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Nature's Medicine Cabinet: Notes on Botanical Therapeutics at the Birth of the New World

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Abstract

The period stretching from Columbus's first voyage in 1492 to the mid-seventeenth century was a formative period in the development of medicine, especially botanical therapeutics. This brief paper outlines the evolution of knowledge of medicinal plants during this period, which also saw the exploration of the New World.

Old World Therapeutics

Therapeutics in the Old World underwent a deep transformation in the 16th and 17th centuries, developing from its classical and medieval roots in directions that led toward modern empirical science.

The Medieval Legacy. As the 15th century ended, the field of therapeutics in Europe was largely dominated by Arabic pharmacy. From the end of the 11th century onward, Arabic medical treatises (including pharmaceutical works) had been translated into Latin in the scholarly centers of southern Europe (Salerno, Toledo, and Montpellier). These translations included many terms that were not translated but simply transliterated from Arabic, thus introducing uncertainty and confusion. This was particularly the case for technical terms and plant names. As a consequence, drugs, especially the Oriental ones previously unknown in the West, were not correctly identified by Western physicians and this gave rise to many mistakes.

Furthermore, Arabic pharmaco-therapy heavily relied on compound drugs. Their action was not as well known as was that of simple drugs: did it associate the properties of all the components or was it a new property, specifically produced by the association of the components? This ambiguity led physicians to hypothetically describe the action of compound drugs by reasoning rather than by clinical experience. Even more: physicians considered that such an action was unpredictable.

Challenge by Early Humanists. After the Fall of Constantinople in1453 brought about wider circulation of Greek texts in the West, such scientists as the Italian Nicolao Leoniceno began to compare Arabic, late medieval, classical Latin and

Greek therapeutic texts. Discovering similarities, Leoniceno concluded that not only the Arabic and medieval works, but also such a classical and authoritative Latin treatise as the encyclopedic *Historia Naturalis* by Pliny, in the first century A.D., were just epiphenomena of previous Greek literature and were characterized by innumerable mistakes, a deep incomprehension of the original texts, and a lack of first-hand knowledge of botany. This was all the more true, he concluded, because as works were passed along to later generations errors accumulated over time. As a consequence, Leoniceno considered that the exercise of therapeutics relying on classical Latin, Arabic and medieval Latin works exposed patients to danger. He recommended that all the non-Greek literature be ignored, and that medical practice should return to Greek therapeutic lore. His booklet, *De Plinii aliorumque in medicina erroribus* (*On the mistakes in medicine by Pliny and others*) first published in 1492 in Ferrara, provoked a harsh polemic by traditionalists.

Medical Humanism. In spite of the opposition to Leoniceno's thesis, Greek pharmaceutical literature was quickly reintroduced into contemporary European science. As early as 1499, indeed, the Venetian publisher Aldo Manuzio published the Greek text of the founding work of pharmacology, *De materia medica* by Dioscorides (1st century A.D.), which is an inventory and analysis of the natural substances of all kinds (but mainly vegetable) used therapeutically. While the Greek text of the work was republished five times during the 16th century (in 1518, 1529, 1529-1530, 1549 and 1598), it was also translated into Latin and printed as early as 1516 by the French doctor Jean Ruelle. This translation was also abundantly reprinted and plagiarized during the whole 16th century. The main purpose of this activity was philological: it aimed to recover a full command of the meaning of the text rather than to transform medical practice.

At the beginning of the 1530s, however, the interest in classical Greek pharmaceutical literature shifted from philology to botany. Scientists became interested in identifying the plants mentioned by Dioscorides. For the first time, they equated the plants described in *De materia medica* with those of Northern Europe. This was particularly the case of two of the so-called "German Fathers of Botany," Otto Brunfels and Leonhart Fuchs, authors, respectively, of the *Herbarum vivae eicones* (*Living plant pictures*), first published in Strasbourg, 1530, and *De historia stirpium commentarii insignes* (*Notable commentaries on the history of plants*) first published in Basel, 1542. The word *historia* (*history*) is significant: it does not refer to *history* as the account of past facts, but is used in the sense it has in Aristotle's scientific works and means *research, compilation of data on a topic.*

In a second phase, scientific efforts were directed at searching for the plants mentioned by Dioscorides in their original environment, the Mediterranean area. This was mainly the contribution of the Italian doctor Pietro Andrea Mattioli, who published first an Italian translation and then a commentary on Dioscorides' *De*

materia medica. With great energy, he constantly updated his work and repeatedly published new versions.

