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How Can Ethnobotany Contribute to the History of Western Herbal Medicine? A Mesoamerican Answer

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Introduction

Ethnobotany, the study of relationships between plants and people, became a formal discipline in the early twentieth century. Though originally distinguished from economic botany by its focus on non-industrialized peoples, ethnobotanical research is being carried out all over the world and in all types of societies. The field is highly interdisciplinary, with contributions from botany, anthropology, archaeology, phytochemistry, ecology, pharmacology, medicine, history, religion and geography.[1] While many ethnobotanists are involved in the identification of new plant chemicals, genes and products for industrial development, they have also made great contributions to biodiversity conservation. However, the most significant aim of ethnobotany is to understand how people interpret and use plants. Medical ethnobotany focuses specifically on the ways people use plants to effect healing and has much to contribute to the study of the history of herbal medicine. Typically the work of a medical ethnobotanist involves the documentation of (1) medicinal species and their uses; (2) techniques involved in using plants as medicines (e.g. recipes, preparation and administration methods); and (3) the role of plants in shaping theories and experiences of illness and healing.

While most ethnobotanical research has been done with contemporary populations, a variety of medicinal plant scientists have started looking at historical relationships between plants and people. Heinrich et al.[2] provide a concise but rich overview of three effective approaches: 'botanico-historical' research that traces the use of particular species back through time; the application of historical linguistic data; and the use of documentary evidence from early ethnobotanical investigations. Historians interested in herbal medicine may also find merit in ethnobotanical approaches to the interpretation and critical analysis of older historical documents, such as a recent look at an early nineteenth-century Brazilian prescription book[3] and a review of malaria remedies from sixteenth- and seventeenth-century European

herbals.[4] The work of Bernard Ortiz de Montellano on Aztec medicine provides a particularly robust method for applying ethnobotanical insights to the interpretation of historical documents that concern medicinal plants. By considering both an Aztec world-view and that of colonial officials (who trained Aztec scribes to develop a Nahuatl orthography), Ortiz de Montellano is able to show that Aztec use of medicinal plants had an empirical logic to it in his innovative *Aztec, Medicine Health and Nutrition*, which was published in 1990.

This chapter shows how to apply ethnobotanical concepts to contextualize the use of medicinal plants, to achieve finer resolution in historical studies of herbal medicine and to gain a more panoramic perspective on the global movement of medical knowledge and practices throughout time. Using Ortiz de Montellano's work as a guide, it addresses the importance of socio-ecological context; political motivations of the authors of historical texts; cosmology, culture and world-view; and local concepts of efficacy as applied to herbal (and other) medicines. The chapter then explores how this ethnobotanically informed Mesoamerican case study fits into, and helps to create, a more complete picture of global historical processes that have led to a widely shared body of medical knowledge and materials which extends throughout Central Asia, North Africa, Europe and the Americas. The main conclusion to be drawn is that ethnobotany can help answer questions about how past populations used herbal medicines, as well as how medical knowledge and materials have been shared with, adopted by, stolen from and/or forced upon, others. Combining ethnobotany and history thus increases the chances of adapting medical texts from the past to benefit people in the present.

The Mesoamerican environment and culture area

Ortiz de Montellano situates his work in historical ethnobotany on the Aztec people, a Postclassic Mesoamerican civilization. The term 'Mesoamerica' refers to a culture area, defined by common characteristics that were present during pre-Columbian times. The northern border of Mesoamerica is a bit nebulous. It is sometimes difficult to distinguish between the regions controlled by Mesoamerican civilizations and territories that were left to more nomadic and less centralized warrior-based societies, but it is somewhere in the vicinity of what is currently known as the Chihuahuan desert. For example, Kirchoff equates the Pánuco River in Sinaloa, Mexico, with the northern border of Mesoamerica.[5] While most scholars agree that Mesoamerica extends southward through Mexico, Guatemala and Belize, and ends in the eastern regions of El Salvador and Honduras, Creamer has argued that the southern border of Mesoamerica is also debatable.[6] Suffice to say that Mesoamerica overlaps extensively with contemporary Mexico.

