

Arthur O. Tucker · Jules Janick

Flora of the Codex Cruz-Badianus

Temahuiztli quauitl. Tlapalcanauatl. Texcalama coztl.



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Arthur O. Tucker • Jules Janick

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 Springer

Arthur O. Tucker (deceased)
Department of Agriculture
and Natural Resources
Delaware State University
Dover, DE, USA

Jules Janick
Department of Horticulture
and Landscape Architecture
Purdue University
West Lafayette, IN, USA

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For Sharon L. Tucker and Patricia M. Ryan

Cover Image: Three phytomorphs of the *Codex Cruz-Badianus* labeled (from left to right) as *Temahuiztiliquauitl*, *Tlapalcacauatl*, and *Tecalamacoztl* are identified as *Castilleja integra* A. Gray Orobanchaceae, *Theobroma cacao* L. Malvaceae, and *Ficus petiolaris* Kunth, respectively.



Emily Walcott Emmart Trueblood

Dedication

This present work honors a magnificent woman who remains relatively unknown and unsung despite her extraordinary achievements in historical botany. She will forever be famous for her book, *The Badianus Manuscript: (Codex Barberini Latin 241) Vatican Library, An Aztec Herbal of 1552*, published by the Johns Hopkins University Press in 1940. This work contained a facsimile in color of an Aztec herbal, *Libellus de Medicinalibus Indorum Herbis* (A Little Book of Indian Medicinal Herbs) “composed” by Martin de la Cruz, a physician of the College of Santa Cruz in Taltelolco, Mexico, and translated into Latin by a colleague, Juan Badiano, a former student of the Colegio. Remarkably both Cruz and Badiano were indigenous Nahuans, and this manuscript is the earliest surviving herbal on Aztec medicine from the New World.

The Latin translation was discovered in 1929 in a Vatican library and came to the attention of Emily in 1931. She proved to be the right person at the right time. She completed an introduction to the codex in 1935 and a full treatment in 1938. It was a breathtaking piece of scholarship. She translated both the Latin and the Nahuatl names embedded in the illustration. It included an extensive historical background, and chapters on Aztec medicine and herb gardens. Most important were the critical notes and scholarly comments of each illustrated folio. She not only wrote the text but obtained critical financial support for publication in color from The American Pharmaceutical Association, the Smithsonian Institution, the nascent Herb Society of America, the Amateur Gardeners’ Club of Baltimore, the Garden Club of America, and a coterie of wealthy benefactors.

Emily Walcott Emmart was born in Baltimore, Maryland, on August 8, 1898. Her mother, Hattie M. Frist Emmart (1869–1939), was a physician, and her father, William Wirt Emmart (1869–1949), was an architect. In 1922, Emily received a B.A. from Goucher College, Baltimore, and then enrolled in Johns Hopkins University, where she received an M.A. in 1924 and ultimately a Ph.D. in 1930 in Zoology. Her Ph.D. thesis involved a marine scud (shrimplike crustacean) and was entitled “*Carinogammaus mucronatus* (Say): Studies on its life history and

development including the effects of temperature upon the embryo.” The larvae for further studies on fruit flies were collected in the field from Cuernavaca and Colima, Mexico, which must have piqued her interest in Mexican history.

In 1949, Emily married Dr. Charles Kingsley Trueblood (1893–1974), then Dean of Instruction and later Professor of Psychology and Chairman of the Department of Psychology at American University in Washington, D.C. In 1967, she started work on an annotated version of the famous 1542 herbal of Leonhart Fuchs, but in 1980, because of ill health, she turned the project over to Dr. Frederick Meyer at the National Arboretum. This two-volume work was published posthumously in 1999. In 1973, she published on *omixochitl*, the Mexican tuberose (*Polianthes tuberosa*), and that year was an Honorary Research Fellow in Historical Ethnobotany, Botanical Museum of Harvard University. She died on November 2, 1984, at the age of 86.

In the preface of the great work, *The Badianus Manuscript*, she mentioned that the most difficult part of her research was the identification of plants that often were referred to only by their Nahuatl name. This work, 80 years later, continues her effort and is devoted to her memory.

Arthur O. Tucker
Jules Janick

Publications

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- Emmart, E.W. 1935. Concerning the Badianus Manuscript, an Aztec herbal, “Codex Barberini, Latin 241” (Vatican Library). *Smithsonian Miscellaneous Collections*, Vol. 94, No. 2.
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Preface

An illustrated Latin herbal entitled *Libellus de Medicinalibus Indorum Herbis* (*A Little Book of Indian Medicinal Herbs*) is one of the most intriguing manuscripts of 16th century New Spain. It was completed in 1552 at the Colegio de Santa Cruz, Tlatelolco, an institution formed in New Spain to train sons of the Aztec nobility to become priests. The author, Martin de la Cruz (*Martinus* in Latin), was an indigenous physician of the Colegio; the translator was Juan Badiano (*Juannes Badianus* in Latin), a former indigenous student who became a Latin instructor. Thus, the manuscript is generally referred to as the *Codex Cruz-Badianus*. The original manuscript written in Nahuatl by Martin de la Cruz is lost, but the Latin translation by Juan Badiano was sent to the Hapsburg Emperor Charles V (Carlos I of Spain) to underscore the progress of the school, in the hope of gaining increased royal support. It passed through various royal libraries, ending up in obscurity in the Vatican Library. Discovered in 1929 by a Columbia professor, it came to the attention of the Mayanist William Gates, an associate at Johns Hopkins University, and Emily Walcott Emmart, a recent graduate student of the same institution. Both independently translated the manuscript to English and attempted to identify the plants. In 1990, during a pastoral visit to Mexico, Pope John Paul II offered to return the manuscript to the people of Mexico. *Libellus de Medicinalibus Indorum Herbis* now resides in the library of the National Institute of Anthropology and History in Mexico City.

