

Learning by Seeing: The Art of Anatomic Illustration

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Abstract

Although medical illustrations are generally understood as visual models for the transmission of knowledge, the history of anatomical illustration brings to light all the interconnections and interrelations that have worked to establish its status as an interdisciplinary approach to the study of the human body. By using aesthetics as a didactic way to knowledge, anatomical illustration merged scientific with aesthetic theories, developing specific ‘period’ styles. From the early demonstrations of Leonardo da Vinci to modern schools of medical illustration, the history of this interdisciplinary enterprise shows a remarkable capacity of changing with the advent of new paradigms in science.

Keywords

anatomical illustration, history of science, didactics

Medical illustrations are primarily understood as visual models for the transmission and communication of knowledge. They refer less to a reality described with what Daston and Galison call ‘mechanical or non-interventionalist objectivity’²⁴, and more to a didactics of knowledge. In anatomy they are often preferred to photography since, as models requiring analysis and interpretation, they are able to provide guidance for the medical student, and to some extent, when corroborated with anatomical preparations and cadavers, even able to educate the ‘clinical gaze’. In this respect, Max Broedel noted that “There are countless structures in the human body, both small and large, and yet so elusive in form and placement that they escape visual registration almost completely. [...] They are there, and yet the eye cannot make them out without close study and observation. The camera in this circumstance is helpless, but the hand-made picture can bring them out with complete fidelity and make them comprehensible to the reader, student, novice, and even layman.” (qtd. in S.K. Patel et al. 2011: 183)

Nowadays it seems inconceivable for the average medical student that he/she should master the complexity of anatomical structures without resorting to visual aids such as anatomical plates or anatomical atlases. The institutionalization of anatomical illustration at the beginning of the 20th century (now studied as an

²⁴ According to Daston and Galison, objectivity has an inherently negative character, each form of objectivity being opposed to a form of subjectivity. Mechanical or non-interventionist objectivity refers to the use of mechanical devices to produce images free from human mediation, images that would thus be truer to the natural phenomena.

‘applied art’ in medical schools) brought with it a certain standardization which effaced its more aesthetic side. Yet when one takes a look at the history of anatomical and medical illustration one cannot miss the interconnections and interrelations that have worked to establish its status as an interdisciplinary approach to the study of the human body, using aesthetics as a didactic way to knowledge.

Although illustrations of the human body for scientific purposes have existed in all cultures, in traditional Chinese, Indian and Arabic medicine, we can speak of anatomical illustration in the modern sense of the word only with the advent of the Renaissance. The polymathic figure of Leonardo da Vinci (1452 – 1519) played an important role in this respect. The refashioning of the concept of Nature led Leonardo as well as other great humanists to revise the meaning of the human body, which had been underplayed for several centuries, due to the dichotomies body/soul, this world/other world, perdition/salvation, on which rested the authority of the Catholic Church. Although at the beginning of his work Leonardo showed more interest for the human form and for an aesthetic rendering of the human body according to certain ratios, the development of his approach anticipated that of anatomical illustration itself in its move from the formal to the functional. Thus, towards the end of his life, Leonardo placed more emphasis on the functional complexity of the human body, insisting that it should be depicted in detail. According to Kemp, he managed to reach a new stage of complexity of drawing in his 1510 series of foot demonstrations, in which he depicted the bones and the muscles of the foot by recording “the forms encountered at a particular stage of dissection” (Kemp 2006: 280). Kemp notes that when faced with the difficulty of illustrating the asymmetry of the foot, Leonardo solved the spatial problem by choosing different angles of viewing the anatomical structures, six in the case of the foot series, eight in the case of the muscles of the arm, shoulder and upper thorax, presenting the viewer with a “cinematographic sequence”. Leonardo’s inventiveness did not stop at this: discovering what was to be one of the “standbys of modern technical illustration”, he chose to model dissection techniques by pulling apart overlying structures one by one, and exposing the structures in a series of ‘exploded’ forms. The emphasis on functionalism and detail, on minute and rigorous anatomical description that should explain the physiology of the illustrated structures is not, however, a ‘natural’ development in the history of anatomical illustration. It has more to do with empiricism, with a certain scientific outlook that favours function over form, moving from the interest in causes and origins towards an interest in observation and experience. It was also Leonardo that underlined the didactic principle behind anatomical atlases: “It is necessary both to illustrate and describe” (qtd. in Kemp 2006: 285), matching illustrations with explanatory texts meant to “describe their functioning in the context of universal laws”. This mutual dependence of text and image is a particularity of anatomical illustration which is worth analyzing. The text and the image refer to each other in an elaborate sequence of perception, induction and deduction, which constructs understanding as a ‘layered’ process, in which the spatial and the temporal dimensions of reasoning are combined.

