

The Evolution of Scientific Knowledge about the Chestnut Tree - Illustrations in Works of the 19th and 20th Centuries

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Abstract: *The chestnut is a tree that has been cultivated for thousands of years around the world, following man since the Paleolithic period, with Romans responsible for its widespread cultivation. Throughout the time the chestnut tree had diverse denominations, such as, "tree of the bread", and "tree of the life". In addition, chestnut has contributed and continues to contribute significantly to the development and sustainability of mountain populations, representing a valuable resource in historical, social, cultural, ecological and economic terms.*

Scientific illustration has been proved important in the learning of Science, assuming a central role in the construction and communication of scientific knowledge.

*In this investigation, a qualitative methodology was applied, using documentary analysis of several works of the XIX and XX century's. The following works were used: *Histoire des chênes de l'Amérique Septentrionale* (1811) of François Andre Michaux; *Pomona Italiana: Trattato degli alberi fruttiferi conteneate la descrizione delle migliori varietà dei frutti coltivati* (1839) by Giorgio Galessio; *Köhler's Medizinal-Pflanzen* (1887) of Hermann Köhler and for last the work *Michigan Trees - A Handbook of the native and most important introduced species* (1915) by Charles Herbert Otis.*

In this study, it was verified that the illustrations during the XIX and XX centuries evolved in a gradual way, with influences of existing image representation techniques, that were becoming more detailed, improved and complete, revealing their authors deep knowledge on plant physiology, morphology and botany, contributing to the evolution of the scientific knowledge about the chestnut tree.

The present work integrates a broader investigation that with the following main objectives: a) Analyze the illustrations of chestnut found in works of the 19th and 20th century; b) To point out the relevance of chestnut illustrations to the history of botany and the development of current scientific knowledge about this tree; c) Highlight the importance of applying the history of science in the classroom as a tool in scientific education; d) emphasize the contribution of the study on the evolution of the illustrations about the chestnut tree to the scientific literacy of the students, when introducing the history of science in teaching.

Keywords: *Botanic illustration; scientific knowledge; evolution; tree of life.*

1. INTRODUCTION

Chestnut is a tree species with a big presence in the countries around the Mediterranean basin, being considered as an important specie by its wood and fruits (Maurer and Fernández-López 2001).

The sweet chestnut emerged around two million years ago, being a tree native from the European continent, namely from Turkey, and was introduced by the Romans during the period of the conquest of many places by this people, although the Celts and the Greeks also had an important role in the developing the cultivation and dispersion of this specie (Conedera and Krebs, 2008). Many researchers mention that chestnut was a tree very valued by Romans and because of this, they promote the dissemination and cultivation of this spice for all Europe, being also designated as "fruit-bearing tree par excellence" for many roman emperors (Adua, 2000).

Researchers mention that chestnut is a tree of great duration, can reach more than thousand years old and are famous for their size, like the one that can be found in Etna Park, which is designated *Chestnut Tree of the Hundred Horses Chestnut*, its name comes from a popular legend, that refers the queen Joan of Aragon and its cavalry constituted by 100 knights, sheltered from the rain under this chestnut tree, as mentioned in the work called *Les plantes originales* (published in 1905 in Paris) by author Henri Coupin (Fernandes & Fernandes, 1987).

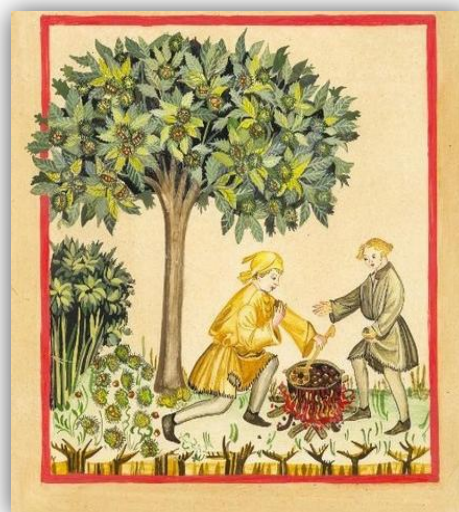
Jean Houel, a french artist, in 1782 drew the *Chestnut Tree of the Hundred Horses Chestnut* illustration (Fig. 1), at that time, with a circumference of 52 meters, this being the largest and oldest chestnut tree in the world with more than 5 centuries (Coupin, 1905).



