Chapter 3
Ethnobotany and Ethnohistorical Sources of Mesoamerica

Robert Bye and Edelmira Linares

Abstract Almost five centuries of interactions and relationships between humans and plants in Mesoamerica have been documented, principally from the etic perspective. This essay focuses on ethnohistorical sources mostly from New Spain (which includes much of contemporary Mexico) during the sixteenth, seventeenth, eighteenth, and early nineteenth century during Mexico's Viceroyalty period. Indigenous documents usually referred to as codices are rare due to their destruction by Spanish authorities; none the less 15 preConquest documents exist and depict the people's interactions with plants as well as other elements of the physical and spiritual worlds. Along with indigenous postConquest codices, the documents generated by ecclesiastical, government, and commercial authorities provide abundant textual and pictorial records of plants that influenced the life of native people as well as that of the Spanish and mestizo population. Botanical identification of the plants is limited in certain documents due to lack of adequate descriptions and/or illustrations. None the less, certain plants can be discerned from vernacular names associated with earlier illustrations as well as their etymological analysis. As sources for ethnobotanical data, the codices of the early Viceroyalty Period were complemented by later census data, commercial and tax records, and governmental inventories of useful resources (especially food and medicinal plants). Various missionaries and travellers authorized by the Spanish crown chronicled their experiences which included occasional observations about the natural history of plants. It was not until the eighteenth and the early nineteenth century that herbarium specimens and associated botanical studies permitted taxonomic identification of many plants of ethnobotanical importance. About 3000 plant names were recorded of which almost 700 have taxonomic determinations. They were important sources of medicines, food, material sources, and ornamentals.

Keywords Iconography • Codices • Relaciones geográficas • Viceroyalty Period • Reversión

R. Bye, Ph.D. (✉) • E. Linares, M.Sc.
Jardín Botánico-Instituto de Biología, Universidad Nacional Autónoma de México, Ciudad Universitaria, México, Distrito Federal 04510, Mexico
e-mail: bye.robert@gmail.com

© Springer Science+Business Media New York 2016

R. Lira et al. (eds.), *Ethnobotany of Mexico*, Ethnobiology,
DOI 10.1007/978-1-4614-6669-7_3

Introduction

Ethnobotany is dedicated to the study of the interactions and relationships between plants and people over space and time. *Interactions* refer to the reciprocal impacts of one component upon the other; these are consequences of such processes as co-evolution, domestication, plant management, and ecological processes (e.g., commensalism, mutualism). *Relationships* between the plant and human components reflect correlations where cases of cause-and-effect are not obvious. Examples include such cultural endeavors as cosmology, generation and transmission of knowledge, nomenclature, classification, description, transformations, exchanges, and utilization. These interactions and relationships occur throughout time and over space. The *time* component is variable. On one hand, the chronological scale of human history from the humanoid era to the anticipated future is usually assumed. None the less, one can view time from the biological–evolutionary scale, especially when considering evolutionary changes which can vary with different evolutionary clocks of organisms or velocity of genetically fixing desired characteristic through artificial selection. Physiological time expressed as growth patterns of plants can be different from normal biological time under different management regimes to which the plants are subject to. *Space* varies with reference to the positioning of the plants relative to human perspective. Depending upon which spatial attributes are given priority, the amalgamation of unit and its delimitation can vary. The cultures with social networks and customs define areas on the earth over which people interact while geopolitical forces impose their spatial control and boundary enforcements that protect the institutional policies. Many times the lack of concordance between sociocultural and political spaces is the basis of conflicts dealing with plant resources. The biogeographic space responds to interactions of biotic and abiotic factors with the biota in the context of historical geography so that regionalization of nature is at once subliminally obvious but generates alternative representations in terms of biogeographic provinces, life zones, floristic regions, vegetation types, among other categories of classification.

The *scales* at which interactions and relationships can be perceived can differ as well. One can take a global perspective of the whole ecosystem, focus on a floristic region, vegetation zone or a gradient of ecological zones, as well as concentrate on one species, its populations, or a particular individual plant. Similarly, ethnobotanical studies can encompass the cultural context, focus on a society, as well as concentrate on a community or an individual.

Another point is important; the interactions and relationships that have been considered are those we physically perceive with our five senses. However, an appreciation of the cosmology of the others worlds that ethnobotanists explore is essential. Some people perceive other worlds through additional senses that are not developed by those outside their culture. None the less, the plants are important manifestations of other beings we cannot perceive or part of a mythical landscape or time that are not part of one's conventional world. Ethnobotanists need to be aware of the world views of others as well as our own limitations.

When conducting research, ethnobotanists need to be conscious of the scale and dimensions which we share with collaborators. Consequently, respect and reciprocity are key concepts in our research. Mutual respect, confidence, and compliance with cultural norms are the foundations that permit us to enter other people's worlds to investigate their plants. Besides generating academic products and providing perspectives for other sectors of societies, ethnobotanists should share with their collaborators the perspective we have developed by working in their plant world, a form of "reversion" or reciprocity of knowledge of mutual benefit. Information and programs with value added (even if it is from outside their perspective) can be offered (not imposed) to those who have shared part of their lives and life ways.

Here we will sample this web of ethnobotany from the perspective of ethnohistorical resources from precontact time through the Viceroyalty Period. Because of the spotty nature of the information (part of which has survived, part of which was lost, and part of which was never recorded), we focus on sources of data and examples of the application of these data in ethnobotany of Mexico.

First, we need to be aware of the purposes for which the documentation was made, the people responsible for its fabrication and control, as well as the type of medium used. *Second*, we should consider if the record and its presentation were made from an emic or etic viewpoint. *Third*, the taxonomic level of the plant identification and its level of confidence are critical to providing and ethnobotanical interpretation.

Important Ethnobotanical Sources

Because the prominence of plants in ethnohistorical documents depends on the indigenous names, the earliest documents which link native plants names to recognizable botanical species are most critical. The etymological origin of the native names [1] and the illustrations of plants depicting diagnostic morphological characters [2] are essential to the identification of plants and to connecting prehispanic sources with post conquest documents. In the of Mesoamerica, the three major information sources for Mexican plants and their importance to the people of that time were written during first 60 years after the conquest of Mexico. Of those, two documents became available to academia community within the last 275 years. Below, each document is briefly described as to its origin, authors, contents, and importance as an ethnobotanical resource reflecting the relationships between people and plants shortly before the Spanish Conquest and during the first half century of the Viceroyalty Period. Further information (in addition to the references cited below) for the these documents (in chronological order of production) can be found in the respective bibliography cited after the titles: *Libellus de medicinalibus indorum herbis—Tratado sobre hierbas medicinales* indias [3–7], *Historia general de las cosas de Nueva* España [8–11], and *Historia natural de las plantas de Nueva* España [12–15]. Because many of the early ethnobotanical sources of the Viceroyalty Period focus on the medical applications of plants, it is worth noting

that the major compilations on Mexican herbolaria make reference to these critical sources [16–18].

A prominent Mexican academic leader who interpreted and provided accessible to the latter two documents and their associated material was Francisco del Paso y Troncoso. During his residence in Europe between 1892 and 1916, he searched for documents related to Mexican history. Being that his professional thesis dealt with history of medicine in Mexico and was based largely upon the writings of Francisco Hernández, he was especially sensitive to references that shed light on the botanical studies of the past. Of the hundreds of published reports on documents relating to Mexican history, over 80 of his articles are of botanical interest.[1]

Libellus de medicinalibus indorum herbis—Tratado sobre hierbas medicinales indias is the first book produced in the New World dealing with American curative plants and written by indigenous people. This *Libellus* documents the encounter of native Mesoamerican remedies with European medicine. Martín de la Cruz [late XIV c.-?], an indigenous healer of fame, *ticitl*, from Santiago, Tlatelolco, had won the confidence of the viceroy of New Spain, Antonio de Mendoza, and his son, Francisco de Mendoza, who promoted de la Cruz to redact a text of local remedies. An older man without institutional schooling, he dictated examples of illness and their cures from the indigenous perspective, which was probably recorded in his native language, Nahuatl. Juan Badiano [1484–1560], a younger man from Xochimilco with knowledge of traditional medicine as well as formal education in Latin and Spanish, collaborated with the former in translating the information into Latin as well as probably adjusted the organization and terminology of parts of the document so as to be comprehensible to Spanish readers. Native artists, *tlacuilo*, painted figures of the plants, although it is unknown if they drew the illustrations from plant samples or rendered the illustrations from verbal descriptions.