From Erudition to Medical Practice. As the re-appropriation of ancient therapeutic literature progressed, doctors gradually re-introduced into their practice the drugs, and their uses, that had been described in classical texts. This implied an examination of previous recipes, aimed at eliminating the problems and dangers of medieval therapeutics. A precursor of this movement of revision was the so-called *Ricettario fiorentino* published for the first time in 1498. Considered to be the first pharmacopoeia, the *Ricettario* was prepared by a committee of doctors commissioned by the City of Florence to ascertain the validity of medicines on the market and to recommend a list of safe preparations.

Later on, the Ferrara doctor Antonius Musa Brasavola, who was a student of Leoniceno, analyzed all the medicines prepared at that time by apothecaries, by types of preparations: *Examen omnium simplicium, Examen omnium syroporum, Examen omnium catapotium vel pilula, Examen omnium loch, id est linimentum* (respectively: *Examination of all simple medicines, of all syrups, of all catapotia or pills, of all loch, that is, unguents*) His works were published from 1536 onward with many new editions, legal and not. As a consequence, many traditional preparations were rejected, opening more widely the door to Greek classical lore.

The Application of Ancient Methods to New Floras. In a further phase, when the ancient Greek legacy was fully dominated by erudite philologists and gradually reintroduced into practice by doctors and apothecaries, its methods were carried beyond the classical Greek texts to describe and analyze other floras, drugs and medicines. Thus Dioscorides' method was transferred from Mediterranean to Central and Northern European flora and drug lore. A good example of this is the series of works by Rembert Dodoens, each of which is devoted to a category of plants: *De frugum historia* (*History of legumes*, Anvers, 1552), *Historia frumentorum* (*History of grain*, Anvers, 1565), *Florum et coronariorum odoratumque historia* (*History of flowers, wreaths and perfumed plants*, Anvers, 1574), *Purgantium ... historiae* (*Histories of purgative plants ...*, Anvers, 1574), *Historia vitis vinique* (*History of grape and wine*, Cologne, 1574).

At the same time, Dodoens also compiled a vast botanical synthesis, first published in two steps: *Trium priorum de stirpium historia commentariorum imagines* (*Illustrations of the first three commentaries on plant history*, Anvers, 1553) and *Posteriorum trium ... de historia stirpium commentariorum imagines* (*Illustrations of the next three commentaries on plant history*, Anvers, 1554). Then the two parts were published together: *Commentariorum de stirpium historia ... imagines novae* (*New illustrations of the commentaries on plant history*, Anvers, 1559). The final version is particularly famous for having been published first in Dutch under the title *Cruydeboek* (*Book of herbs*), in Anvers, 1554.

This change in the object of botany and pharmacy was understandingly accompanied by a gradual move of the center of activity from Italy, first to Southern France (Montpellier) and then to Northern Europe, Belgium and the Netherlands (Leiden).

Botanical Gardens: a Teaching Tool. In this progressive but rapid evolution of botany and pharmacy, a turning point was the creation of new botanic gardens in Pisa and Padua in 1542 and1543 respectively. Such gardens were not a novelty. Since the early Middle Ages, indeed, monasteries had created botanic gardens for the cultivation of the medicinal plants used for the treatment of sick monks and people. The new element in these Italian creations was their link with university teaching. Botanic gardens were conceived as teaching instruments, to make it possible for medical students personally to know the plants to be used for therapeutic purposes. The study of plants was no longer limited by season and location, but was more widely available. This was all the more true when fresh plants were dried (*hortus siccus*). Furthermore, botanic gardens enabled botanists to acclimate non-native plants. In all these ways, botanic gardens transformed teaching activity and, hence, knowledge of plants, enhancing the practice of therapeutics.

