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Andreia Garcês
Inno – Serviços Especializados em Veterinária, R. Cândido de Sousa 15, 4710-300 Braga, Portugal

Corresponding Author:
Andreia Garcês
Inno – Serviços Especializados em Veterinária, R. Cândido de Sousa 15, 4710-300 Braga, Portugal

Art and science: The importance of scientific illustration in veterinary medicine

Andreia Garcês

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Abstract
The importance of illustration in veterinary is usually overshadowed by its use in human medicine and forget. Nonetheless, it is important to recognize the importance of illustration in the development of veterinarian, as this is also a profession based on observation. Through history there are several examples of how illustration help to increase and share the knowledge in veterinary sciences. There is no doubt that illustration is an important tool in learning. That makes scientific illustration an important and irreplaceable tool, since they have the ability of takes scientific concepts, from the simplest to the complex, and bring it to life in an attractive and simplified way.

Keywords: art, science, scientific illustration, veterinary medicine

Introduction
Biological illustration, has many branches being one of the medical illustrations. It is a form of illustration that helps to record and disseminate knowledge regarding medicine (e.g., anatomy, virology) [1, 2]. Usually, medical illustration is associated with human medicine, with the great anatomical illustrations of Da Vinci and Andreas Vesalius coming to mind [3, 4], but illustration also has an important role in veterinary medicine. Maybe, illustration has been used longer in veterinary than in human medicine but never is referenced its importance [3]. The explanations behind this circumstance are many [5–7]. Animals always run through the human visual culture that it's almost impossible to know where to begin, since we always lived in close contact with them, even before we could walk in two limbs. In the past they were hunted to provide food and shelter, later some were worshipped as gods and associated with magic practices and later domesticated to our use [8]. They were accessible and knowledge about them could be easily obtained. Since remote times, the vivisection and dissection of animals were used for teaching and experimentation of anatomy and physiology, and as a model for the human bodies [4, 5]. This because, knowledge regarding human anatomy and physiology was hard to obtain because dissection of the human body was forbidden in many cultures thought history [3, 4, 9]. Many civilizations continued the study of anatomy and medicine in animals, although many times as a replacement to human medicine, but those studies allowed the development of veterinary medicine, with a great source of works existing till nowadays [5, 8].

The contribution of illustration along with Veterinary Medicine History
Archaeologically it is hard to determine when veterinary medicine first start, being the first record of what could be veterinary practice skulls of *Bos taurus* and *Sus scrofa* in France with signs of cranial surgery (trepanation) from the Mesolithic period (3400–3000 BCE) [10]. In pre-historic times before the written words exist, some pictograms were left in cave walls and stone all over the world with representations of fauna and flora. The first recorded anatomical illustration was in El Pindal cave in Spain, where is represented a mammoth with a leaf-shaped dark area where the heart should be (15000 BCE) (Fig. 1) [3].
The earlier civilizations produced simple biological and medical drawings which were made principally as ornaments or portraiture on vases, columns, walls, and tablets. For example, in a wall of a Babylonian temple, around 75,000 years ago to 3,000 B.C, is a carving of a wounded

lion with arrows lodged in his spine and lungs, with the hind limbs dragging stick-like and blood dripping from his wounds and nose (Fig. 2). These simple drawings give us information that one of the arrows perforated the lung, the consequences of that trauma and the first representation of animal pain [4].

The first extensive record of veterinary medicine practice was provided by the Egyptian Papyrus of Kahun (Twelfth Dynasty of Egypt): the Kahun Veterinary Papyrus (2025–1700 BCE) [11]. In the Mauryan Empire, between 268 BCE to 232 BCE, the edicts of Asoka provide some information regarding veterinary practices, but without any relevant illustration [12]. During the same period, in India (Sravasti), the Shalihotra Samhita appear as one of the most completed and illustrated treaters on veterinary medicine, that described anatomy, physiology, surgery and diseases in equine and elephants (Fig. 3) [13]. In China, during this period some works regarding the treatment of animals start to appear. Later, between 500 ADE to 600 ADE, during the Byzantine empire appears a compilation from unknown authors, dedicated to the care and healing of the horse called Hippiatrica (Fig 4) [14, 15].