Libellus was created for a practical reason and was directed to the Spanish crown. The College of Santa Cruz in Tlaltelolco near Mexico City, headed by Friar Jacobo de Grado, was facing financial decline and health crisis in this institution that was established to educate the children of the Mexican society's nobility after the Conquest of Mexico. Diseases (especially smallpox upon first contact with the Spaniards and later during 1545–1548) had reduced the indigenous population and threatened the students; also, the new college was in need of proper maintenance. These necessities required greater funding from the Spanish authorities. Upon its completion in July of 1552, Francisco de Mendoza (son of Viceroy of New Spain, Antonio de Mendoza) personally presented it to the Spanish crown as evidence of the high intellectual level of its subjects in New Spain. Also, the son the viceroy of New Spain sought to obtain crown-sanctioned concessions to commercialize American medicinal herbs; Nicolás Monardes of Sevilla profited from this venture as seen by his later importation of herbal remedies and by the publication *Historia medicinal de las cosas que se traen de nuestras Indias Occidentales*.

[1] See I.K. Langman. A Selected Guide to the Literature on the Flowering Plants of Mexico. 1964; Philadelphia, PA: University of Pennsylvania Press. pp. 567-569.

The document was produced at College of Santa Cruz located Tlaltelolco where the students of noble background were instructed in Latin, Greek, and Spanish, learned to write their native tongue, and were evangelized. The school also served as a center to document the Mexican culture, although the authorities later censored the products. In addition to generating *Libellus*, Tlaltelolco was home to other scholars such as friar Bernardino de Sahagún who began in 1555 to generate manuscripts that later formed what is known today as the Florentine Codex o *Historia General de las Cosas de Nueva España*.

Even though King Carlos V did not examine the *Libellus*, his son who later became King Philip II of Spain probably saw it. *Libellus* remained in the royal library at Escorial; during the early seventeenth century, Diego de Cortavila y Sanabria (pharmacist of Spanish King Philip IV) incorporated it into his collection. Probably during his visit to Spain 1624–1625, Cardinal Francesco Barberini acquired the book which was catalogued as "Codex Barberini Latin 241". At that time *Libellus* drew the attention of a member of the Cardinal's staff, Cassiano dal Pozzo who made a copy which became part of the English King George III library in Windsor Castle [19]. Up to the twentieth century, the inaccessibility of the document and absence of recognized botanical names (most of which are in Nahuatl) account for the limited contribution *Libellus* made to science and medicine.

The appreciation of *Libellus* began to change in 1902 when the Barberini library was transferred to the Vatican Library in Rome. Charles Upson Clark rediscovered the book in the Vatican Library in 1929. Two scholars in particular, William Gates [3] and Emily Walcott Emmart Trueblood [4], independently studied photographs of *Libellus* and published the Latin texts with English translations along with illustrations. A Spanish version with selected drawings was published by Francisco Guerra [5]. Not until 1964, did a full color facsimile edition with Spanish translations and scientific analysis become available [6]. In 1990 during this visit to Mexico, Pope John Paul II arranged for the transfer of *Libellus* from Vatican City to Mexico where it is currently deposited in the library of the Museo Nacional de Antropologia e Historia.

The information in *Libellus* is organized by sicknesses in 13 chapters. Indigenous medical system arranges the illnesses from the head to the feet, also common order in European texts, as well as dealing with death. The relationships of some ailments are associated with cosmology of the Mexico. In other cases, European terms are used to describe specific maladies recorded in classic medical texts of the Old World such as those of Plinio, Dioscórides, and Galeno. Hence, *Libellus* documents the mestization of Mexico's medical tradition based upon indigenous concepts tempered with European influence. This mingling has created a challenge for today's researchers to not only separate the respective bases of health concepts and practices but also to identify the sources of contemporary Mexican cultural identity.

The structure of each entry in *Libellus* contrast with that of the European herbals which focused on the plants and their curative properties. But in appearance they are similar because each illness treated in *Códice de la Cruz-Badiano* is prefaced by an image of some (but not all) the plants mentioned in the corresponding remedy along with its Nahuatl name. Few plants are referred to by Latin names; such a

situation may explain why the *Libellus* was not readily accepted by the medical profession of the Old World who did not recognize such foreign terms. The illustrations reflect the pre-Hispanic style with glyphs. The base of each plant is imbedded in a figure with various colors which depicts specific properties of the plant, in most cases its ecological habitat. Such holistic representation disappeared in later registers of the same century; they appear rarely in the works Sahagún and Hernández produced shortly after the *Libellus*.

The de la Cruz-Badiano manuscript illustrates 185 plants and mentions 227 plant names, mostly in Nahuatl. Since the 1930s, various scholars, principally from USA and Mexico, have proposed the taxonomic identifications of more than half of the plants based principally upon vegetal and reproductive characters in the illustrations, along with their indigenous names (some of which continue to be employed in Mexico), and its implied bioactivity derived from its medicinal application. The landmark botanical study was established by Miranda and Valdés [20] and subsequent modifications have been proposed by among others Valdés, Flores, and Ochoterena [21], Clayton and de Ávila [19] and Bye and Linares [22].

Historia general de las cosas de Nueva España (also known as the Florentine Codex) is the principal contribution of the Franciscan Friar Bernardino de Sahagún [1499–1590], today recognized as the Father of American Ethnography. Upon his arrival in Mexico in 1529 he immersed himself in the task of evangelizing the recently conquered Mexican nation. Based on the various ecclesiastical sites at the Valley of Mexico, he learned the Nahuatl language. In contrast to his contemporaries who later produced bilingual dictionaries [23], Sahagún attempted to depict in words and illustrations the cultural basis of the language. The description and explanation of pre-Hispanic religion, beliefs, practices, deities, and elements of the environment were initially intended to assist the friars and civil authorities comprehend the idolatrous religion and, in turn, convert the Aztecs to Catholicism. Over time, Sahagún appreciated the richness and value of the great cultural inheritance of the indigenous people of New Spain and attempted to record it for posterity. Certain authorities of the viceroyalty recognized that his contributions could be counterproductive and subject to an Inquisition inquiry, a situation that lead to the confiscation of his works that were sent to Spain in 1577 (known as the *Codices matritenses*) and, in 1580, the deposition of the bilingual, illustrated compilation known today as the Florentine Codex by friar Rodrigo de Sequera, the Franciscan Commissary General and Sahagún's defender. To this day, the curious omission of the Spanish translation of certain Nahuatl texts (e.g., those related to hallucinogenic plants) may be interpreted as a form of protecting indigenous knowledge or may have permitted more space of illustrations of these ethnobotanical important plants. The Archivo General de la Nación produced the first facsimile that appeared in 1979 [24]. Presently, the only full translation of the Nahuatl text is in English edition [25].

Most of the preliminary work was conducted by Sahagún at the College of Santa Cruz in Tlatelolco, near Mexico City. He was assisted by two important indigenous people: the elders of central Mexico and the Nahuatl students (and former students). The elders' responses to Sahagún's questionnaires [26] were recorded in traditional pictorial form by *tlacuilo* and the students provided interpretations and clarifications

written in Nahuatl and Latin. Sahagún reviewed the Nahuatl text which he translated into Spanish. Although the compilation of information began during the 1530s, the actual compilation of the bilingual version occurred between 1575 and 1577. A possibly earlier Spanish version of 1532, is known as the *Manuscrito de Tolosa*, was deposited in the Franciscan convent of Navarra, Spain; this document may have been consulted by other earlier chroniclers of Mexico such as Francisco Javier Clavijero [27]. The original Florentine Codex consisted of 12 books (now bound in three volumes) was initially sent to Pope Gregory XIII in 1580 and later deposited in *Biblioteca Medicea Laurenciana* in Florence, Italy, where it resides today. Usually each page consists of two columns with the left column in Spanish and the right in Nahuatl. Many of the almost 2500 illustrations are in the Nahuatl column and depict people, animals, and plants with diagnostic characters in European style although a few images include pre-Hispanic artistic traits. Although plants and their relationships with people, mostly the Aztecs, are found in all 12 books, Book 11 entitled "Earthly Things, about properties of animals, birds, fish, trees, herbs, flowers, metals, and stones, and about colors" concentrates on 74 % of the plants with ethnobotanical information.

The first notice about the Florentine Codex appeared in the inventory of books in the Medici Library in 1793. In 1829–1830, Carlos María Bustamante published the Spanish texts in the first edition in Mexico with taxonomic identification of the plants by Vicente Cervantes, the Spanish botanist who arrived with the Royal Botanical Expedition during the previous century. The pictorial elements were copied between 1905 and 1907 under the supervision of Francisco del Paso y Troncoso to produce the first set of colored illustrations that were copied from the Codex and reproduced in 158 plates that have been used in most of the publications to date. The landmark reference for the botanical identification of the plants, principally in Book 11, was published in 1941 [28] while the extensive compilation of the indigenous plant names, for which 382 species have been determined, was prepared based upon the 1979 facsimile by Estrada [29].