The nation of Mexico is one of the richest in biological diversity on earth and is also home to tremendous ecological and cultural diversity. The topographic and climatic variations of Mexico create a mosaic of environmental conditions, including mountain ranges, desert regions, rainforests and coastal zones. This diversity of environments and wealth of natural resources explain why Mexico was the birthplace of the major

early civilizations of Mesoamerica.[7] In addition to Mexico's majority Spanish-speaking *mestizo* population, there are currently around 10 million people who belong to some 56 ethno-linguistic groups[8] and live in nearly all of the major ecosystems of the country. The multi-use land management strategies of these indigenous peasants tend to maintain and even increase biodiversity.[9] Mexico's robust heritage of indigenous cultures has also made it a nation with a complex cultural wealth of traditional medical systems. In Mexico, cultural and biological diversity form the basis of traditional medicine that helps support the health of the nation, largely through the use of over 5,000 species of medicinal plants.[10]

Ortiz de Montellano, alongside others, argues that 'early Mesoamerica was a cultural unit sharing a common worldview, religion, and ideas of human physiology and health'.[11] The common cultural characteristics of pre-Columbian Mesoamerica include intensive agriculture, religion manifested in monumental architecture, developed art styles expressed in several media, urban centres, expansionist politics, social stratification, specialization, markets and extensive trade, elaborate calendars, and hieroglyphic writing. In the Valley of Mexico, where the Aztec once built their capital Tenochtitlan and present-day Mexico City still stands, Tula and the Toltecs ascended to political dominance by 950 CE, the beginning of the Mesoamerican Postclassic period. This was about 200 years after the collapse of Teotihuacan, the first great metropolitan centre in Mesoamerica, which was located in the northern part of the Valley of Mexico. Although Tula never reached the scale or architectural grandeur of Teotihuacan, the city did have ties with, and influence on, other areas. Tula fell by 1200 CE, marking the beginning of the Aztec phases. Early in Aztec times, conditions appear to be similar to those around the collapse of Teotihuacan, but later Tenochtitlan-Tlatelolco became a dominant centre.[12] The Aztec, or Mexica, were a group of 'chichimec' warlords who came from the north, and claimed Toltec descent to legitimize their rule.[13] The formation of the Triple Alliance Empire (Tenochtitlan, Texcoco and Tlacopan) is generally recognized as a major turning point in the political and economic history of central Mexico. The Triple Alliance expanded and conquered neighbouring areas. As the Triple Alliance tribute was imposed on top of prior local tributes, it led to greater economic hardship and a lowered standard of living in provincial areas. Presumably this would have affected the lower classes more intensely, as they were not receiving tribute goods and services like the provincial nobility.[14]

Aztec ethnohistorical sources

The Aztec state has been one of the most intensively studied civilizations in Mesoamerica. Aztec agricultural development and standard of living,[15] trade,[16] architecture,[17] women's production[18] and even attitudes toward homosexuality[19] have all been the subject of research. During the sixteenth and seventeenth centuries, a number of ethnohistorical works about Mesoamerican cultures were produced. Bernal Diaz (b. 1492 to 1498, d. 1585)[20] wrote an account of the conquest of New Spain in 1568. He provides a fairly detailed description of the Aztec emperor Montezuma

(c. 1466–1520), and how he lived, as well as the battle/fall of Tenochtitlan. However, much of the book focuses on the exploits of Hernan Cortes. The most important ethnohistorical work on the Aztec is the *Florentine Codex*. The translators, Anderson and Dibble, consider its author, Bernardino de Sahagún (1499–1590), to be one of the best 'ethnographic missionaries' of his time. They note that he used trained Aztec informants, as well as other 'anthropological techniques'. Altogether there are 12 volumes: I. The Gods; II. The Ceremonies; III. The Origin of the Gods; IV. The Soothsayers; V. The Omens; VI. Rhetoric and Moral Philosophy; VII. The Sun, Moon and Stars, and the Binding of the Years; VIII. Kings and Lords; IX. The Merchants; X. The People; XI. Earthly Things; and XII. The Conquest. Sahagún was a remarkable scholar with an apparently insatiable appetite for information. The work is thorough and ethnographically sophisticated.

