New World Crops: Iconography and History

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Abstract

Evidence of the introduction of New World plants in Europe, Asia, and Africa comes from the written record of explorers, correspondents, travelers, and botanists. However, the iconographic record of artists and illustrators in both the New and the Old World is a particularly valuable resource because it provides information on plant characteristics that are often incomplete in the written record and is particularly useful for such fields as taxonomy, genetics, crop domestication, crop evolution and genetic diversity. The New World civilizations developed an advanced agriculture and a rich source of iconographic evidence still survives despite the despoiling of many of their manuscripts by the conquistadores. Images of New World plants in the Old World are derived from illustrated manuscripts, herbals, paintings, and sculpture (Janick, 2007).

PROLOGUE

The Iberian encounter with the new found lands stumbled on by Christopher Columbus in 1492 was inspired by a shorter trade route to the spice-rich "Far East." It proved to be the greatest event of the late Middle Ages and marks a convenient beginning to Modern Times. Columbus refused to believe that he had not found Asia, and the New World became known as the West Indies, a misnomer carried over to the present time in reference to the islands of the Caribbean. In anticipation of the riches promised by Columbus, Pope Alexander VI, the Spaniard Rodrigo Borgia (born Roderic de Llançol), divided the world in 1494 between Portugal and Spain in a line of demarcation 100 leagues west of the Cape Verde Islands. At the treat of Tordesillas, January 24, 1506, the line was changed to 370 leagues west of this point, a miscalculation that not only assured Portugal's rights to India and the Far East, but provided a toehold in Brazil. After Columbus there were immediate incursions by various Europeans adventurers (Thomas, 2003) and it was soon realized based on a southern voyage navigated by Amerigo Vespucci that the new area was a huge continent and the name America was given on a map by Martin Waldseemüller in 1507. Although Vasco Núñez de Balboa discovered the Pacific in an overland trek over the isthmus of Panama, a sea passage proved more difficult but was found by the Portuguese Ferdinand Magellan, sailing for the King of Spain, in the strait that now bears his name in his famous voyage circumnavigating the globe (1519-1522) and chronicled by the Italian passenger Antonio Pigafetta. The English were less successful in finding a Northwest Passage but soon developed their foothold in North America along with the French.

During the first two decades after the "discovery" the Americas provided only false hopes. Dyewood, cotton, monkeys, and parrots began to trickle out but the enormous riches desired, in terms of gold, silver, and jewels, treasures alluded to by Columbus for the ears of his greedy patrons, did not materialize. For 20 years the Spanish confined themselves to a small piece of the Isthmus of Panama and the islands of the Antilles. No riches materialized and America was dismissed as another example of Spanish braggadocio. But on December 9, 1519, the first treasure ship consisting of booty sent by Hernán Cortés, conqueror of Montezuma, arrived from Mexico, and the world was changed. It soon became apparent that the New World was not a land of savages but the home of great civilizations.

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Three great cultures coexisted in tropical America, although they were not aware of each other: Aztec, Mayan, and Incan. These were monumental civilizations similar in many respects to that in Ancient Egypt, with enormous temples in the form of pyramids, pictorial writing, a system of cities and government, a bewildering theology, a magnificent art, and a developed agriculture. It also had a dark side—slavery, constant warfare, the offering of living human hearts as sacrifice, and cannibalism. Archaeological evidence indicated that the New and Old worlds were once connected through the Bering Straits and Asian peoples migrated to the Americas about 50 thousand years ago. Ironically, Columbus searching for Asia, did discover its descendants.

The gold and silver objects of the New World were melted down to enrich Iberia in the short run, but they were used to finance European wars, which ultimately led to Spain's decline. However, much more valuable than gold and silver treasures were the new crops from the New World which have continually enriched the bounty and cuisine of Europe and the world. Important New World crops include maize (*Zea mays*), tomato (*Solanum lycopersicum*), pepino (*Solanum muricatum*), husk tomato (*Physalis* spp.). chili peppers (*Capsicum* spp.), potato (*Solanum tuberosum*), cassava (*Manihot utilissima*), common bean (*Phaseolus vulgaris*), lima bean (*Phaseolus lunatus*), peanut (*Arachis hypogaea*), squashes and pumpkins, (*Cucurbita* spp.), chayote (*Sechium edule*), cacao (*Theobroma cacao*), avocado (*Persea americana*), guava (*Psidium guajava*), papaya (*Carica papaya*), passion fruit (*Passiflora edulis*), pineapple (*Ananas comosus*), Brazil nut (*Bertholletia excelsa*), cashew (*Anacardium occidentale*), cactus pear (*Opuntia ficus-indica*), pitaya (*Cereus*, *Hylocereus*, and *Stenocereus* spp.); American cotton (*Gossypium hirsutum*), rubber tree (*Hevea brasiliensis*), tobacco (*Nicotiana* sp.), and sunflower (*Helianthus annuus*). Here, we review the history and images of New World crops with particular relevance to horticulture.