Historia natural de las plantas de Nueva España by Francisco Hernández [1514–1587] was the first formal inventory of biotic resources of New Spain sanctioned by the Spanish Crown. In 1567, Hernandez became the court physician of King Philip II who, in 1570, charged him to document the natural history of his lands in the New World. His title "Protomédico general de nuestras Indias, islas y tierra firme del Mar Océano" (Chief medical officer of Spanish Indies, islands and lands of the Sea) covered a large area of the Spanish Empire, in particular the Caribbean Islands, contemporary Mexico and Central America to northwestern South America. Most of his time between 1571 and 1577 was spent in New Spain although his initial arrival in the New World was spent in the Caribbean region. Hernández travelled throughout central Mexico with his team that included his son as well as indigenous specialists and artists. The inhabitants bestowed upon him the name "El preguntador del Rey" (The King's questioner) because he inquired about plants, animals, and minerals throughout the Viceroyalty as well as documented all with texts (in Spanish, some in Nahuatl), dried specimens, seeds, live plants, and drawings.

He recorded the plants by providing indigenous names (and their etymology in some cases), comparative morphological descriptions, ecological, and geographical data as well as organoleptic and pharmacological properties. Although some of the organoleptic and medicinal properties are derived from indigenous informants, the therapeutical properties reflect Galenic principles of medicine, suggesting that his work reflects more an etic perspective. While visiting convents and hospitals, he was able to record experimental results of the application of some of the remedies. In some cases he included forms of preparation and dosages in addition to their medical uses. In some cases, he presented different plants with similar names, therapeutic properties, and medical uses suggestive of the concept of medicinal plant complexes [30] in which different taxonomic entities have the same or similar plant names, similar uses, yet have different geographic distribution; usually each complex has a preferred signature species considered to be the most effective. A few of the surviving illustrations contain elements of the indigenous *tlacuilo* style and others with European style (possibly due to their depiction after the compilation of the work).

Before Hernandez passed away in 1587, King Philip II charged Nardi Antonio Recchi, a Neapolitan book editor, to produce an abbreviated edition of his work based upon the voluminous notebooks and drawings. Upon the Recchi's death in 1595, Federico Angelo Cesi of the Accademia dei Lincei completed the publication. The result was the Roman edition that became available in 1651 with the title *Rerum medicarum Novae Hispaniae thesaurus, seu, Plantarum animalium mineralium Mexicanorum* historia [31]. None the less, copies of Hernandez' notes were available and copied into publications of others. One of the most recognized is that of Francisco Ximénez [32], who published in the City of Mexico *Quatro libros. De la naturaleza, y virtudes de las plantas … en el uso de medicina en la Nueva España … que el doctor Francisco Hernandez escribió en lengua latina* with credits to Hernández. None the less, Juan de Barrios [33] also printed in Mexico City a treatise entitled *Verdadera medicina, cirugia y astrologia, en tres libros dividida* but does not credit Hernández. The detailed comparison of the documents of both Barrios and Hernández by López and Pardo [34] leaves no doubt that Barrios copied the Hernandez' first text, *Index medicamentorun Novae Hispaniae*. A similar case has been made for *El tesoro de medicinas para diversas enfermedades* by Gregorio López [35].

The plants, documents, and illustrations of the Hernandez' expedition were deposited in the library of the Royal Monastery of San Lorenzo de El Escorial (located about 45 km northwest of Madrid). Elements of his archive became disassociated from the main collection in order to further study the information, to prepare parts for publication, or to decorate the walls of the royal palace. Much of his archive was lost in the fire of 1671 in the El Escorial. Surviving fragments were assembled to produce the Madrid edition in 1790 known as *Opera: cum edita, tum inedita, ad autographi fidem et integritatem expressa, impensa et iussu region …* with chapters titled "Historia Natural de las Plantas de Nueva España" [36]. This work probably stimulated the Spanish Crown's Royal Botanical Expedition to New Spain and was supervised by Casimiro Gómez Ortega, first professor of botany at

the Royal Botanical Garden Madrid. Isolated fragments have been associated with such favors of King Philip II as gifts of drawings to Jaime Honorato Pomar (professor of botany at the University of Valencia) that form part of the Pomar Codex said to date to 1590 [37].

These publications based upon the sixteenth-century expedition of Hernández constitute the primary source of botanical knowledge for Mexico and parts of the Caribbean over the next two centuries. Excerpts appeared in various international books: *Historia naturae* by Juan Eusebio Nieremberg [38], *Historia plantarum generalis* by John Ray [39], *A voyage to the islands Madera, Barbados, Nieves, S. Christophers and Jamaica* by Hans Sloane [40], *Histoire naturelle, générale et particulière, avec la description du Cabinet du Roy* by Georges-Louis Leclerc, better known as Comte de Buffon [41], *Historia antigua de México* by Francisco Javier Clavijero [42], among others. Hernández, himself, attempted to contextualize the biodiversity of New Spain by incorporating his observations in the New World into a translation of Pliny the Elder [13].

Most European books describing the world's flora published prior to 1753 make reference to plants in the Rome edition of Hernández. The basis of the attribution of any particular plant of Hernández to more recent plant species is uncertain; the synonymy may have been based upon the indigenous name, the description, or the illustration. After 1753 when Carl Linnaeus' *Species Planatarum* was published (and later recognized as the official date for priority of scientific names), some botanical treatments include names of Hernández but usually cite the synonymy in earlier publications. Linnaeus honored Francisco Hernández for his contribution to Mexican botany by dedicating to him the genus *Hernandia*,[2] of the family Hernandiaceae, with 25 species distributed in the tropics worldwide; five species are native to Mexico.

In order to re-evaluate the works of Hernández, King Charles III inaugurated the Royal Botanical Expedition to New Spain that functioned from 1787 to 1803 in direct contact with the Royal Botanical Garden Madrid. The expedition's focus was to update the two-century-old contributions of Hernández and validate the medicinal use of plants based on concepts of that period.

The most complete work of Francisco Hernández was produced by the Comisión Editora de las Obras de Francisco Hernández that was centered at the Universidad Nacional Autónoma de México between 1950 and 1984. The seven volumes include *Historia natural de Nueva España* (in two volumes plus another with commentaries on the work), Hernández' work on Pliny and his own writings. The principal source for the botanical determination of the plants was compiled by Valdés and Flores [43] in which, of the 3076 descriptions, 667 species are identified. Major advancement in the botanical interpretation during the Porfiriato Period was made by researchers at the Museo Nacional and Instituto Médico Nacional (Fernando Altamirano, Francisco del Paso y Troncoso, José Ramírez, and Manuel Urbina).

[2] Linnaeus accepted this generic name that was originally proposed by Charles Plumier and Joseph Pitton de Tournefort in 1703 in their description of plants of the West Indies, *Nova plantarum americanarum genera*.

Other scientific institutions have concentrated on the study of the contributions of Francisco Hernández such as the Smithsonian Institution during the early twentieth century (William Safford, Paul C. Standley), University of Valencia (José María López Piñero, José Pardo Tomás), and Stanford University Press (Chabran, Chamberlin, and Varey).

Iconography

The pre-Hispanic Mesoamerican cultures have left an iconographic legacy of their cosmology and accomplishments through vibrant murals and detailed decorative artifacts distributed throughout central and southern Mexico and northern Central America. The large-scale paintings incorporated into the building's architecture provided a visual record of the rulers' accomplishments as well as served to communicate social and political values in private and public places. With the Conquest by the Spaniards, the evangelistic authorities appropriated this medium to transmit the European Catholic faith among the newly converted with historical and religious themes.

The most comprehensive project to document and interpret pre-Hispanic Mesoamerican murals is being undertaken by an interdisciplinary team centered at the Instituto de Investigaciones Estéticas at UNAM. Six areas have been designated (Cacaxtla, Teotihuacán, Área maya, Oaxaca, Costa del Golfo, and Altiplano Central) and publication of the results is underway [44–46]. Special attention has been given to the iconographic representation of the plants [2]. Plants in the murals are frequently associated with paradise and serves as metaphors for song, poetry, authority, sun, transformation, and battle [47].

For centuries, anthropological, historical, and artistic perceptions have been given to the interpretation of pre-Hispanic iconography. With recent interdisciplinary studies, alternative analyses of Mesoamerican iconography have evolved. Such is the case of the epigraphic and iconographic reinterpretation of Classic and post-Classic images of the Mayan serpent, *chan* or *kan*, and the water lily [48]. The revelation of the symbolic permutations of the water lily and the feathered serpent provides a different perspective of the Maya's cosmological watery underworld for which these mythological beings served as a conduit. The psychotropic properties of the vegetative manifestation of the mythological water lily support previous hypotheses of the ritual importance of *Nymphaea ampla* among the Mayan dynasty.

Murals of the Viceroyalty Period reflected, in general, religious themes that were important for converting the native population and providing a contemplative atmosphere for the religious community [49]. However, the recent restoration of the Augustine monastery San Cristóbal or El Divino Salvador (founded in 1540) in Malinalco, State of Mexico, has afforded ethnobotanists a rare opportunity to view plants and animals in an enchanting garden setting [50, 51]. More than 33 taxonomical identified plants are illustrated, of which 31 are medicinal. Of those, 90 % are native taxa; 77 % of these are still employed in Mexican *herbolaria* today [52]. Some of the species no longer used had indigenous religious significance.