More information is available about Aztec religion and medicine than for any other American culture, as this is the best documented state-level society in the New World. Sahagún's work, for example, reveals a preoccupation with the health of both the body and the soul. Like other anthropologists,[21] Ortiz de Montellano treats these historical works ethnographically, using them as a source of ethnobotanical data. However, it is important to distinguish historical documents that were written by explorers, missionaries and conquerors from the work of trained ethnographers. For example, Diaz freely admits that he was a soldier, and was more concerned with following orders than closely observing the cultures and peoples he was conquering. The *Florentine Codex* was written with the intent of teaching missionaries to understand the Aztecs in order to convert them to Christianity.[22] The information that Sahagún collected when he specifically asked about Aztec medical knowledge focuses on illnesses and medicinal plants. Thus, Sahagún's work gives an impression of less supernatural involvement in Aztec medicine than there actually was. *Historia natural de la Nueva España* was written by the Spanish doctor Francisco Hernández and published posthumously in 1648. It is the most comprehensive work on Aztec medicinal plants, listing over 3,000, and Hernandez attempted to test plants on himself and on hospital patients. However, the work is limited by his inability to let go of his own medical (humoral) models in order to understand Aztec concepts of disease (for example, he classified plants according to ascribed Galenic qualities rather than documenting Aztec medicinal plant categories).[23]

Primary sources about Aztec medicine are also influenced by the Spanish to a certain extent, as it was the Spanish who trained Aztec scribes to render Nahuatl as a written language. In 1552, Martín de la Cruz, an Aztec doctor, wrote a herbal in Nahuatl that was translated into Latin by Juan Badiano (the *Codex Badianus*). The herbal was intended to be a tool for convincing Charles V (1500–58) that Indians were capable of being educated. Thus, it was heavily influenced by European medical concepts.[24] Nevertheless, the Badianus manuscript is the oldest known medical text from the Americas that was written by indigenous physicians. The work discusses 251 plants and their uses. Only 15 plants overlap with the 255 listed by Sahagún. These include sacred intoxicants and stimulants, such as datura (*Datura stramonium*), morning glory (*Ipomoea* spp.), tobacco (*Nicotiana tabacum*) and cacao (*Theobroma cacao*).[25] In 1629, Hernando Ruiz de Alarcón published a *Treatise on Superstitions*

in order to cast out paganism and syncretism in Aztec practices by recording pagan beliefs and activities to help clerics identify them. The work mentions fewer than 30 medicinal plants and gives the impression that Aztec medicine was primarily magical, that is, based on ritual.[26] As a consequence of the strong European influences on authors of Aztec medical (and other) texts, it is important to read them with a broader understanding of Aztec cosmology, world-view and culture.

Aztec society, cosmology and medicine

Some anthropologists have argued that the Aztec population was excessive and that ritual cannibalism was carried out to obtain adequate protein. However, studies of the carrying capacity of the Valley of Mexico and Aztec agricultural techniques show that it was possible to have a balanced, nutritious diet without recourse to human flesh. The *chinampa* system was key to the Aztec economy and, by extension, to the health of the population. *Chinampas* are floating agricultural plots that were constructed in lakebeds around the Aztec capital. The technology dates back to earlier phases in Mesoamerican pre-history, beginning with early piecemeal pioneering efforts at *chinampa* construction. However, large-scale *chinampa* development of later Aztec phases was planned, as evidenced by hydrological complexity and uniform *chinampa* size. At its peak, surplus production of the entire system could have been as much as 20 million kilograms per annum. It has been estimated that between one-half and two-thirds of Tenochtitlan's food needs were probably supplied by local *chinampas* alone.[27]

During early small-scale *chinampa* construction, land tenure was communal. Tenants produced tribute to a local ruler and there was little stratification among commoners. The Aztec intensification of the *chinampa* system gave rise to a distinction between 'free' commoners (*macehualtin*) and serfs (*mayeques*), but there is evidence that the two social classes enjoyed roughly the same standard of living and had a similar range of production activities.[28] Water transport was critical to the success of the system and all *chinampas* were connected to Tenochtitlan by canals. The state provided hydrological coordination and planning in exchange for rent and tribute.[29] Postclassic trends in all parts of Mesoamerica were toward the decentralization of ritual and decision-making, but with increasing economic integration. Toward the end of the period, rulers appeared to rely more on promoting economic stability (rather than religion) to retain power and there appeared to be development of a more trade-based power structure in which religion was commercialized and trading centres lacked religious architecture. Among the Aztec, more labour was going into agricultural development and craft specialization than into temple building, or even the military.[30]