Figure1. Illustration of Chestnut Tree of the Hundred Horses. J. Houel (1782) in *Les plantes originales* (Coupin, 1905).

Chipev et al. (2008) in their studies refers that for the mountainous populations, this tree constituted an important source of food, because the chestnuts were a fruit that was largely consumed before the appearance of the potato in Century XVI providing food to the families and allowing bake bread with the flour made by grinding chestnuts and they were also used for the fattening pigs, the populations could live all winter by consuming this nutrient fruit (Loohuizen, 2006). Lamark (1744-1829), French naturalist in his work *Encyclopedie methodique botanique* published in 1810, in the city of Paris, also mentioned the application of chestnuts in the manufacture of bread for the alimentation of several habitants of different countries of the world, such us, France, Perigord and Limousin. Another author who refers to the importance of chestnuts is Gosselet (1832-1916), in *Cours élémentaire de botanique - description of familles et des espèces utiles*, published in Paris in 1898. The chestnut fruit was very important because can produce a greater amount of flour than the potato itself (Londe, 1838).

Loohuizen (2006) adds that because of its nutritive value, this tree has played a significant role in the history of mankind since ancient times, doubtless helped by the fact that the seeds could resist for quite a long time, without refrigeration or other care. Ancient physicians like Dioscorides and Galen and writers like Homer and Pliny the Elder described and prescribed the chestnuts in your works (Loohuizen, 2006). Since ancient times the chestnut use is mentioned by several authors, such as the Greek physician Hippocrates (460 b.C - 377 b.C) in the work *Hippocratic Oath* (IV century B.C in Ancient Greece.) and the Greek writer Xenophon (427 b.C. - 355 b.C.) in *Anábasis* work (377 b.C - 371 b.C in Ancient Greece.). These personalities mention that chestnuts are a nutritional product that has laxative functions and can usually be consumed cooked or baked (Carvalho and Rodrigues, 2016b). Currently in several European countries, the chestnut tree continues to have great economic relevance in the fruit production regions.



Figures 2 and 3. Illustrations of chestnuts harvesting and the use of chestnut fruits in feed in the work *Tacuinum sanitatis* (Butlan, 1400).

The history of botanical illustrations as a source of accurate and useful information about plants is generally considered to have begun in classical times, with the publication of the first known herbals-books describing the medicinal properties of plants (Ben-Ari, 1999; Carvalho and Rodrigues, 2016 b).

Different peoples throughout the history have made botanical illustrations, the Egyptians portrayed plants on the walls of their temples, on the other hand Greeks and Romans decorated their coins and ceramics with the plants images. Russo (2015) adds that Aristotle studied plants and their medicinal value and ancient historians such as Pliny the Elder (23-79 a.C.) noticed the existence of botanical illustration. The term "botanical illustration" is used to denote the more technical scientific illustrations within the larger genre of botanical art (Russo, 2015).

The Renaissance was an important era because allowed the resurgence of naturalism and the herbals once again, that included accurate representations of plants drawn from nature (Ben-Ari, 1999). Besides that, in the enlightenment, some factors were very important for the development of natural illustration: the world-wide exploration of nature; discovery of new species; scientific focus on understanding and codifying the natural world (Marshall, 2004).

Relatively to the botanical illustration in the XVIII and XIX centuries, it was possible to identify different types of plants through the artists that recorded the flora discovered on expeditions which the main criteria was scientific accuracy, to describe and represent the subject in sufficient detail to be recognized (Rix, 2012). This time is considered a golden age of exploration with persons traveling around the world to gain firsthand knowledge about unknown countries, highlighting the journeys of Captain James Cook for Australia and the South Seas at 18th century, and the Charles Darwin's trips on the Beagle in the middle of 19th century they used artists to record their finds and were servicing collectors on their return, developing the era of scientific exploration (Mayer et al. 1996; Marshall, 2004).