That Leonardo's move from form to function was an individual preference which, accidentally or not, anticipated the development of modern science is proven by the art of other humanist illustrators, such as Charles Estienne (1504 – 1564) and Jan Stephan von Kalkar (1499 – 1546). The latter's illustrations adorned the famous *De Humani Corpori Fabrica*, the first comprehensive anatomical atlas compiled by Andreas Vesalius (1514 – 1564), a landmark in the development of modern anatomy away from Galen, whose errors had dominated medicine in Europe throughout the Middle Ages. Kemp calls this style a 'heroic' one, due to its underlying ideology:

What Estienne is doing is to provide a grand 'history' of the human body, in the Renaissance sense of 'historia', [...] to denote a story which signifies great things. The figures – whether men acting out heroic dramas in grand settings such as all'antica landscapes, or women anatomized in bedrooms – correspond in tone to the author's definition of the nobility and grandeur of the human estate in relation to God's creation, a definition that he derives from the ancient Stoic authors whom he cites in his preface. (Kemp 2010: 196)

Estienne's "Demonstration of the Nerves" may look rather ridiculous from a modern point of view, with its depiction of a skeleton on whose bare bones the hanging nerves seem to resemble vineyard tendrils. From a functional point of view such an illustration would be hardly helpful either for a student desiring to understand the location of a nerve or for a surgeon undertaking a complex surgery. Yet at that time, such an illustration was part and parcel of the humanist project, and indicated, by its refusal to depict separate parts of bodies, and by placing its subject against majestic and sublime landscapes, the heroic, god-like quality of the human body. The same holds true for Jan Stephan van Kalkar's plates of muscle men, which underline the heroic, male lines of the human anatomy, revealing to the expert gaze their master's apprenticeship with Titian.

It was this type of visual rhetoric which was to become a tradition in anatomical illustration until the 19th century, and not Leonardo's functional drawings. Following the discovery of the New World and the conquest of the Indian subcontinent, a new interest in the remote and exotic led both to the establishment of the *Kunstammern* (cabinets of curiosities) that glorified Nature as well as its aberrations and to the introduction of the 'wondrous' in anatomical illustration. Jan Wandelaar's illustration of the typical muscle-man is produced against a background which features an enormous rhinoceros, grazing peacefully in a bushy landscape²⁵. The skeleton's position in the foreground and its patronizing hand extended over the docile grazing rhinoceros is highly suggestive of the

²⁵ Dutch artist and engraver Jan Wandelaar (1690 - 1759) illustrated Bernhard Siegfried Albinus' *Tabulae sceleti et musculorum corporis humani* (1747). Clara, the rhinoceros depicted in the picture, had been brought from India on the ship when she was still a calf, and subsequently, due to the enterprising spirit of the Dutch sea captain who was her owner, she became the central attraction of a European rhinoceros craze, going on a European tour of the royal and aristocratic houses in Europe for almost 20 years.

Enlightenment's scientific optimism and trust in the reasoning capacity of man, who, although from the same order as the whole creation, was nevertheless the master of it.