Nevertheless, spiritual practice was important in Aztec society, especially as it related to healing, even if the state authorities did not invest so much power in religion. According to Aztec cosmology, there is a link between astronomical events and bodily function. Thus, from the Aztec point of view, the stability of the universe had to be maintained by feeding human flesh to the Sun. This is what the practice

of human sacrifice stemmed from, rather than a cultural predisposition to excess and exoticism, that is, strange or bizarre behaviour. In fact, the Aztec world-view supported an ethic of moderation and balance, while disequilibrium was seen as a major cause of illness and disease. Throughout contemporary Mexico (and most other Latin American nations), the 'hot–cold' system of balancing bodily 'humours', foods and elements is a predominant ethnomedical theory. Evidence for the historical continuity of this theoretical system extends back to Aztec times.[31] In general, foods, illnesses, medicines and even people are classified as 'hot' or 'cold', though 'hot' and 'cold' do not necessarily refer to the actual thermal temperatures of substances, but rather to innate characteristics.[32] Browner also reminds us that there may be more to Mesoamerican equilibrium models of health than a balance of hot and cold alone. Extremes of all type (heat, cold, moisture, dryness) can cause disequilibrium, as can displaced or 'wandering' organs and clogged orifices.[33] To help regulate equilibrium and balance, the Aztec had a range of healing options, from supernatural to mundane, to choose from, and plants played key roles in most, if not all, of them.

In 1976, George Foster (1913–2006), a medical anthropologist, first defined the difference between personalistic (e.g. supernatural, wilful) and naturalistic (e.g. empirical) aspects of traditional medical systems.[34] This theoretical distinction helped to acknowledge and elucidate the coexistence of empirical and magical models of health and healing in many medical systems. Personalistic aetiologies are based on the idea that the volition or intervention of a natural or extra-natural force causes misfortune, including illness. The treatment of personalistic illnesses is the speciality of shamans, who conduct healing ceremonies aimed at appeasing angered gods or spirits, or counteracting the influence of witches or other shamans, and so on. Naturalistic causes of ill health are the product of natural events or properties of natural substances, such as microorganisms or an imbalance of hot and cold humours in the body. Treatments of conditions resulting from naturalistic causes are usually pragmatic and empirical and involve medicinal preparations of plant or animal substances.[35] The Aztec believed that the world had been created and destroyed many times. Their pantheon was large and incorporated deities of the peoples they conquered. These deities were seen to be anthropomorphic, animistic and involved with astrological aspects of health and illness. Words were also thought to have the power to harm and heal and multiple souls had specific roles related to growth, development, function and death. In Aztec religion, the roles of shaman and priest were fused. Shamanic healing centred on the use of hallucinogenic plants such as the morning glory, but with the ultimate aim of reordering the ecological and spiritual balance of the ill person. The Aztec city-state also supported doctors who treated mild, naturalistic illnesses with herbs, and referred sufferers of chronic/severe illness to priests for religious ritual/confessions. Doctors kept botanical gardens in Tenochtitlan where they gave patients free medicinal plants on the condition that they reported results. There were also battle surgeons who used obsidian blades.[36]

Herbal medicines and concepts of efficacy

Medical ethnobotany has advanced the study of naturalistic medicine further by demonstrating that the use of medicinal plants in traditional societies is rational and systematic. Traditional healers and other people who use medicinal plants employ species that are biologically effective and actively experiment with plants to meet evolving social, spiritual and public health needs. Most ethnobotanical inventories (whether drawn from contemporary or historical populations) are excellent sources of raw data that can be used to answer theoretical questions and conduct cross-cultural studies of medicinal plant use. They may also become important leads for pharmaceutical development. However, the way efficacy is measured must be culturally appropriate, if ethnobotany is to contribute to our understanding of the practice of herbal medicine.

Anthropologists and ethnobotanists view efficacy as directly or indirectly producing a set of required, culturally defined outcomes. Etkin suggests that the key to any consideration of efficacy is the distinction between its emic (insider/subjective) and etic (outsider/objective) interpretations. Whether one chooses to adopt an emic or etic perspective, an important gauge of the efficacy of herbal medicines is related to their physiological effects.[37] In the context of Western science, biochemical assays are a common first step in determining the efficacy of medicinal plants. Such an exercise is used to identify physiologic responses to treatment.[38] The efficacy of plant medicines may be judged on their ability to induce full remission of symptoms. However, in many cultures other physical signs such as fever, salivation or emesis (proximate outcomes) are also important, as they indicate that the plant has initiated the healing process.[39] In other medical systems, the alleviation of physical symptoms is not enough. Chinese-style doctors have been known to tell patients that they are still ill, even when they experience complete alleviation of physical symptoms. This occurs because the underlying problem causing the symptoms has not been adequately treated.[40] There are also many examples in the literature that suggest that some medicinal plants are effective based on both emic and etic criteria, even though perceptions of disease aetiology and mode of drug actions may be different. Nettles are externally applied to the body in both New Guinea and Ecuador to reduce pain. The emic understanding of this practice dictates that the plant consolidates the disease substance at some internal locus, and facilitates its expulsion or chases away the pain. The biomedical explanation for the efficacy of this practice is based on the principle of counterirritation (i.e. superficial irritation at the skin that relieves inflammation of underlying structures).[41] Thus, while definitions of what is effective vary across time and space (especially between industrialized and traditional societies), they may also overlap.