Entering the Dark Ages, medicine was based on the knowledge of ancient civilization (Rome and Greece, particularly on the works of Galen (131-201 ad)) [5, 16] and folk medicine. No new advances or studies were made during this period, with the monks only copied classical texts. Before the 10th century, the illustrations in the manuscripts were rare and crude. Only, after the 11th century forwards there is an increase in the number of miniatures and an occasional full-page illustration began to appear, but nothing very complex or scientifically accurate (e.g., bestiaries) [7, 17]. With the Renaissance, physicians and artists start to have a new interest in this field and new advancements were made. This period is marked by great artists like Leonardo Da Vinci (1452–1519), Berengario da Carpi (1460–1530), Albrecht Durer (1471–1528) and Vesalius (1514–1564) [5]. In veterinary many treats regarding these fields start to appear, some richly illustrated. The appearance of printing (15th Century, Gutenberg) and the Age of Discovery help to bring back the interest in biological illustration and make it accessible to a greater public [5]. In this period biological illustrations could be found in anatomy textbooks, nature guides, scientific magazines and journals, botanical gardens, museums and others. Étienne de Flacourt (1600) was the first to documented his travels to Madagascar, and illustrated the unique fauna there, setting a model for the future explorers (as Charles Darwin or Ernst Haeckel) to document the natural world and improve the fields of medicine [3, 5, 18].

The first great treaty on animal anatomy was Carlo Ruini's book “Anatomia del Cavallo”, published in 1598 (Fig. 5). It was the first complete comprehensive treatise on the anatomy of a non-human species [8, 15, 18, 19]. This was the start, and afterword’s numerous publications on anatomy and veterinary procedures appeared, not only in diverse species of animals but in different fields of veterinary, from anatomy to microbiology [15, 18].

The importance of illustration on Veterinary

There is no doubt that illustration is an important tool in learning. Several studies have shown that illustration in a medical text aids in the learning process, as many studies have shown [20–22].

In the last century, medical illustration has specialized and became a profession on its own, and develop in an infinite variety of techniques, from charcoal to digital painting. On one side the scientist can help the illustrator in the solution of an artistic problem and by other and the illustration helps the scientist to expose the information. Art always helped to solve communication dilemmas in science, including veterinary. [3, 4, 6].

The illustration techniques used to represent medical knowledge have been evolving at the de throughout history along with the artists and technology present, from drawing, engraving, photography, animation to digital processing. The development of each new technique has built on previous experience to improve medical knowledge and make it more accessible to the target audience [3].

Although we live in the Era of technology with digital photography, electron micrographs, magnetic resonance imaging and computers, illustration still has an important role. Both, traditional illustration and computerized images are important tools in veterinary education and transmission of knowledge [3]. Scientists still prefer to use drawings to illustrate their working models (fig. 6), because 1) represent simplified descriptions of the reality; 2) enables the creation of images that are more abstract than photographs; 3) more depth and accurate than schematics; 4) present spatial visualizations that could never be photographed or easily schematized; 4) integrate contextual information obtained from different fields or experiments; 5) possibility of share scientific information to the public without a scientific background [23].

With the development of the new methods in which information is distributed, e.g., internet, the scientific knowledge is available faster and more accessible to everyone, in comparison to what happened in the past. That makes scientific illustration an important and irreplaceable tool, since they have the ability of takes scientific concepts, from the simplest to the complex, and bring it to life in an attractive and simplified way [1, 3, 6].

Fig 1: Mammoth painted in El Pindal Cave (Spain), with what appears to be a heart, painted on the left shoulder. Photo: Berenguer (1994).

Fig 2: wounded lions with arrows from The Royal Lion Hunt, Assyrian c. 645-635 BC, Nineveh, North Palace, Iraq. Photo: Jon Parise (2008).