From Italy, this new model of teaching relying on direct observation of plants was transferred to Southern France (the University of Montpellier) by Archbishop Guillaume Pellicier, the ambassador from King François I to Venice, who lived in the *Serenissima Repubblica* from 1539 to 1542. With Guillaume Rondelet, teaching of botany in Montpellier thus included field expeditions to directly observe plants in nature. This new kind of medical education attracted students from all over Europe, who later duplicated this model in their native countries. Among these students, there was the Swiss Felix Platter, who created the botanic garden of Basel, and Charles de l'Ecluse, who succeeded Dodoens in 1593 as a professor of botany at the University of Leiden, newly founded in 1575. In 1587 a botanic garden was founded at Leiden and the university became very rapidly the botanical center of Europe. New botanic gardens were created later: Oxford in 1621, the *Jardin des Plantes* of Paris in 1626, Uppsala in 1665 and the Chelsea Physic Garden of London in 1673.

Medicinal Botany in Spanish and English Literature

The rapid re-assimilation of ancient botanical and therapeutic literature and their re-insertion into practice led, as early as the 1540s, to an abundant literature in vernacular languages. Brunfels and Fuchs first published their works in Latin: *Herbarum vivae eicones* (*Living plant pictures*, Strasbourg, 1530), and *De historia stirpium commentarii insignes* (*Notable commentaries on the history of plants*, Base, 1542), respectively. Further on, they translated them into German: *Contrafayt Kreüterbüch* (*Book of herbs*, Strasbourg, 1532), and *New Kreüterbuch* (*New book of herbs*, Strasbourg, 1543).

Jerome Bock, instead, first published his treatise in German: *New Kreütter Buch* (*New book of herbs*, Strasbourg, 1539), and translated it into Latin later on: *De stirpium commentariorum libri tres* (*Three books of commentaries on plants*, Strasbourg, 1552). At about the same time, a first Italian translation of Dioscorides' *De materia medica* was published in Venice, in 1542, to be followed shortly by the first edition of Mattioli's translation, also in Venice, in 1544.

In the Spanish world, Dioscorides' *De materia medica* was translated into Castillan by Andres de Laguna. Like Mattioli's, this translation included an abundant commentary on the text aimed not only at identifying the plants, but also – if not primarily – at ascertaining their therapeutic properties. First published in Anvers by Jean de Laet in 1555, the work was then printed in Salamanca, first in 1563 and no less than four other times before 1586. During the same period, Juan Jarava translated into Castillan Fuchs' *Historia stirpium* (*History of plants*): *Historia de yerbas y plantas* (*History of herbs and plants*), in Valencia, 1557.

Laguna's translation of Dioscorides' *De materia medica* remained a reference in Spain until late in the 18th century. Fifty years after the last Salamanca edition (1586), it was reprinted in Valencia in 1635 and reprinted another four times before 1695, with yet another edition in Barcelona in 1677. Then it was printed in Madrid in 1733 and reprinted three more times by 1783.

In England, the first herbal to be printed was *The Grete Herball* (London, 1526), which was a translation of the French version of the medieval *Herbarius*. The first original work on medicinal plants was the herbal of William Turner, published in several parts: the first part came out in London in 1551, and the second and third in Cologne in 1562 and 1568, with a reprint of the whole work the same year, also in Cologne (*The first and seconde partes of the Herbal ... lately oversene corrected and enlarged with the Thride parte lately gathered and nowe set oute withe the names of the herbes in Greke Latin English Duche Frenche and in the Apothecaries and Herbaries ...*). The work was illustrated with plant representations that reproduced the tables of Fuchs' *De historia stirpium*.