As Anderson points out, the attribution of efficacy to 'time-tested' traditional medicines simply because they 'work' is not acceptable for a scientific anthropology. Nor does it comprise rigorous historical or ethnobotanical study.[42] However, pharmacological screening and biochemical assays are also limited in their ability to measure the efficacy of medicinal plants. When medicinal plants are evaluated in a clinical setting and removed from their cultural context, they are transformed into something

other than traditional medicine.[43] Laboratory procedures of extraction and purification do not always resemble traditional recipes, and active compounds may likewise vary depending on the methods by which a medicinal plant is processed. Even when extractions with biologically active constituents are the focus of study, the failure of researchers to consider the cultural context within which the plant is used can result in misunderstandings of the plant's efficacy. Etkin points out that one of the most significant obstacles to the full comprehension of efficacy is the failure to understand healing as a process. In order to adequately evaluate efficacy (using either emic or etic criteria), one must understand the cultural expectations and biological outcomes of the medicinal plant in question.[44] For example, the raw tubers of several *Aconitum* spp. contain the alkaloids mesaconitine and hypaconitine. Due to the toxicity of these alkaloids, the use of *Aconitum* in Asian medicine has been criticized as irrational, or ignorant, despite the absence of reported fatalities following the use of these plants. In more recent investigations, it has been shown that when the tubers of *A. japonicum* are heated (the traditional method of processing these plants), the concentration of toxic alkaloids drops from 0.35 per cent to 0.04 per cent.[45]

Ortiz de Montellano was one of the first anthropological ethnobotanists to suggest that traditional medicines must be evaluated according to the standards of their own medical systems, rather than those of biomedicine. He evaluated whether chemical components in 25 Aztec medicinal plants could produce the effects ascribed to them by Aztec physicians. Ortiz de Montellano found that 16 components would produce the effects claimed in native sources, four may possibly be active and five did not appear to possess activity.[46] In a later study, Ortiz de Montellano and Browner developed a method for assessing the efficacy of medicinal plants according to both indigenous understandings of their therapeutic effects and the standards of biomedicine, by placing them in one of four 'confidence levels'. The first level is comprised of reported folk use. Multiple reports of use by populations widely dispersed through space, or persistent reports over long periods of time, increase the probability that a plant will exhibit pharmacological activity. Level II plants meet the criteria of level I and show the desired activity of isolated compounds or extracts in in vitro or in vivo tests. In level III, plants satisfy level II requirements and show a plausible biochemical mechanism by which the active constituents could exert the indicated physiological effect. Finally, level IV plants fulfil the criteria for level III and have been clinically tested, or are commonly used in medicine. Information on a plant's level of confidence is then considered by Ortiz de Montellano and Browner in light of its emic evaluation of efficacy.[47]

In 1988, Browner, Ortiz de Montellano and Rubel[48] developed a more elaborate model for analyzing ethnomedical data in their own terms, as well as according to the standards of biomedicine. This model builds upon the earlier work of Ortiz de Montellano and Browner described above, and can be applied to both the study of folk illnesses and the assessment of plant medicines. The first step is to identify the phenomena under investigation in emic terms (e.g. the reasons given for using a particular plant for specific symptoms of diseases). In the second step, one determines the extent to which the phenomena described can be understood in terms of biomedical concepts and methods. For example, if the emic explanation for the

efficacy of a plant medicine is that it causes bleeding, the biomedical evaluation will assess whether the plant has chemical constituents that will evoke bleeding. Finally, the third step is to identify the areas of convergence and divergence between the emically described phenomena and their biomedical understandings. In this stage, biomedical concepts are not used to examine the phenomena in their own terms (as in the second step), but to see if they are consistent with biomedical assumptions.