Fig.1. Jan Wandelaar, Clara the rhinoceros and a human skeleton,
Tabulae Sceleti et Musculorum Corporis Humani

Earlier, Gottfried Bidloo's anatomical atlas (1685) combined the tradition of heroic illustration with the close-up views of Leonardo, and the result was a striking one. While man and woman showed their anatomic beauty against the classical setting of Baroque architecture, an anatomized skull rested on a music score and the traditional skeleton rose from the grave with an hourglass in its hand, the demonstrations of the viscera were accompanied by minute reproductions of the paraphernalia of dissection (a surgeon's knife, nails) and on the liver one could even see a fly. The painter who produced the illustrations was a well-known master of the *trompe l'oeil*, Gerard de Lairese, himself suffering from an incurable disease (congenital syphilis). Kemp notes that the use of the *trompe l'oeil* suggests

a different rhetoric, that of the real thing, intended “to give us confidence that we are seeing the real thing” (Kemp 2010: 200). This was also the high time of the scientific revolution and the creation of scientific communities across Europe, so the author’s social and scientific status is emphasized by his title (*Medicinae Doctoris et Chirurgi*) and three prefatory poems in Latin, one of which is a *carmen epaeneticum* (poem in praise of) dedicated to Bidloo²⁶, *clarissimus vir* (“highly-regarded man”, a term used only for Roman Senators), whose anatomical atlas is an “*opus anatomicum illustrissimum, et absolutissimum*”.



Fig 2. Interior and Exterior of the Skull with a Sheet of Music.
Plate 89 from *Anatomia Humani Corporis*, by Gerard de Lairesse

The rhetoric of the “real thing” becomes the hallmark of the intense empiricism of the 18th century in Britain, giving birth to what Kemp calls the “proto-photographic” method, where images and representations lose their universal value and become specimens. While the anatomical illustrations of the Renaissance and the Baroque addressed the universal as an epistemological and

²⁶ Godfried Bidloo himself was also a poet and a playwright.

didactic value, with William Hunter's *Anatomy of the Gravid Uterus*, illustrated by Jan van Rymsdyk, the emphasis shifts on presenting particular specimens, whose value consists in the fact that they are true to reality.

A step forward towards the modern conventional rendering of anatomical structures is the replacement of the monochrome techniques of stippling and cross-hatching with color drawings. Although one of Vesalius' copies of the *Fabrica* (the one offered as a gift to the Holy Roman Emperor Charles the V) was hand-coloured, and arteries and veins appeared in red and blue, often the colours were interchanged for the same vessel. This of course is not surprising, given that the circulation of blood and the role of heart were to be correctly depicted some hundred years later (1651), by the English physician William Harvey. The first to use colour in anatomical illustration was the Italian surgeon Gaspare Asellio, who discovered the chyliferous vessels a few years before Harvey published *De motu cordis* – at the end of his work there are two plates which present the lacteals in white against the reddish brown of the mesenteric vessels. Yet the conventional use of color begins with Jan Swammerdam's illustration of the anatomy of the uterus (1672), where the arteries appeared red, following his techniques of injecting them with red wax, so that they became more visible.

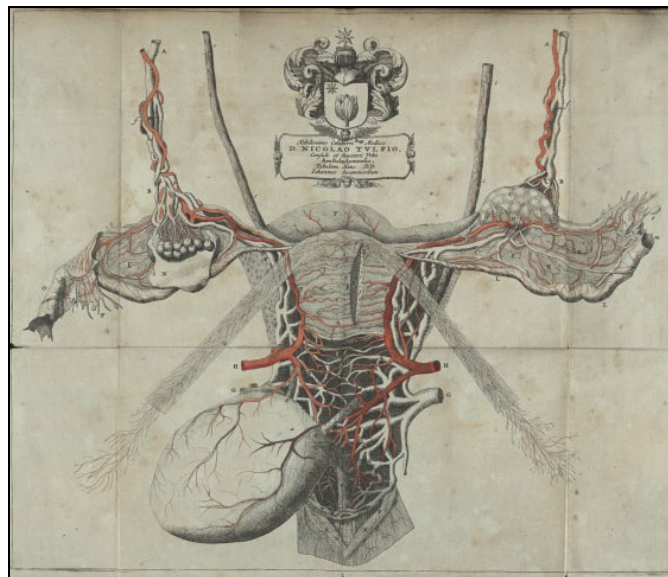


Fig.3. Jan Swammerdam's illustration of the anatomy of the uterus.
First use of symbolic colouring in an anatomical illustration

