valuable contributions with revealing new case studies, they have offered new perspectives on the study of imperialism and they have questioned traditional ways of understanding the character of science. However, current discussion, though stimulating and of major importance, remains in an unbalanced state.

The academic world, largely dominated by English-speaking scholars, seems to be trapped in a Eurocentric, western and centralized view of history. Research is largely focused on the empires themselves and is rarely detached, in one way or another, from a celebration of the success of Western science. The works available in English are usually written in a liberal tone, revealing, perhaps, a taint of guilt. No doubt, some of the current literature dealing with imperialism, has been written by scholars sympathetic to the history of

other, non-western cultures and this has been the source of a more critical analysis of the diffusion of science and technology. However, from George Basalla's "The spread of Western science" in 1967, to some more recent works, such as those of Lewis Pyenson, historians of science have shown little concern about problems of appropriation, domination and exploitation.

"Overseas" historians (historians from what is generally called the Third World), if known at all, have been, in the main, partly trained in European or North American universities and their academic recognition is still largely dependent on institutions and publications based outside their own countries. But the problem is not just the lack of opportunities for "overseas" scholars to present their own stories; there is also a need for a deeper revision of traditional ways of writing the history of Western science.

There is a silence, which has been successfully maintained whether deliberately or not. Our challenge is to explore strategies to break it.

For us to imagine a non-Eurocentric, western view of history - as for us to imagine a feminist science, to paraphrase Elizabeth Fee - might be like asking a medieval peasant to imagine the theory of genetics. Our images are still incomplete, but I would like to appear less pessimistic and argue that important critical tools are already available.

I do not attempt to review all the literature on imperialism and science, but rather to give a brief description of some of the contributions particularly relevant for my own research. A number of international meetings devoted to the problem of science and imperialism have been the source of the most illuminating discussions and publications on the matter. I shall mention and comment some of their contributions. Three major and ambitious international congresses have been held in the past few years: "Scientific colonialism" in Melbourne Australia (1981), "Science and empires" in Paris (1990) and "Science, discovery and the colonial world" in Madrid (1991). Another meeting, "Visions of Empire" this time in California (1991), and largely devoted to Joseph Banks and the British Empire, offered relevant contributions to the study of natural history and voyages of exploration in the imperial context.

Basalla's model* for the diffusion of Western science has been both the target of numerous critics, and a common ground for discussion among historians of science. It has been said that the search for a single

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* Basalla's model consists of three overlapping stages. In phase 1, the nonscientific (absence of Western science) society or nation provides a source for European science. Phase 2, is marked by a period of colonial science entirely dependent on European practices. And phase 3, completes the process of transplantation with a struggle to achieve an independent national scientific tradition.

model to describe the diffusion of science is worthless because of the complexity of the problem, that his model is too general and abstract, and that concrete case studies which have their own particular idiosyncrasies do not necessarily fit such a model. Some commentators have also pointed out that Basalla's three phases offer a convenient framework for discussing the history of science in the USA, Russia, or Japan, but that his model fails to explain the history of scientific practices in underdeveloped countries.[1] The case of Latin America is a clear example of these limitations.[2] His third stage, "national science", does not guarantee independence from foreign control.[3] As we have partly explained in chapter five, after the revolution in the Spanish America there was, not and there is not, such a thing as "national independent science". In our case study, it was shown that independence was an illusion.

Basalla has also been accused of being a simple-minded positivist who depicted science as a progressive superior form of knowledge, and that, thanks to Europeans, its benefits were spread to the rest of the world. I share such criticism, but it is well to remember that "The spread of Western science" was published in 1967 when the history of Western science was confined to its places of origin, and despite the limitations of his work pointed out by later scholars, Basalla is largely responsible for putting the history of science into imperial history. Besides, it is worth

saying, that his paper of 1967 ended with the suggestion that it is the task of future scholarship to reveal more profound effects of local cultural and social factors. Even more revealing, are Basalla's own thoughts twenty five years later. In his essay "The Spread of Western Science revisited" (1993) he recognized: "If I were to reconsider these matters today I would certainly make use of recent work in the social construction of science".[4]

Alternative approaches for the study of the diffusion of science have been put forward, among others, by Nancy Stepan (1985), Antonio Lafuente (1987), Roy Macleod (1987), David Wade Chambers (1987), and Xavier Polanco (1990).

At the Melbourne conference, a number of detailed case studies on the diffusion of European (especially English) scientific practices, to North America and Australia, were discussed. The results are presented in the volume, Scientific colonialism. A cross-cultural comparison edited by Nathan Reingold and Marc Rothenberg, and offer new perspectives on the topic. The volume includes articles by, among others, Roy Macleod, Lewis Pyenson, David Wade Chambers, and Susan Sheets-Pyenson. I would like to mention just a few of the contributions which relate to issues explored in my thesis.

Roy Macleod, for example, in his "On visiting the 'moving metropolis': Reflections on the architecture of

Imperial science", pointed out how "western science has traditionally been regarded as benevolent, apolitical, and value neutral; its extension, a value free aid to material progress and civilization".[5] This constitutes one of the major reasons why science has had, for traditional historians, little or no role in the process of conquest and domination of other cultures. Macleod invites us to study science not only _in_ imperial history but science _as_ imperial history. This is a crucial point that goes beyond Macleod's paper and which deserves a closer examination.

As I have suggested in previous chapters, one of the obstacles to a critical analysis of science in the context of imperialism is the dichotomy between science and power, a division which has been reinforced by the separation of "internal" and "external" histories of science.

The rhetoric which builds a sharp distinction between science and ideology, science and religion, science and politics, and so on, has been part of our culture for centuries. However, recent discussions in the sociology of scientific knowledge have disclosed new alternatives which help to avoid such a dichotomy. Joseph Rouse, for example, has discussed the problem extensively. Following David Bloor, Barry Barnes, and particularly Bruno Latour, amongst many others, Rouse in his _Knowledge and power: toward a political philosophy of science_ (1987), calls for an investigation of scientific

practices and skills as forms of justification, mobilization and control in themselves. "The growth of scientific knowledge", he says, "must also be understood in political terms as power relations...."[6]

The systematic distinction of state interests - usually related to commerce, religion, political domination, and so forth - and science - generally seen as opposed to, repressed or led by some external forms of power - might have offered helpful studies of institutions, patronage, state policies and economic interests, but is not sufficient for our analysis of exploration. The analysis of power cannot be limited to political sovereignty and royal schedules; power is not only the attribute of kings, popes and ministers. If we limit our understanding of control to political, legal or religious ideology, we shall remain confined in the conventional notion that ideology stands in opposition to something else, i.e., knowledge.[7] Indeed, control and domination become more visible when concrete social practices are examined. Botany and medicine are not just interacting with external interests, as we have explained, they were forms of power at work, and the dissemination of these disciplines was the dissemination of power itself.

The distinction between "external" and "internal" factors is artificial and unnecessary. The analysis of scientific practice itself is the analysis of the mobilization of control. Knowledge, as it has been

described in this thesis, implies manipulation of both objects and people. Imperialism means appropriation and control of distant lands where other people live, and that is what natural history was about.

The naturalist, while collecting, classifying and representing natural objects was put into a certain relation to nature that felt like possession, and therefore like power.

David Wade Chambers in his "Period and process in colonial and national history" also pointed out problems related to the traditional internalist-externalist split, which he suggested have contributed to a marked centralized and Eurocentric periodization of history. That conventional models for explaining the diffusion of science, are Eurocentric in conception. He recognized that this was to some degree inevitable, but that it "minimizes local contributions and trivializes distinctive aspects of local development."[8] The divisions of conventional historical periods have been drawn by political historians with exclusive regard to European political hegemony. To illustrate the point we may go back to the concrete case of Latin America, where the "indigenous" period is generally supposed to end in 1492, and the "colonial" in 1810 (or whatever date you want to give to "independence"). We have seen that scientific practices and their political effects have been largely overlooked by the conventional

historiography of Latin America and it is clear that the periodization of South American history has no relation to the history of science in those countries. If the concept of "colonialism", for example, is considered to include scientific practices, as well as economic or cultural factors, it would be necessary to extend the colonial period into the present day.

Moreover, Chambers argued that models which explain the spread of western science, e.g., Basalla's, tend to be "linear and progressive; that is, they pass through a series of stages which move not only from then to now, but also from darkness to light, from error to fact, from poverty to wealth, from wrong to right."[9]

Medicine, in particular, has provided many opportunities to explore aspects of cultural imperialism.[10] As Teresa Meade and Mark Walker explained, "Science and medicine are often considered clear examples of cultural superiority of industrialized countries over what is now called the third world. That superior view takes for granted that western science and medicine are inherently progressive, that non western countries are fortunate to have science and medicine transmitted to them and that such fortunate countries should also be grateful".[11] However, a number of recent studies have investigated the role of medicine as an instrument of control and domination.[12]

The traditional notion of science described above, prevents us from seeing that scientific knowledge

contains both progressive and regressive tendencies. As Sandra Harding has pointed out, "Western science has also led to the simultaneous de-development of 'others'", and Harding included nature, women and third-world people in the category of "others". The implantation of western science and technology, so often related to ideals of progress and liberation, can also act to take away the power of indigenous people to control their lives. One of our challenges is to explore new ways of understanding power which are more in accord with the actual practices by which some people control others. New trends in the sociology of scientific knowledge can help. As I have suggested, the works of Latour and Callon, as well as some of the discussions in SSK, offer valuable tools to tackle some of the fundamental problems of science and power. Unfortunately, not many historians outside the circles of SSK welcome these tools and views, and influential writers in the field of the diffusion of science, such as Lewis Pyenson, clearly despise and attack them as unacceptable.

Lewis Peynson has become a widely recognized and influential historian of the diffusion of Western science. Unlike Basalla he might have benefited by recent discussions in the sociology of scientific knowledge, but Pyenson is openly against any sort of relativism which he says "historians do well to disregard".[13] Pyenson's work has been strongly

criticized by Paolo Palladino and Michael Worboys. They have pointed out that Pyenson makes an artificial and inadequate distinction between "exact" and "descriptive" sciences, a distinction which seems to be fundamental to Pyenson's views of science and imperialism. Pyenson has focused his research on what he calls "exact" sciences, i.e., physics and astronomy. In his opinion, these disciplines cannot be subjected to the same sociological analyses that "descriptive" sciences could be, and certainly cannot be subjected to the sort of analysis proposed by contextualists and relativists.

Palladino and Worboys suggested that, considering the central role of biological, environmental and medical sciences for Western expansion, an analysis of science and imperialism focused on physics and astronomy can be narrow and misleading. In addition to Pyenson's lack of appreciation of contemporary sociology of scientific knowledge, Palladino and Worboys have pointed out another (and arguably related) deficiency: that Pyenson's interest in "the relation between science and imperialism does not seem to stem from any concern about the problem of imperialism, of why and how one people dominates another".[14] The study of European knowledge operating in distant countries which takes for granted the uniqueness and superiority of Western religion, botany, medicine, astronomy or physics, sees no need to explain the imposition of European values. My investigation has aimed for a less partial account of

the "civilizing process" in which both the success and failure of Western knowledge needs to be explained.

I will now deal with some of the scholars and publications devoted to natural history and exploration, more particularly to colonial science in Spanish America.

The congress "Science, discovery, and the colonial world" held in Madrid in 1991, included not only already known historians interested in the diffusion of Western science, Basalla, Pyenson, Vessuri, Macleod, McClelan, Meade and others, but also a considerable number of Spanish and Latin American historians. The different papers delivered in Madrid constituted an important volume, Mundialización de la ciencia y la cultura nacional (1993). This volume represent an important effort of communication and interchange of ideas among European, North American, Australian, and Latin American historians usually isolated by geographical and linguistic boundaries.

Some of the papers delivered in Madrid are particularly relevant for my own investigation. The Spanish-speaking researchers contributed detailed case studies which focused on the local and particular social contexts in which Western scientific practices were implanted in both in Spain and Latin America, e.g., Miguel Angel Puig-Samper, Eduardo Estrella, Jose Luis Peset, Emilio Quevedo, Luis Carlos Arboleda and so on. The discussions that took place in Madrid proved to be

stimulating and the importance of the publication is undeniable. However, in my opinion their analysis and criticism could have gone further. A detailed investigation of the different social settings in which science and medicine emerged in Latin America is essential, but one cannot overlook the European roots of such practices, the ideology and interests embedded in western science. Issues of appropriation, domination and exploitation, and the understanding of concrete scientific practices as forms of power, are once again, treated superficially.

Some of the literature available in English on exploration and imperialism seem to offer more fertile analyses. Visions of empire (in press) is a collection of papers delivered at the conference of the same name held at the William Clark Memorial Library in January 1991. It provides some examples of new possibilities which help in explaining natural history, voyages of exploration and their imperial function. I will just mention some of the works that have the closest bearing to my own research. David Miller, following Bruno Latour and borrowing his notion of "centres of calculation", examines Joseph Banks's exercise of power, the mechanisms by which distant lands and objects are rendered mobile, stable and combinable so that they could be reordered in European museums and gardens. As I have already mentioned in chapter one, Lisbet Korner provides an illuminating account voyages of exploration

by Linnaeus and his followers in an imperial context. Martin Kemp presents a number of strategies for investigating the role of visual imagery in botany and in art. The analysis of visual representation has only recently become a major topic for historians of science.[15] In the case of botany and natural history, Kemp's work is one example of the new possibilities in the field.[16] However, central question such as how visual representation and taxonomy functioned as forms of appropriation and how natural philosophy, botanical practice and medicine contributed to the legitimation of western control, are, once more, left aside.

As Simon Schaffer points out in an afterword to the same volume, some recent arguments from the sociology of scientific knowledge seem relevant to an assessment of this revisionism. The notion of "discovery" for example, is re-examined more critically (see chapters two and three of this thesis). Sociology has also been useful for the investigation of the processes that give local practices a global and universal character. Above all, we should insist, sociology has provided new methods that allow us to make explicit the link between knowledge and power.

Another recent publication, Mary Louise Pratt's Imperial Eyes: Travel writing and transculturation, provides stimulating views on voyages of exploration, natural history and European expansion. Pratt focuses her investigation on travel writing with revealing

references to botany and the exploration of South America. Being one of the most critical approaches to exploration yet published, Pratt's work is largely devoted to the European explorers and their accounts. Any investigation of eighteenth-century voyages of exploration that overlooks the cultures and people inhabiting the territories explored will always remain incomplete. The appropriation of the New World's nature was, to a large extent, a process of negotiation and translation in which indigenous communities and local practitioners of natural history, and medicine played an active role. In Spanish America during the late eighteenth century - as we have seen in previous chapters - there was a group of Americans that made possible the success of Western science in the New World. The practice of Western science and medicine in South America was not only brought in or implanted by Europeans, it was actively imported and adopted by an elite of aristocratic creoles.