These principles were applied in *Aztec, Medicine, Health and Nutrition*, in a study which evaluated a group of 118 medicinal plant species. Eighty-five per cent of these species could be shown to be effective according to Aztec standards. However, concordance with biomedical criteria for efficacy was lower at about 60 per cent. The following examples help to explain these findings. Some Aztec remedies for headaches have no known analgesic properties. However, headaches were thought to be caused by an excess of blood in the head, and treatment required blood to be released through the nose. Thus, plants to treat headaches were selected for their ability to induce nosebleed (which have been confirmed), but not necessarily to provide analgesia. Likewise, Aztecs believed fever to be caused by hot phlegm in the chest, and sweating/purging was the appropriate course of treatment. Thus, while many medicinal plants used for fever do not necessarily reduce inflammation, most do induce sweating.[49] As an ethnobotanical perspective guides the objective assessment of the efficacy of Aztec medicinal plants, both the species used and the reasoning behind their use become more intelligible. This not only allows contemporary medicinal plant scientists to more accurately identify healing applications of species documented in historical texts, but also provides insight on global processes of medical diffusion.

Medical diffusion between the old and new worlds

Eventually, after the conquest of Mesoamerica by the Spanish was firmly established, the Aztec Empire became the colony of New Spain. Ortiz de Montellano's work (complemented by a variety of other sources) sheds light on ethnobotanical continuities throughout pre-colonial, colonial and modern times in this region. By critically assessing historical records and interpreting them within their socio-ecological contexts, this work shows which species, practices and concepts are likely to be artefacts of colonialism and which pre-dated contact between the Old and New Worlds. The remainder of this chapter will show that the Spanish conquest and subsequent colonial rule of Mesoamerica had a dramatic impact on the morbidity and mortality of the indigenous population. However, the colonial reaction to indigenous medicine (and medicine in general) in New Spain was not as repressive as in other parts of the world, where medicine was much more integral to colonial rule. The Church did transform certain Mesoamerican spiritual customs and traditions (including those related to healing), but it seems that their underlying cosmologies received less attention from religious authorities, and the syncretization of Catholicism and indigenous traditions was allowed to flourish. Moreover, as Aztec healing was grounded in an empirical system of medicinal plant use, Mexican plants were adopted into the Spanish pharmacopoeia, in addition to many Old World species being introduced into Mesoamerican

herbal medicine. Spain also had strong ties to the Islamic world and there was an enormously powerful medical tradition in Islamic Spain, which filtered into European medical schools and influenced medical learning throughout Europe.[50] Ortiz de Montellano's work has important implications for determining how far the influence of Islamic medicine spread through the Americas, as it helps historians to identify which aspects of Mesoamerican medical thinking are part of a global philosophy of humoral medicine introduced through (Islamic) Spain and which elements of the Aztec medical system were similar to Old World medical theories.

Ethnohistorical data, as well as religious and fiscal documents, have been used to estimate the effect conquest and colonization had on the indigenous population of Mesoamerica. While there is disagreement among scholars about the size of the indigenous Mesoamerican population leading up to the conquest, population estimates suggest a large and rapid decline during the early colonial period.[51] While the indigenous population was declining, the Spanish population in Mesoamerica was increasing (from 63,000 in 1570 to 1,050,000 in 1793). As the Spanish were dependent on indigenous peoples for the production of foods and supplies, the decimation of the indigenous population sent New Spain, as well as other areas in Mesoamerica, into a century of depression.[52] The extent and scale of the Amerindian population decline that followed the Spanish conquest has been the subject of intense debate. However, Whitmore argues that it is most likely that the scale of the population collapse was moderate, and that the population of the Basin of Mexico on the eve of the conquest was 1.59 million. This population was reduced (in an irregular fashion) to 183,000 by 1607. By far the most significant contributor was epidemic disease, although disease-induced famine also played a part. Whitmore also states that epidemics were cause enough for this population decline, even if legends of excessive Spanish brutality and genetic vulnerability to disease are exaggerated. The Amerindian depopulation, along with the introduction of exotic biota and technologies, and the reordering of land and the rural economy, had a severe impact on the Mesoamerican environment.[53]