Continental scholarship was further assimilated into the English speaking world with Henry Lyte, who in 1578 published the first edition of his English translation of Dodoens' *Cruydebock* (*A niewe herball*) made from the French version of the work. Then, in 1577, John Frampton published a version of Monardes' complete works under the title *Joyfull newes out of the New-Found Worlde*. Twenty years later in London there appeared the *Herbal* of John Gerarde. Mainly relying on Dodoens' herbal, it also compiled material from other previously published works, be it the herbal by Turner or other Continental herbals such as those of Jakob Theodorus Tabernaemontanus, Pierre Pena and Matthias de L'Obel . Full of errors of all kinds, the work was corrected by L'Obel until Gerard stopped the revision. It was not republished until 1633, when it was revised by Thomas Johnson, assisted by John

Goodyer, author of an English translation of Dioscorides' *De materia medica* that remained unpublished. Almost simultaneously (1597) William Langham published a similar compilation on medicinal plants: *The garden of health containing the sundry rare and hidden vertues and properties of all kindes of simples and plants. Together with the manner how they are to bee used and aplyed in medicine for the health of mans body ... Gathered by the long experience and industry* (...).

Discovery of the New World's Therapeutic Resources

After Christopher Columbus reached the New World in 1492, Spaniards quickly understood that the newly discovered continent was full of invaluable resources, not only gold and precious stones, but also medicinal plants. As early as 1518, Paulus Riccius, Court Physician to the Emperor, realized that the bark of a small tree found on the North coasts of South America, guaiacum (*Guaiacum officinale* L.), had diuretic and laxative properties. He had obtained its bark during a mission in Spain and shared it with a German physician, Ulrich von Hutten, who in turn used it successfully to treat syphilis. In 1519 von Hutten celebrated the efficacy of the plant in a small treatise entitled *De guaiaci medicina et morbo gallico* (*On the French diseases and its treatment by means of guaiac*) printed in Mainz by Johann Schoefler.

Tobacco (*Nicotiana tabacum* L.) was known by Colombus from his first voyage to the New World. Used in medicine to treat "blotches" according to Gerard's Herbal (1597), it was cultivated by European settlers from 1531 onward, and traded to Portugal beginning about 1548. In 1561, it was brought to the French Court by Jean Nicot, the ambassador of the French kings François II and then Charles IX to the Court of the Portuguese king Sebastiao.

After these first discoveries, importing plants from the New World became gradually more important. All such products identified and shipped by Spaniards arrived in the harbor of Sevilla. There, in the mid 1500s, Nicolás Monardes collected all kinds of plant products from the ships as they arrived, and analyzed their therapeutic properties, using the concepts and methods of contemporary botanical and pharmaceutical systems. In 1565 he published in Sevilla the results of his investigations in his *Dos libros, El uno trata de todas las cosas que traen de nuestras Indias Occidentales, que serven al uso de medicina y como se ha de usar de la rayz de Mechoacan, purga excellentissima. El otro libro, trata de dos medicinas maravillosas que son contra todo veneno, la piedra bezaar, y la yerva escuerçonera. Con la cura de los venenados. Do veran muchos secretos de naturaleza y de medicina, con grandes experiencias.* (*Two books. One deals with the products brought from our Western Indies, which are used in medicine, and with how to use the Mechoacan root, an excellent purgative. The other book deals with all the marvelous medicinal products that are against all venoms, the bezoar stone and the escuerçonera herb.*

With the cure of victims of venom. From which will come many secrets of nature and medicine, with many great experiences.)

In spite of Monardes's claim to describe all the products coming from West Indies, the work was necessarily incomplete. A first attempt toward a systematic inventory of traditional New World Indian therapeutic lore was made by Martin de la Cruz in collaboration with Juannes Badianus. In 1552 these two Aztec Indians, who had been educated in a Spanish Catholic school, compiled in both Latin and Aztec a list of diseases known to Aztec natives and the therapeutics traditionally used to treat them. The text was illustrated with 204 representations of plants. The manuscript, now owned by the Vatican Library—the so-called *Badianus* manuscript—was sent by the Vice-Roy of India, Don Francisco de Mendoza, to Charles V, King of Spain and Emperor of the Holy Roman Empire.