Next I would like to sum up some of the results of my own research on natural history, medicine and exploration.

My thesis begins with a general description of the institutional setting in which Spain's projects of exploration took place, although the aim of my investigation is not to illustrate the ways in which external power (the state or the crown) acts upon a

neutral science.

Following the example of English mercantilism, the ministers of Charles III promoted new policies for the economic revival of Spain in which the American colonies would have a central role. Ministers and naturalists designed a program for a more efficient exploitation of American natural products which aimed to establish a commercial network where the metropolis would control and monopolize the economic benefits.

First of all, the program demanded an inventory of the natural products which were to be commercialized. During the second half of the eighteenth century the Spanish enlightened elite was embarked on a number of reforms to provide Spain with the infrastructure for such an enterprise. The state's major learned institutions, the Royal Botanical Garden, the Protomedicato and the Royal Pharmacy gained a central position in the new economic and political commitments of Spain. The Spanish project, in turn, was part of a wider network of European expansionist enterprises. The economic and social setting in which scientific exploration flourished during the eighteenth century was characterized by an international contest between European powers for the accumulation of possessions. The eighteenth century explorers were central to the imperial commitment to impose order and conquer foreign and unfamiliar objects of nature. The day-to-day tasks of scientific exploration, i.e., drawing, classifying,

naming and moving objects of nature, have been described here as forms of appropriation which not only responded to the scientific ideal to dominate nature but also to the commitment of the European empires and aristocratic Americans to maintain order and control over the land and people.

The translation of objects into images had a key function in that process of appropriation. In deciding what a painting should look like, in preferring one feature to another, the artist-botanist is imposing standards on his or her subject. In the process of being drawn, natural objects go through a process of purification in which they are dispossessed of their wildness and transformed into idealized types, nature is codified and domesticated. The unknown overseas natural specimens and cultures represented a threat for the European aspirations of global control. It was important to portray plants as discrete entities existing within a stable system. Each specimen had its own assigned position in a greater pattern which exhibited both a religious and social European order.

The assumed passive fidelity and neutrality of scientific representation allows us to use the language of photography and say that the images are not only made but also "taken" or "obtained". The mimesis of nature is an attempt to capture it in a determined act of domination. To draw is to appropriate the thing drawn.

Similarly, as I have indicated in chapter two, naming plants was a central practice in the process of appropriation. Language constitutes a strong imperial instrument which confers power upon its users. European naturalists, like Adam, in naming the objects of God's creation, acquired control over nature and other people. The replacement of local names and classifications was an attempt to draw near and possess unfamiliar objects.

Classification, therefore, cannot be understood as a process of neutral discovery; different styles of drawing boundaries always involve selection and processing of information; classification is never a passive and disinterested process of discovery unrelated to social concerns.[16]

The "discovery" of new species cannot be explained as an event occurring in the field while the naturalist is wandering around the forest. A "discovery" can only be understood as a process of negotiation by means of which nature is segmented into units, the object "discovered" is created and therefore subject to be possessed and controlled.[17] The idea of "discovery", heroic individuals finding and possessing natural objects needs to be explained rather than celebrated.

I am not arguing that the botanists' classification involved a distortion of "the real facts", nor that it was erroneous. But it is important to insist that a thorough understanding of botanical exploration cannot be achieved without examining the day-to-day practices

of the explorers and the language and criteria that made botanical and pharmaceutical knowledge legitimate.

The concrete case studies examined in this work, i.e., the search for medicinal plants, illustrate particular forms of appropriation that correspond to specific imperial interests. It is clear that the Spanish botanical exploration of the New World was largely shaped by a policy of import substitution. The actual processes of possession have been described as "translation", a process in which botanical and medical knowledge was displaced from one group of spokesmen to another. The act of translation, as we explained, conferred increasing control on the actors involved.

I do not seek to put forward a universal interpretative model, nor to reduce the process of appropriation to distinct and isolated sections. However it is useful to describe the translation of knowledge and control in three main stages. 1. We have made evident the permanent contact and the central influence of indigenous knowledge upon the Spanish botanists, and we have indicated the uses that explorers made of those local practices in order to raise interests and certify their own claims. 2. We have emphasized the role of taxonomy in the legitimation of new useful plants. 3. We have revealed the function of chemical pharmaceutical laboratories in the

certification of reliable medical knowledge.

The transition from the field to the laboratory, from taxonomic to chemical criteria, constituted a fundamental stage in the process of appropriation of new remedies. Inside the laboratory walls of the Royal Palace, the chemists were able to reduce the complexity and variety of vegetable species to measurable principles.

Concrete case studies such as the case of quinine make evident the negotiability both of taxonomic and chemical criteria, and expose how the supposed global, homogeneous and universal character of European knowledge - upon which domination was justified - was far from homogeneous and confined to particular European learned institutions.

In order to make sense of the equation power=science we had to question traditional views of power, control and imperialism that are generally limited to military, legal or state forms of domination. Such explanations of imperialism tend to identify power exclusively with the imperial state, the government or with the crown, and this conception of history has led people to fabricate illusions of freedom and autonomy when this single image of power is replaced or denied.

Traditional analyses of power tend to underestimate scientific knowledge as a form of domination. Old cliches that identify science with progress and freedom,

upon which a great deal of the colonial history stands, trap us in the dominating celebratory Eurocentric historiography.

Authority and power are usually seen as repressive forces, in the form of prohibition or punishment that one person, in his or her central position, exercises and imposes over others.[18] But for the present analysis it is essential to understand domination in a wider sense, that has to do with forms of control not necessarily identifiable with punishment or wicked dictators. Power, we believe, is exercised and disseminated through concrete social practices such as natural history and medicine.

It is interesting to see Mutis's own view of authority. He regarded himself and the state operating "not as a boss giving orders, but as a prudent and human leader that begs, advises, and persuades like a father",[19] a practising physician who taught and contributed to the spread of the benefits of Western knowledge.

Mutis, like many other physicians in the eighteenth century and particularly visible in the colonial context, functioned as a producer and manager of health, as a authority in institutional management and as a guardian of social order.[20]

"Medicine, as a general technique of health" - to put it in Foucault's words - "even more than a service to the sick or an art of cures, assumes an increasingly

important place in the administrative system of power."[21] Even though the present research is focused on botany and medicine, in the final chapter we also examined the moral contents Mutis teaching of Newtonian natural philosophy, the ideology involved in modern mechanics as well as the imperial role of geography and the importance of the astronomical observatory of Santa Fe.

A common assumption among historians is the notion that modern science led the colonies to independence. I hope to have shown that this vision of Western science needs to be revised. The independence movement has often been depicted - caricatured - as popular emancipation channelled through the ideas of French philosophes and liberal European thought. Certainly, the rhetoric of the Enlightenment was not unknown to the colonial aristocracy and leaders, like Simon Bolivar or Antonio Miranda, who used it. But it is also important to remember that the Spanish version of the Enlightenment took a particular form and was presented as a programme of modernization within the established order, a modernization more concerned with fruitful exploitation than with any kind of liberation. As John Lynch put it, "The Spanish Enlightenment in America was really little more than a program of renewed imperialism".[22]

We do not want to diminish the importance of Tupac

Amaru or any other indian or mestizo attempts at emancipation, but we have to remember that their fight was against the privileges of the whites, both Spaniards and Creoles. Certainly, the creole elite used the force of popular emancipation in order to negotiate their own interests with the European government. The interests of the creole elite proved to be more effective than the French philosophes and more efficient than the needs of the indian and mestizo population in the struggle for autonomy. After the revolution of independence new landlords took the place of the old, or old ones managed to increase their holdings. Consequently, neither the concentration of ownership over the more desirable agricultural and exploitable lands, nor the general structure of power, were significantly altered.

In the last chapter we described the role that both European and born-American practitioners of science had in the history of the new "independent" nations of Latin America. We pointed out that their activities and interests were inseparable from a privileged social status. In so doing we aimed to contextualize and question the often celebrated liberating effects of knowledge. Vernacular statements such as "The truth sets us free", raise a number of questions: Who do we mean by "us"? , Whose truth are we talking about? "Truth" cannot set us free, on the contrary, it is always produced and accepted "only by virtue of multiple forms of constraint."[23]

The creole elite as well as their European masters and colleagues, by virtue of the colonial aristocracy ownership and control of the means by which nature was manipulated to their needs, retained a power rooted outside the continent.

With all due respect to the enlightened European explorers of the eighteenth century and their noble and christian incentives, with all admiration for the naturalists' achievements, we must never forget that the object of scientific exploration of America was not only commercial exploitation but also a reinforced imposition of values and culture, the destruction of indigenous knowledge and the substitution for it of the "true reason".

There is no excuse to ignore the systematic destruction and violence perpetrated by the European empires on the people and cultures of America; and there is not much need to insist that the very purpose of science and exploration was the exploitation and appropriation of America for the benefit of the Spanish empire. However, the attempt to give an answer to questions such as: who were the barbarians and who the civilized? is elusive and ultimately misplaced. We want to understand the structure which allowed things to happen, we aim to explain processes of appropriation, and we hope to describe the practices, interests, beliefs and values involved in the scientific exploration of the New World. We do not need to blame

or glorify individuals or nations; on the contrary I believe that the moral evaluation of past events is not much more than the justification of our own moral canons and beliefs, a legitimation of our actions or passivity. My criticism is not addressed to the actors involved in this account of the Spanish Royal Botanical expeditions but rather to the historians themselves. If the views presented here tend to debunk individuals or policies it is only to redress the balance and disclose richer ways of understanding the practice of science as a form of power.

NOTES

1. See Helge Kragh, On science and underdevelopment, (Roskilde Universitetsforlag, 1980).

2. See the works of: La Fuente, Quevedo, Arboleda or Saldaña, (see complete refences in bibliography).

3. David Wade Chambers, "Locality and science: Myths of centre and periphery", in A. Lafuente, A. Elena and M.L. Ortega (Eds.), Mundialización de la ciencia y cultura nacional, (Madrid: Doce calles, 1993), pp. 605-618.

4. George Basalla, "The spread of Western science revisited", in A. Lafuente et al (Eds.) Mundialización de la ciencia, pp. 599-604.

5. Roy Macleod, "On visiting the 'moving metropolis': Reflexions on the architecture of imperial science", in Nathan Reingold and Marc Rothenberg (Eds.) Scientific Colonialism: A cross-cultural comparison, (Smithsonian Institution Press, 1987).

6. Joseph Rouse, Knowledge and power: Toward a political philosophy of science, (Ithaca and London: Cornell University Press, 1987), preface, p. xi.

7. Michel Foucault, "Truth and power", in Knowledge/ power: Selected interviews and other writings 1972-1977, (London: Harvester Wheatsheaf, 1980), pp. 109-133.

8. David Wade Chambers, "Period and process in colonial and national science", in Reingold and Rothenberg (Eds.) Scientific colonialism.

9. Chambers, "Locality and science", p. 315.

10. See for example, Vicente Navarro, (Ed.) Imperialism, health and medicine, (New York: Prodist, 1982); Teresa Medea and Mark Walker (Eds.) Science, medicine and cultural imperialism (London: Macmillan, 1991); Roy Macleod and Milton Lewis (Eds.) Disease, medicine and Empire: Perspectives on Western medicine and the experience of European expansion, London: Routledge, 1988) and David Arnold, Imperial medicine and indigenous societies, (Manchester: Manchester University Press, 1988).

11. Meade and Walker, (Eds.) Science, medicine and cultural imperialism, p. 1.

12. The works of Michel Foucault were pioneering in this area, see for example, Madness and civilization (London: Routledge, 1965), The birth of the clinic, (London: Routledge, 1973).

13. Lewis Pyenson, "Why science may serve political ends: cultural imperialism and the mission to civilize". Berichte zur Wissenschaftsgeschichte, 13 (1990) p. 78. Cited by Paolo Palladino and Michael Worboys, in "Science and imperialism", Isis, 84 (1993): 91.

14. Paolo Palladino and Michael Worboys, "Science and imperialism", Isis 84 (1993): 91.

15. See for example, Bruno Latour, "Drawing things together" in Michael Lynch and Steve Woolgar (Eds.) Representation in scientific practice (Cambridge, Mass., The MIT press, 1990) pp. 19-68.

16. See John Dean, "Controversy over classification: a case study from the history of botany", in Barnes and Shapin (Eds.) Natural Order, (London: Sage Publications, 1979).

17. For a sociological analysis of scientific discoveries see Augustine Brannigan, The social basis of Scientific discoveries, (Cambridge: Cambridge University Press, 1981).

18. See Foucault, Power/knowledge, p. 96.

19. Jose Celestino Mutis, "Problema ecológico de los platanales sembrados a inmediaciones de villas y pueblos, Santa Fe, septiembre 26 de 1792" in Escritos Científicos de Don José Celestino Mutis, (Bogotá: Instituto Colombiano de Cultura Hispánica, 1983), p. 252.

20. Christopher Lawrence, "Disciplining disease: Scurvy, the navy and imperial expansion 1750-1825", in Visions of Empire (Cambridge: Cambridge University Press, forthcoming).

21. Michel Foucault, "The politics of health in the eighteenth century", in Power/knowledge, p. 176.

22. John Lynch, "The origins of Spanish American independence", in L. Bethel (Ed) The independence of Latin America (Cambridge: Cambridge University Press, 1989), p. 40.

23. Foucault, Power/knowledge, p. 131.

Appendix I

List of the publications used by Ruiz and Pavon during the publication of the Florae peruvinae et chilensis, as it appears in volume I of the Flora p. 71

"Catalogus auctorum Quibus in hoc opere praesertim usi sumus"

AUBLET (Fusée) Hist. Plant. Guyan.

BOWNE (Patrick) Hist. Nat. Jamaica.

CAVANILLES (Ant.Joseph) Desc. et Icon Plantar Monadelph Dissert.

DILLENIUS (Joann Jacob) Hort. Elthamensis

FEWILLEUS (P.Ludov) Journal des Observations

FOSTER (Joann Reinold et Georg) Characteres Generum Plantarum

GMELIN (Jo Frid) Systema Vegetabilum

JACQUIN (Nico Joseph) Flora Austriaca
Hortus Vindobonensis
Miscellanea Austriaca
Observationes Botanicae
Plantar. Americanar. Pictur.

JUSSIEU (Ant. Laur.) Gener. Plantar.

L'HERETIER (Carol Ludoviic.) Stirpes novae fasc. 1-5

LINNAEUS (Carol) Flor. Lapponic
Zeylanica
Hortus Clifortianus

LINNAEUS (Filius) Suplement. plantar.

LOEFLING (Petr.) Inter Hispanic.

MILLER (Philippus) Icones Plantar.

MOLINA (Joann Ignatius) Comp.Hist. Nat. Regn. Chil.