NEW WORLD CROPS

Maize

Mesoamerica is the center of maize domestication. The transformation of teosinte that bears about a dozen seed covered in a very hard fruit case that shatters at maturity, into maize with an ear (pithy condensed inflorescence) that bears hundreds of naked seeds that remain attached to the cob at maturity, is one of the wonders of evolution and plant domestication. Maize was cultivated by Aztec, Mayan, and Incan farmers and its production and utilization made settled life and civilization possible. Beans were sown in the same hole and the two crops complemented each other both horticulturally and nutritionally. Maize acts as a support of the climbing beans, and is nitrogen demanding while beans are nitrogen fixing as a result of rhizobium bacteria and provide this element to the soil. Furthermore, maize and beans complement each other nutritionally to form a complete protein; maize seed is deficient in the essential amino acid lysine and bean seed is deficient in the sulfur-containing amino acids (cysteine and methionine). The mixture of beans and tortillas (maize pancakes) provide a complete protein food that was the basis of Aztec and Mayan diets. The significance of maize as a major staple among the natives of the New World is evident in the deification of this crop and its popularity as a common feature of ceramic pottery (Fig. 1). Columbus descriptions of maize is found in a letter of Pedro Martyr de Anghiera, an Italian teacher connected with the Spanish court, to Cardinal Ascanio Sforza Vice-Chancellor of the Papal court. These and subsequent letters describing the voyages of Columbus were later incorporated in a Latin work entitled *De orbe novo* (1511). The letter dated November 13, 1493 specifically mentions maize:

> *The islanders also easily make bread with a kind of millet, similar to that which exist plenteously amongst the Milanese and Andalusians. The millet is a little more than a palm in length, ending in a point, and is about the thickness of the upper part of a man's arm. The grains are about the form and size of peas. While they are growing, they are white, but become black when ripe. When ground they are whiter than snow. This kind of grain is called maiz.*

On May 3, 1494, at the return of some ships from Columbus' second voyage, Peter Martyr delivered seeds to Cardinal Sforza that includes maize. Maize was rapidly planted in Spain, Portugal, Italy, and Turkey and was reported in China in 1555 in the province of Hunan, probably obtained from the Philippines, that were occupied by Spain after Magellan's voyage (Desjardins and McCarthy, 2004).

The earliest representation of maize in Europe is found in the ceiling of the loggia of Cupid and Psyche in the Roman villa of Agostino Chigi "the Magnificant" (1466-1520) but now known as the Villa Farnesina (Janick and Caneva, 2005). Images of maize are among hundreds of plants in the frescoed festoons painted by Giovanni Martini da Udine (1487-1564) surrounding the depictions of the heavenly adventures of Cupid and Psyche based on an ancient novel by Apuleius in the second century CE, and designed by Raphael Sanzio (1483-1520). Three different types maize are portrayed: long, medium, and short eared (Fig. 2) and these types still exist in the landraces of Spain, Portugal, and Italy. The frescoes were painted between 1515-1518, only 22 to 24 years after Columbus' return from the first voyage to the New World, evidence of the very rapid diffusion of maize into Europe. Maize then appeared in the decorations of the Vatican, now known as the Loggia of Raphael ordered by Pope Julius II (Giuliano della Rovere) from the same artists. The appearance of maize as a woodcut in the herbal *De historia stirpium* of Leonhard Fuchs (1542) under the name *Türckisch korn*, was long considered to be the first European illustration and the preliminary painting exists (Fig. 3). Maize soon appears as a regular feature in European art; for example it can be found representing a human ear on Giuseppe Arcimboldo's paintings *Summer* (1573) and in the *Portrait of Rudolph II as Vertumnus* (1590), two fabulous portraits constructed entirely of fruits and vegetables (Fig. 4). Maize has had a strong impact in Asia as indicated in a humorous painting of maize in Japan (Fig. 5).