Codices

The codices (codex, in the singular) are important Mesoamerican documents because they provide the revelatory instrument for interpreting indigenous knowledge which underwent acculturation and for permitting ethnobotanical studies from both emic and etic perspectives. They were fabricated originally from paper (derived from *amatl* (or amate, tree bark of various species, in particular *Ficus petiolaris*), *ixtli* (maguey fiber from different species of *Agave*), or *amoxtli* (an aquatic moss of unknown source)) or from animal skins (*ehuatl*). *Amatl* is the term applied to paper in Nahuatl while *huun* is the name in Maya. The physical document of collective memory is referred to as *amoxtli*, a sort of book that was doubled usually in a multiple page Z-fold or in half, third, or quarter French fold (but not as a book being bound along one side of the pages to form a single spine). Initially the Spanish military and ecclesiastical authorities feared that the natives would return to paganism and, consequently, destroyed most of the codices produced in central Mexico and Mayas. Today only 15 *amoxtli* of the precontact period are known. None the less, the Spanish authorities realized the importance of this medium of communication and appropriated the pictorial form to record information of the newly conquered lands and to proselytize the Catholic faith among the Mesoamerican people. Francisco Antonio de Lorenzana, Archbishop of Mexico, marveled at the *Matrícula de tributos* and stated that it was the truest testament to the opulence, grandeur, and majesty of the Mexican Empire. The Mesoamerican codices have attracted the attention of the authorities, the public as well as academics for almost five centuries. They dominate the Mexico's ethnohistorical foundation having been studied from various perspectives [27] and have been replicated as facsimiles (e.g., La Colección Códices Mexicanos of the Fondo de Cultura Económica) and in collections (e.g., Edición Especial Arqueología Mexicana—Series Códices) by various publishers. None the less, the leading expert on Mexican codices, Miguel León-Portilla [53] in his book overviewing the current status of codices studies and their inventories summarizes the current academic state of affairs succinctly, only an "invitación más que conclusión" (an invitation rather than a conclusion).

The pre-Hispanic codices have a purely emic viewpoint with only pictorial images, no texts. The contents focus on history (recording events and genealogies of important figures) and cosmology (registering religious calendars, rituals, and time markers). Four major codex groups are recognized: Maya, Borgia, Mexico, and Mixteco. These documents were dictated by the priests and indigenous sages (*tlamatinime*) to the recorders or painters (*tlacuilo*) who specialized in the production and reproduction of these documents on vegetal or animal parchment. The communication arising from codices required the collective memory of the privileged class. The pictorial codification in the image allowed the knowledgeable interpreters to bring the images to life through their oratory talents—"dar a luz verbal a la imagen" (to give voice to the image) [54]. The codices were sacred and the source of the society's collective knowledge, calendric events, and moral foundation. In order to prevent religious reversion and bellicose hostilities, the *amoxcalli* or indigenous

libraries and their contents were destroyed. Today most of the surviving *amoxtli* are housed in foreign repositories to which they migrated over the last five centuries.

The sacredness of plants and their integration into the spiritual world as well as the natural environment are exemplified by the pillars of the cosmos in the Fejérváry-Mayer Codex [55]. The first sheet of this member of Borgia Codex group (originating probably from the Oaxaca-Puebla region) illustrates the four sacred trees supporting the four cardinal directions of the universe: the cacao (*Theobroma cacao*), a cauliflorous tree with pendent fruits, upholds the South, the turquoise-green riparian *ahuehuete* (*Taxodium mucronatum*) with woody projections or water glyphs is located in the East, the *pochote* (*Ceiba* sp.) with the spine-like bark prickles and hollow-like trunk fixes the North, and the mesquite/*huizache* (*Prosopis* sp./*Acacia* sp.) with bicolored spinose stipule spines supports the West.

Given the lack of texts, the Spanish authorities were unable to confidently read and comprehend the contents of the codices. Afterwards, they regretted the loss of long-standing records to such valuable information as the location of pueblos, communication routes, distribution of the natural resources, and access to new areas for spiritual and tactical conquest. As a consequence, the talents of the artists-recorders were revived and redirected to producing new documents in service of the civil, military, and church authorities. These *tlacuilo* (some having learned European pictorial techniques and alphabetized writing of Spanish, Latin, and Nahuatl) copied the remnants of the original *amoxtli*, repainted from memory vanished documents, and codified religious themes so as to aid the conversion of the people and uncover concealed pagan idolatry. Today over 500 codices of the Viceroyalty Period have been inventoried. The new images were labeled and transcribed into texts for interpretation. Although the content was based upon the emic perspective, the interpretation and application now contained etic viewpoints. Overtime, certain symbols changed their significances or became meaningless. The details of others degenerated and disappeared. For instance, the tree, a vital event marker in the pre-Hispanic times, acquired a hybridized appearance with a European crown and indigenous roots in the post-Conquest codices. The barrel cactus and mesquite tree that were closely linked to certain ancestral rituals shifted to decorative generalities. Curiously, the representation of the maguey diverged. On one hand, such ritual functions as the sacred refuge of *ltzpapalotl*, goddess of the ancestors, disappeared while the utilitarian functions of maguey and its management to generate the life-sustaining liquid, *agua miel* and its fermented product *pulque*, persisted in codices and were important scenes in the landscape paintings up to the twentieth century.

The Mendoza Codex and its predecessor, *Matrícula de Tributos*, registers hundreds of products paid as taxes in kind to the Triple Alliance from about 38 pueblos. Among the ethnobotanically important botanical themes illustrated are: food plants (amaranth, avocado, beans, black cherry, cacao, chia, chili, chirimoya, cuajilote, guaje, huazontle, Spanish bayonet, maguey, maize, mamey, squash, sweet potato, tuna fruit); medicinal and stimulating herbs (thistle, lobelia, tobacco); plant sources of dyes (añil, cochinilla); plant sources of materials (amate, amole, cane grass, cattails, cotton, Spanish bayonet, palm, tree gourd, willow); resin sources (amber, copal, liquidambar); and trees (bombax, oaks, pine).

New Spain's first Viceroy, Antonio de Mendoza, commissioned the Mendoza Codex between 1541 and 1542 as a gift to King Charles V in order to illustrate the rich resources from different ecological sectors of the New Spain. Unfortunately, it was captured by French pirates aboard a Spanish galleon and eventually was acquired by an Englishman who deposited it in London where it resides today. The representation of people and products with the distinctive illustrations each accompanied by the corresponding textual descriptions has permitted scholars since the sixteenth century interprets the legacy of Mexican codices. The iconographic features of the phytomorphs expressed in the pre-Hispanic style provide a link between the traditional representations of the *tlacuilo* and the later Mexican–European plant illustrations in such essential ethnobotanical works as the Florentine Codex.

Many codices include glyphs which function as ideographic location markers that have given rise to contemporary toponyms. These are important sources for ethnohistorical studies that focus not only on place names (where there are human settlements) but also geographic features in the landscape. They also provide perspectives to time depths and on ethnic affiliations [56].

An example of an ethnobotanical study of a pre-Hispanic-like codex (with traditional pictorial symbols, produced with indigenous prigments on amate paper, and without European text) is Mapa Cuauhtinchan number 2 (MC2) [57]. Almost 150 phytomorphs are presented as part of toponymic glyphs or as interactions among people and their environment. A diachronic analysis of 30 phytomorphs between the MC2's mythological age in Aridoamerica and the map's contemporary period in Mesoamerica suggests continuities as well as changes in the relationships between the plants and the Cuauhtinchan culture over time [58]. Plants such as *Agave*, *Laelia,* and *Yucca* present a symmetric association being culturally important for both periods. Other plants such as *Amaranthus*, *Capsicum*, *Leucaena,* and *Phaseolus* are part of the asymmetric pattern in that the migrating people adopted new plants upon arrival in Mesoamerica. The curious presence of *Zea mays* in the pre-Mesoamerican timeframe appears to be a contradiction. However, the facts that the figured Chichimecan person apparently harvested the plant from a sandy bank along a stream,[3] that the cane was of prime value, and that Tolteca-Chichimeca tradition required that one must eat maize before one can learn to speak Nahuatl all suggest a harmonious relationship during cultural evolution rather than an inconsistency.

Perhaps the most studied postConquest codex and one of the three key ethnohistorical documents that are critical for ethnobotanical studies is Florentine Codex. A brief description of this classic document and selected publications that provide access to botanical information are discussed above.

[3] Sandy stream sides were common habitat used to grow (but not cultivate) maize by nonagriculturist hunters and gatherers up to the nineteenth century in America.

Relaciones Geograficas

Throughout the Viceroyalty Period, the Spanish Crown was interested in the inventory of its territories. On various occasions, census-like questionnaires were circulated to civil and ecclesiastical authorities for their responses [59]. The instructions for the *Relaciones Geográficas* (RG) were sent to 713 settlements; of the 191 RG returned for the period 1577–1585, 167 are known to be housed in Archivo General de Indias (Seville, Spain), Real Academia de la Historia (Madrid, Spain), and University of Texas (Austin, USA). Another set of RG, sometimes called *Relaciones Topográficas* (RT), was gathered between 1777 and 1778 after the expulsion of the Society of Jesus from the Spanish territories. The number of questions varied from 37 to 200. The quality of the answers is highly variable because of the many human factors such as familiarity with the region, ability to communicate in the native languages, available time for obtaining data, among others. Specific details of these reports are available [27, 60]. Because the constant change of civil and ecclesiastical political units during this period, a useful guide to the geography is that of Gerhard [61].