Fig 3: Illustration of an elephant gastric disease and eye operation on a horse from Shalihotra Samhita. Collection: Asian Collection. Photo: Purusottama (2012).

Fig 4: Page from the Hippiatrica with written and illustrated instructions on drenching a horse to induce diarrhoea. Photo: Hippiatrica, Parisinus greacus 2244, fo. 74v. Author: unknown.

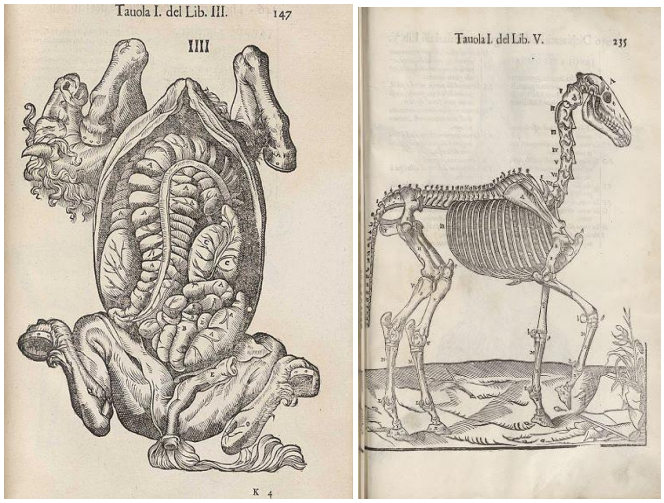

Fig 5: Carlo Ruini. Anatomia del Cavallo (Venice, 1618). Photo: US National Library of Medicine.

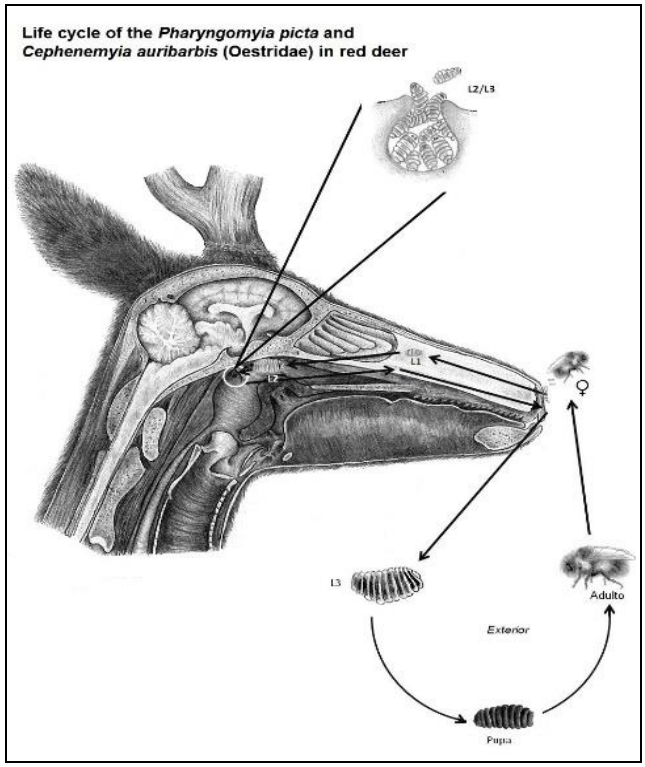

Fig 6: Representation of the life cycle of *Pharyngomyla picta* and *Cephenemya auribarbis* in red deer. Illustration: Andreia Garcês

Conclusions

Animal health has always had a very important role, and even more nowadays days with the new concept of “One Health”.

Artist has an important role in the transmission of knowledge, not only to professionals in this area but also to the general population. The future of medical illustration, particularly in the veterinary field, are wide and fascinating with the rise and expansion of veterinary sciences. The importance of illustration in veterinary is usually overshadowed by its use in human medicine and forget. Nonetheless, it is important to recognize the importance of illustration in the development of veterinarian, as this is also a profession based on observation.

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