MURRAY (Andreas) Systema Vegetallium.

ORTEGA (Casimiro Gomez) Decades Plantar.

PLUKENETIUS (Leonard) Opera Omnia Botanica

PLUMIER (Carolus) Gener. Plantar. Americ.

RHEDE (Hericus van) Hortus Malabaricus.

RUMPHIUS (Georg) Herbarium Amboinense

SCHREBER (Jo Christianus Dan) Genera Plantarum.

SLOANE (Hans) Hist. Nat. Jamaica.

SMITH (Jacob Eduardus) Icones Plantarum fasc. 1-3

TOURNEFORT (Jos) Instit RH.

VANDELLI (Dominicus) Flor. Iusitanic et Brasil.

ARCHIVES

Archivo del Real Jardín Botanico de Madrid.

Archivo General - Palacio Real de Oriente.

Archivo de Farmacia - Palacio Real de Oriente.

American Room - Wellcome Institute for the History of Medicine.

Biblioteca Nacional de Colombia - Libros raros y curiosos.

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ILLUSTRATIONS

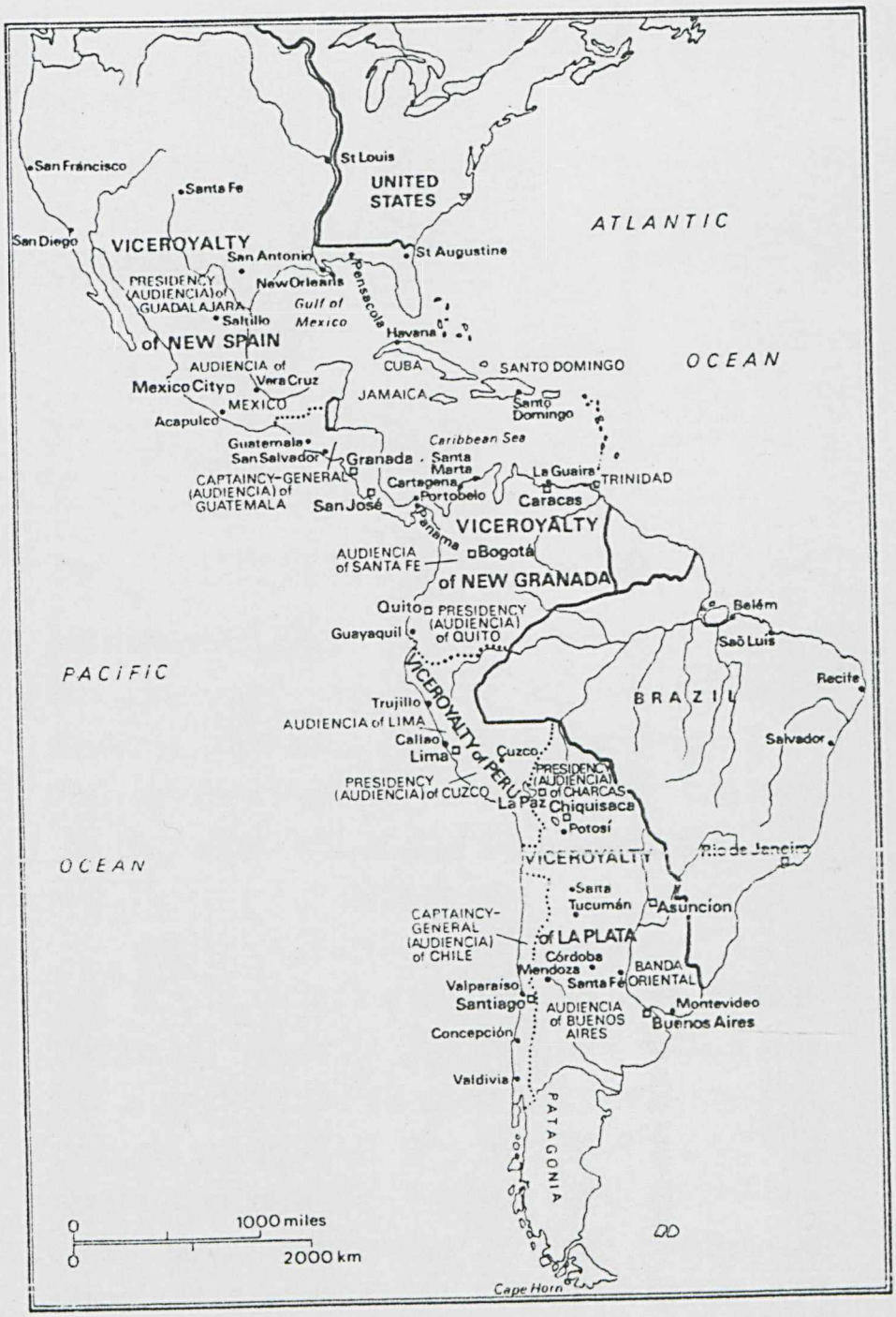


Fig. 1. Spanish America c.1790, in: Leslie Bethell, (Ed.) Colonial Spanish America, p. 121.

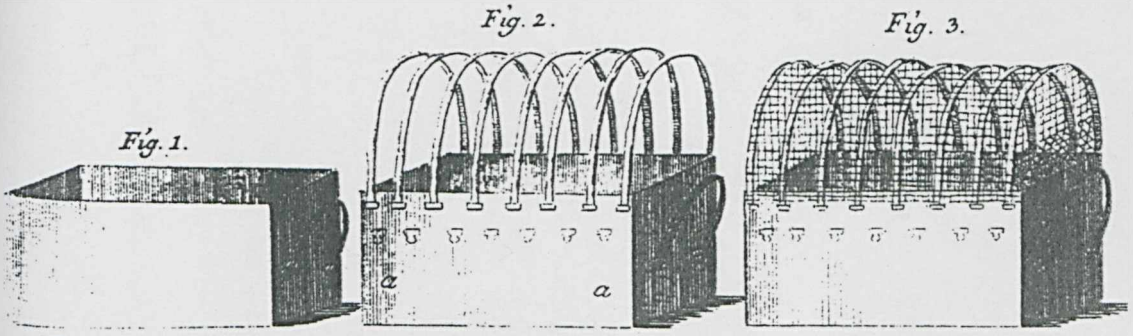


Fig. 1. representa la echura de un Cajon, para conservar las plantas á bordo.
.....2. El mismo Cajon con sus cercos, y ganchos, ó grapas, a....a, para asegurar el encerado.
.....3. El mismo armado ya con su red de cordeles.

ARTICULO PRIMERO.

INSTRUCCION PARA ARRANCAR CON SU CESPED LOS ARBOLITOS, ARBUSTOS, MATAS, Y DEMAS PLANTAS PERENNES, Y TRANSPLANTARLAS, NO SOLO DE UNA PROVINCIA Á OTRA, SINO TAMBIEN POR TIERRA Y MAR Á LOS PAISES MAS DISTANTES.

1 Para arrancar del modo mas conveniente las plantas y arbolitos, se deberá llevar á prevencion un pico con azada, y una pala de cavar. Con el primer instrumento se abrirá una zangilla, ó reguera circular al rededor de la planta que se vaya á sacar de tierra; é introduciendo luego la azada por

Fig. 2a. Boxes for the conservation of plants on board, in: Casimiro Gomez Ortega, Instrucción sobre el método más seguro y económico de transportar plantas vivas, p. 13.

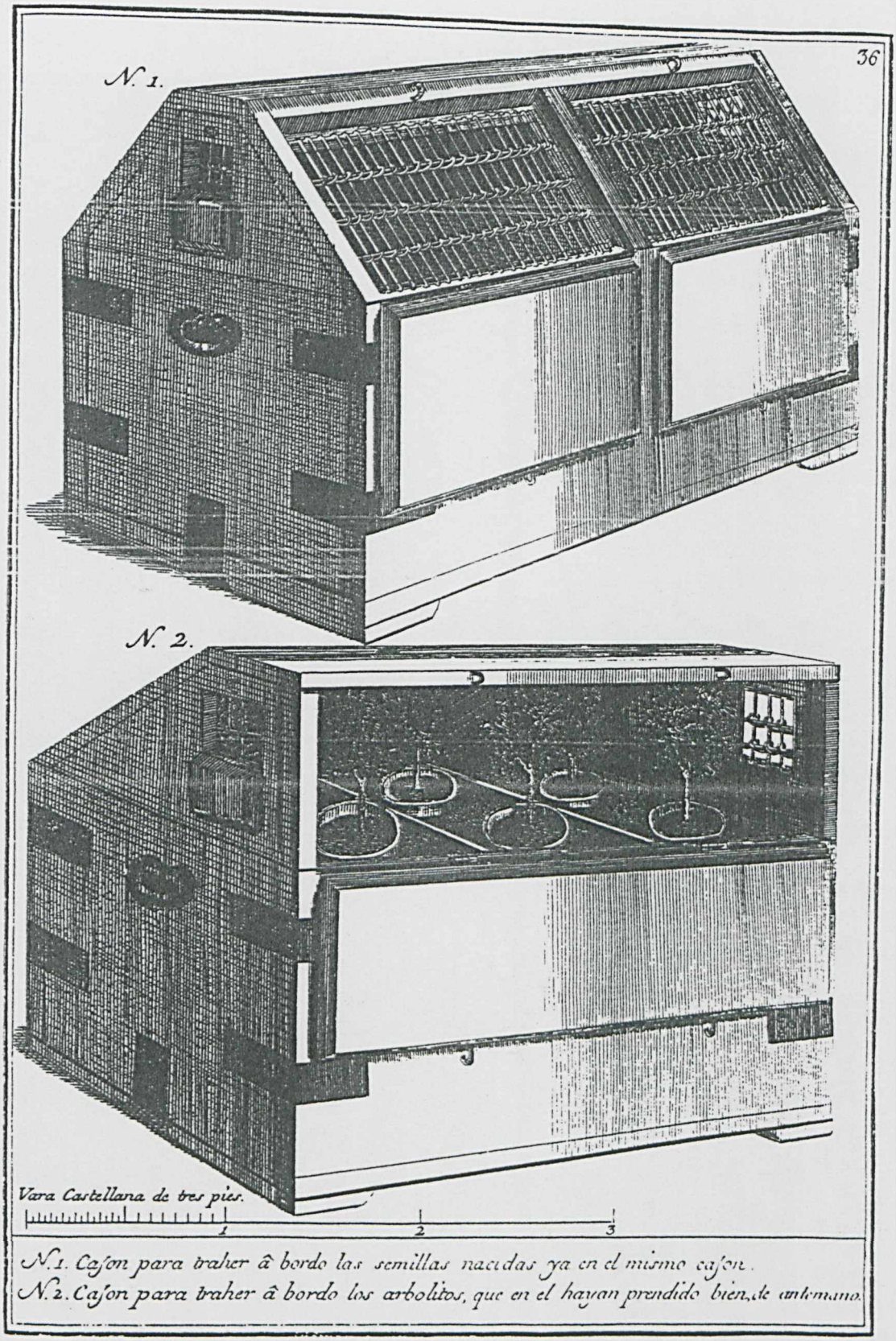


Fig. 2b. Boxes for the transportation of germinating seeds and small trees, in: Casimiro Gomez Ortega, Instrucción sobre el mmodo más seguro de transportar plantas vivas, p.36.

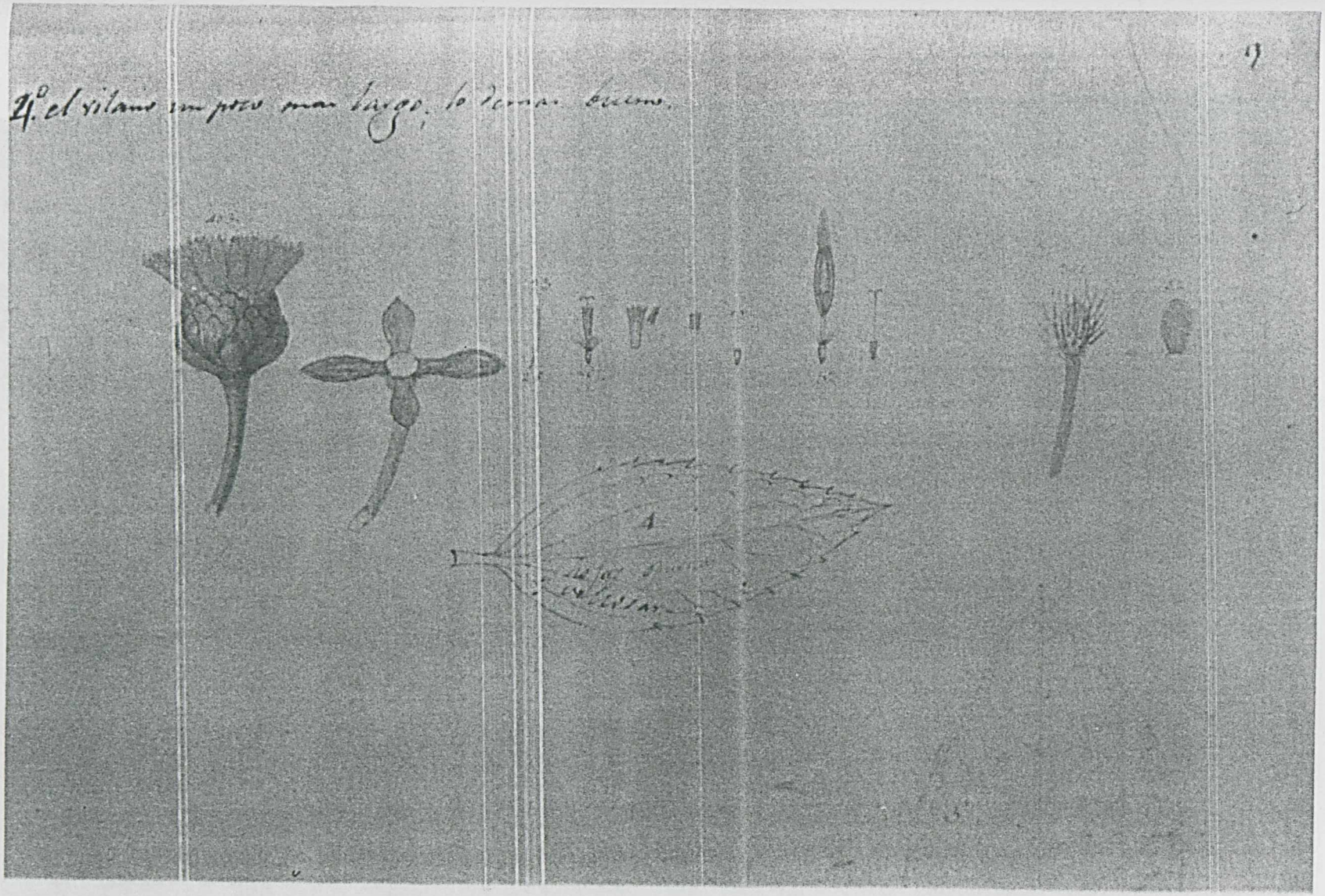


Fig. 3. "Sinanterologias", anatomies of the family Compositae. Archivo Real Jardin Botánico de Madrid, (MOO174).