Yet this valuable first hand report does not seem to have been used at the Spanish Court. It was not until 1570 that a systematic inventory of the New World resources was planned. In that year Felipe II, King of Spain and Emperor, sent Francisco Hernández to the New World with the mission of gathering from local populations everything they knew about the natural resources of the New World. After three years of field work (February 1571 – March 1574), Hernández wrote his massive *Historia de las Plantas de Nueva España.*

Meanwhile, Orta had fled to India to avoid the Catholic Inquisition, and began studying India's traditional uses of medicinal plants. He discovered that they were very similar to those of classical Greek authors. Greek classical medical and therapeutic texts had been translated into Arabic during the 9th century A.D., and then diffused through the whole Arabic world, including India. In Goa, Orta created a printing press and printed his work in 1563 under the title *Coloquios dos simples, e drogas he cousas mediçinais da India, e assi dalgumas frutas achadas nella onde se tratam algumas cousas tocantes a mediçina, pratica, e outras cosas boas, pera saber ...* (*Conversations on simples, drugs and medicinal products from India, and also on some fruits ... where it is dealt with some things related to medicine, practical, and other things good to know ...*).

The Portuguese Cirstobal Acosta met Orta in India, brought Orta's work back to Spain and translated it into Spanish. Costa also published another work, in which he plagiarized Orta's *Coloquios*, though he added some new data and representations of plants.

Unfortunately, these systematic and organized efforts had little or no impact on therapeutics—the European range of drugs was not transformed, nor did the colonial troops and settlers in the New World absorb and use local medicinal resources. The case of Hernandez' encyclopedia is significant: the 38 volumes that the *Protomedico* brought to Spain contain copious information about plants, along with dry specimens and plant representations. However, all this material was left unstudied in the King's

library at El Escorial until King Felipe II, in 1580, commissioned his personal physician, the Italian doctor Antonio Recchi, to prepare an abridged version. A Castillan translation of this short version was published in Mexico in 1615 by Fancisco Ximenez (the Latin original text was not printed until 1651 in Rome). Hernandez' full manuscript was destroyed in the fire that ravaged the Escorial in 1671.

French, Dutch and English settlements in North America came later than the Spanish explorations. They did not substantially contribute to the knowledge of the natural medicinal resources of the New World, being more oriented toward trade. The Virginia Company settled Jamestown in 1607. There, tobacco was successfully cultivated from 1612 onward and traded to England seven years later. The Pilgrims, arriving on the *Mayflower* in 1620, largely modeled their daily life – including their therapeutic practices – on those of their homeland, all the more so because, in a first phase at least, their subsistence was shipped from the Old World.

In their transfer to the New World, colonists at first merely continued their previous practice of therapeutics. According to a theory that had a certain success in a period of national rivalry, people had to use the typical resources of their own natural habitat, particularly the plants, which were supposedly provided with specific properties to treat local diseases (i.e., those from the region of their birth). Already illustrated by the French doctor Symphorien Champier in his *Rosa Gallica* (Paris, 1514), the theory was repeated just before the beginning of the English colonial enterprise by an Englishman Timothy Bright, in the *Treatise wherein is declared the sufficience of English medicines* ... (London, 1580).

Settlers' drug lore was not, however, strictly limited to the resources of their native area, but included the European common flora. This was all the more so because texts circulated all across Europe, first in Latin and then in vernacular translations. They created a common botanical and therapeutic knowledge, determined by the equation of local flora and therapeutic practices with those of previous works, be it ancient Greek treatises or more recent texts rooted in the classical tradition. Exchange of plants between the members of what has been rightly called "the Republic of Botanists" created this feeling of community and the unity of therapeutic lore.

The species transferred by colonists to the New World and acclimated there for therapeutic purposes thus were those described in herbals diffused throughout Europe, from the medieval *Herbarius* to Laguna and most recent English works, be it original treatises or translations.