Cucurbits (Crops of the *Cucurbitaceae*)

The New World *Cucurbita moschata*, *C. pepo*, and *C. maxima* (squashes and pumpkins) and *Sechium edule* (chayote) were important crops of the indigenous population and a representation of *Cucurbita pepo* can be found in Incan ceramic pottery (Fig. 6). The first representation of this cucurbit in Europe is a painting of *C. pepo* subsp. *texana* (Paris et al. 2006) found in an illustrated prayer book *Horae ad usum romanum* (Les *Grandes Heures*) painted for *Anne de Bretagne*, twice Queen of France, by Jean Bourdichon (1457-1521) between 1503 and 1508. The image bears the name the Latin name *Colloqui*[*n*]*tida* and the French name *Quegourdes de turquie* (Fig. 7). The festoons on the ceiling in the Villa Farnesna in the Loggia of Cupid and Psyche also contain various examples of *Cucurbita maxima* (both gray and white pumpkins) and *C. pepo*

Fig. 1. Pre-Columbian images of maize. Mohica pottery vessel, Moche, Peru, 300-700 CE.

Fig. 2. Images of maize from the Loggia of Cupid and Psyche, Villa Farnesina, 1515-1518. The circled fruits were used to determine size. Source: Janick and Caneva, 2005.

(pumpkin type and gourds (Fig. 8). The New World cucurbits soon became a prominent part in Renaissance herbals in the 16th century and the genre known as *natura morta* (still life) popular in the 17th and 18th century and many can be found on the Plant Image website www.hort.purdue.edu/newcrop/iconography/default.html. New World cucurbits can be also found in the portraits of Archimboldo (Figs. 4 and 5) and the 1580 paintings of the Fruit Seller by Vincenzo Campi (Fig. 9). An image of chayote, a minor New World cucurbit, can be found in the second version of a famous painting of Juan Sánchez Cotán (Fig. 10) both likely painted before 1603 that is likely to be the first non-herbal illustration of this species (Janick and Gonzáles Reimers, 2009).

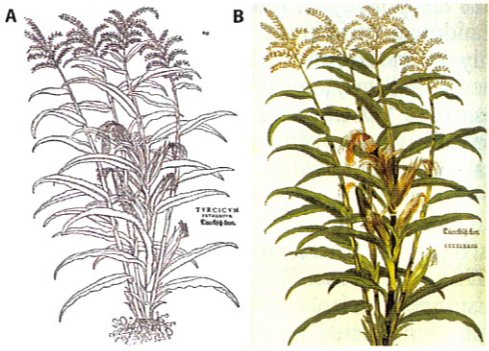

Fig. 3. *Turkische korn* of Leonhart Fuchs 1542: (A) wood cut from *De historias stirpium*, 1542, (B) earlier source painting from *Vienna Codex*.

Fig. 4. Maize as ears in paintings of Giuseppe Arcimboldo: (left) *Summer*, 1573; (right) portrait of *Rudolf II as Vertumnus*, 1590.

Fig. 5. Humorous maize anomalies in Japanese woodcuts.

Fig. 6. Peruvian ceramic of cucurbit, probably *Cucurbita pepo*. Source: Leonard, 1973.

Fig. 7. *Cucurbita pepo* subsp. *texana* in the *Grandes Heures d'Anne de Bretagne*. Source Paris et al., 2006.

Nightshades (Crops of the *Solanaceae*)

Tomato, pepino, chili peppers, potato, were important food crops in pre-Columbian America and are represented in various indigenous art forms (Fig. 11A-E). In addition tobacco was widely smoked, chewed, or snuffed for medicinal and possibly

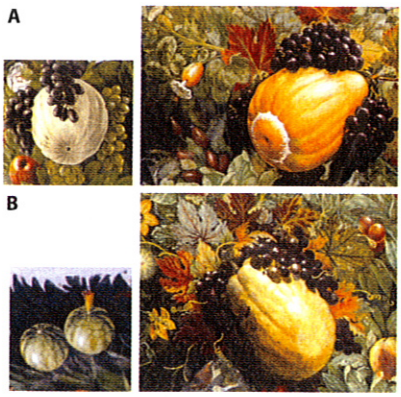

Fig. 8. New World cucurbits on the ceiling of the Loggia of Cupid and Psyche in the Villa Farnesina painted by Giovana Martini da Udine, 1515-1518: (A) pumpkins (*Cucurbita maxima*) and (B) gourds (*C. pepo*). Source: Paris et al., 2006.