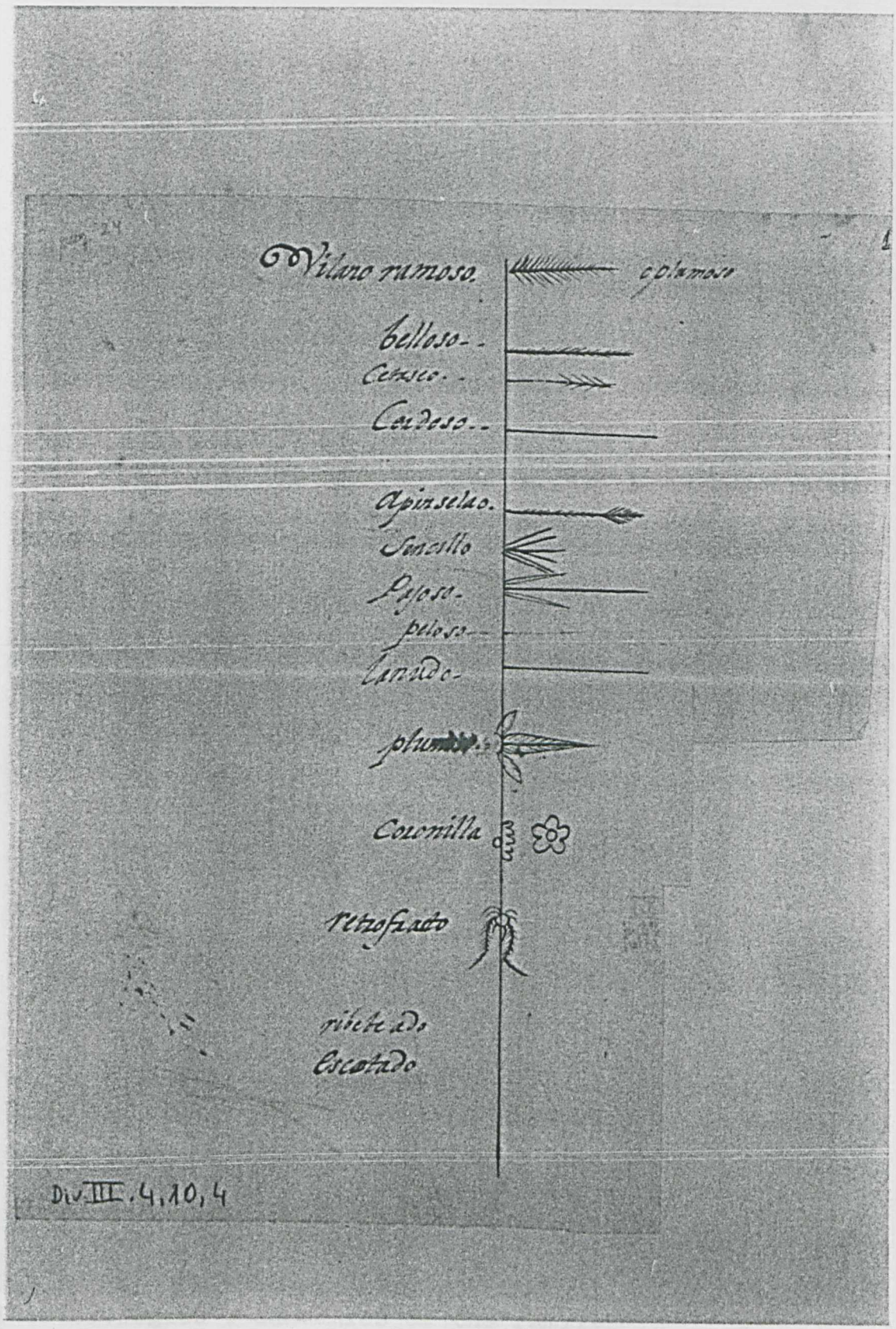
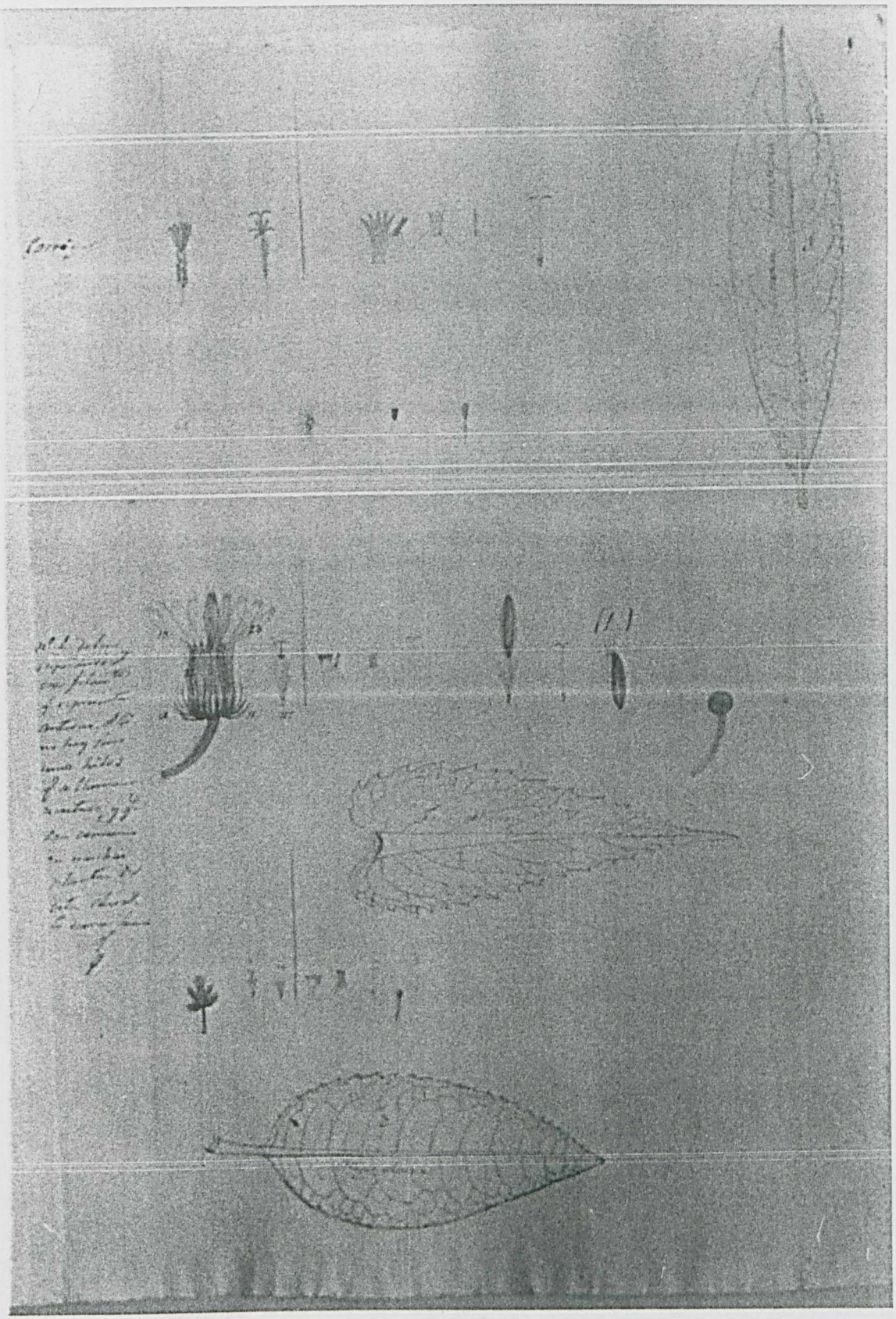


Fig. 4. "Vilanos", twelve different types of thistledown. Archivo Real Jardín Botánico de Madrid, Div. III, Leg.4,10,4.



ig. 5. "Sinanterologias", anatomies of the family Compositae. Archivo Real Jardin Botánico de Madrid, (MOO174).

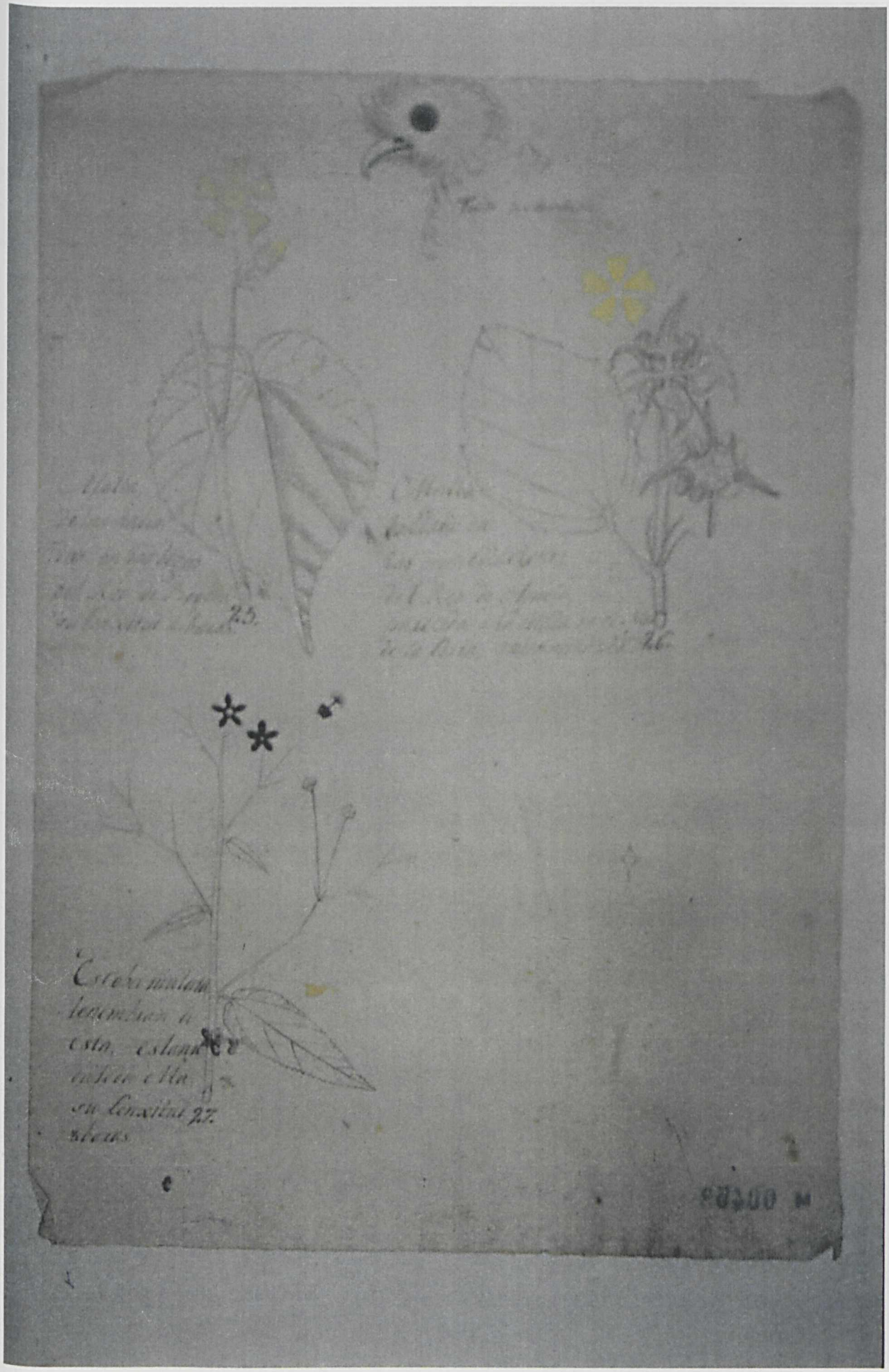


Fig. 6. Sketches and annotations for the Flora del Nuevo Reino de Granada. Family Malvacea. Archivo Real Jardín Botánico de Madrid, (M-00453).

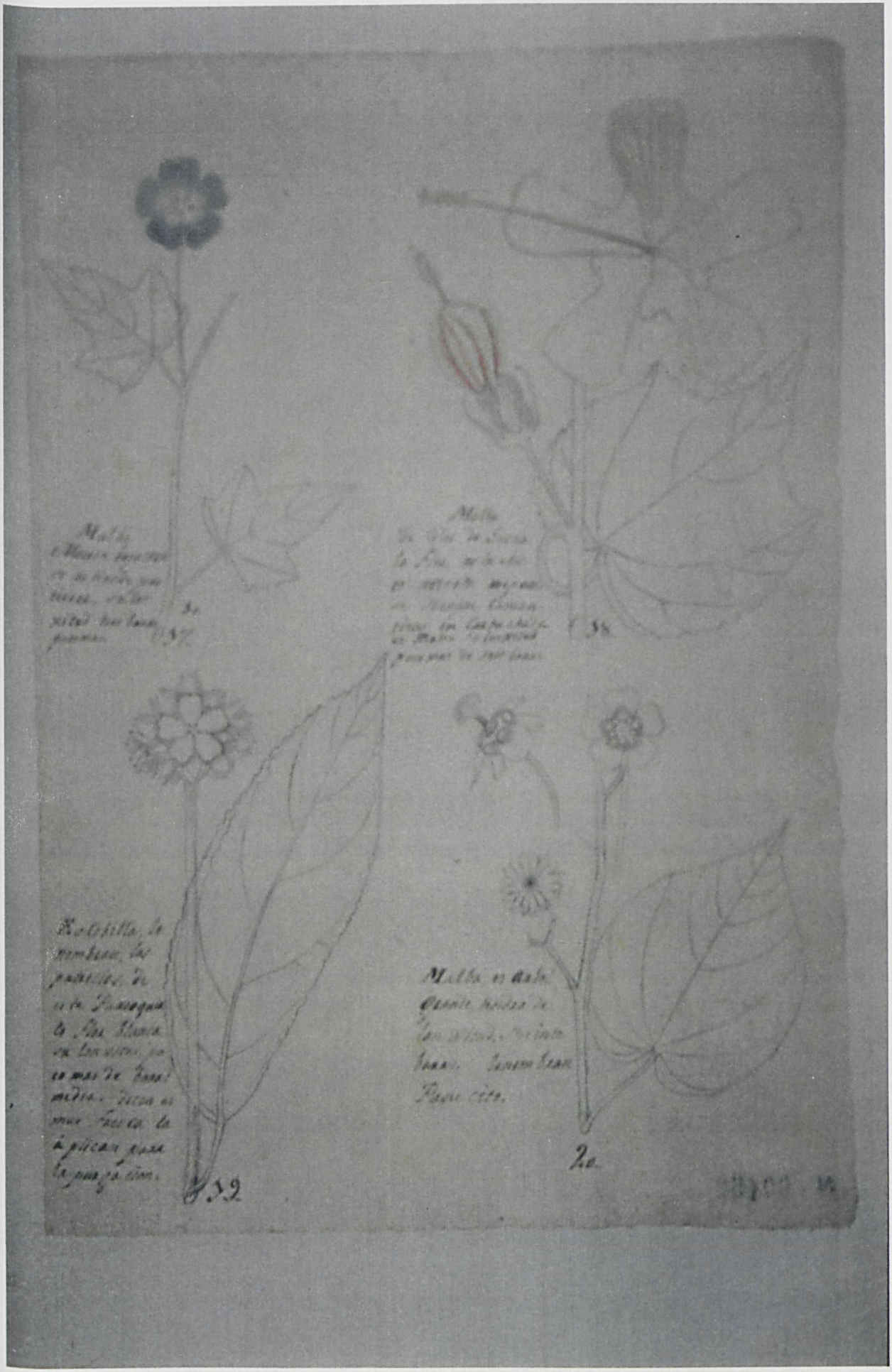


Fig. 7. Sketches and annotations for the Flora del Nuevo Reino de Granada. Family Malvacea. Archivo Real Jardín Botánico de Madrid, (M-00452).