The botanists, physicians, and pharmacists have making representations of plants not only for decoration and medicinal purposes, but also for scientific study and to identify, analyze, and classify plants. In this context, emerged Charles Linnaeus an important plant classifier, and an explorer, that also collected the world most beautiful flora, and their findings were recorded for posterity, mainly for the identification and binominal nomenclature of the plants (Rix, 2012).

All over the years the illustrations had been influenced by the development of different techniques and can display an entire organism, often in profile, with certain parts magnified or specific structures more fully displayed in drawings (Marshall, 2004). The botanic illustrations have relevant aspects that contributed to the scientific knowledge of each of the periods of the history in which the authors of them lived (Rix, 2012; Raymond, 2013).

These illustrations can be applied to the History of Science Teaching giving to the students information about the scientific image and allowing transmit scientific knowledge and understanding about nature. Therefore, the images give the students a more comprehensive scientific literacy, leading them to reflect about their ideas, shaping thought and assimilating the conceptions of reality (Blum, 1993; Marshall, 2004). Mayer (1993) showed that illustration is best suited for summarizing a scientific explanation and most effective in promoting retention of knowledge scientific.

The use of illustrations on teaching of History of Science may increase the interest in scientific matters and the capacity of the student to retain a greater number of concepts about plants and to improve students' learning (Harp and Mayer 1997).

The botanic illustrations are documents with scientific detail of nature that can serve as historical sources on the working practices about botanists and pieces of art of scientific and historical significance (Nickelsen, 2006). On the other hand, Fang (1996) adds that pictures allow capture attention, to amplify and to teach a concept, reinforcing the literacy scientific.

Regarding its scientific classification, chestnut belongs to the Fagaceae family, to the genus *Castanea*, with seven species, however only four have main economic relevance: *C. sativa* (Europe), *C. mollissima* (Chinese), *C. dentata* (North America), *C. crenata* (Japan) (Vossen 2000).

The objectives of this work are to show that the study of the evolution of the chestnut illustrations contributes to the scientific development and that can be applied in the teaching of the History of Science in the classroom, for example, when addressing the systematics of living beings, representing a useful tool for capturing students' attention and interest in learning new concepts. All this knowledge about the evolution of the illustrations of the chestnut tree can be a valuable contribution to the improvement of scientific culture.

This paper is structured as follows: abstract, next introduction, the presentation of the methodology and the works that we used for this study then present the chestnut illustrations, with the respective analysis and description and finally the conclusions.

2. MATERIALS AND METHODS

A qualitative methodology was used in this research work, applying the documentary analysis of several works. The research was mainly carried out in primary sources, because they were more reliable records and was used a few secondary sources. The works used in this study were:

- *Histoire des chênes de l'Amérique Septentrionale* (1811) of François Andre Michaux;
- *Pomona Italiana: Trattato degli alberi fruttiferi conteneate la descrizione delle migliori varietà dei frutte coltivat* (1839) of Giorgio Galessio;
- *Köhler's Medizinal-Pflanzen* (1887) of Hermann Köhler;
- *Michigan Trees - A Handbook of the native and most important introduced species* (1915) of Charles Herbert Otis.

The works were influenced by the Renaissance, the Enlightenment and Contemporary Age. The Renaissance were part of the period marked deeply by great advances in the sciences, while the enlightenment was marked by the defense of the use of reason as the best (and only) way to achieve freedom, autonomy and emancipation (Albuquerque, 2015). On the other hand, the Contemporary Age, is an historical period where the arts experienced different aesthetic movements in their various fields, resulting in different genius artistic productions that influenced the elaboration of illustrations (Santos Pinto, 2015). In 19th and 20th centuries the color became a common preoccupation of the artists and naturalists.