The present volume, *Flora of the Codex Cruz-Badianus*, resulted from a long-time collaboration between Arthur O. Tucker and Jules Janick, co-authors of two books also published by Springer: *Unraveling the Voynich Codex* (2018) and *Flora of the Voynich Codex: An Exploration of Aztec Plants* (2019). We were intensely interested in *The Codex Cruz-Badianus*, which appeared to us as a precursor of the *Voynich Codex*. Both were herbals and both were authored by a faculty member in the Colegio de Santa Cruz in New Spain.

In 2019, while recuperating from a stroke, Arthur informed me that he had finally identified most of the illustrations of the *Codex Cruz-Badianus* with varying degrees of certitude. I complimented him, and offered to help get his identifications published. He proposed that I be a coauthor, so I edited and formatted his preliminary

identifications and drafted an introductory and concluding chapter in the spring of 2019. However, on August 5, 2019, Arthur passed away in hospital from an undiagnosed infection, 11 days after admittance. We were all stunned. I resolved to complete *Flora of the Codex Cruz-Badianus*, which has now been achieved. It is appropriate here to briefly summarize the life and career of Dr. Arthur O. Tucker.

Arthur was born on June 22, 1945, in Allentown, Pennsylvania. He received his B.A. degree at Kutztown University in 1967, majoring in biology and with an emphasis in botany, and an M.S. (1970) and Ph.D. (1975) from Rutgers University. Leaf proteins, morphology, cytology, and morphology and cytology of *Mentha* were the subject of his theses. Arthur joined the staff at Delaware State University and rose to the rank of Research Professor. He founded and financed the Claude E. Phillips Herbarium and served as Co-Director. He was a prolific author and published widely on herbs, essential oils, and various floras, and authored or coauthored nine books, including the *Encyclopedia of Herbs*. In 2012, Arthur retired as Emeritus Professor but never stopped writing. He and his beloved wife of 48 years, Sheron, have three children and four grandchildren. He will be missed and never forgotten. This book is a final tribute to an indefatigable botanist.

West Lafayette, IN, USA

Jules Janick



Arthur O. Tucker

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Chapter 1

An Introduction to the *Codex Cruz-Badianus*



The Discovery

In 1929, Charles Upson Clark (1875–1960), a history Professor at Columbia University, carrying out bibliographic research for the Smithsonian Institution on the early history of the Americas in the Vatican Library, came across a remarkable illustrated Latin manuscript from 1552 entitled *Libellus de Medicinalibus Indorum Herbis* (*Little Book of Indian Medicinal Herbs*). In the same year, Lynn Thorndike, Columbia Professor of Medieval Science and Alchemy, noted its existence in Cardinal Francesco Barberini's catalogue of Vatican manuscripts, and Giuseppe Gabrielli (1872–1942), librarian at the Royal Academy of the Lincei, published a note on the Windsor copy. The 1552 manuscript, now generally referred to as the *Codex Cruz-Badianus*, was a revelation, spreading new light on botanical and medicinal knowledge of the indigenous peoples of Mexico known today as Nahuans or Aztecs. It was to have a major impact on the history of Aztec culture in sixteenth-century New Spain.

Origins

The obsequious and self-deprecating comments on the title page of the manuscript, translated to English by Dr. Emily Walcott Emmart and published in 1940, provide information on the author and the origins of the work:

*A little Book of Indian medicinal herbs
composed by a certain Indian, physician
of the College of Santa Cruz,
who has no theoretical learning,
but is well taught by experience
alone. In the year of
our Lord Saviour 1552*

For the most eminent Don Francisco de Mendoza, most excellent son of Don Antonio de Mendoza, illustrious first viceroy of this India, his unworthy servant, Martin de la Cruz, prays for the greatest health and prosperity.

Since in you the graces and adornments of all excellences and the gifts of all good things, that are desired by anyone, shine forth, most distinguished Master, I really do not know what in you to praise especially. Indeed, I do not see by what praises I may extol your remarkable love, by what words I may express gratitude for your unsurpassable kindness. For I cannot adequately say in words how your father, a man at once most Christian and most pious, has been above all others my benefactor. For whatever I am, whatever I possess, and whatever renown I have, I owe to him. I can find nothing equal to, nothing worthy of that beneficence. I can give great thanks, indeed, to my Maecenas, but very little repayment. On that account, whatever I am, I offer, dedicate and consecrate myself to your service; and not only to him alone, but also to you, my most eminent Master, as a most supplicant token and testimony that best bears witness to my singular affection. Indeed I suspect that you ask earnestly for this little book of herbs and medicaments for no other reason than to commend us Indians, even though unworthy, to His Holy Caesarian Catholic Royal Majesty. Would that we Indians could make a book worthy in the King's sight, for this is certainly most unworthy to come before the sight of such great majesty. But you will recollect that we poor unhappy Indians are inferior to all mortals, and for that reason our poverty and insignificance implanted in us by nature merit your indulgence. Now, accordingly, I beg that you take this little book, which by every right I ought to inscribe with your name most noble sir, from the hand of your humble servant, in the spirit in which it is offered, or what will not surprise me, that you cast it out where it deserves. Farewell. Tlatilulco, in the year of our Lord Saviour 1552.

Your Excellency's most devoted servant.