The Underlying "Science"

Therapeutic use of plants relied on a tradition dating back centuries, if not millennia. Knowledge was probably gained empirically by trial and error from the dawn

of Mankind onward. Across time and across cultures, people ate certain plants or brushed against certain plants and observed that these actions had certain effects – for good or ill. Ultimately, a body of lore grew up, the plants were named, the effects codified, and certain plants were routinely paired with the amelioration of specific conditions. Later on, this kind of science was recorded by learned physicians. In the Western World, this was not the case until Hippocrates and his followers, the so-called Hippocratic physicians, authors of the sixty treatises ascribed to Hippocrates himself, but written from Hippocrates' period to the 2nd century A.D. From this epoch onward, previous empirical knowledge was theoretically analyzed according to different systems. One of the most striking, was atomism applied to medicine (ca. 1st century. B.C. – 1st century A.D.). This said that the therapeutic efficacy of drugs results from an exchange of particles between the drugs and the substance of the body.

Fundamentally, two systems prevailed: holism and materialism. Their general conceptual framework was provided by the so-called theory of four elements. The entire universe (the cosmos) was supposedly made up of four elements associated in couples (earth and air, water and fire) that had opposite qualities (heavy and light, moist and dry). These elements and qualities combined to produce the basic fluids of life—blood, phlegm, yellow and black bile—themselves associated with specific organs. Disease was due to a disequilibrium in the nature or quantity of these fluids. Therapeutics thus consisted in restoring the original equilibrium. Its basic principle was the law of the contraries (*contraria contrariis*). Concretely, a deficiency or alteration of a vital fluid of the body had to be counter-balanced by a re-injection of this fluid by means of therapeutic substances.

According to holism, the therapeutic activity of natural substances—mainly, but not only, plants—resulted from their inter-action with the four elements that constituted the world. For example, a plant was considered calefacient because it was particularly exposed to the sun and assimilated its warmth as if it was an element it could capture. According to materialism, the action of therapeutic substances results from exchanges of particles as described above. During antiquity, holism was mainly represented by Dioscorides' *De materia medica* and materialism by Galen's works such as *De simplicium medicamentorum temperamentis et facultatibus (On the mixtures and properties of simple medicines)*.

Galen's system constituted a complicated association of material of different origins. According to it, indeed, therapeutic substances contained not one, but two properties—in fact, a couple of opposites. Hence, the title of his work: *On the mixtures ... of simple medicines*, where mixture refers to the association of two opposite qualities in each matter. This association of properties was measured on a double scale of four degrees (one scale for each of the two opposite). As a consequence, the zero degree did not represent the absence of the two opposite qualities,

but their equilibrium. On the other hand, Galen's system relied on a certain form of materialism: the properties of therapeutic substances and their dynamic within the body was explained by the weight and structure of the particles the substances were made of.

Galen's therapeutic theories were not widely diffused in Byzantium, nor in the Middle Ages. In the Arabic World, however, they were greatly praised and constituted the specific reason why Arabic physicians could not determine the final property of compound medicines: if, indeed, an ingredient of a compound medicine associated two opposite qualities, what is the final property of the medicines that contain it?

This type of speculation was transmitted to the late Middle Ages from the 12th century A.D. onward and further preserved and transmitted, so that they dominated the field of therapeutics in the Renaissance, even though such a classicist as Leoniceno fought to reject the influence of Arabic science and to return, instead, to Greek pharmacology, specifically, Dioscorides' holism. He did not fully succeed in his attempt, however. Therapeutic practice remained largely influenced by Arabic preparations.

While erudite physicians were involved in academic discussions and polemics, traditional healers continued to practice empirical therapeutics. They used remedies transmitted to them from the most remote past without any other justification than that they were told such remedies worked and that they did. The best example was the use of foxglove to treat cardiac pathologies by a traditional English healer, whose secret William Withering revealed in his 1785 *Account of the Foxglove, and Some of Its Medical Uses*.