3. RESULTS AND DISCUSSION

The Illustrations of Chestnut Found in the Works of the 19th and 20thcenturys – Some Considerations

François Andre Michaux (1770 – 1855), french botanic on 19th century in his work *Histoire des chênes de l'Amérique Septentrionale* published at 1811 presented a chestnut illustration of *Castanea vesca* synonymous of *Castanea sativa* specie (Fig. 4). Analyzing the Figure 4, it was possible to verify that leaves presented a dentate and asymmetric form, the upper page of the leaves showed a

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bright appearance and a dark green color, while the lower page presented an opaquer appearance and lighter green color, demonstrating the this botanic add already relevant knowledge about the biological characterization of the chestnut tree.



Figure 4- Castanea vesca ou Castanea sativa (Michaux, 1811).

In addition, the picture show the hedgehog covered by spines, the elongated and elliptical form of chestnuts fruits, we can also observe the shell of the chestnut with dark brown and the beige pericarp (Fig. 4). The illustrator designed very outlined the flowers in detail displaying its catkins form, axillary and yellowish drawn and represented them next to the leaves as it occurs in nature. In this illustration, the petiole of the leaves is very visible and all the constituents represented are enumerated, besides that the author applied vivid colors to this image that attract the attention of the observer (Fig. 4).

The Figure 5 shows another image of the same author, that corresponded to the chestnut tree of Chinquapin California, the characteristics mentioned overhead it also can be observed here, as well the catkins and glomeruli that are more visible by the use of different tones paintings.



Figure 5- Castanea pumila (Michaux, 1811).

In these images (Fig. 4 and 5), it is possible to see that the illustrations are well defined, with clear colors and a well-designed set of shadows, that give a detailed touch, looking as real as possible, like a photograph.

A few years later, at 1839, the Italian botanist Giorgio Galessio (1772 - 1839), in the Pisa city, published his work denominated *Pomona Italiana: Trattato degli alberi fruttiferi contenente la descrizione delle migliori varietà dei frutti coltivati*, when it is possible to find an illustration of the chestnut tree that consists in a painting (Figure 6). Analyzing this picture, it is possible to observe the hedgehogs covered with spines, containing inside its fruit, the chestnut, frequently the European chestnut tree contains about three fruits per each hedgehog. Furthermore, it can be also observed the dentate and asymmetric leaves, the chestnut which bark presents striations, as well the hedgehogs with brownish coloration, which means that the fruits are matures.

Compared this picture (Fig. 6) to the previous ones, this illustration is different, because shows the chestnuts inside the hedgehogs, being this unique fact. In addition, this picture is clear and illustrative, as well one of the most closest to reality, representing very well the European chestnut tree with its main constituents.



Figure 6. *Castanea sativa* Mill. (Galessio, 1839).

Hermann Köhler (1834-1879), a German doctor and pharmacologist, in his work *Köhler's Medicinal-Pflanzen*, published at 1887 in Germany, presents an illustration of the European chestnut tree (Figure 7), being in our opinion the most complete and detailed of all the pictures presented before. As shown in Figure 7, it is possible to visualize all the constituents of the chestnut tree, with their key morphological characteristics, demonstrating that the author already had vast knowledge about the vegetal physiology and the biological characterization of the species.



Figure 7. *Castanea sativa* Mill. (Köhler, 1887).

We note that the author was careful to represent the hedgehogs at an earlier stage of development and at the mature stage, in this way you can see the differences in the size of the spines as well as the color of them (Fig. 7). In addition, we can observe the leaves in the initial phase of development of the species that are smaller, it is also possible to see a particular plan of some reproductive organs of the plant and of the glomeruli that constitute the masculine and feminine catkins of the *C. sativa*.

The author also made something exceptional, allowing the observer to visualize not only the chestnut, but also its inside aspect and the pericarp, for a better understanding and analysis. The print is accompanied by an indication of the family, genus and species of the European chestnut tree, being an illustration with a graceful disposed of colors and shadows that captivates the attention of the public, for its beauty and aesthetic value (Fig. 7).