Martin de la Cruz was an indigenous physician on the staff of the Colegio de la Santa Cruz in Tlatelolco (present spelling of Tlatilulco), now a borough of Mexico City (Fig. 1.1). His name was undoubtedly provided during his adult baptism. In early records he is listed as Martin Momauhti (Silvermoon 2007:81). The colegio was established to train sons of the Nahua nobility to become priests. Martin de la Cruz was appointed physician for indigenous students at the colegio after the 1545

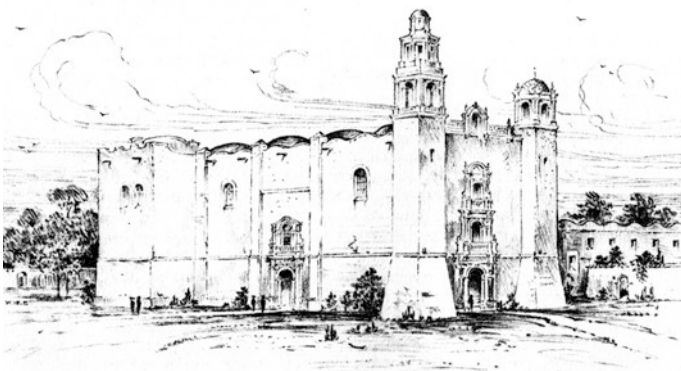


Fig. 1.1 Chapel and Convent of Tlatelolco, site of the Colegio de Santa Cruz. (Source, Bassler and Wright 2008)

epidemic of *cocoliztli*, a mysterious hemorrhagic fever characterized by high fever and bleeding, which devastated the indigenous populations. An associated bacterial pathogen has been identified as *Salmonella enterica*. The abilities of Martin de la Cruz as a physician were recognized by Viceroy Don Antonio Mendoza, who in 1550 granted him a license to practice medicine, and he was given the rare privilege of being allowed to ride a horse. The *Little Book of Indian Medicinal Herbs* was originally written in Nahuatl, but the illustrator is not identified. Emmart (1940:80) thought the likely illustrator was Martin de la Cruz, but Valdes Gutierrez et al. (1992:152) identified at least two artists. The manuscript was translated into Latin by Juan Badiano, a faculty member and a former student from Xochimilco. He provided the following comments at the end of the manuscript:

Juannes Badianus, the translator, to the fairminded reader, Greetings

I beg again and again, most excellent reader, that you consider favorably the work I have put into this translation, such as it is, of this little book of herbs. For my part I would prefer to have my labor perish rather than to undergo your most exacting judgment. Furthermore be sure that I spent some spare hours on this edition, not to show off my own talent, which is almost nothing, but only because of the obedience which I vey rightly owe to the priest and superior of this Monastery of St. Jacob, the apostle and most excellent patron of the Spaniards, the very reverend Franciscan father, brother Jacob de Grado, who laid this task upon my shoulders. Farewell in Christ the Saviour.

At Tlatilulco the College of the Holy Cross, on the holy day of Saint Mary Magdalene, in the year 1552 after the restitution of the world.

*End of the little book of herbs, which
Joannes Badianus, an Indian by race,
a native of Xochimilco, reader at
the same college, translated
into Latin.*

Glory be forever to Him by whose gift I translated
the book you see, good friend reader.

The Manuscript

The original manuscript is bound in velvet, 6 × 8 inches and 3/4 of an inch thick, with a label on the spine, Barb. Lat. (*Barberiniano Latino*) 241, indicating it was once part of the library of Cardinal Francesco Barberini. There are 126 pages, of which 8 are blank. It contained 185 paintings of plant images (phytomorphs) in color of New World plants with associated text organized into 13 chapters based on their ability to control particular human ailments. Martin de la Cruz dedicated the work to Francisco de Mendoza, son of the viceroy, Antonio de Mendoza.

Each page has red margins that must have been created first. Plant images were first painted on the top of the page or in three cases (folios 38r, 38v, 39r) on the entire page. Rubricated Nahuatl names were added above each plant image, sometimes squeezed around the images when there was insufficient room. The rubricated title of the Aztec medicinal use was added below. A scribe must have then added

Badiano's Latin translation of Cruz's Nahuatl text in a different, more elaborated script. Occasionally the spelling of the plant above the image varies from the text. The paper of the manuscript has watermarks of the early sixteenth century, indicating that the Vatican manuscript is an authentic document.

The Aztec medicinal uses written in brown ink under rubricated headings are usually found directly below the phytomorphs, with the exception of folios 38r, 38v, and 39r; these have 11, 7, and 10 phytomorphs whose medicinal uses are found on 2 pages after folio 39v. The text provides medical properties of the plants and methods of preparation; it often includes the name of other plants, precious stones, and parts of animals, which were often used in Aztec remedies. As might be expected from a manuscript produced in a Franciscan institution, the text and style contain European influences including one reference to Pliny, some reference to the humoral theory of medicine, and perhaps the doctrine of signatures (Hassig 1989).

All students of the manuscript comment on the difficulty of precise identification of the plants. Our aim in the present work is to identify the plants from a botanical perspective based on morphology of the image and compare it with three previous attempts. We have relied on Gates (1939), Emmart (1940), and Clayton et al. (2009) for the translation of Nahuatl names. The phytomorph identifications were made by Arthur O. Tucker.