The rediscovery of the RG in the archives of the *Consejo de Indias* prompted interest among scholars. The academic residency of Francisco del Paso y Troncoso in Europe between 1892 and 1916 allowed him to make available copies of various documents. Many of these were published; for an extensive list of the RG of potential interest for botanical studies, one should consult Langman [62]. The available RG of Mexico and Guatemala for the sixteenth century have been published [63]; even though many plants are mentioned in the texts and noted in the glossary, there is no botanical analysis.

The five questions of most interest to ethnobotanical studies are related to: (1) wild trees and their appropriateness for construction, (2) fruit trees, (3) the grains and vegetables included in the native diet, (4) the plants introduced from Spain and their response to the new lands, and (5) the plants and aromatic herbs with medicinal or toxic properties.

Probably because of the limited knowledge of the local resources by the responders to the questionnaire, there are more reports of cultivated foreign plants than registers of native useful plants. Using RG from the Rio Balsas depression, 46 crops were introduced into the area during the sixteenth century [64]. The RG records the establishment of exotic ingredients for mole, the famous mestizo sauce of Mexico, over different periods [65]. Nonetheless, some Franciscan friars provided detailed lists of the indigenous plant names and keen observations about plant management. A diachronic study of the eighteenth century RT of Chihuahua has been able to document the continuity (and in some cases the loss) of certain medicinal and edible plants among the Tarahumara and Tepehuan of Nueva Galicia Province [66, 67]. In the one of these RT, an observant friar registered how the Tarahumara manipulated the planting of introduced mustard so as to alter this annual plant's photoperiodic response to simulate a biennial herb and promote the production of edible basal leaves rather than flowers [68].

Other Sources from the Viceroyalty Period

During the Viceroyalty Period, a variety of documental sources provide ethnobotanical insights. Shipping manifests, warehouse inventories, supply requisitions, customs declarations, taxation records, still life paintings among other archival sources document in a fragmentary manner the values, movements, demands, and utilization of plant and plant products. Travellers in quest of material riches, souls, and adventures generated few publications and archival documents for Mesoamerica. The rustic routes, the lack of accommodations, and the restrictions enacted by the Spanish Crown did not favor frequent movement or exploration of extensive areas. References for botanical sciences during most of this period are limited [69]. As a consequence, the ethnohistorical sources for ethnobotanical data are inadequate.

The testimonies of the missionaries are useful for this period. As part of their need to communicate in the native languages, various published and unpublished bilingual dictionaries were constructed; many of these contain indigenous terms for plants, especially those used as food, construction, and medicine. Some friars had the opportunity to write books about their experiences.

An English Dominican friar, Thomas Gage [1597–1656], travelled through southern Mexico and Guatemala between 1625 and 1637. After returning to Europe and converting to Protestantism, he recorded his impression of these lands, their people, and general comments about useful plants [70]. Many Jesuit missionaries with academic training were keen observers of the cultures and natural history of Mesoamerica. When they were expelled from Spanish Empire in 1767 and exiled to Europe, some of them took the opportunity to record the cultural, physical, and biological landscapes that they remembered. Francisco Javier Clavijero [1731–1787], a creole from Veracruz, focused on central México and Baja California from an historical perspective [71]. Much of his ethnobotanical observations were secondary in nature, some derived from the work of Francisco Hernández. On the other hand, the Spaniard Miguel del Barco [1706–1790] documented in text and drawings the life, including plants and indigenous people, of northwestern New Spain based upon his personal experiences [72].

Some friars were able to document culturally important plants while stationed at their monasteries. Juan de Esteyneffer [1664–1716], German Jesuit who dedicated much of his life working in mission hospitals, compiled various treatments for illnesses that he encountered. The formulations include almost 300 different plants or plant derivatives and are based upon European and indigenous medical concepts [73]. It was so popular, that, after its initial publication in 1712, various editions were produced and distributed through New Spain; it was still consulted by Mexican traditional healers during the twentieth century [74].

While based in the Central Valleys of Oaxaca, Juan Caballero [1730?–1787] documented useful plants in the valley and mountains surrounding his monastery [75]. In his *Dendrología Natural y Botaneología Americana*, 55 plants were described, named and illustrated; many were medicinal, 17 were cultivated. Near the Valle of México, another priest, José Antonio de Alzate y Ramírez [1737–1799],

was dedicated to science and literature. In 1772, he wrote "Memoria del uso que hacen los indios de los pipiltzintzintlis" in which he suggested that the psychotropic effect of *pipiltzintzintli*[4] was not the work of the devil but due to natural causes [76]. Among his writings that had major impact was "Memoria sobre la naturaleza, cultivo y beneficio de la grana." The information about this commercially important carmine pigment produced by an insect (*Dactylopius coccus*) on *Opuntia* was so valuable and the illustrations so detailed that various editions were produced in the eighteenth and nineteenth centuries [77].

A Spanish friar, Juan Navarro [1730?–1787?], contributed to the register of the plants in the area of Queretaro while living in the Franciscan monastery. Only the fifth volume of his *Jardín Americano* (dated 1801) survives today. It contains colored illustration of 517 plants, mostly native species for which he provides Spanish and native names, where possible, along with information on their application, usually medicinal [78]. He may have been stimulated to produce this work by his contacts with the Royal Botanical Expedition but probably was not acquainted with the work of Francisco Hernández.

At the end of the Viceroyalty Period, botanical documentation gained a solid footing due to the decrees of Charles III and Charles IV. The Spanish Age of Enlightenment attempted to base, in part, the development of the Spanish Empire upon science. The natural resource explorations of New Spain were carried out essentially by three groups. Under Charles III, the Malaspina Expedition [1789–1794] circumnavigated the world under the command of Alejandro Malaspina [1754–1810]. During 1791–1792, his botanical team, Tadeo Haenke, Luis Née, and Antonio Pineda explored the western coast of New Spain. They radiated from Acapulco and collected many herbarium specimens that attended to their primary interest in the flora.

The second team, Royal Botanical Expedition of 1787–1803 (also known as the Sessé and Mociño Expedition), had a more ambitious task and covered New Spain from the northwest portion to Central America. Not only did they document the flora with herbarium specimens (now deposited in Madrid) but also colored paintings (which had been lost until recently and now published) [79]. Team consisted of Martín de Sessé y Lacasta [1751–1808], Vicente Cervantes [1755–1829], Juan Diego del Castillo [1744–1793], and José Longinos Martínez [1777–1802]; afterwards, a creole graduate of the University's botany program joined, José Mariano Mociño y Losada [1757–1820]. The major part of botanical work was published by the Royal Botanical Gardens Madrid under the authorship of its directors, Casimiro Gómez Ortega [1741–1818] and Antonio José Cavanilles [1745–1804]. Part of the team's responsibility was to update the two-century-old work of Francisco Hernández. With the deterioration of the Spanish government in the early 1800s, much of the work was not completed. Sessé and Mociño returned to Spain with specimens and illustrations in order to publish the results. They were unable to do so before their deaths. Part of the material was dispersed among botanists in different European herbaria; part was lost. Their actual publication of Mexican flora

[4] He compared the plant to *cáñamo*, generally referable to *Cannabis sativa*, although some authors have suggested that it is *Salvia divinorum*, *Ipomoea* sp., or *Turbina corymbosa*.

was produced at the end of the nineteenth century [80, 81]. Some plants described in the publications (of Sessé and Mociño, but not those of Gómez Ortega and Cavanilles) and drawn in the field have names written in Nahuatl, sometimes with references to Hernández. In *Anales de Historia Natural* of Madrid, these botanist and their students described only the medicinal plants that demonstrated curative effects in their experiments and clinical trials; there was no place for reporting on indigenous "superstitions" about plants that did not pass their tests. Hence, the magnificent Spanish scientific expedition that documented Mexico's flora just prior to Mexico's Independence provided limited contribution to our knowledge of the Mexico's vegetal resources and their importance to its inhabitants.

Observations recorded by non-Spanish explorers are very limited, essentially because foreigners, with one exception, were not permitted to explore the region much less take specimens and data back with them. An unauthorized opportunity to document useful plants of Veracruz occurred in 1729. A ship of the British South Sea Company was anchored in the port of Veracruz, a practice known as *asiento inglés* that allowed safe anchorage for English ships in Spanish harbors but without permission to disembark. As the ship's medical officer, William Houstoun [1695–1733] acquired (probably through the trade of contraband and the salvage of vegetal supplies brought aboard) various useful plants. These were shipped to Philip Miller [1691–1771] of Chelsea Physic Garden of London where they were grown out and described in his *Gardeners' Dictionary* [82]. Miller commented on the history, qualities, and utilities of such plants as avocado, contrahierba, jalapa, stramonia, tobacco, tomato among other important Mesoamerican plants, no doubt based, in part, on notices from Houstoun. The herbarium specimens presented to Joseph Banks for identification included those of cultural importance such as Francisco Hernández' plant *xiloxochitl flores capillaces* (as *Pachira aquatica*).