Fig. 8. Sketches for the Flora del Nuevo Reino de Granada. Family Passifloracea. Archivo Real Jardín Botánico de Madrid, (M-00578).



Fig. 9. Sketches for the Flora del Nuevo reino de Granada. Family Passifloracea. Archivo Real Jardín Botánico de Madrid, (M-00578).

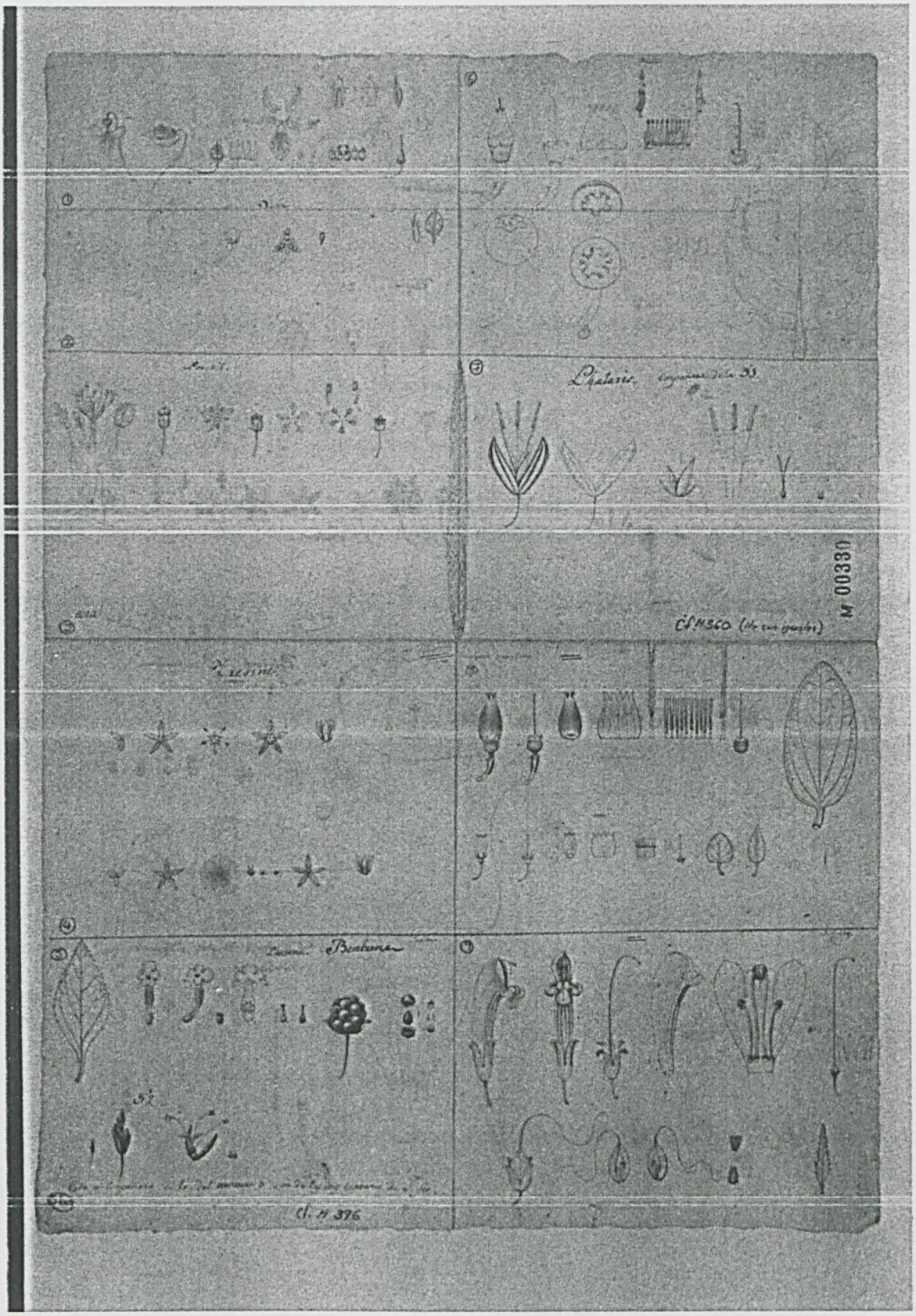


Fig. 10. Floral Anatomies, Archivo Real Jardín Botánico de Madrid, (M-00330) 1-9.

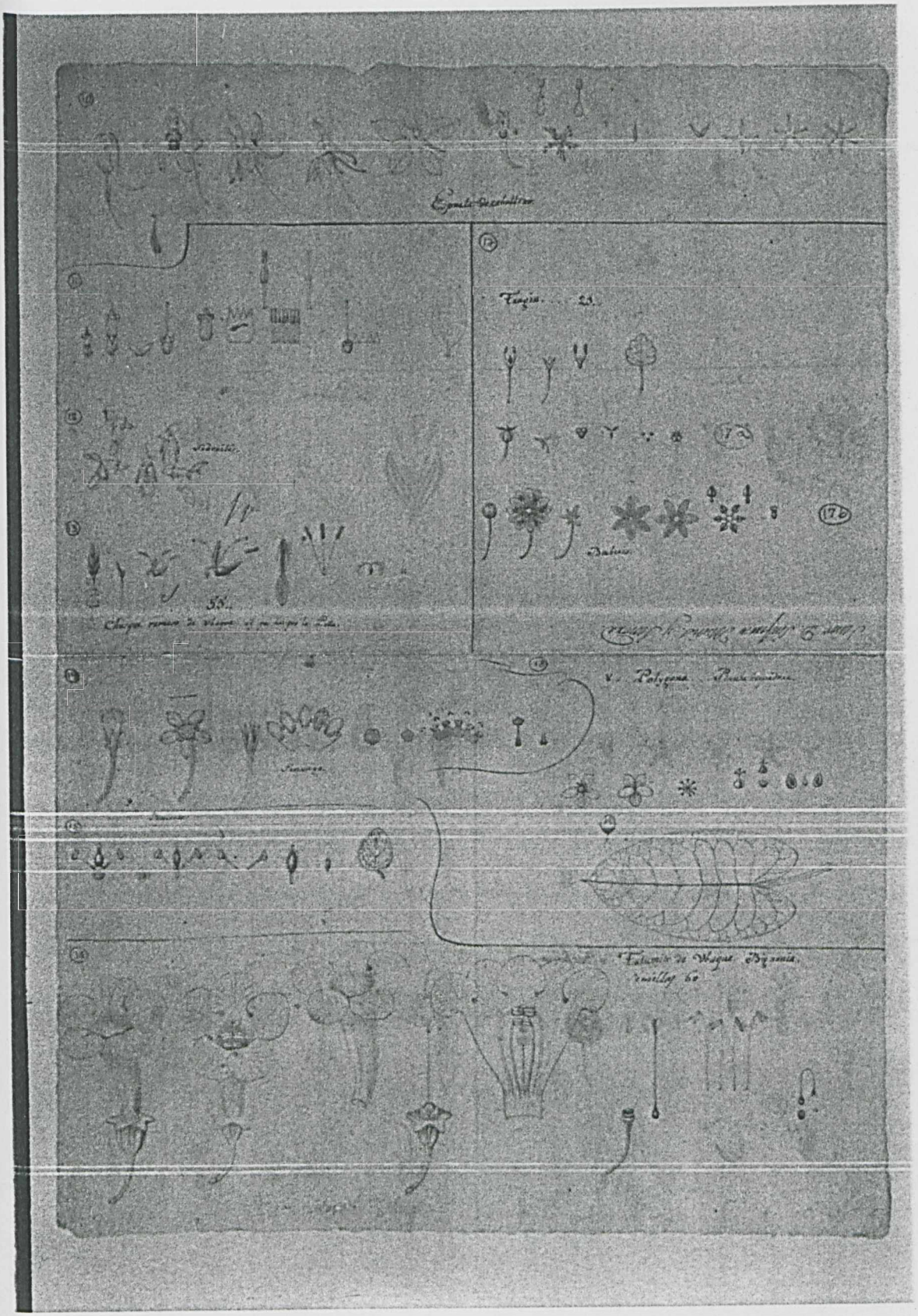


Fig. 11. Floral Anatomies, Archivo Real Jardín Botánico de Madrid, (M-00330) 10-18.



Fig. 12. Cinchona cordifolia, Icon 16 A, Flora de la Real Expedición Botánica del Nuevo Reino de Granada.

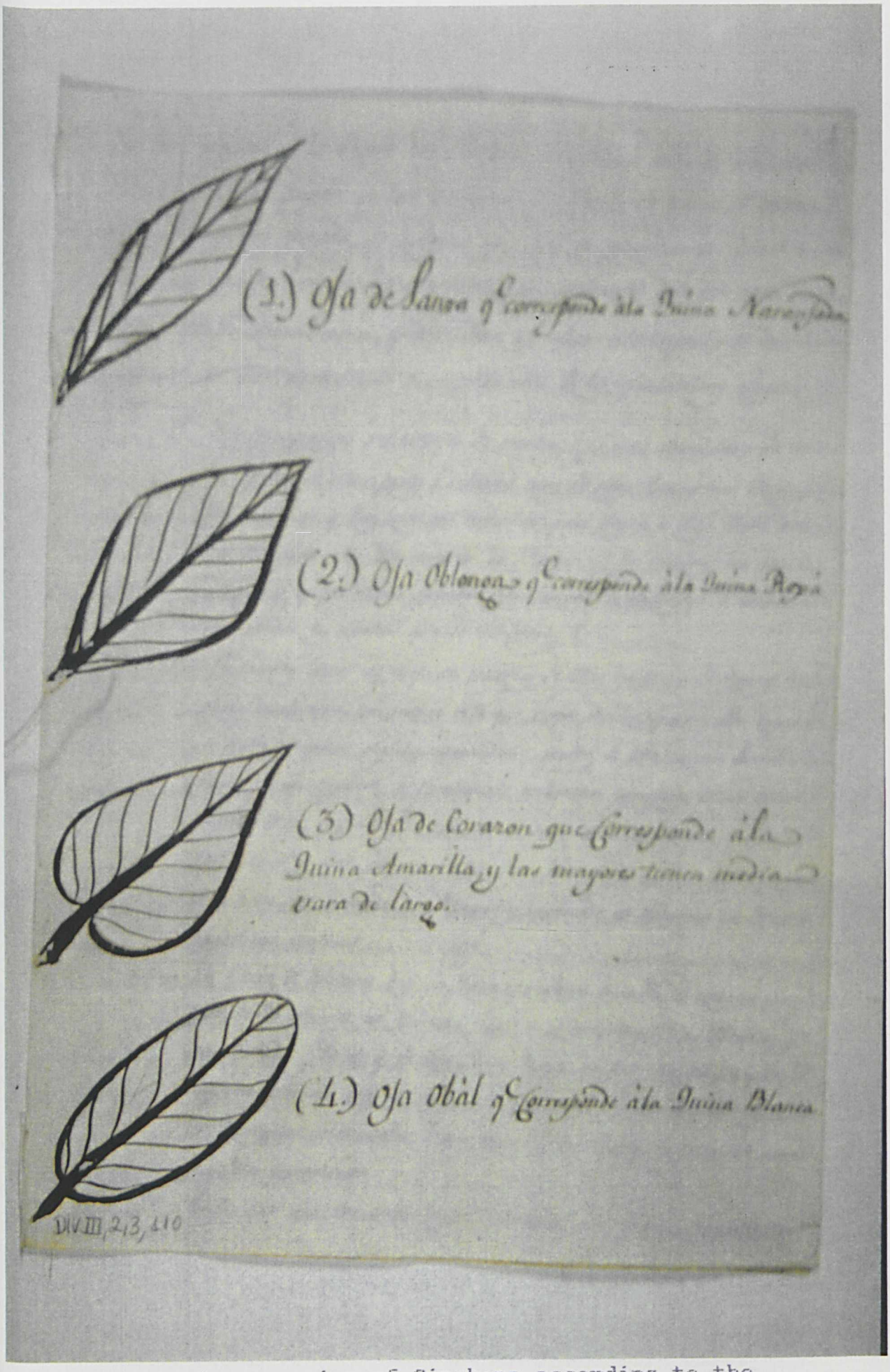


Fig. 13. Mutis's four species of Cinchona according to the shape of the leaves. Archivo Real Jardin Botánico de Madrid, Div. III, Leg. 2, 3, 110.



Fig. 14. Cinchona oblongifolia, Icon 21 A, Flora de la Real Expadición Botánica del Nuevo Reino de Granada.



Fig. 15. Cinchona ovalifolia, Icon 25 A, Flora de la Real Expedición Botánica del Nuevo Reino de Granada.



Fig. 16. Cinchona lanceifolia, Icon 2 A, Flora de la Real Expedición del Nuevo Reino de Granada.