Provenance

Libellus de Medicinalibus Indorum Herbis had prominent backers. The effusive laudatory dedication of Martin de la Cruz indicates it was commissioned by Don Francisco Mendoza, the son of the first viceroy of New Spain. Juan Badiano's translation was made at the request of Friar Jacobo de Grado, Guardian and Director of the Covent of Tlatelolco and President of the Colegio de la Cruz. The gorgeous manuscript bound in velvet was brought to Spain in late 1552 in a sealed box as a gift to the king by Francisco de Mendoza, who was visiting the monarch while substituting for his father (Viesca and Aranda 1996). There were written instructions that the seals not be broken until the son's verbal explanations were received. The traditional explanation for the gift was that it was a means for the viceroy to emphasize the progress of the school in the hopes of gaining increased royal support. It succeeded. The manuscript was well received by the 25-year-old Prince Philip; King Carlos I of Spain (also Emperor Carlos V of the Holy Roman Empire) was out of the country. In 1552, 800 pesos of gold was allotted annually to the colegio, and support for a new hospital for the Indians (Royal College of Naturals) was decreed. In 1552, Martin de la Cruz and two other indigenous physicians were granted licenses to practice and serve as examiner of indigenous physicians. In 1555, in the last document to mention Martin de la Cruz, the second viceroy, Don Luis de Velasco, awarded him a license and permission to carry a crossbow for protection in his duties of collecting herbs.

Don Francisco's visit to Spain also included other financial interests of the Mendoza family. The boxes containing the manuscript also contained the first shipment of ginger that had been introduced and cultivated in New Spain. A contract was arranged for the Mendoza family to import other drug crops from the New World. Clearly, the *Codex Cruz-Badianus* had served the purpose of the Mendoza family.

The codex ended up in the library of Didacus Cortavila y Sanabria, apothecary to King Felipe IV (Fig. 1.2). In 1626, Cortavila presented the manuscript as a gift to Cardinal Francesco Barberino, nephew of Pope Urban VIII, who headed a diplomatic mission to Spain and was visiting Cortavila's renowned garden. The codex

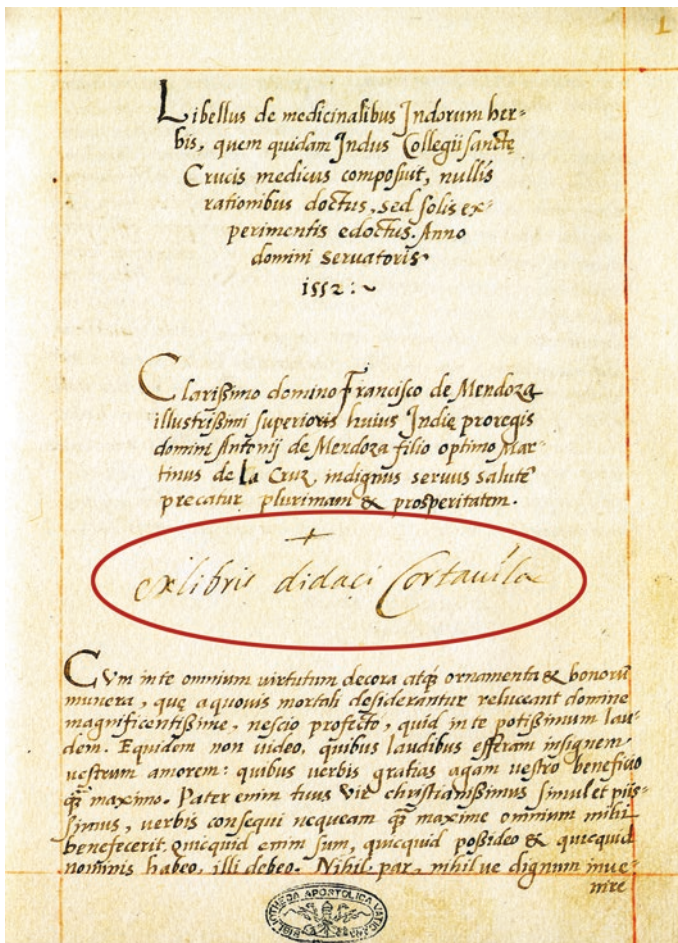


Fig. 1.2 First page of the *Libellus de medicinalibus Indorum Herbis* known as the *Codex Cruz-Badianus*. Note the handwritten inscription: *ex libris didaci Cortavila* which indicates the manuscript was once in the library of Didacus de Cortavilla et Senabria, apothecary to Felipe IV of Spain

became part of the cardinal's extensive collection of manuscripts, and in 1902 it was catalogued in the Vatican library as *MS Barberiniano Latino 241*. In 1990, the *Libellus de Medicinalibus Indorum Herbis* was returned to Mexico by Pope John Paul II, and it now resides in the library of the National Institute of Anthropology and History of Mexico in Mexico City.

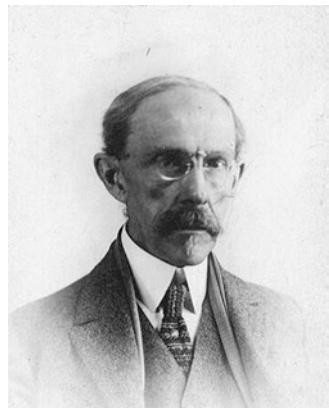
At least two copies of the manuscript were made, one lost and the other ending up with George III of England, catalogued in the Windsor Castle library as *RCIN 970335*. This copy was made in 1627 for the paper museum of Cassiano dal Pozzo, who was under the employ of Barberini. The copy eventually passed on to the Accademia dei Lincei, founded in 1603 by Federico Cesi, who was instrumental in publishing the botanical works of Francisco Hernández. The copy passed on to Cassiano's great nephew, Cosimo Antonio dal Pozzo, to Clement XI in 1703, and to his nephew Cardinal Alessandro Albani in 1714, who sold it to George III in 1762. The lost copy may have been made by Francesco Stelluti, a friend of Federico Cesi (Guerrini 2009).