The only authorized foreign scientific expedition to the Spanish Empire in the Americas was that of Alexander von Humboldt and Aimé Bonpland. With the permission of Charles IV, they explored the route between Acapulco and Mexico City, the mining regions in central Mexico, and the route between Mexico City and Veracruz between 1803 and 1804. Their botanical specimens, which are housed at the herbaria in Paris and Berlin, are among the earliest extant herbarium specimens from Mesoamerica and form the basis of contemporary taxonomic knowledge of the regional flora based, primarily, upon the works of Kunth [83]. After returning to Europe, Humboldt published *Ensayo político sobre el Reino de la Nueva España* in 1811 (English edition) and in 1822 (Spanish edition), a detailed report of his travels, his analysis of socioeconomic statistics of the Viceroyalty, and the condition of Mexico at that time [84]. Although the taxonomic publications and the herbarium specimens lack ethnobotanical data, his *Ensayo* contains observations about 69 taxa of economic importance to colonial Mexico of which half are native [85]. Many species were important for nourishing the mining communities throughout New Spain while a reduced number generated export income via trade. Humboldt drew attention to botanically derived foods, medicines, and raw materials as an underutilized pillar of New Spain's economy with great potential for the Crown's international commerce and as the foundation for the advancement of the social well-being of its inhabitants.

Reversión: Reciprocity and Participatory Research

As defined above, ethnobotany involves different components of the interactions and relationships between plants and people over time and space. The examples above focus on major sources used in the ethnobotanical research for the timeline of pre-European contact period through the Viceroyalty Period, prior to Mexico's independence. Space does not permit the citation of examples of the application of ethnohistorical documents to such ethnobotanical phenomena as agriculture, domestication, plant migration, continuity, acculturation, biocultural diversity, and other important topics. Nonetheless, one important feature of Mexican ethnobotany deserves a brief sampling. Reciprocity between different knowledge systems is based upon mutual respect and synergistic benefits for all participants.

One of the objectives of historical research in public institutions is to make ethnohistorical documents available to present-day society in a manner that is informative. The basis of academic programs in most Mexican institutions is tripartite: investigation, teaching, and public outreach (i.e., "difusión"). Such a framework provides an influential platform for reciprocity between different knowledge systems and for participatory research of ethnobotanical investigation based upon ethnohistorical evidence.

The market provides an entry into the world of plant–human relationships that spans centuries and affords the opportunity for participatory research, especially for addressing problems of interest to the local communities. The *tianguis* of Ozumba concentrates many local useful plants that play roles in the economic and ceremonial life of the inhabitants of the region of the volcanoes Iztaccihuatl and Popocatépetl, southeast of Mexico City [86]. In recent years our market partners brought to our attention the inaccessibility of wild populations in the National Park Izta-Popo of a mountain grass, *popotl* (*Muhlenbergia quadridentata*), used for the fabrication of *escoba de popotillo* which they sold in the past. Responding to their request and in collaboration with the stakeholders (the collectors of San Pedro Nexapa, State of Mexico, and the CONANP), a cooperative ethnobotanical project revealed that the people not only harvest the subalpine grass in a sustainable manner but that there is cultural continuity registered in pre-Hispanic codices and practiced today by the surrounding communities [87]. The Codex Fejérváry-Mayer Codex and the Borbonicus Codex as well as the Sahagún's Florentine Codex record the association of this grass broom with the Mesoamerican goddess of purification, Tlazolteotl. Ritual cleansing, seed planting, and symbolic battles associated with the *Ochpaniztli* feast revolve around *Tlazolteotl* and her *escoba de popotillo*. Today the cleansing or "sweeping" ceremonies occupy this grass broom at the landscape scale (such as the mountain veneration observances of May) as well as at the domestic level in wedding ceremonies and in funerary rites of removing the "sombra" (or shadow) the dwellings of the recently departed.

Combining ethnohistorical information with archeobotanical samples has particular relevance for Mexico. Although archaeological remains are fragmentary and their representativeness is skewed by factors beyond the control of ethnobotanists,

the taxonomic determination of plant remains permits the elaboration of a dynamic ethnoflora for a particular site over a certain period of time. The most visited archaeological site in Mexico is that of Teotihuacan, which flourished between 0 and 750 AC. Combining the archeoethnobotanical interpretation of such material with historical documents permits the construction of an Index of Cultural Importance [88]. In the case of Teotihuacan, 125 plants of ethnobotanical importance were identified, of which 20 were selected as the foundation for a botanical garden so as to present to the public, a vision of the relationships between plants and humans in central Mexico almost 2000 years ago. On one hand, local traditional healers were involved in the generation of comparative information. Given that there are no known direct descendants of the Teotihuacan culture, the communities surrounding the archaeological site inherited, to a certain degree, the area's ethnobotancial legacy. Also, they continue to employ certain plants in their communal ceremonies. Also, some of these plants are applied in traditional medicinal practices that are offered to the inhabitants and tourists. On the other hand, the changes of the importance of certain plants in response to climatic fluctuations and anthropogenic factors can be incorporated into public educational programs for schools, the onsite museum and the general publications so that, with this value added information, today's society possess criteria for planning the future.

The rescue and elucidation of ethnohistorical resources provide another opportunity for ethnobotanists to collaborate in the process of *reversión*. Recently, a benefactor gifted with foresight rescued a codex produced about 1540 BC on *amate* paper, Mapa Cuauhtinchán number 2 (MC2) [57]. It is one of the most pictorially expressive codices of the Tolteca-Chichimeca tradition with 147 phytomorphs and is a copy of a pre-Hispanic document destroyed during Conquest. An interdisciplinary group of scholars studied MC2 for 5 years; some of its members visited the pivotal locality, Cuauhtinchán, Puebla, and worked with inhabitants to interpret certain pictorial elements. The ethnobotanical interpretation focused on identification of the plants and selected ethnobotanical processes represented as well as on a diachronic analysis of 30 plants in mythological period and the map's contemporary time [58]. Subsequently, continuity (*sensu* Kubler) [89] was evaluated based upon the present-day field work. The images of the original document and the derived interpretation are available in two forms. The collective information is available in a book with Spanish texts. The artifact and the associated academic information are most appropriately exhibited at Puebla's regional museum, Museo Amparo, in the city of Puebla [90], because MC2 covers geographic areas bounded by the states of Mexico, Tlaxcala, Veracruz, and Oaxaca.

The application of ethnobotanical historical studies to contemporary socioeconomic circumstances is exemplified by the documentary video "Los Mezcales del Occidente de Mexico y la Distilación Prehispánica" [91]. The application of the name mezcal, a distilled liquor from "hearts" of various species of *Agave*, is protected by a 1994 Mexican law on Denomination of Origin of "Mezcal". Because the original regulation did not adequately cover the mezcal producing areas, it was modified in 2012. None the less, these laws were founded upon industrial interests rather than ethnohistorical facts. The "Mezcales…" video combines archeobotanical

discoveries, data from seventeenth-century tax records, geographic distribution of toponyms, and contemporary field investigation to demonstrate that the region around the Volcano of Colima (currently excluded from the geographic denomination of origin), the region that may be the center of origin of distilled agave spirits as far back as 3500 years. The post-contact introduction of more efficient Philippine and Arabian distillation apparatus probably displaced the Mesoamerican device. The 20 ethnotaxa of mescal agaves may be in danger of disappearance if the local mescal production is repressed due to irrational application of federal regulations. Should the current legal contradiction (which presumably protects a national product, its prime material, processes, and producers) be rectified, it would illustrate the impact that reciprocity of the historical ethnobotanical research can have on the conservation of plant diversity and the fortification of national identity.

Conclusion

Interactions and relationships between humans and plants in Mesoamerica have varied over time and space. The ethnohistorical documents for the epoch between the late PreConquest period (prior to 1519) through Viceroyalty era (early nineteenth century) provide a fragmentary view. Because Mesoamerican cultures expressed their relationships with plants through glyphs and illustrations, the early Conquest documents (e.g., Codex de la Cruz-Badiano, Florentine Codex, and Natural History of Plants of New Spain) are the key for linking indigenous names and images with western scientific nomenclature.

Pre-Columbian sources such as codices and murals are limited due to the colossal destruction of indigenous codices and other cultural artifacts. The few extant items are difficult to elucidate from an emic perspective; none the less interdisciplinary studies are beginning to revise century-old etic interpretations of Mesoamerican cosmology which is strongly connected to the plant world.