Fig. 9. *Fruit Seller* of Vincenzo Campi, 1580. Source: Paris and Janick, 2005.

Fig. 10. Chayote (lower left) in a painting of Juán Sanchez Cotán probably painted before 1603. Source: Janick and Gonzáles Reimers, 2009.

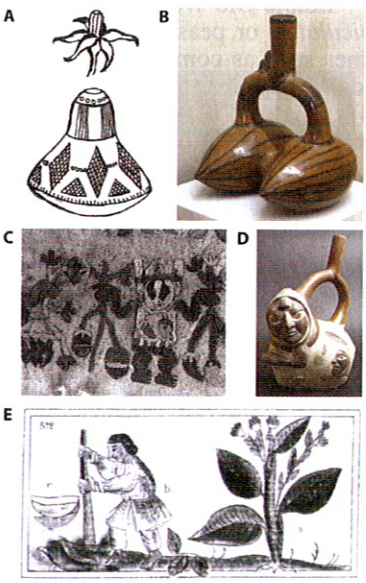

Fig. 11. Pre-Columbian images of solanums, (A) tomato, (B) pepino, (C) *Capsicum* peppers, (D) potato, (E) tobacco. Source: Daunay et al., 2008.

hallucinogenic purposes in a complex system of rituals and is widely found in Mayan images (Robicsek et al., 1978). Since Columbus was looking for black pepper, the discovery of an even more pungent fruit, in the form of various species of *Capsicum* were immediately accepted and chili peppers were to become extremely popular throughout the world, particularly in Asia and China where they became an important part of their cuisine. Herbal images of pepper are abundant (Fig. 12) and sculpted forms can be found on the door of the Pisa cathedral along with tomato (Fig. 13). Interestingly except for one dubious image based on a spinning whorl (Fig. 11A) we have found no indigenous images of tomato. An early images painting of tomato in Fuchs' unpublished *Vienna Codex* painted between 1542 and 1565 by A. Meyer was only published in 2001 (Fig. 14). Tomato fruit because of its resemblance to the poisonous Old World mandrake was treated with skepticism but soon were consumed raw and cooked to become an integral part of Italian cuisine, and now one of the most important fresh and processed world vegetables. There are numerous images of potato in pre-Columbian sculpture (Fig. 11D) and potato culture of the Incas is illustrated in a calendar presented to the King of Spain in 1580 (Fig. 15). The first printed illustration of potato in Europe is from the famous English 1597 *Herball* of John Gerard(e) (Fig. 16). Potato has become one of the most 10 most important world food crops. Two paintings of potato by Vincent Van Gogh in the 19th century (Fig. 17) have become iconic images. Other New World solanums such as husk tomato, datura, and tobacco are well represented in European herbals. A painting by J.A. van der Baren contains datura, along with *Capsicum* pepper, and some New World cucurbits (Fig. 18).

Legumes

Edible Old World legume seeds such as broad beans (*Vicia faba*), cowpeas (*Vigna unguiculata*), or peas (*Pisum sativum*) were well known in Europe but the New World legumes such as common bean, Lima bean, and peanut were to become very important worlds food crops. Caneva (2004) has claimed that the Villa Farnesina ceiling (1515-1518) contains *Phaseolus vulgaris* and J.L. Myers (pers. commun.) has confirmed that one example might be this species. However, an early illustration in Europe (Fig. 19) is

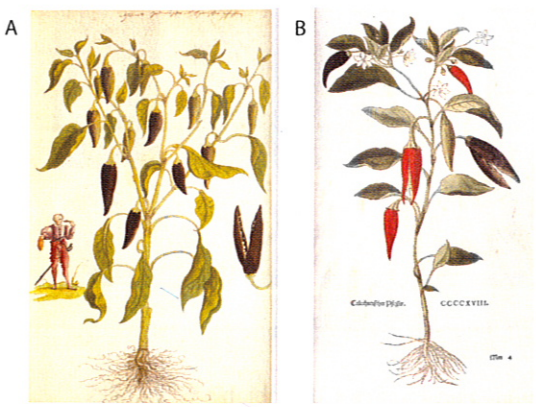

Fig. 12. Early European images of *Capsicum* pepper: (A) *C. frutescens*, *Codex amphibiorum*, 1540; *C. annuum*, in Fuchs' *New Kreüterbůch* (1543). Source: Daunay et al., 2008.