The *Codex Cruz-Badianus* is an extraordinary document. Written and translated into Latin by two indigenous faculty members of the Colegio de Santa Cruz in New Spain, the herbal can be considered a seminal work on Aztec medicine and culture, providing information on plants, animals, minerals, and ecology.

English and Spanish Translations and Facsimiles

In 1931, William Edmond Gates (1863–1940) and Emily Walcott Emmart (1898–1984) (*see Dedication*) became aware of the discovery of the *Libellus de Medicinalibus Indorum Herbis*. Both were associated with Johns Hopkins University. Gates (Fig. 1.3), a self-financed Mayan linguist and collector of manuscripts, was a research associate; Emmart had received a PhD in zoology in 1930.

Fig. 1.3 William E. Gates ca. 1920, Mayanist scholar and collector. (Source: Bassler 2008)



They independently initiated English translations of the Latin text and Nahuatl plant names and identified many of the plant images (phytomorphs). In her Preface, Emmart acknowledges that Gates lent her books from his private library, but there are no references to his translation or identifications. There may have been a rivalry. Gates was a difficult person, who feuded with Johns Hopkins in 1938 (Bassler and Wright 2008). A brief history by Bruce Byland of both works can be found in the introduction to the 2000 Dover edition of Gates's work, entitled *An Aztec Herbal: The Classic Codex of 1552*.

The translation by William Gates, entitled *The de la Cruz-Badiano Aztec Herbal of 1552*, appeared in 1939, originally published by the resurrected Maya Foundation, which Gates had founded in order to publish his writings. He worked from photographs of the manuscript and watercolor copies made in 1932 and 1933 by Marie Therese Vuilnemin, the niece of Eugene Tisserant, Pro-Prefetto of the Vatican Library. However, Gates did not have the resources to publish the work in color. Identifications are found in the *Analytical Index to Plants named in Herbal*, but the Nahuatl names are not always in alphabetical order.

The translation by Emily Walcott Emmart, with the expansive title "The BADIANUS MANUSCRIPT (CODEX BABERINI, LATIN 241) Vatican Library *An Aztec Herbal of 1552*," appeared in 1940, published by the Johns Hopkins Press. She was successful in gaining support to incorporate Vuilnemin's watercolor copies in color. Her English translation is more graceful than Gates's, and her scholarship was excellent despite quibbles by later workers. Her botanical expertise surpassed that of Gates, and her book has been considered the most important work on the manuscript. It includes an extensive introduction, a facsimile, and extensive translation comments.

The most recent English analysis of the codex, entitled *Flora: The Aztec Herbal*, was published in 2009 by Royal Collection Enterprises Ltd. It was coauthored by Martin Clayton, Luigi Guerrini, and Alejandro de Ávila. Martin Clayton is an art historian and specialist in the drawings of Leonardo da Vinci; he is presently Deputy Curator of the Print Room at Windsor Castle. Luigi Guerrini is a historian of science, specializing in the seventeenth and eighteenth centuries. Alejandro de Ávila is an anthropologist, ethnobiologist, and founding director of the Jardín Etnobotánico in Oaxaca, Mexico. This work included illustrations from both the original Vatican version and the copy in the Royal Library in Windsor. All three versions (1939, 1940, and 2009) contain all the phytomorphs, but Gates slightly altered the sequence.

There are two Spanish translations. One was published in 1952 by Francisco Guerra; it is based on Gates's version but contains only a few plates. A more extensive Spanish edition was published by the Instituto Mexicano del Seguro Social in 1964, with a second edition in 1991. There are color differences in the various reproductions; the 1991 edition is considered closest to the original. These images based on the original manuscript are used in this volume. A number of works concentrating on the medicinal aspects of the manuscript are listed in Additional References at the end of this chapter.

The *Codex Cruz-Badianus* as a Herbal: Medical Uses

The symptoms recognized by Aztec physicians encompassed a wide variety of disorders, and many were treated by herbal medicine. This is apparent in the *Codex Cruz-Badianus*, where the phytomorphs are grouped into 13 chapters treating ailments from the head downwards (Emmart 1940):

1. Of the treatment of the head, boils, dandruff or alopecia, scabies, falling hair, laceration of the head, or fractures (folio 6v-9v)
2. Of treatment of the eyes, heat blood-shot eyes, glaucoma, numbness of the eyebrow or rather of the eyelids, tumor of the eyebrow or rather of the eyelids, tumor of the eyes, induction of sleep, and prevention of drowsiness (folio 10r-14r)
3. Of purulence of the ears, or deafness, or rather obstruction (folio 14r-15r)
4. Of coryza, medicine to be installed into the nose, and blood herb (folio 15r-16v)
5. Of sparkling of the teeth or dentifrice, cure of swollen and abscessed gums, pain and decay of teeth, severe heat, tumor or suppuration of the throat, angina, medicine by which pain in the throat is soothed, that which brings forth dried-up saliva, that which cures bloody sputum, that which relieves coughing, and that which removes noisome and fetid breath, of hiccups (folio 17r-21v)
6. Of cooling the heat of swelling cheeks, of healing one who cannot open his mouth for the pain, of scabies of the face, scabies of the mouth, struma of the neck or scrofula, water under the skin, and weakness of the hands (folio 23r-26r)
7. Of oppression of the chest, pain in the heart, heat, pain in the side, medicine to kill worms and small animals which enter the stomach, antidote, swelling of the stomach, pain in the abdomen, dysentery or choleric, rumbling of the abdomen, coldness, and purgation (folio 26v-32r)
8. Of cure of the pubes, plant for groins, bladderwort to halicacabum, dysuria or difficult discharge of the urine, ailment of the fundament, podagra, pain of the knee, incipient contraction of the knee, remedy for what makes cracks in the soles of the feet, injury of the feet for fatigue, and trees and flowers for the lassitude of those administering the government and those holding public jobs (folio 32v-40r)
9. Of the remedy for back blood fever, leprosy, hemorrhoids, condyloma, excessive heat, injured body, lychen or mentagra, the recurrent disease, scabies, wounds received, disease of the joints, psora, pus already infected with worms, burned body, difficult digestion, cut veins swelling because of phlebotomy, and one struck by lightning (folio 40v-50v)