Finally, we present an illustration of the American author Charles Herbert Otis (1886 -?), in the work *Michigan Trees - A Handbook of the native and most important introduced species*, published at 1915, in the University of Michigan. It is a black-and-white illustration of the American chestnut tree (*Castanea denticata*) (Fig. 8), where the author represents the detailed aspect of the branches in winter, the open hedgehog, the characteristic form of the leaves with its dentate aspect, their flowers in general, as well of the staminate flower magnified in the particular. Furthermore, it also presents the outline of the chestnut, which presents a distinct aspect to the European chestnut, since it is much more elongated.

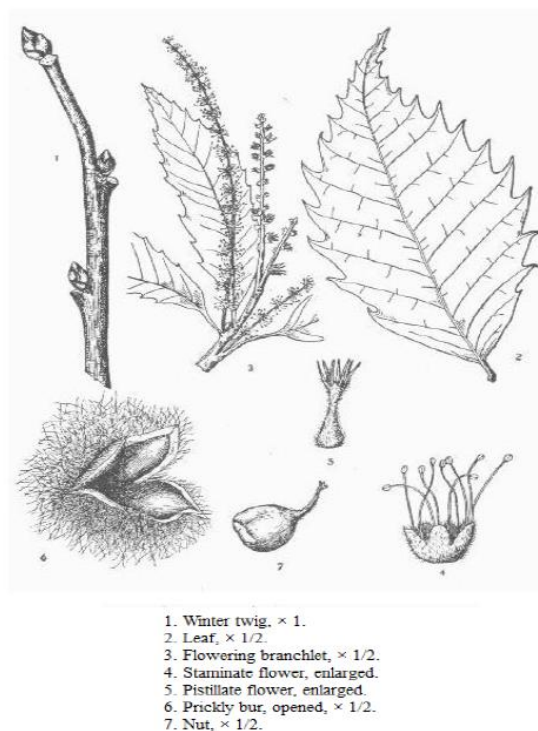


Figure 8– *Castanea denticata* (Otis, 1915).

This image (Fig. 8) is attended by the enumeration of the constituents of this chestnut tree species and also by a legend, where it denotes to the magnification which these elements were drawn, therefore, it is the most detailed of all presented, revealing more detail compared to the previous illustrations.

4. CONCLUSIONS

In summary, it can be mentioned that the illustrations of the chestnut tree as well as the respective legends had a gradual evolution all over the time, in the 19th century the color application in the illustrations become more frequently by the artists, while some authors still preferred to draw in black and white in order to give the engraving more detail. Furthermore, we can verify that the illustrations have become over the centuries increasingly detailed and complete, as well as the respective legends.

All the illustrations presented contributed to the increase of knowledge about the European and American chestnut tree.

The present study allows to understand that the illustrations of the chestnut tree evolved in a gradual form over the time, being influenced by the different techniques of representation of the image and by the contributions of the diverse artistic currents that dominated the times in which these were realized.

This study also lets us to understand that the illustrations of the 19th century were executed in color, revealing a great deal of detail, clarity and precision in their elaboration, presenting a significant number of constituent elements, as well as the main biological characteristics of the chestnut tree. In contrast, the illustration of the 20th century was in black and white, presenting all the constituents of the American chestnut tree, individually, for a better observation and understanding by the observers, besides that, presenting the same ones enumerated and with the respective extension that applied to their drawings, being very personalized.

This research can also contribute to the understanding of the evolution of the scientific knowledge about the chestnut tree during the 19th and 20th centuries, which can be an important tool for current morphological and structural knowledge of this species.

The scientific illustrations can be applied in History of Science teaching with the students because represent an important resource in Science Education, making the learning of scientific content more attractive, enhancing students' scientific literacy.

The illustrations by great botanicals in this era, contributed to the advancement of scientific knowledge in the field of Botany, about the chestnut species.

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