Early on, the Spanish realized that they could not effectively control people, in terms of tax collection or proselytization, who live scattered about in remote areas. The indigenous population was forced to move to larger, more centralized towns (*congregaciones*). The Spanish tried to claim that moving people to *congregaciones* was for their own good, but indigenous people did not appreciate the policy. Gerhard describes how the concentration of indigenous settlements occurred in two stages: one in 1550–64 and the other in 1593–1605. Both of these stages came after devastating epidemics. Additionally, he suggests that present day settlements in Mexico are in essence the same towns that were formed in 1550–64.[54] However, it has also been argued that the *pueblos de indios* of the eighteenth-century central Mexican highlands should be seen as the continuation of pre-Hispanic indigenous landed estates. The *pueblos* were highly stratified entities and were ruled by a small group of elite families (*caciques*). The local level elite either traced descent from the pre-Hispanic nobility, or had taken the place of that nobility by acquiring parts of early post-conquest grants in which pre-Hispanic claims were recognized. Consequently, Spanish institutions might have changed the form but not the basic substance of indigenous lordship.[55] Likewise,

the form and substance of indigenous medicine were not uniformly influenced by colonial medical thought and practice.

The medical system that the Spanish took to the New World drew heavily on Greco-Arab and Islamic medicine, which was developed between the seventh and fifteenth centuries. Islamic medicine was grounded in the work of Hippocrates, Galen and other Greek physicians, along with important Persian, Indian and Chinese medical texts.[56] Greek, Ayurvedic and Chinese medicine are found within a continuous geographical area, throughout which there has been much cultural diffusion. These medical systems share some major theoretical similarities, particularly concepts that relate to balancing various fluids/energies/humours in the body to maintain health.[57] According to these medical systems, disease results from disharmony between body and spirit. Such disharmony was attributed to humoral imbalance (which could be corrected by physicians) rather than supernatural forces. These global medical theories were set within Islamic ethics and, under the umbrella of Islamic, Muslim, Christian and Jewish physicians, became highly influential in Western science and medical education.[58] Great Islamic physicians and scholars helped transform Hippocratic-Galenic-Persian medicine into orthodox medicine in both Western Europe and its colonies.[59] Avicenna's *Canon of Medicine* was the most widely studied medical text in Europe from the twelfth into the seventeenth century and was a major guide to medical science in European universities.[60] Moreover, Avicenna's set of rules for testing the efficacy of new medications still serves as the basis for modern day clinical trials.[61] Spain became not only an important centre of Islamic culture, but cities such as Seville, Toledo and Granada were especially well known for their contributions to the development of Arab-Islamic medical sciences.[62] However, medical knowledge in Spain at the time of the Mesoamerican conquest was generally restricted to the elite classes, especially clergy and physicians.[63]

Throughout Mexico, missionaries, rather than doctors, were primarily responsible for the care of the sick during the colonial era.[64] The clergy was generally preoccupied with extinguishing models of sickness that related to Mesoamerican deities, spirits and magical entities, although many of these supernatural agents were blended with Catholic saints, and a syncretic shamanistic tradition exists in many parts of Mexico to this day. During the colonial period, Catholic priests shared much of the professional medical models developed by (Spanish-Islamic) physicians, which emphasized naturalistic aspects of health and healing. For three centuries following the conquest, humoral concepts were pervasive among all educated and intellectual people in New Spain. It has been argued that the elite theory was then filtered into popular Latin American medical traditions through missionaries, hospitals, pharmacies and home medical guides. Although a long time has passed since humoral theory was supplanted by other biomedical models of disease (and virtually erased from elite biomedical theory), models of health and healing that focus on balancing hot and cold elements of the body are still popular in Latin America (and other parts of the world). There is evidence of hot–cold data in Sahagún and the *Badianus Codex*, but this is generally dismissed as colonial contamination.[65] The question remains, did humoral theory filter down into the general populace from Spanish missionaries and physicians and become the Latin American hot–cold model of healing, or was there an emphasis

on balancing hot and cold in Aztec (and other indigenous Mesoamerican) medicine before the conquest?