Of the falling sickness or comitial sickness, remedy for fear or faintheartedness, mental stupor, for one afflicted by a whirlwind or a bad wind, warts, fetid odor of the infirm, odor of the armpits, phthiriasis, and phthiriasis of the head, one crossing a river or lake, traveler (folio 56r-56v)
10. Of the medicines for recent parturition, for menstruation, for washing the abdomen of a woman in bed, tubercles of the breast. Medicine to produce lactation (folio 60v-61v)

11. Of scabies or inflammation of children and when an infant is no longer willing to suck the breast because of some pain (folio 60v-61v)
12. Of certain signs of one who is going to die (folio 61v-63r)

Identification of Phytomorphs

The 185 plant illustrations (phytomorphs) in the manuscript are in bright colors and beautifully stylized but sometimes botanically inaccurate. Many are difficult to identify. Some illustrations do not include inflorescences, and flowers and fruits are often crudely portrayed; root systems are presented symbolically (Fig. 1.4). In some cases, colors are used to identify soil type: patches of blue indicate moist soil. Plants grown near ant hills show pictures of ants (folios 13v1 and 28r). Nevertheless, some phytomorph identifications are obvious, including *Cucurbita pepo* (folio 59v2), *Opuntia ficus-indica* (folio 49v), *Theobroma cacao* (folio 38v2), (d) *Philodendron mexicanum*, (folio 18v1), and (e) *Stenocereus thurberi* (folio 17v) (Fig. 1.5).

The Nahuatl names in red above the images are often compound, providing information on the description, ecology, and uses based on the Aztec classification. Four basic types were recognized: food plants (*quilitl*), medicinals (*patili*), ornamentals (*yochitl*), and economic plants. Medical plant names often relate to their medicinal uses. A number of different plants have the same name.

The appropriate guidelines for identifying plant images (phytomorphs) were outlined by Tucker and Janick (2017) and bear repeating here:

1. For any identification of a plant, the strength of evidence depends on the qualifications of the identifier(s).
2. Identification of plants, just as with forensic identification of faces or fingerprints, requires pattern recognition. For botanical subjects, this requires

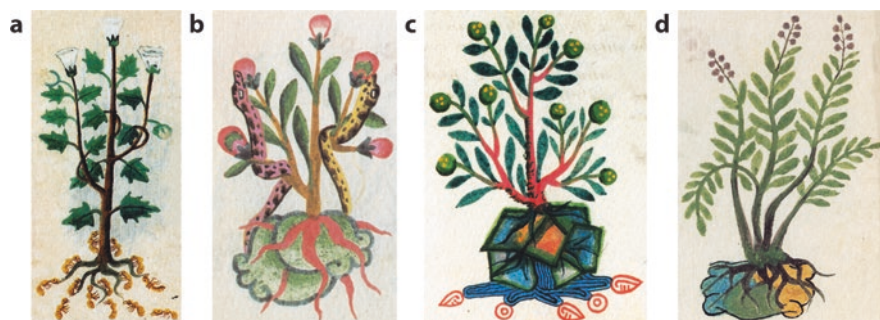


Fig. 1.4 Examples of symbolic features in the phytomorphs: (a) folio 13v1, presence of ants, pun on name “ill smelling medicinal coming out of ant hill”; (b) folio v4, presence of serpents, pun on name “serpent fruit”; (c) folio 61r1, presence of Aztec water symbol and blue color for watery ecological habitat; (d) folio 27v3, presence of Aztec stone symbol reflecting association with climatic or ecological conditions

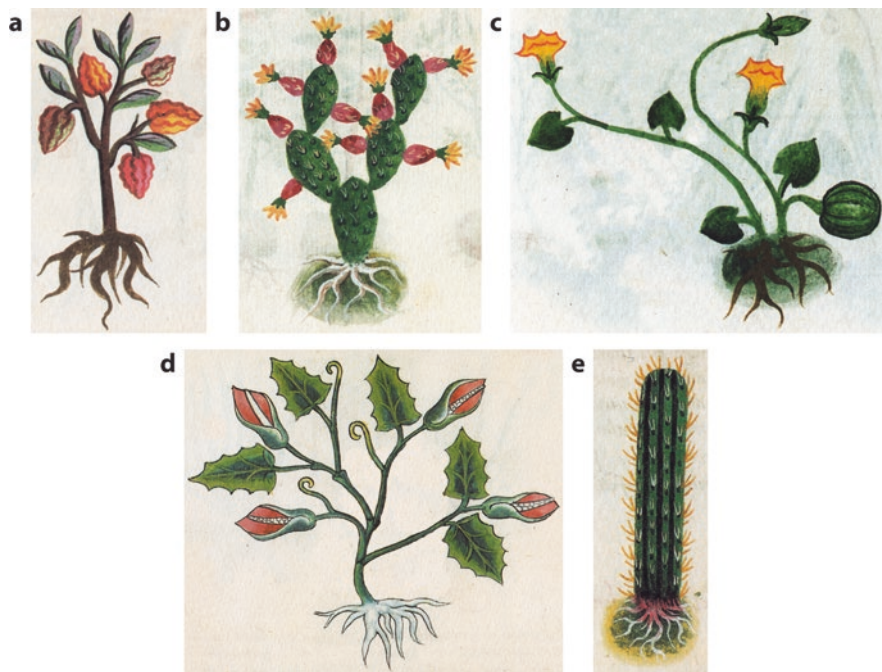


Fig. 1.5 Readily identifiable plants of *Codex Cruz-Badianus*: (a) *Theobroma cacao*, folio 38v2; (b) *Opuntia ficus-indica*, folio 49v; (c) *Cucurbita pepo*, folio 59r2; (d) *Philodendron mexicanum*, folio 18v1; (e) *Stenocereus thurberi*, folio 17v

recognition of the appropriate plant family, then to genus, and eventually species. Amateurs of botanical identification often reverse this process and try to identify the species first and ignore the patterns of the plant family, usually leading to false identifications.