As medical teaching was becoming increasingly institutionalized and students needed affordable anatomical atlases as learning aids, the conditions were set for what was to become the most influential anatomy book: Henry Gray's *Anatomy: Descriptive and Surgical*. A Lecturer on anatomy at St. George's Hospital in London, Gray convinced his colleague Henry Vandyke Carter to produce an accessible textbook for students. Carter produced 363 illustrations of

dissected bodies (just made available by the Anatomy Act of 1832²⁷) and the book came out in 1858. The aim of the atlas was purely practical, as Gray emphasized in the preface, and the didactic connection between image and text was made with regard to the improvement of the accuracy of learning:

This Work is intended to furnish the Student and Practitioner with an accurate view of the Anatomy of the Human Body, and more especially the application of this science to Practical Surgery.

One of the chief objects of the Author has been, to induce the student to apply his anatomical knowledge, to the more practical points in Surgery, by introducing, in small type, under each subdivision of the work, such observations as shew the necessity of an accurate knowledge of the part under examination. (Gray 1858: vii)

Henry Gray's *Anatomy* differed from previous atlases and textbooks not only in its lack of any pretense to artistry and beauty, but also in its conciseness and strict adherence to the didactic code. It was singularly unimpressive and flat, as its only purpose was to provide the students the accurate knowledge necessary for surgery. Kemp argues that in spite of the lack of artistry, atlases like Gray's anatomy inaugurated a new style in anatomical description, a style that could best be described as 'non-style', emerging as a result of the new requirement of objectivity that was gaining ground in the sciences. Daston and Galison, who analyzed several types of objectivity in the sciences called the type of objectivity that gave rise to such 'restrained' texts and images, 'mechanical' or 'noninterventionist'. According to Daston and Galison, mechanical objectivity

combated the subjectivity of scientific and aesthetic judgment, dogmatic system building, and anthropomorphism. It took on a moral aspect because these aspects of subjectivity were thought amenable to control through self-restraint; it centered on the scientific image because images were thought least vulnerable to such subjective intrusions-protective charms against ambiguity, bad faith, and system building. (Daston and Galison 1992: 82)

Thus the conventionalism and flatness prevailing in most anatomical illustrations today seems to be the heir of both of a 19th century concept of 'mechanical objectivity' with its new imperative of representational simplicity and truthfulness towards the subject matter, and of a revolutionary 20th century, when medical illustration became institutionalized at Johns Hopkins School of Medicine in Baltimore, due to Max Broedel (1870 – 1941). Max Broedel devised a new technique of anatomical illustration called the carbon dust technique, which was not only fit to exhibit exemplary layers of anatomical structures, but it also contributed to Harvey Cushing's fame as a neurosurgeon through its intelligent renderings of the surgeon's groundbreaking operating techniques. Broedel himself,

²⁷ The Anatomy Act of 1832 gave free licence to medical students and practitioners to dissect donated and unclaimed bodies. Before that it had been permitted only to dissect the bodies of executed murderers.

after years of anatomical study, created a special surgical procedure for nephropexy called the Broedel stitch, as if foreshadowing Netter's own pronouncement that "I came to realize that pictures have played a vital role not only in teaching but in the actual development of surgery to its high levels" (qtd. in Tsafrir and Ohry 2001: 101).