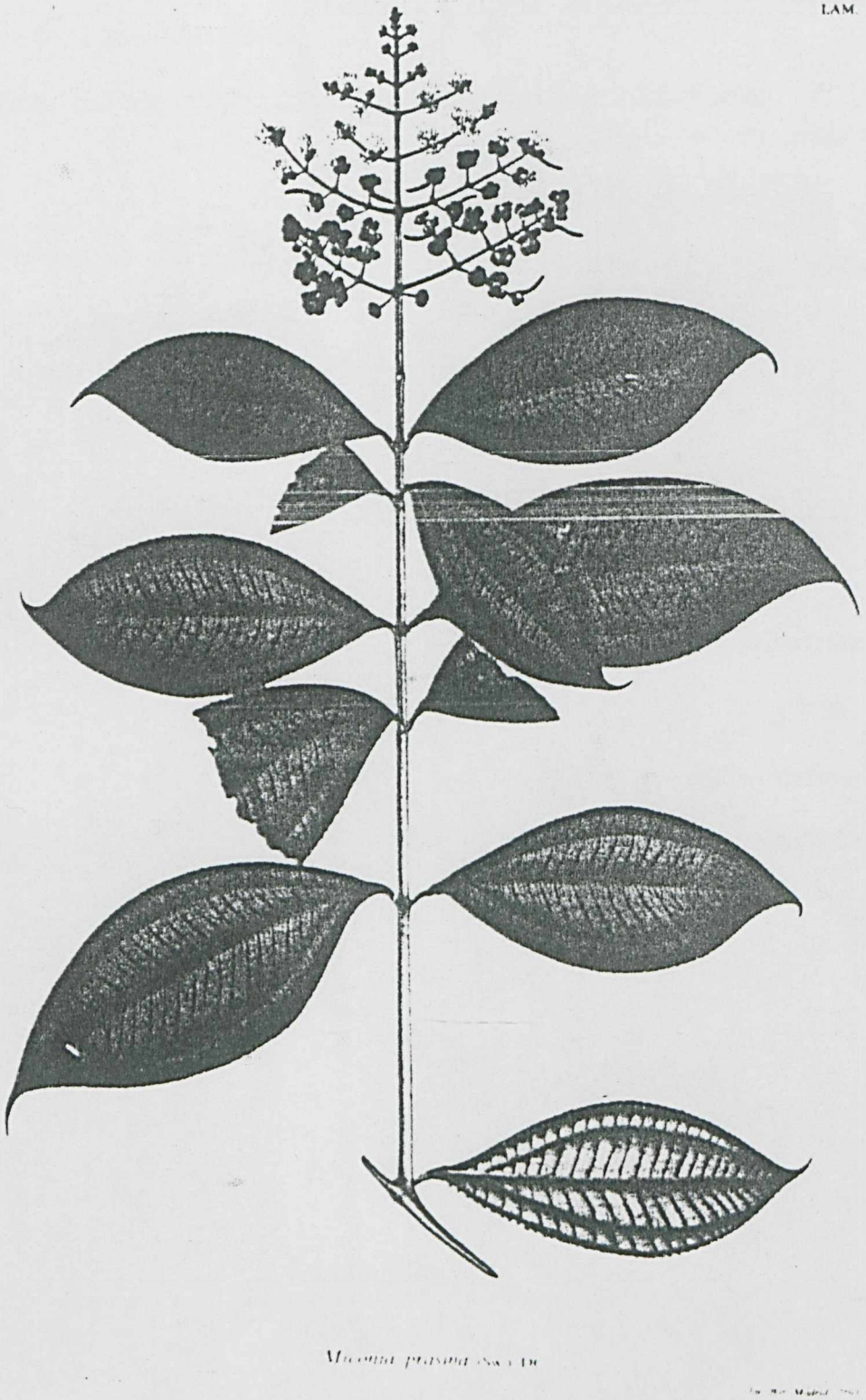


Fig. 17. Miconia prasina, Icon 37, Flora de la Real Expedición Botánica del Nuevo Reino de Granada.



Fig. 18. Cinchona cordifolia, Herbario de Mutis, Real Jardín Botánico de Madrid.

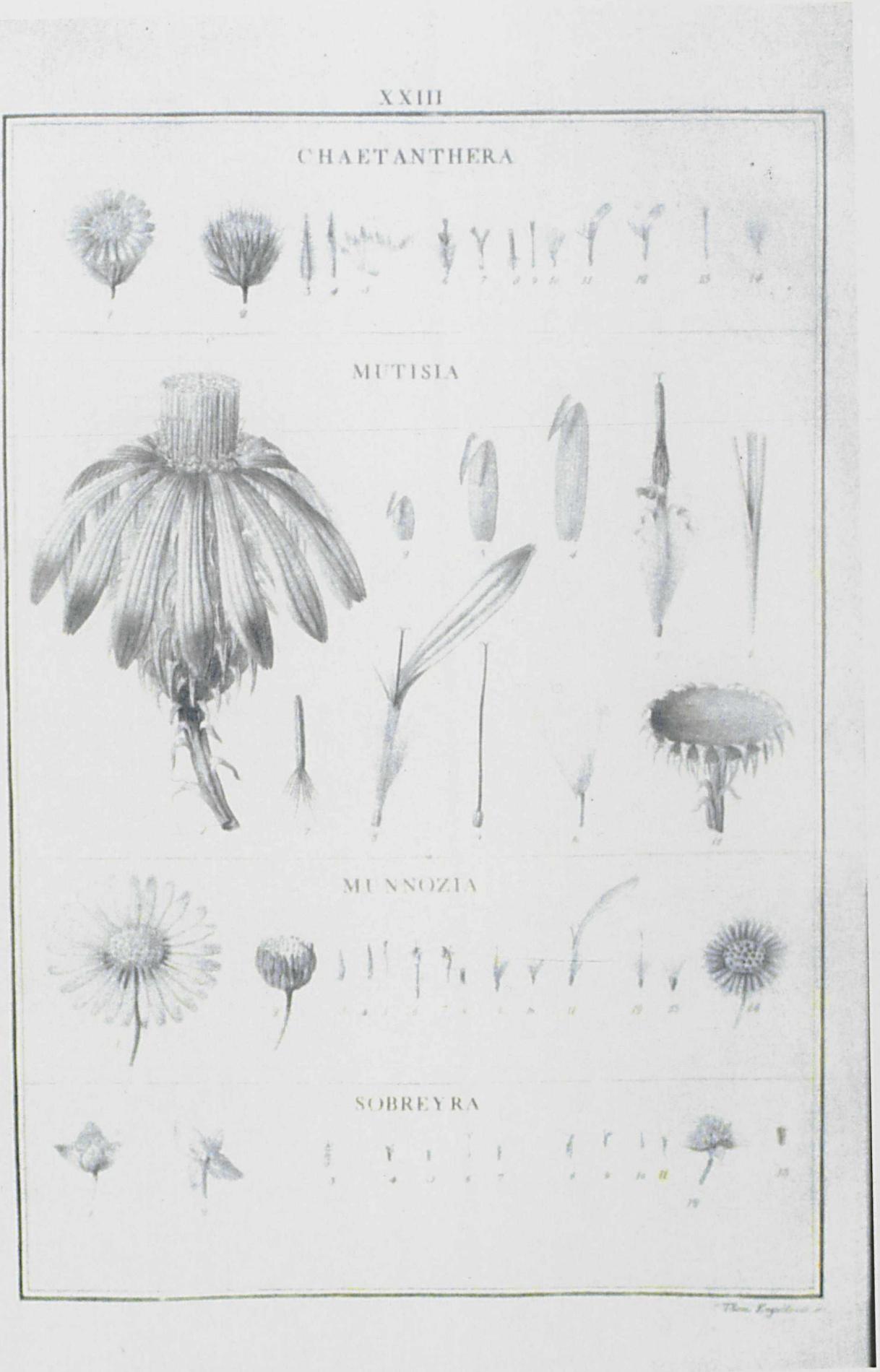


Fig. 19. Genera "Chaetanthera", "Mutisia", and "Munnozia", Flora Peruviana et chilensis, Prodromus.

SYNGENESIA POLYGAMIA SUPERFLUA.

MUTISIA.

CAL. communis *cylindricus, imbricatus:* Squamis *lanceolatis, superne coarctatis, deflexo-uncinatis.*

COR. composita, *radiata:* Coroll. Herm. *numerosae in disco;* Fémin. *pauciores in radio.*

Propria Hermaphroditis *tubulosa, profunde trifida:* laciniis *aequalibus, linearibus, revolutis;* lateralibus duabus *angustioribus, acutis, integris;* intermedia *tridentata, lateralibus triplo latiore.*

Femineis *ligulata, lanceolata, tridentata;* Seta *brevi ad basim ligulae.*

STAM. Hermaphroditis: Filamenta *quinque, filiformia.* Anthera *cylindracea, tubulosa quinquesulcata, apice quinquefida, basi in setas quinque villosas desinens.*

Femineis: Rudimenta filamentorum *quinque, tenuissima, brevia, patentia.*

PIST. Hermaphroditis: Germen *parvum, lineare, tetragonum.* Stylus *filiformis longitudine antherae.* Stigmata *duo.*

Femineis: Germen *hermaphroditis simillimum.* Stylus *filiformis, corollula duplo brevior.* Stigmata *duo.*

PER. *nullum.* Calyx *vix immutatus.*

SEM. Hermaphroditis *solitaria, linearia, obtuse tetragona.* Pappus *plumosus.*

Femineis *simillima hermaphroditis.* Pappus *ut in hermaphroditis.*

REC. *nudum, punctatum, excavatum.*

CHARACTER DIFFERENTIALIS.

Receptaculum *nudum.* Pappus *plumosus.* Corollulae disci *trifidae.* *Femineis* Rudimenta *filamentorum quinque.* Anthera *basi quinquesetae.*

OBSERVATIO. *In* Mut. lanata Calyx *squarrosus;* Setae, *quam in ceteris Speciebus, longiores.*

Species quatuor. Suffrutices.

Genus Mutisia in memoriam D. Josephi Caelestini Mutis, *Hispani, summi ut ipse cum appellat, Americes Botanici, a Linnaeo f. constitutum libenter retinemus, quatuor Speciebus adaugemus, characterem reformamus et Icone illustramus.*

EXPLIC. ICONIS XXIII. *MUTISIA.*

1 Flos *integer.* 2 Squama *exterior.* 3 Squama *intermedia.* 4 Squama *interior.* 5 Flosculus *disci.* 6 Corollula *disci.* 7 Anthera *cum filamentis, et seta.* 8 Flosculus *radii.* 9 Pistillum. 10 Semen *cum pappo.* 11 Receptaculum.

CLASE XIX. POLIGAMIA SUPERFLUA.

MUTISIA.

CÁL. *comun* cilíndrico y recargado de *Escamas* lanceoladas, por arriba estrechadas y dobladas en forma de ganchos.

ROS. *compuesta* y radiada: muchas *Roset. Hermaf.* en el disco; *Femeninas* mas pocas en el radio.

Propia de las *Hermafroditas* acañutada y hendida profundamente en tres *lacinias*, iguales, lineares y revueltas; las *dos laterales* mas angostas, agudas y enteras; y la *intermedia* de tres dientes y tres veces mas ancha que las laterales.

De las *Femen.* de hechura de cintilla, lanceolada, de tres dientes y con una *Cerda* á la base de la cintilla.

EST. de las *Hermafroditas*: cinco *Filamentos*, filiformes. *Borlilla* cilíndrica, acañutada de cinco surcos, por la punta hendida en cinco, y que remata por la base en cinco cerditas.

De las *Femeninas*: cinco *Rudimentos de filamentos*, muy delgados, cortos y extendidos.

PIST. de las *Hermafroditas*: *Gérmen* pequeño, lineal y de quatro esquinas. *Estilete* filiforme y de la longitud de la borlilla. Dos *Estigmas*.

De las *Femeninas*: *Gérmen* muy semejante al de las hermafroditas. *Estilete* filiforme y al doble mas corto que la rosetilla. Dos *Estigmas*.

PER. ninguno. *Caliz* apenas sin variacion.

SEM. de las *Hermafroditas* solitarias, lineares y de quatro ángulos obtusos. *Vilano* plumoso.

De las *Femeninas* semejantes á las hermafroditas. *Vilano* como en las hermafroditas.

REC. desnudo, punteado y excavado.

CARÁCTER DIFERENCIAL.

Receptáculo desnudo. *Vilano* plumoso. *Rosetillas* del *disco* de tres hendeduras. En las femeninas hay cinco *Rudimentos* de filamentos. *Borlilla* por la base de cinco cerditas.

OBSERVACION. En la *Mut. lanuda* el *Caliz* es desparrancados; y las *Cerdas* son mas largas que en las demas Especies.

Quatro Especies. Matas.

A este Genero establecido por el hijo de Linneo en honor de *D. Joseph Celestino Mutis*, Español, y el mas excelente Botanico de America, como él le llama, le conservamos el nombre gustosamente, le aumentamos con tres Especies, perfeccionamos su carácter, y le ilustramos con la Estampa.

EXPLIC. DE LA ESTAMPA XXIII. MUTISIA.

1 *Flor* entera. 2 *Escama* exterior. 3 *Escama* intermedia. 4 *Escama* interior. 5 *Florecilla* del disco. 6 *Rosetilla* del centro. 7 *Borlilla* con los filamentos y cerdas. 8 *Florecilla* del radio. 9 *Pistilo*. 10 *Semilla* con el vilano. 11 *Receptáculo*.