PostConquest documents are based upon those generated by ecclesiastical, government, and commercial authorities. Some are products of education and communication associated with evangelization of the Catholic Church. Others include codices, census data, commercial and tax records, inventories of useful (usually medicinal) plants by agents of the Crown, chronicles of missionaries, among others. Few travellers have left testimonies of their observations of the environment of New Spain. During the Age of Spanish Enlightenment at the end of the Viceroyalty, observations of plant–human interactions were complemented by herbarium specimens which facilitated the proper taxonomic identification. The Spanish Crown sponsored official expeditions such as those of Malaspina and Sesse y Mocino. The only foreign exploration sanctioned by the Crown was that of Humboldt and Bonpland.

Despite the incomplete ethnobotanical record over this three century plus period, over 3000 plants were documented of which almost 700 have taxonomic determinations. Many of these were used medicinally while others have been employed as

food, material sources, ornamentals, among other purposes. Plant–human interactions documented include plant domestication, while plant–human relationships are reflected in the nomenclatural etymology and classification. Much of the etic perspective has focused on the appropriation of useful plants by politically dominant sectors of the indigenous dynasties and later Viceroyalty society. Documents with an emic perspective diminished over time.

These ethnohistorical sources provide basic data for diachronic studies of biocultural diversity, resource management, continuity, acculturation, ethnotaxonomy among other topics. Synchronic studies may be limited due to incomplete inventory and complementary data. Nonetheless, ethnobotanists have the opportunity to share with the Mexican society this information on plant–human relationships with value added. Programs of reciprocity of ethnobotanical studies for indigenous people and the public via the analysis of the historical sources not only benefits the many Mesoamerican communities searching to rescue and fortify their cultural roots but also offers contemporary society alternatives to plan for the future.

References

1. de Ávila-Blomberg A. Yerba del Coyot, Veneno del Perro; la evidencia lexica para identificar plantas en el Códice de la Cruz Badiano. Acta Botánica Mexicana. 2012;100:489–526.
2. Luna SA. La flora representada en la iconografía pictórica. In: de la Fuente B, editor. La pintura mural prehispánica en México. Vol. 1, Teotihuacán. Part 2, Estudios. México, DF: Universidad Nacional Autónoma de México; 1996.
3. de la Cruz M. The de la Cruz-Badiano Aztec Herbal of 1552, with translation and commentary by William Gates. Baltimore: The Maya Society; 1939.
4. de la Cruz M. The Badianus Manuscript (Codex Barberini Latin 241), An Aztec Herbal; introduction translation and annotations by Emily Walcott Emmart. Baltimore: John Hopkins Press; 1940.
5. de la Cruz M. Libellus de Medicinalibus Indorum Herbis: el manuscrito pictórico mexicano-latino de Martín de la Cruz y Juan Badiano. Editado por Francisco Guerra. México, DF: Editorial Vargas Rea y El Diario Español; 1952.
6. de la Cruz M. Libellus de Medicinalibus Indorum Herbis, manuscrito azteca de 1552 según traducción latina de Juan Badiano; versión española con estudios y comentarios por diversos autores. México, DF: Instituto Mexicano del Seguro Social; 1964.
7. Kumate J, compiler. Estudios Actuales sobre el Libellus de Medicinalibus Indorum Herbis. México, DF: Secretaria de Salud; 1992.
8. Hernández de León-Portilla A. Bernardino de Sahagún—diez estudios acerca de su obra. México, DF: Fondo de Cultura Económica; 1990.
9. León-Portilla M. Bernardino de Sahagún: first anthropologist. Norman: University of Oklahoma Press; 2002.
10. Martínez JL. El Códice Florentino y la Historia General de Sahagún. México, DF: Archivo General de la Nación; 1982.
11. Viesca C. El Evangelizador Empecinado, Bernardino de Sahagún. México, DF: Consejo Nacional para la Cultura y las Artes; 1994.
12. Chabran R, Chamberlin C, Varey S. The Mexican Treasury: the writings of Dr. Francisco Hernández. Stanford: Stanford University Press; 2000.
13. Hernández F. Obras Completas de Francisco Hernández, 7 tomos. México, DF: Universidad Nacional Autónoma de México; 1959.

14. López-Piñero JM, Pardo-Tomás J. La Influencia de Francisco Hernández (1515-1587) en la Constitución de lal Botánica y la Materia Médica Modernas. Valencia: Univeristat de Valencia; 1996.
15. Varey S, Chabrán R, Weiner DB. Searching for the secrets of nature: the life and works of Dr. Francisco Hernández. Stanford: Stanford University Press; 2000.
16. Argueta A, Cano LM, Rodarte ME, coordinators. Atlas de las Plantas de la Medicina Tradicional Mexicana. México, DF: Instituto Nacional Indigenista; 1994.
17. Díaz JL, editor. Índice y Sinonimia de las Plantas Medicinales de México. México, DF: Instituto Mexicano para el Estudio de las Plantas Medicinales; 1976.
18. Martínez M. Plantas Medicinales de México. México, DF: Ed. Botas; 1990.
19. Clayton M, Guerrini L, de Ávila A. Flora: the Aztec herbal. London: The Royal Collection; 2009.
20. Miranda F, Valdés F. Comentarios botánicos. In: de la Cruz M. Libellus de Medicinalibus Indorum Herbis. México, DF: Instituto Mexicano del Seguro Social; 1964.
21. Valdés J, Flores H, Ochoterena-Booth H. La botánica en el códice de la Cruz. In: Kumate J, compiler. Estudios Actual sobre el Libellus de Medicinalibus Indorum Herbis. México, DF: Secretaría de Salud; 1992.
22. Bye R, Linares E. Códice De la Cruz-Badiano—Medicina prehispánica. Arqueología Mexicana; 2013, Edición Especial 50:8–91, 51:9–93.
23. Molina A de. Vocabulario en langva castellana y mexicana. Mexico: Casa de Antonio de Spinsoa; 1571.
24. de Sahagún B. Historia General de las cosas de Nueva España. Manuscrito 218-20 de la Colección Palatina de la Biblioteca Medicea Laurenziana, Florencia. México, DF: Archivo General de la Nación; 1979.
25. Sahagún B de. General History of the Things of New Spain: Florentine Codex. 13 vols. Translated and edited by Arthur J. O. Anderson & Charles E. Dibble. Salt Lake City: University of Utah Press; 1950–1982.
26. López-Austin A. The research method of Fray Bernardino De Sahagún: the questionnaires. In: Edmonson MS, editor. Sixteenth-century Mexico: the work of Sahagún. Albuquerque: University of New Mexico Press; 1974.
27. Cline HF, editor. Guide to ethnohistorical sources, handbook of Middle American Indians, vol. 12. Austin: University of Texas Press; 1972.
28. Rivera Morales I. Ensayo de interpretación botánica del libro X de la historia de Sahagún. Anales del Instituto de Biología de la Universidad Nacional Autónoma de México, Serie botánica. 1941;12:439–88.
29. Estrada EIJ. El Códice Florentino—su información etnobotánica. Chapingo, Estado de México: Colegio de Postgraduados; 1989.
30. Linares E, Bye R. A study of four medicinal plant complexes of México and adjacent United States. J Ethnopharmacol. 1987;19:153–83.
31. Hernández F. Rerum medicarum Novae Hispaniae thesaurus, seu, Plantarum animalium mineralium Mexicanorum historia. Rome: Vitalis Mascardi; 1651.
32. Ximénez F. Quatro libros. De la naturaleza, y virtudes de las plantas, y animales que estan receuidos en el vso de medicina en la Nueua España. México: Viuda de Diego Lopez Daualos; 1615.
33. Barrios J de. Verdadera medicina, cirugía y astrología, en tres libros dividida… México: Fernando Balli; 1607.
34. López-Piñero JM, Pardo-Tomás J. Nuevos Mateirals y Noticas sobre la Historia de las Plantas de Nueva España de Francisco Hernández. Valencia: Univeristat de Valencia; 1994.
35. López G, Salzedo M, Días J. El tesoro de medicinas para diversas enfermedades. México: Francisco Rodríguez Lupercio; 1674.
36. Hernández F. Opera: cum edita, tum inedita, ad autographi fidem et integritatem expressa, impensa et iussu region. Madrid: Ibarra; 1790.
37. López-Piñero JM. El Códice Pomar (ca. 1590), el interés de Felipe II por la historia natural y la Expedición Hernández a América. Valencia: Univeristat de Valencia; 1991.