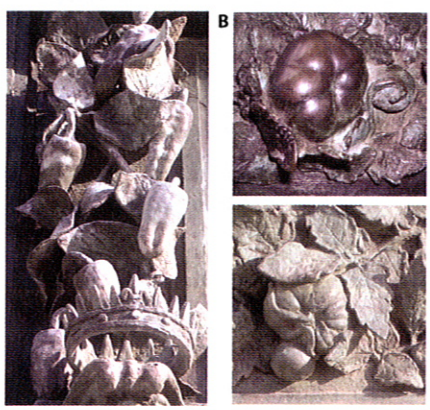

Fig. 13. Sculptures of capsicum pepper and tomato fruits on the doors of the Pisa cathedral, 1601: (A) pepper; (B, C) tomato. Photo by J. Janick.

found in Fuchs' *De historia stirpium* (1543). The peanut or groundnut found in ceramics from the Moche Culture in Peru (Fig. 20) was spread worldwide by European traders and became particularly important in Africa after being brought there from Brazil.

Fig. 14. Herbal images of tomato from Fuchs' *Codex Vindobonensis*, *Palatinas*, 1542-1565. Source: Daunay et al., 2008.

Fig. 15. Planting and harvesting of potato by the Incas, 1580. Source: Leonard, 1973.

Fig. 16. The first illustration of potato in the *Herball* of John Gerard(e), 1597.

Fig. 17. Iconic paintings by Vincent Van Gogh: (A) *Potatoes*; (B) *The Potato Eaters*, 1885.

Fruit Crops

There are a number of temperate, subtropical, and tropical fruits in the New World that have become important world crops and the most important will be treated here.

Fig. 18. A painting of J.A. van der Baren, *Still life with cucurbits*, showing datura flower, *Capsicum* pepper, and various New and Old World cucurbits. Source: Daunay et al., 2008.

Fig. 19. Common bean from Fuchs' *De historia stirpium*, 1543. (Facsimile edition in Meyer et al., 1999).

Fig. 20. Pre-Columbian images of peanut. Source: Leonard, 1973.

Fig. 21. The first illustration and description of pineapple shows modern type fruit. Source: Gonzalo Fernandez de Oviedo y Valdéz, 1535, *La Historia General y Natural de la Indias*, Seville.

1. Pineapple. Columbus in his second voyage of 1493 found domesticated pineapple in the island of Guadeloupe, an island in the Eastern Caribbean, and described it as piña de India because of its resembles to a pine cone. Antonio Pigafetta described it exuberantly in 1519: "*this fruit resembles a pine cone and is extremely sweet and savoury; in fact is it the most exquisite fruit in existence.*" The fruit was introduced to Africa, and reached southern India by 1550 and by the end of the 16th century had reached the Philippines, Java, and China. The first illustration and description in 1535 shows a fruit similar to present day cultivars (Fig. 21).

2. Papaya. This tropical fruit is now ubiquitous as a backyard tree in the tropics worldwide and has become an important export in Brazil, Hawaii, Mexico, and Thailand. A papaya plant (Fig. 22) can be seen in the drawing dated about 1586 of an Indian planting seed with the aid of a digging stick in a wattle enclosed garden in an illustrated manuscript titled *Histoire naturelle des Indes* known as the Drake Manuscript in the Pierpont Morgan Library since there are two mentions to Sir Francis Drake. The amateurish illustration titled in French, *The manner and style of gardening and planting of the Indians*, probably by one of two unknown French Huguenot sailors, also shows multi-eared maize, a cucurbit vine bearing many large round fruits, two bean plants climbing on a living stake, capsicum pepper, and a pineapple.

3. *Cacao*. The seeds of cacao originating in the Amazon were long prized in Mesoamerica and the seeds once used as currency by the Aztecs; the fruits are a common feature in pre-Columbian pottery (Fig. 23). The beverage *xocolatl*, an Nahuatl word meaning bitter water was introduced to the Spanish court in 1544 and soon became very popular in European when the chili flavoring was replaced with sugar. Ground fermented cocoa beans is the source of the confection chocolate. The pulp surrounding the seed is delicious and remains to be commercially exploited.

4. Strawberry. The small fruited diploid *Fragaria vesca* ($2n$=14) was well known in Europe but the modern large fruited octoploid strawberry ($2n$=56) is derived from *F. chiloensis* found growing in Chile by Amédee François Frézier (Fig. 24) whose name

Fig. 22. An Indian garden from *Histoire naturelle des Indes*: The Drake Manuscript, about 1586, in the Pierpont Morgan Library showing beans, cucurbit, capsicum pepper, a cucurbit vine, maize, and papaya.