Looking at this question in medical history from an ethnobotanical perspective reveals that reverse acculturation (colonists adopting aspects of indigenous culture) occurred in New Spain. While many indigenous cosmological beliefs about health and sickness were lost or transformed by Spanish missionary activity, the empirical use of medicinal plants remained vibrant. In fact, the Spanish were greatly interested in the medicinal plants of the New World and incorporated many Aztec plants into colonial medicine because of the fit of their reported properties with European conceptions of illness and the Greco-Arab/Islamic doctrine of balancing humours. The colonial pharmacopoeia included Aztec (and other indigenous) remedies for Aztec ailments, though indigenous aetiological explanations were rationalized to fit Old World humoral principles.[66] To the indigenous pharmacopoeia, European *materia medica* were added. In modern times, the use of the same medicinal plants (both introduced and native species) for related disease conditions is common among Mexican *mestizos* and Mexican Americans, as well as numerous indigenous Mexican groups.[67] The syncretic nature of Mexican traditional medicine reflects a high degree of medical pluralism, which continues to be a major characteristic of Mexican health care culture, despite the pre-eminence given to biomedicine by the state.[68] During the colonial period, clear evidence for the adoption of Aztec medicinal plants into the pharmacopoeias of both Spain and New Spain suggests that the transmission of medical knowledge flowed in two directions. Thus, scholars cannot conclude that Greco-Arab/Islamic humoral theory was a dominant paradigm that completely displaced indigenous models of balance and healing and is therefore the only possible inspiration for Latin American hot–cold systems.[69] Scholars such as Sahagún certainly took Aztec medicinal plant knowledge seriously and likely had a similar amount of respect for indigenous medical theories, especially if they were based on similar concepts (e.g. hot and cold). There is no conclusive evidence that references to Aztec models of hot–cold equilibrium in the *Florentine* and *Badianus* codices were simply the result of their authors' influence. Rather, the ethnobotanical data suggests that hot, cold and other empirical qualities of Aztec medicinal plants were recognized prior to the conquest.

Conclusion

Ethnobotany has much to contribute to the history of herbal medicine. Specifically, the anthropological and ethnobiological perspectives on the study of people–plant relationships that form the foundations of ethnobotanical research complement traditional historical approaches to understanding the use of herbal medicines in the past. As this chapter has shown, historical sources must be contextualized to illuminate cultural, social, political, cosmological and environmental factors that influence the practice of medicine in a given time and place. In evaluating the empirical efficacy of herbal remedies, we need to understand how the people who first developed them understood and experienced the illnesses they were, or are, used to treat. This is because some species that are empirically effective according to such emic criteria do

not measure up to biomedical expectations. To achieve this understanding, herbal/medical texts must be read alongside other historical documents (e.g. colonial) that provide a broader picture of social and political relationships that influence the theory and practice of medicine. By drawing on ethnobotany to better understand alternative models of health, illness and healing, historians can create respect and appreciation for other medical systems throughout space and time. This, in turn, encourages innovation in medicine. Although Mesoamerica may at first seem far removed from the study of the history of Western herbal medicine, ethnobotanical consideration of Aztec medicinal plants shows that many questions remain about what exactly happened when New and Old World medical theories collided. Colonization certainly had a transformative effect on indigenous Mesoamerican medicine, but it is important to bear in mind that there is also evidence of reverse acculturation, especially in the domain of medicinal plants.

On the eve of the conquest, the Valley of Mexico was the seat of an Aztec Empire that controlled and managed much of Postclassic Mesoamerica's biological diversity. The capital cities were cosmopolitan homes to a variety of learned medical professionals, as well as botanical gardens and centres of agricultural innovation. Although most Aztec literature was destroyed, several key medical texts remain. While the very act of writing Nahuatl texts was made possible only through contact with colonial missionaries and physicians, the texts nevertheless provide insight into pre-colonial Aztec cosmology and ethnobotanical practice. The Aztec world-view, similar to that of other Mesoamerican civilizations, is one of multiple material, spiritual and energetic elements that are set into states of balance and/or imbalance. Aztec healing was a sophisticated combination of shamanic practices and naturalistic applications of herbal (and other) medicines. However, there are notable differences between ancient Aztec and contemporary biomedical explanatory models for many conditions and their treatment. There is much to be learned from scientifically assessing medicinal plants documented in historical and ethnohistorical texts, but unless such herbal medicines are evaluated according to their own ethnomedical criteria, important pharmacological properties could be misunderstood or missed altogether. Looking at the history of Mesoamerican herbal medicine from an ethnobotanical perspective provides deeper insight into the history of medicine on a global scale, particularly the relationships between (Islamic) Spain and New Spain and the two-way flow of medical knowledge, practices and materials across the Atlantic. This provides contemporary students and scholars with a more holistic understanding of the history of Western herbal medicines and how to apply it to current questions in health, illness and medicine.

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Notes

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