3. Any attempt at identification must use currently accepted scientific names and the appropriate vocabulary of terms pertinent to plant taxonomy.
4. Details of habitat or ecological association may provide evidence to support an identification of a phytomorph.
5. Associated names often provide supporting evidence for the identification of a phytomorph.
6. Because of inherent biological variability of plants and differing talents of the artist(s), no identification of a phytomorph can be considered absolute. Rather, degrees of accuracy must be stated, from high to low. Confidence is based upon high percentages of match with a list of features that agree or do not agree with the identification.
7. All previous attempts at identification from books and refereed publications must be presented and discussed as to accuracy. Similar representations of phytomorphs in other original sources should be cited to bolster the identification, along with any ethnobotanical uses or mythology.

8. Identifications of phytomorphs in a transcultural society such as sixteenth-century New Spain, pre- and postconquest, must consider as artistic methods of representation.
9. Pigments (even mineral pigments in European paintings) vary in stability, and the transient nature of vegetable-derived pigments in New World paintings means that the colors seen today may not be the same colors as originally applied.
10. The purpose and background of the portrayal must be considered. Is any mythology associated with it? Are certain diagnostic characteristics emphasized for identification?
11. Any identifications from restored materials should be not be considered as absolute because of past practices with little or no record of the degree of restoration. In the past, some restorations had more in common with forgery, employing identical or similar techniques, along with pigments and pigment binders, used by restorers with questionable ability, who sometimes even distressed the restoration to agree with the rest of the work.

In each chapter, there were from 1 to 11 phytomorphs per page, each labeled with medicinal uses and method of preparation. One might expect that the Nahuatl name provided by Martin de la Cruz would make the modern identification straightforward, but in fact there is no recognized flora based on Nahuatl names. Putative identifications based on Nahuatl plant names summarized in an appendix in the *Flora of the Voynich Codex* (Tucker and Janick 2019) indicate substantial disagreement and many duplications. Furthermore, many of the identifications were not made by recognized systematic taxonomists and are questionable. In some cases, the same Nahuatl name is used for more than one plant. The identification of the 185 phytomorphs of the *Codex Cruz-Badianus* is presented in the following chapter.

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Chapter 2

Phytomorph Identification of the *Codex Cruz-Badianus*



The *Codex Cruz-Badianus* contains 185 phytomorphs separated into 13 chapters based on medical disorders, as explained in Chap. 1. Each image is labeled with its folio number followed by *r* (recto) or *v* (verso) and a number from 1 to 11 when there is more than one image per folio. Emmart (1940) reported only 184 illustrations, and we assume that folio 56v1 and 56v2 (two intertwined plants) were incorrectly listed as one illustration even though two Nahuatl names are attached. A letter from Eugene Tisserat to William Gates, dated July 26, 1933, listed charges for illustrations by his niece Marie-Thérèse Vuillemin for “185 flowers” (Gates 2000). A number of other folios (14v, 18v, 32r, 44r, 51v, 54r, 59r) contain superimposed images. The phytomorphs are those found in Emmart (1940), which were based on the Vuillemin illustrations.

Of the 185 phytomorphs, 157 contain inflorescences or fruits generally essential for precise identification; 28 are vegetative. The roots tend to be stylized, but rhizomes are emphasized. Some of the phytomorphs have symbolic clues (see Fig. 1.3). All the individual phytomorphs are associated with Nahuatl names, but these are not definitive because many names are generic and refer to more than one species.

The phytomorphs are discussed in sequence based on folio numbers derived from Clayton et al. (2009). The folio numbers are difficult to discern in Emmart (1940), who used plate numbers, and these are also provided for each folio with figures. Each identification is divided into seven subsections:

Nahuatl name: the name printed in red above the phytomorph, followed by its translation by Emmart (1940) and Clayton et al. (2009); alternative spellings may be added

Description: using appropriate botanical vocabulary

Previous identifications: based on the literature, which is cited

Putative identification: based primarily on morphology of the image, using appropriate botanical nomenclature

Distribution: range and ecology

Names: common names, usually English, Spanish, or Nahuatl

Uses: medicinal, culinary, and other uses of these and related species

These are followed by a photograph of the figure of each of the 185 phytomorphs, coupled with a photograph, drawing, or herbarium sheet of the putative species. The figure captions provide the folio number and the putative botanical name and family. The reliability and accuracy of identification will be explained in the text. Species in doubt will be associated with a question mark (?).

The nomenclature follows our interpretation of the cited revisions, and/or the Germplasm Resources Information Network (GRIN) (USDA, ARS 2015), and/or the collaboration of the Royal Botanic Gardens, Kew, and the Missouri Botanical Garden (Plant List 2013). The folio numbers are found in Cruz and Badiano (1964) and Clayton et al. (2009), and the plate numbers found in Emmart (1940) are included. Translation of Nahuatl names is provided by Emmart (1940) and Clayton (2009).