Fig. 20. Description of the genus Mutisia, Flora Peruviana et Chilensis

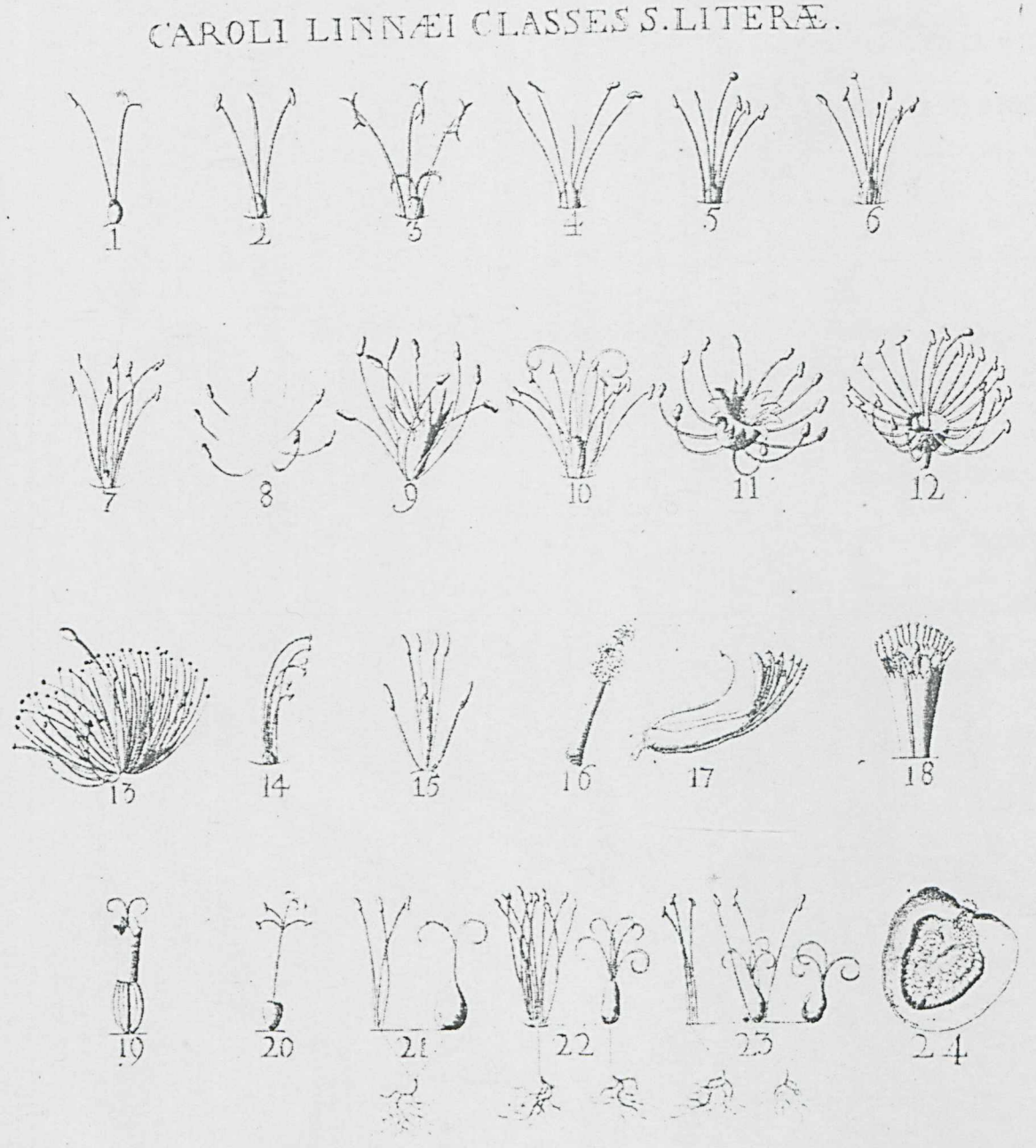


Fig. 21. Linnaeus' system for classifying plants into classes according to their reproductive parts. Species Plantarum, 1736.



Fig. 22. "Star-reed", Aristolochia fragantissima, Hipólito Ruiz, Memoir on the virtues and uses of the Star-reed (1821).



Fig. 23. "Calaguala", Polypodium calaguala, Hipólito Ruiz, Memoir on the genuine Calaguala (1821).

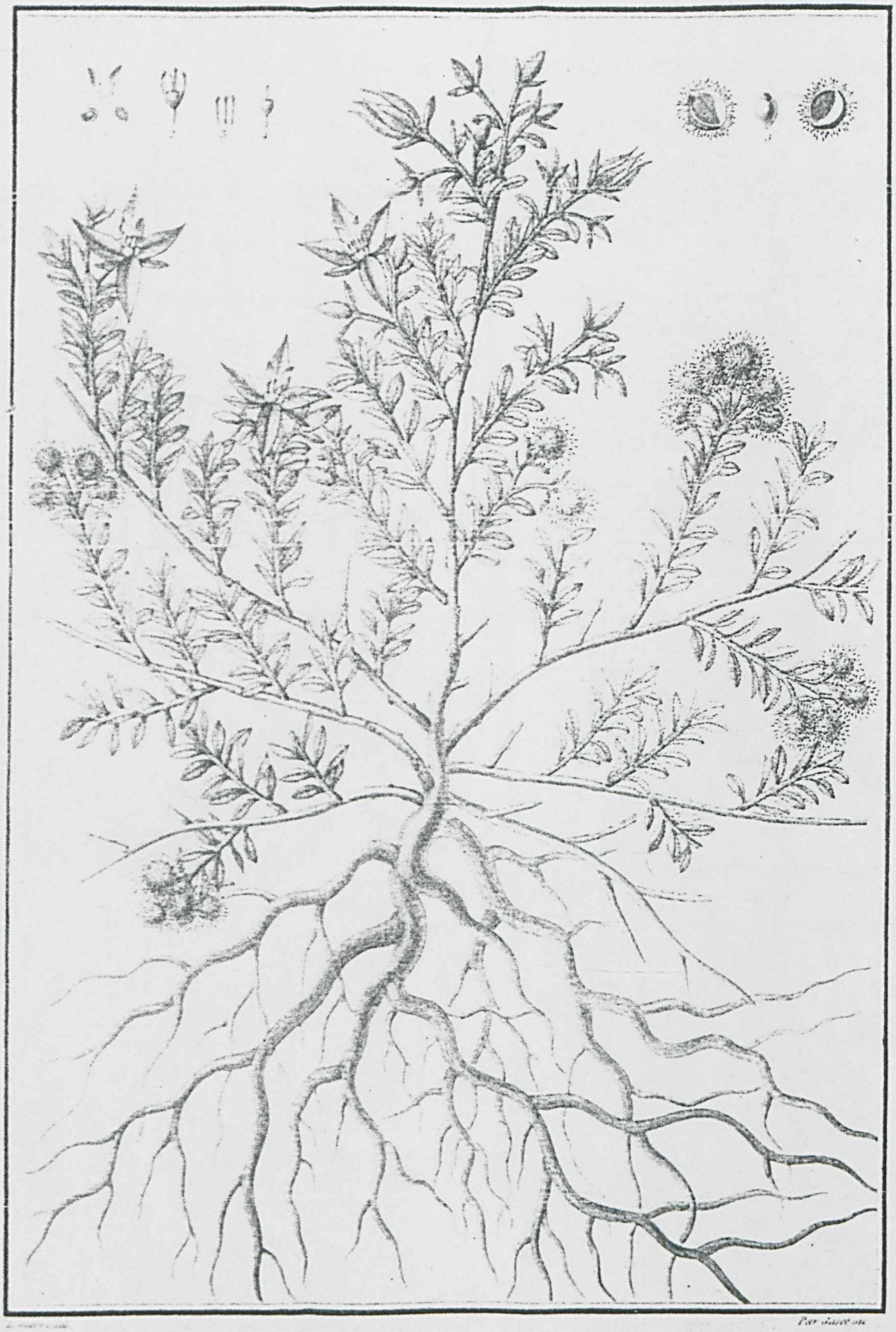


Fig. 24. "Ratanhia", Krameria triandra, Hipólito Ruiz, Memoria sobre la Ratanhia (1796).



Fig. 25. "Yallhoy", Monnina polystachya, Hipólito Ruiz, Memoir on the uses of Yallhoy (1821).

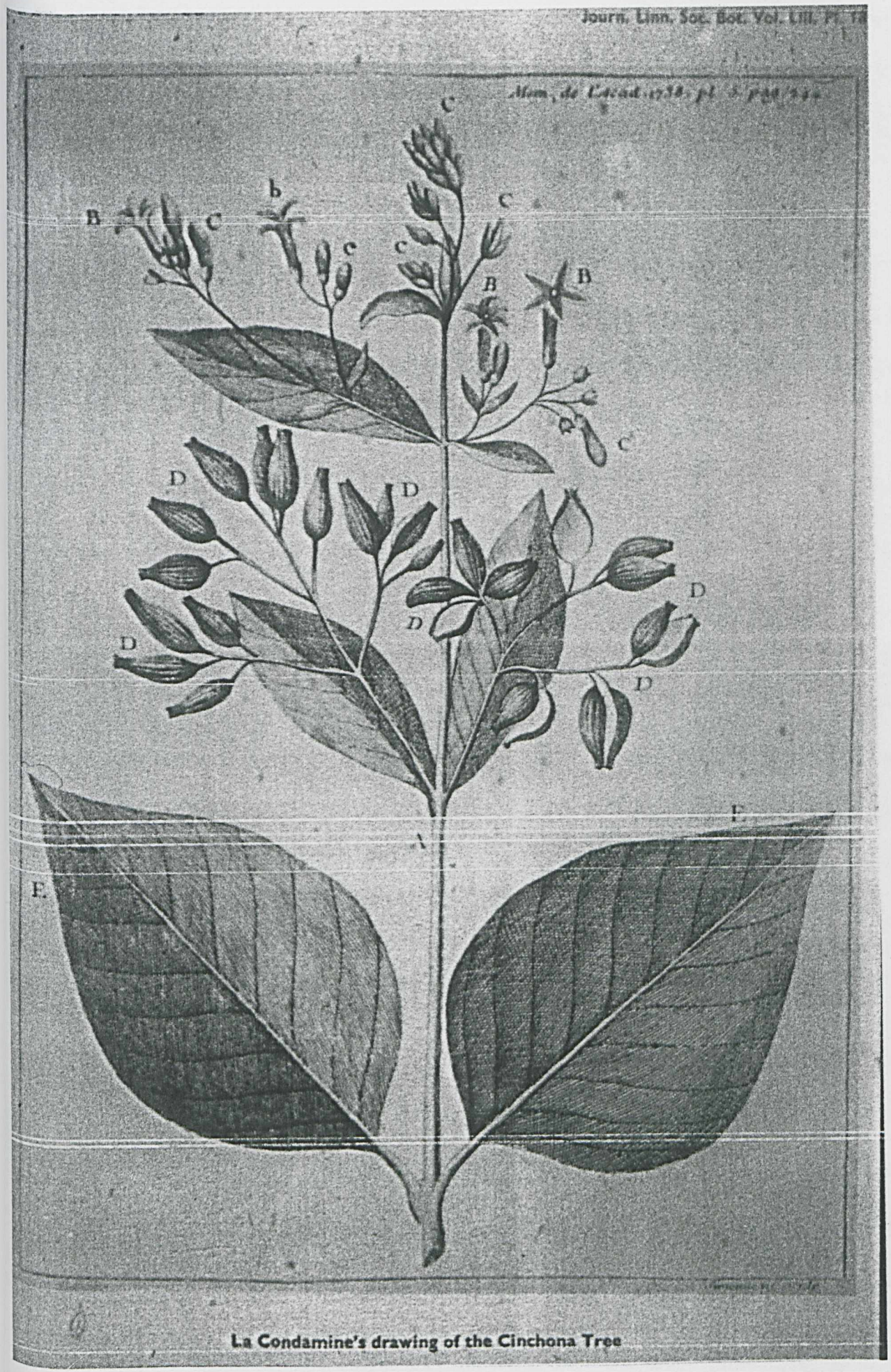
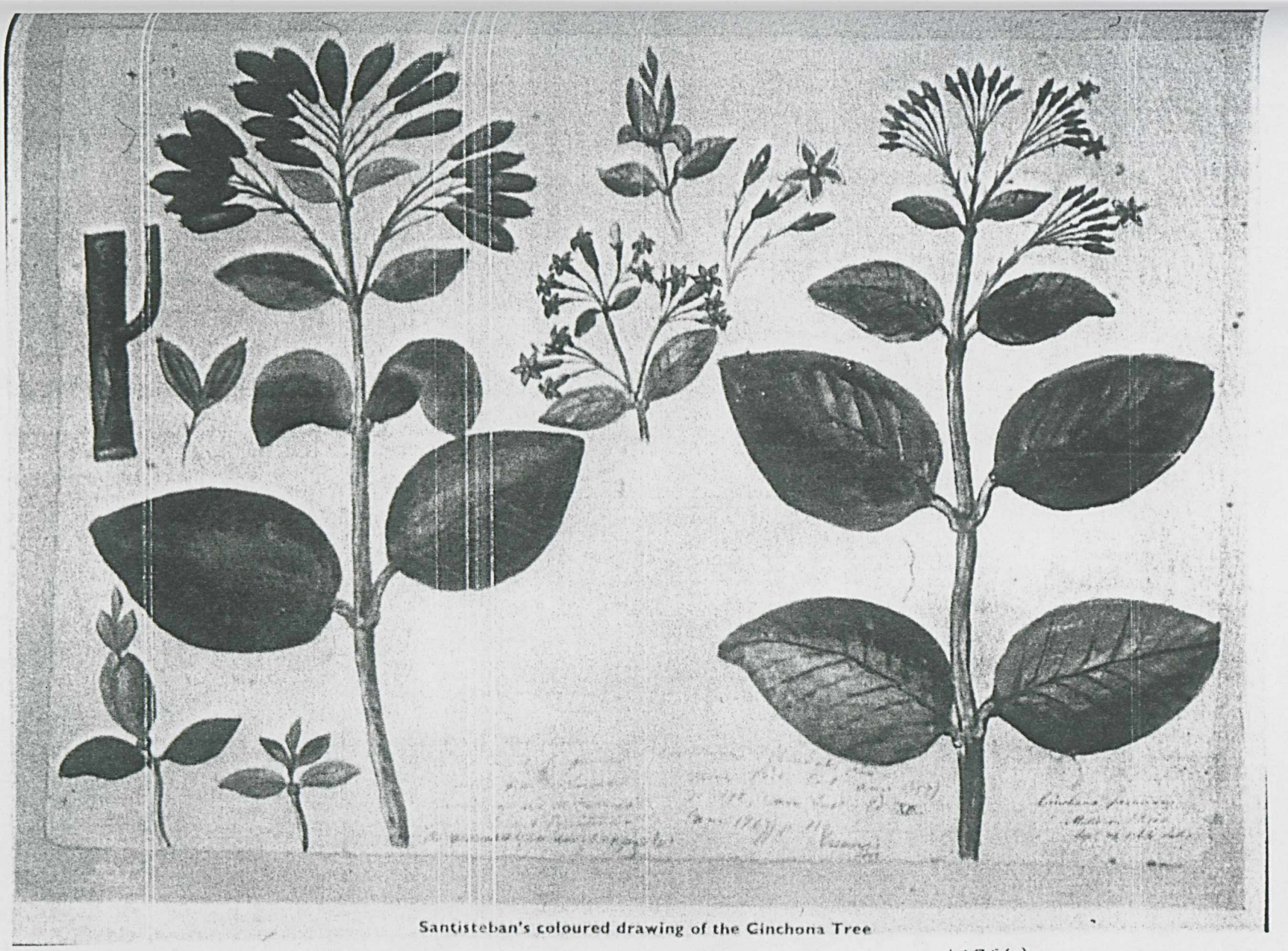


Fig. 26. La Condamine's drawing of the Cinchona tree. Memoirs de L'Academie (1738).



Santisteban's coloured drawing of the Cinchona Tree

Fig. 27. Santisteban's drawing of the Cinchona tree (1764).



CINCHONA

Fig. 28. Cinchona nitida, Ruiz and Pavon, Flora Peruviana et Chilensis, vol.II, 1799.

Capsula fusco-fulva, turbinata, compressiuscula, didyma, bisulca, decemnervis.

Semina fulvescentia, margine dilutiori cincta.

Habitat in *Andium* praeruptis et imis locis calidis, inter *Chaulla* et *Mutia* vicos, praesertim versus *Santo Domingo* cullem.