38. Nieremberg JE. Historia natvrae, maxime peregrinae. Antwerp: Plantiniana Balthasaris Moreti; 1635.
39. Ray J. Historia Plantarum Generalis. London: Samuel Smith & Benjamin Walford; 1693–1704.
40. Sloane H. A Voyage to the Islands Madera, Barbados, Nieves, S. Christophers and Jamaica. London: British Museum; 1707–1725.
41. Buffon, C de. Histoire naturelle, générale et particulière, avec la description du Cabinet du Roy. Paris; 1749–1789.
42. Clavijero FJ. Storia Antica del Messico. 4 vols. Cesena: Italia; 1780–1781.
43. Valdés J, Flores H. Historia de las plantas de Nueva España. In: Comentarios a la Obra de Francisco Hernández. Obras Completas, Tomo VII. México, DF: Universidad Nacional Autónoma de México; 1985.
44. De la Fuente B, coordinator. La pintura mural prehispánica en México. Vol. 1, Teotihuacán. México, DF: Universidad Nacional Autónoma de México; 1996.
45. De la Fuente B, Fahmel Beyer B, coordinators. La pintura mural prehispánica en México. Vol. 3. Oaxaca. México, DF: Universidad Nacional Autónoma de México; 2005.
46. Staines L, coordinator. La pintura mural prehispánica en México. Vol. 2, Área Maya. México, DF: Universidad Nacional Autónoma de México; 1998.
47. Heyden D. Mitología y Simbolismo de la Flora en el México Prehispánico. México, DF: Universidad Nacional Autónoma de México; 1985.
48. McDonald JA, Stross B. Water lily and cosmic serpent: equivalent conduits of the Maya spirit realm. J Ethnobiol. 2012;3:74–107.
49. Estrada de Gerlero EI. La pintura mural durante el virreinato. In: Historia del Arte Mexicano. México, DF: Salvat Editores; 1982.
50. Peterson JF. The Paradise Garden Murals of Malinalco. Austin: University of Texas Press; 1993.
51. White L, Zepeda C. El Paraíso Botánico del convent de Malinalco. Toluca, Estado de México: Universidad Autónoma del Estado de México; 2005.
52. Zepeda C, White L. Herbolaria y pintura mural: plantas medicinales en los murales del Convento del Divino Salvador de Malinalco, Estado de México. Polibotánica. 2008;25: 173–99.
53. León-Portilla M. Códices—los antiguos libros del Nuevo Mundo. México, DF: Aguilar; 2003.
54. Johansson KP. La Palabra, la Imagen, y el Manuscrito—lecturas indígenas de un texto pictórico en el siglo XVI. México, DF: Universidad Nacional Autónoma de México; 2004.
55. Anonymous. Códice Fejérváry-Mayer. México, DF: Fondo de Cultura Económica; 1994.
56. Dyckerhoff U. Mexican toponyms as a source in regional ethnohistory. In: Harvey HR, Prem HJ, editors. Explorations in ethnohistory—Indians of Central Mexico in the sixteenth century. Albuquerque: University of New Mexico Press; 1984.
57. Carrasco D, Sessions S, editors. Cueva, Ciudad y Nido de Águila—Una travesía interpretativa por el Mapa de Cuauhtinchan núm. 2. Albuquerque: University of New Mexico Press; 2010.
58. Bye R, Linares E. Simetría y asimetría botánica en el Mapa de Cuauhtinchan núm. 2. In: Carrasco D, Sessions S, editors. Cueva, Ciudad y Nido de Águila—Una travesía interpretativa por el Mapa de Cuauhtinchan núm. 2. Albuquerque: University of New Mexico Press; 2010.
59. de Solano F. Cuestionarios para la formación de las Relaciones Geográficas de Indias siglos XVI-XIX. Madrid: Consejo Superior de Investigaciones Científicas; 1988.
60. Mundy BE. The mapping of New Spain: indigenous cartography and the maps of the Relaciones Geográficas. Chicago: University of Chicago Press; 1996.
61. Gerhard P. A guide to the historical geography of New Spain. Norman: University of Oklahoma Press; 1993.
62. Langman IK. A selected guide to the literature on the flowering plants of Mexico. Philadelphia: University of Pennsylvania Press; 1964.
63. Acuña R, editor. Relaciones geográficas del Siglo XVI, vol. 1–10. México, DF: Universidad Nacional Autónoma de México; 1982–1988.

64. Machuca P, Colunga P, Zizumbo D. Introducción y difusión temprana de recursos fitogenéticos en la Región Balsas-Jalisco durante el siglo XVI: una perspectiva agro-histórica. Revista de Geografía Agrícola. 2010;45:77–96.
65. Linares E, Bye R. The botany of moles. In: Castillo G, editor. Mole: FIt for the Gods, Gentry's delight. México, DF: Fundación Herdez; 2014.
66. Pennington CW. The Tarahumar of Mexico: their natural and material culture. Salt Lake City: University of Utah Press; 1963.
67. Pennington CW. The Tepehuan of Chihuahua: their material culture. Salt Lake City: University of Utah Press; 1969.
68. Bye R. Incipient domestication of mustards in northwest México. Kiva. 1979;44:237–56.
69. Herrera T, Ortega MM, Godínez JL, Butanda A. Breve Historia de la Botánica en Mexico. México, DF: Fondo de Cultura Económica; 1998.
70. Gage T. The English-American: his travel by sea and land or a new survey of the West Indies. London: R. Cotes; 1648.
71. Clavijero FJ. Historia Antigua de México. México: Porrúa; 1991.
72. del Barco M. Historia Natural y Crónica de la Antigua California. México, DF: Universidad Nacional Autónoma de México; 1973.
73. de Esteyneffer J. Florilegio Medicinal de todas las enfermedades sacado de varios y clásicos autores para bien de los pobres y de los que tienen falta de médicos. Edición, estudio preliminar, notas, glosario e índice analítico—Ma. De C. Anzures y Bolaños. México, DF: Academia Nacional de Medicina; 1978.
74. Kay MA. The Florilegio Medicinal: source of Southwest Ethnomedicine. Ethnohistory. 1977; 24:251–9.
75. Caballero J. Dendrología Natural y botaneología americana, o tractado de los árboles y hierbas de la América. Alejandro de Ávila, editor. Oaxaca, Oaxaca: Biblioteca Francisco de Burgoa; 1998.
76. Alzate y Ramírez JA de. Memoria del uso que hacen los indios de los pipiltzintzintlis: In: JA de Alzate y Ramírez, Memorias y ensayos. México, DF: Universidad Nacional Autónoma de México; 1985.
77. Alzate y Ramírez JA de. Memoria sobre la naturaleza, cultivo y beneficio de la grana. México, DF: Archivo General de la Nación; 1981.
78. Navarro J. Historia Natural o Jardín Americano (Manuscrito de 1801). México, DF: Universidad Nacional Autónoma de México; 1992.
79. Labastida J, Morales E, Godínez JL, Flores MH, Chiang F, Vargas A, Montemayor ME, editors. José Mariano Mociño y Martín de Sessé: La Real Expedición Botánica a Nueva España. 12 vols. México, DF: Universidad Nacional Autónoma de México y Siglo XXI Editores; 2010.
80. Sessé y Lacasta M de, Mociño y Losada JM. Flora Mexicana. México, DF: Oficina Tipográfica de la Secretaría de Fomento; 1887.
81. Sessé y Lacasta M de, Mociño y Losada JM. Plantae Novae Hispaniae. México: Apud I. Escalante; 1890.
82. Miller P. The Gardeners Dictionary. 8th ed. London: John and Francis Rivington; 1768.
83. Kunth KS. Nova Genera et Species Plantarum. 7 vols. Paris: Librariae Graeco-Latino-Germanico; 1815–1825.
84. de Humboldt A. Ensayo Político sobre el Reino de la Nueva España. México, DF: Editorial Porrúa; 2004.
85. Bye R, Janota T. Did Humboldt shift his paradigm of botanical exploration upon his arrival in New Spain? In: Lubrich O, Knoop CA, editors. Cumaná 1799—Alexander von Humboldt's travels between Europe and the Americas. Bielefeld: Aisthesis; 2013.
86. Linares E, Bye R. La dinámica de un mercado periférico de plantas medicinales en México: el Mercado de Ozumba, Estado de México, como centro acopiador para el Mercado Sonora. In: Long J, Attolini A, editors. Caminos y Mercados de México. Universidad Nacional Autónoma de México—Instituto de Investigaciones Históricas; 2010.
87. Linares E, Bye R, Hernández N. Escoba de popotillo. Edición: Manuel Anaya. México, DF: Universidad Nacional Autónoma de México; 2012. http://www.youtube.com/watch?v=13N3FNr6o7w.

88. Vázquez-Alonso MT, Bye R, López-Mata L, Pulido-Salas MTP, McClung de Tapia E, Koch SD. Etnobotánica de la cultura teotihuacana/Ethnobotany of the Teotihuacan culture. Botanical Sciences. 2014; 92:563-574.
89. Kubler G. On the colonial extinction of the motifs of pre-Columbian art. In: Lothrop SK, editor. Essays in pre-Columbian art and archaeology. Cambridge: Harvard University Press; 1961.
90. Yoneda K. Cueva, ciudad y nido de águila. Una travesía interpretativa por el mapa de Cuauhtinchan núm. 2. Ichan. 2013;23(275):9–10.
91. Aldana P, Colunga P, Zizumbo F, González F. Los Mezcales del Occidente de Mexico y la Distilación Prehispánica. Explora Mexico Documentales; 2012.