In this work, the reliability and accuracy of each identification are as follows. Those phytomorphs in which the species cannot be accurately determined are identified as “generic name sp.” indicating the specific epithet is unknown. Species in doubt will be followed by a question mark (?). Where an identification is suggested or likely, sometimes the species will be followed by the abbreviation “cf.” meaning “compares favorably,” and a suggested species will be listed. The identification of the 185 phytomorphs by four sources (Tucker & Janick as presented in Chap. 2; Clayton et al. 2009; Emmart 1940; and Gates 1939) can be found in Table 1 of the Appendix arranged by folios and include the Nahuatl name. The nomenclature follows our interpretation of the cited revisions, and/or the Germplasm Resources Information Network (GRIN) (USDA, ARS 2015), and/or the collaboration of the Royal Botanic Gardens, Kew, and the Missouri Botanical Garden (Plant List 2013). The folio numbers are those found in Cruz and Badiano (1964) and Clayton et al. (2009).

Folio 7r



Aztec medicinal use **Treatment of the head.** The shrubs *xiuhecapahтли*, *yztac ocoxochitl*, and *teamoxтли*, and the precious stones *tetlahuitl*, *yztactlalli*, *eztetl*, and *temamatlatzin*, ground up together in cold water, stop heat in the head; when ground up in hot water, they stop coldness therein. Apply three times a day (morning, noon, and evening) and bind the neck and throat with the sinew of an eagle's foot and neck. Those suffering from headache should eat onions in honey and should not sit in the sun, work, or enter the baths (Emmart 1940).

Folio 7r1

Nahuatl name *Xiuhhecapatli* (*xiuh* = herbaceous plant; *eca*, *ecatl* = wind; *patli* = medicinal plant; thus, plant wind remedy [Emmart 1940]; herbaceous wind remedy [Clayton et al. 2009]). Alternate spellings: *xiuehcapahтли*, *xiuhehcapahтли*, *xihuecapahтли*, *xiuhecapatli*.

Description This phytomorph has alternate, simple, elliptic leaves with erect, golden yellow flowers or fruits (shaded orange in Emmart [1940] but not in Cruz and Badiano [1964]) that are terminal, single, and semi-orbicular, subtended by a calyx with acute lobes. The stem is blue. It appears to be perennial because the stems arise from a caudex or tuber. This is different from the phytomorph portrayed as *xiuehcapahтли* on fol. 37a1.

Previous identification This has been identified as *Senna occidentalis* (L.) Link (*Cassia laevigata* sensu auct., *C. occidentalis* L.) (de Ávila Blomberg 2012; Díaz 1976; Gates 2000; Guerra 1952; Reko 1947; Miranda and Valdés 1964; Valdés Gutiérrez et al. 1992) or *Senna septemtrionalis* (Viv.) H.S.Irwin & Barneby (*Cassia laevigata* Willd.) (Bye and Linares 2013; Linares and Bye 2013), both of the Fabaceae.

Putative identification Both species of *Senna* have compound leaves with a flower or fruit that differs from fol. 7r. A better match would be a species from the Solanaceae, but most of these have pendulous fruits and are not erect, and those that are erect fruit are clustered. An exception is a species allied to *Solanum pseudocapsicum* L. (*S. capsicastrum* Link ex Schauer) (Fig. 2.1), which has alternate, simple, elliptic leaves and erect golden yellow to orange-red berries subtended by calyces with acute lobes. This is an evergreen shrub, living up to 10 years, and 0.3–1 m tall, occasionally to 2 m. The glabrous form is most often in cultivation.

Distribution *Solanum pseudocapsicum* is found in forests, forest margins (seres), and waterways, is native from northern Mexico to southern South America, and is naturalized in Africa and Australasia.

Names Jerusalem cherry, winter cherry, Christmas cherry (English); *coral de jardines*, *manzanita de amor* (Spanish).

Uses While not poisonous to humans, *S. pseudocapsicum* will produce gastric upset from the alkaloid solanocapsine, suggested by the synonym *S. ipecacuanha* Chodat (ipecac nightshade). This species also has antitumor and antiviral activity (Badami et al. 2003; Van Den Berghe et al. 1978).



Fig. 2.1 *Solanum pseudocapsicum*, Solanaceae: (a) folio 7r1; (b) fruit and leaves of *S. pseudocapsicum*. (Source: https://commons.wikimedia.org/wiki/File:Solanum_pseudocapsicum1.jpg KENPEI CC BY-SA 3.0)

Folio 7r2

Nahuatl name *Yztac ocoxochitl* (yztac = white, oco, ocotl = pine; xochitl = flower; thus, white pine flower [Emmart 1940; Clayton et al. 2009]).

Description This phytomorph has two types of leaves. The principal stems bear semi-orbicular, terminal, single, orange, and yellow flowers or fruits that are subtended by calyces with acute lobes with simple, opposite, elliptic leaves. The lateral shoots bear smaller yellow, single flowers or fruits subtended by calyces with acute lobes with simple, opposite, linear leaves. The stems arise from a basal caudex, possibly indicating a perennial plant, or perhaps a parasite.

Previous identification This has been identified as *Didymaea* sp. (Gates 2000) of the Rubiaceae, *Didymaea mexicana* Hook. f. [*D. alsinoides* (Standl.) L.O. Williams] (Clayton et al. 2009; Miranda and Valdés 1964; Reko 1947), a species with relatively small flowers and black fruit. The identification of this phytomorph as *Pimenta dioica* (L.) Merr. of the Myrtaceae, based upon non-botanical evidence by Abud Molina (2015), does not match the phytomorph.