Fig. 23. Pre-Columbian images of cacao pods.

curiously derived from the French word (fraise) for strawberry. The pistillate plants were sent to the King's Garden in Paris but did not bear fruit but intercrosses with the octoploid *F. virginiana* obtained originally from the East coast of America gave rise to the modern strawberry *F.* ×*annanassa* (Darrow, 1966).

Cactus

Cactaceae are one of the gifts of the New World and are common in the art of the Americas (Fig. 25). Cacti have become important world crops for fruit (cactus pear, pitaya) vegetables (cladodes), animal feeds, ornamentals, and as the source of a red dye known as cochineal from the bodies of a parasitic scale insect (*Dactylopius coccus*).

Ornamentals

The Americas have been the source of over 1000 garden plants (Taylor, 2010) and various ornamentals have become very important in floriculture including dahlia, fuchsia, helianthus, and petunia, that are now grown worldwide. The sunflower was long associated with America as an ornamental has become an important oilseed crop in the 20th century. Associated with the sun they were long known as *Flos Solis peruvianus*. The first European illustration of sunflower (Fig. 26A) is found in an herbal of Rembert Dodoens, *Florum, et Coronariarum* (1568, 1679) and soon sunflower became an ever-present symbol in European art and remain so until the present. The iconic portraits of sunflower by Van Gogh (Fig. 26B) have become some of the highest priced paintings.

Fig. 24. *Fragaria chiloensis*, progenitor of the modern strawberry found in Concepción Chili in 1712 and whose fruit was described by Amédee François Frézier, "*as big as a Walnut and sometimes a Hen's egg*. Source: Darrow, 1966.

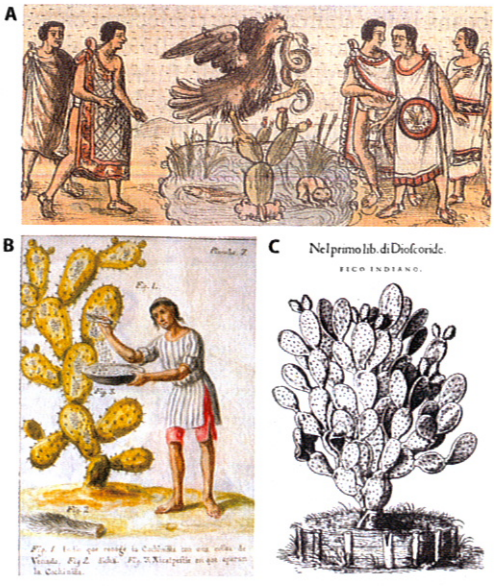

Fig. 25. Early images of cactus pear: (A) an iconic Aztec image that has become the symbol of Mexico 1579; (B) harvesting cochineal from a cactus pear, 1700; (C) cactus pear from the herbal of Pier Andrea Mattioli, 1558. Source: Inglese, 2009.

CONCLUSIONS

The bounty of new plants in the Americas and their transfer worldwide as a result of the Iberian encounter with America is one of the great sagas of botany and horticulture. The influx of new plants created a sensation in botany and with the recent discover of printing the new plants of the New World and their medical properties became available in herbals woodcuts that became an essential resource for Renaissance physicians. Furthermore, many of the new crops became incorporated in agriculture throughout the world, and some, such as *Capsicum* pepper, tomato, and potato became an essential part of the cuisine in various countries.

There are two important points that must be stressed. The first is that the native cultures of the New World were not wild savages and cannibals, but were sophisticated agriculturists. In fact, most of the present day important New World crops were already domesticated and in cultivation by indigenous peoples. The second important point is that the outflow of new plants from Americas did not cease in the 15th and 16th centuries but continues to the present day. Many American species are still emerging as new crops; the list includes blueberries, blackberries, and many tropical fruits such as avocado, passion fruit, pitaya, and sapote. The outgo of New World plants should not obscure the inflow of Old World crops to the Americas, an exchange of plants that has enriched the New World. This exchange of plants between continents is an example of the global benevolence of horticulture and agriculture.

ACKNOWLEDGEMENT

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Fig. 26. Sunflower images (A) the first image in Europe from Dodoens: *Florum et Coronariarum*, 1568, 1569; (B) painting by Vincent Van Gogh, 1888. Source: Mancoff, 2001.

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