Floret Majo, et Junio.

Explic. Icon. 1 Flos integer. 2 Pistillum cum calyce. 3 Corolla scissa cum staminibus. 4 Capsula calyce coronata. 5 Eadem aperta, à calyce et epidermide exteriori libera. 6 Receptaculum alterum cum seminibus. 7 Semina.

CINCHONA. Linn. *Gen. plantar. pag.* 121.

CHARACTER GENERICUS REFORMATUS.

Cal. *Perianthium* parvum, campanularum, quinquedentatum: *dentículis* acutis, erectis superum, persistens.

Cor. infundibuliformis. *Tubus* calyce multò longior, cylindricus, vix curvatus. *Fauces* subrotunda. *Limbus* planus, quinquepartitus: *laciniis* patentibus, ovato-lanceolatis, intus hirsutis.

Stam. *Filamenta* quinque, filiformia, ferè medio tubi inserta, fauce breviora. *Antherae* inclusae, incumbentes, lineari-oblongae, basi bifidae, biloculares, longitudinaliter utrinque dehiscentes.

Pist. *Germen* oblongum, truncatum, parvum, obsoletè striatum, umbilicatum. *Stylus* filiformis, longitudine staminum. *Stigma* bilobum: *laciniis* oblongis, erectis.

Per. *Capsula* oblonga, obsoletè compressa, bisulca, decemstriata, coronata, umbilicata, bilocularis, bivalvis, sulco à basi ad apicem longitudinaliter utrinque dehiscens: *valvulis* margine extrorsum divergentibus, cymbiformibus, apice connexis, duplicatis: *exteriéribus* corticosis, fragilibus, in siccitate ab interioribus defixis; *interioribus* integerrimis, callosis, nitidis, marginibus introflexis, dissepimentum constituentibus.

Sem. In singulo loculo numerosa, imbricata, ovalia, compressa, margine oblongo, membranoso, inaequaliter lacero, basi emarginato cincta. *Receptacula* linearia, utrinque acuta.

Obs. 1. Limbus *Cinchonae grandiflorae* glaber.

Obs. 2. Capsularum *Cinchon. grandiflorae* et *dichotomae* Valvulae post dehiscentiam superné divergunt, et calyces *C. grandiflorae* adulto germine decidunt; reliquarum verò Specierum Valvulae usque ad decidentiam ferè apice connexae, calyce coronatae persistunt.

Obs. 3. *Cinchonae* Genus à *Portlandiae* et *Macrocnemi* Generibus, quibus magis affine est, differt *Filamentorum* et *Antherarum* insertione et longitudine; *Capsularum* structurâ et dehiscentiâ; *Valvularum* et *Seminum* figurâ, reliquisque notis, minus insignibus, quae in Characterе genérico omitti possunt.

Habitus.

Arbores procerae aut humiles. *Truncí* solitarii, aut plures, erecti. *Rami* teretes, scabri, aut laeves, cicatriculis annularibus ab insertione stipularum provenientibus notati: *teneri* obtusè tetragoni, saepius sulcati. *Folia* opposita, petiolata, integerrima, venosa, supra nitida: *tenera* antice viscosa, adpressa. *Stipulae* interfoliaceae, oppositifoliae, supraxillares, basi connatae, subovatae, antice visco agglutinatae, caducae. *Panicula* terminalis, brachiata, foliosa, plerumque magna, subracemosa, vel *Inflorescentia* subcorymbosa. *Pedunculi* et *Pedicelli* tetragulares. *Flores* breviter pedicellati. *Bracteae* parvae, deciduae. *Corollae* extus tomentosae, aut glabrae, limbo hirsuto aut rarius glabro. *Capsulae* leviter aut profundè striatae. *Semina* alâ utrinque elongatâ, lacerâ cincta. *Color* purpureus, frequens in paniculis et inferioribus venis foliorum. Materies lignosa sublutescens. Arbores undique incisae succum gumosum rubicundiusculum exudant, inferné disseccatae plures ramos emittunt.

CINCHONA NITIDA. Icon. CXCI.

1. C. foliis obovatis nitidis, paniculâ brachiatâ, corollis albo-purpureis, limbo parum hirsuto.

Cascarillo oficinal. Hip. Ruiz *Quinolog. Art. II p. 56.*

Arbor procera, 10-40ulnaris, glabra.

Trunci plures, 3 ad 5, aliquando solitarii, erecti, divergentes, stoloniferi, teretes. *Cortex* extus scaber, fusco-nigricans, saepè ex fusco et cinereo colore variegatus; intus obscurè fulvus, amarissimus, acidulus, non ingratus.

Rami *seniores* teretes, patentes, scabri, fusco-atri, cinereo colore variegati: *teneri* obtusè quadrangulares, fusci.

Folia opposita, petiolata, obovata, integerrima, nitidissima, plana, marginibus ad basim revolutis, subtus venosâ, venis saepe purpurascentibus: *nonnulla* ovali-oblonga ovato-oblongaque, 1-2palmaria.

Petioli pollicares, subtus semiteretes, supra planiusculi, purpurei.

Stipulae interfoliaceae, supraxillares, basi coalunatae, oblongae, obtusae, caducae, intus rubescentes, marginibus reflexis.

Panicula terminalis, composita, subracemosa, rubescens, 2-3palmaris.

Pedúnculi brachiati, tetragoni, multiflori.

Flores breviter pedicellati.

Pedicelli bracteolis subulatis stipati.

Calyx parvus, purpureus.

Corolla alba, extus dilute purpurea, vix semipollicaris. *Limbus* parum hirsutus.

Capsula oblonga, angusta, superné attenuata, rubescens, coronata, decemstriata.

Semina ovalia, fulva, margine membranaceo, oblongo, bivolvo, inaequaliter denticulato cincta.

Habitat in *Andium* montibus altis nemorosis frigidis ad *Pampanuscu*, *Chachuassi*, *Casape*, *Cascapillo*, *Cayumba*, *Sipan*, *Cachero* aliisque tractibus, et in montibus Provinciarum *Huamalies*, *Tarmae* et *Xauxae*.

Fig. 29. Description of the genus Cinchona, Ruiz and Pavon, Flora Peruviana et Chilensis, vol.II, 1799.



Fig. 30. Jose Celestino Mutis by Antonio Garcia, 1801. The Spanish physician, surrounded by religious books and scientific instruments, appears working on a Copernican diagram of the solar system.

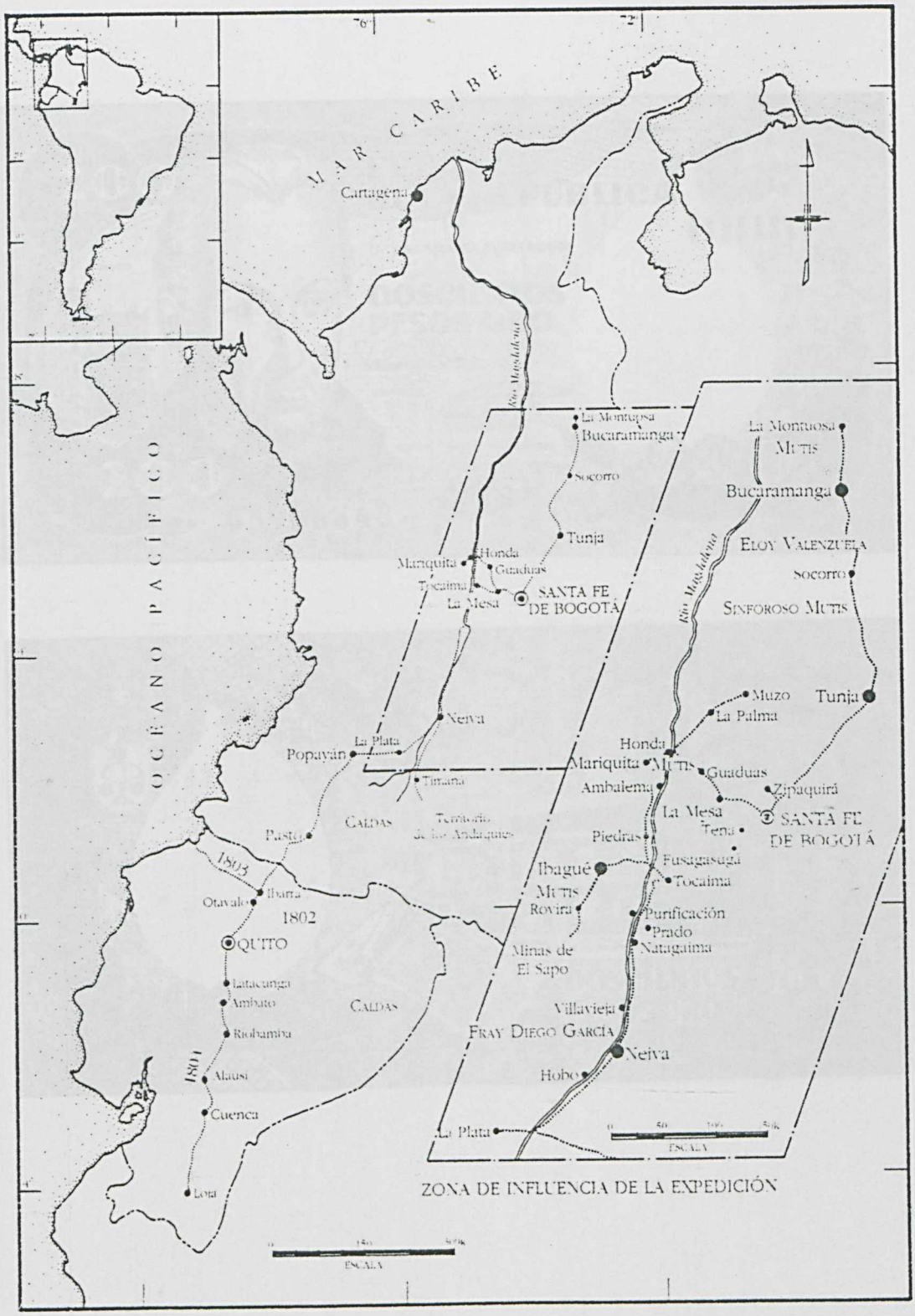


Fig. 31. Area covered by Mutis's expedition. From: Mutis y la Real Expedición Botánica del Nuevo Reino de Granada. p.49.





Fig. 32a. 200 Colombian pesos note showing Mutis, the Astronomical Observatory and the Colegio Mayor de Nuestra Señora del Rosario.

Fig. 32b. 2000 Spanish pesetas note showing Mutis, the main entrance of the Royal Botanical Garden of Madrid, the front page of Mutis's Historia de los Arboles de Quina, and Salvador Rizo's drawing of the species Mutisia clematis.

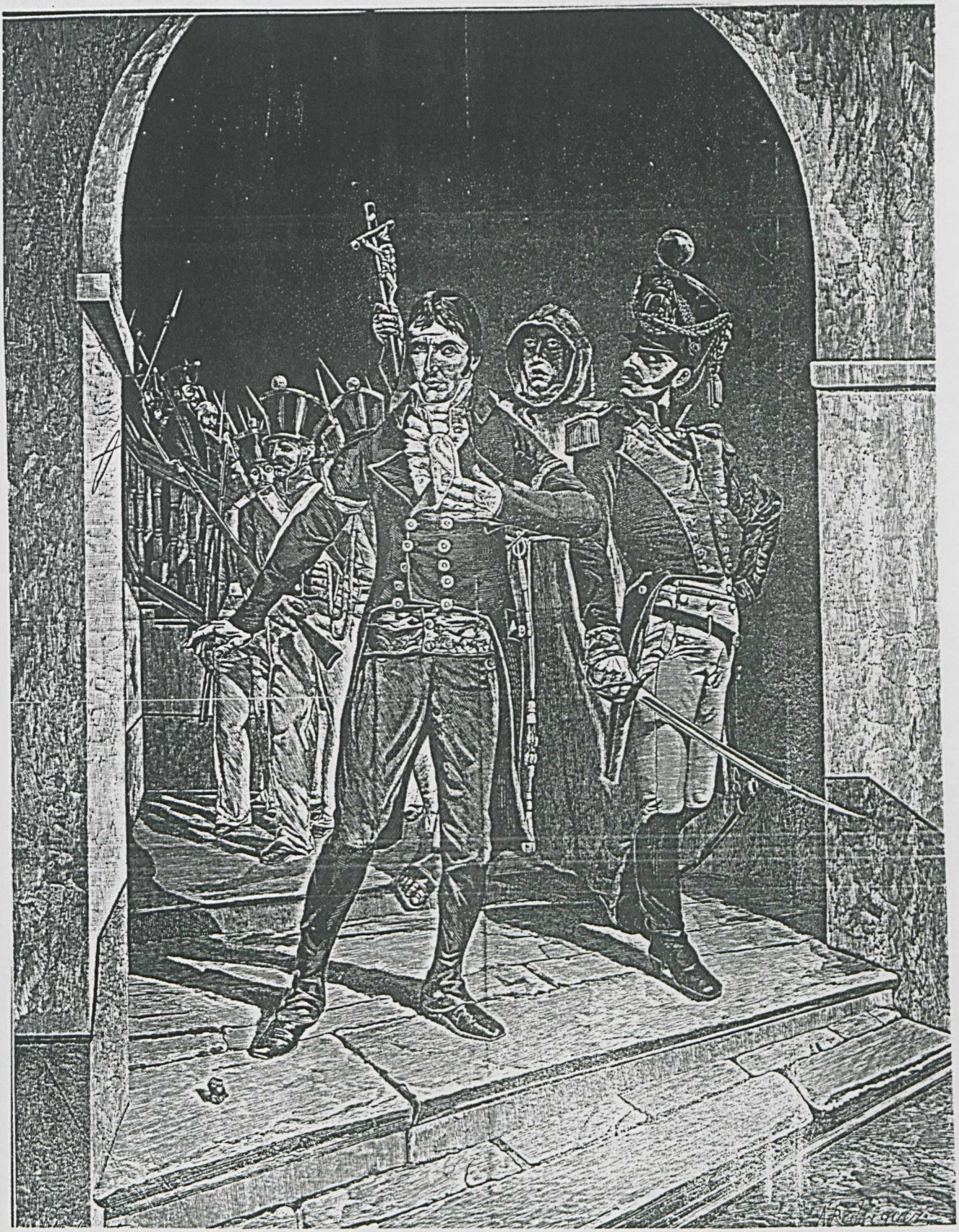


Fig. 33. Papel Periodico Ilustrado, Santa Fe de Bogotá, 1882. Francisco Jose de Caldas led by Spanish soldiers to be executed. With a piece of coal, Caldas draws on the wall a circle divided in two which, as the inscription explains, was Caldas's laconic and sorrowful farewell.