Fig.4. Max Broedel's drawing of Harvey Cushing during an operation

Frank Netter (1906 – 1991), whose atlases are the learning material of choice for the majority of medical students nowadays, did not limit himself to a purely representational style, but added a number of dramatization techniques and individualized his characters to the point where many of the surgical procedures and disease symptoms resemble illustrations from comic strips. Nicknamed the Michelangelo of Medicine, Netter, although he chose to stick to the symbolic colour conventions (red for arteries, blue for veins, and yellow for nerves) for obvious didactic reasons, reintroduced the subjectivity of aesthetics into his atlases. However, if during the Renaissance and the Baroque, the aesthetic served as a basis for the ideology of the heroic, divine, universal or particular man, the aesthetics underlying Frank Netter's drawings points more towards the individual, in accordance with the modern and postmodern focus on individuality. For example, a heart attack is beautifully rendered through the image of a well-dressed middle-aged man (wearing a scarf and a fedora) grabbing the left side of his chest and dropping his rather heavy briefcase. The man is portrayed in front of the restaurant where he has been eating – an allusion to the fact that the cause of a heart attack is coronary heart disease, a condition brought about by lack of exercise, bad diet, smoking and

drinking. It is not the universal that is portrayed by means of the particular, but an assortment of individual factors is made to stand for the general. Employing his genius for comic strips, Netter was able to create wonderful renderings of first aid procedures such as the Heimlich maneuver or cardiopulmonary resuscitation, as well as depict classic symptoms of various diseases.

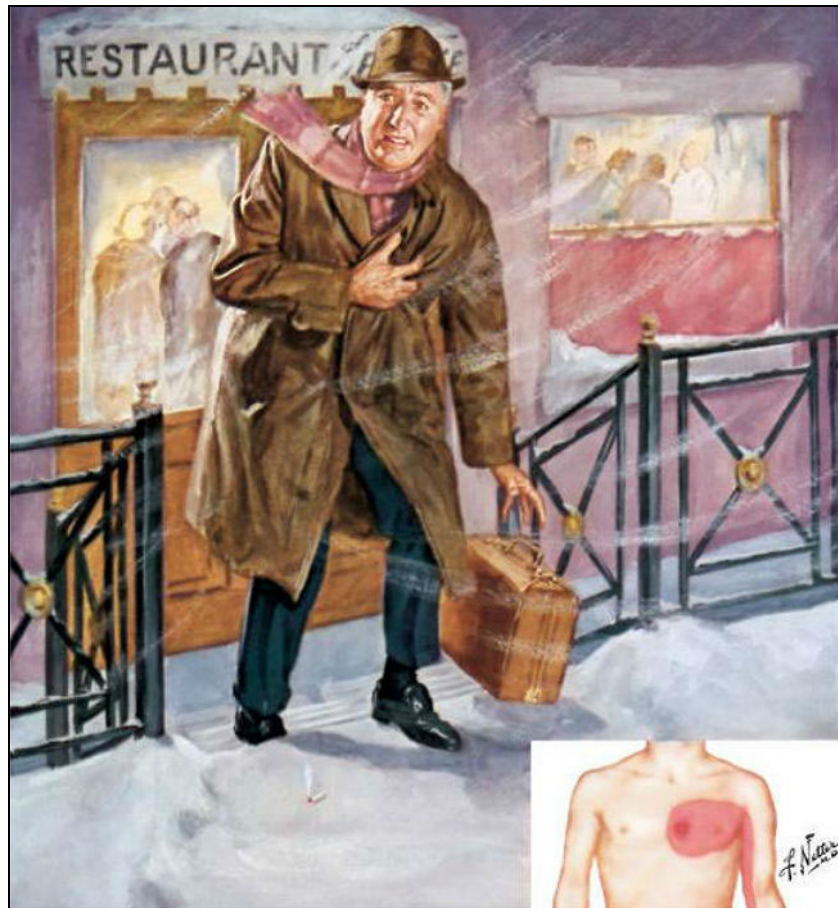


Fig.5. Frank Netter's illustration of *angina pectoris* during a heart attack.

It seems thus that although the emergence of the modern scientific spirit based on observation and experiment and the self-fashioning of science as a field of objectivity has resulted in an aesthetic of 'non-style' for anatomical illustrations in the 19th century and led further to the institutionalization of anatomical illustration and the creation of codes and conventions, reproduced in almost all anatomical atlases today, there are some notable exceptions. Netter's atlases in particular prove that popularity in the sciences is not just a matter of strict adherence to the codes and rules of the epistemic community.

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