

Art in Science

Frank H. Netter MD and a Brief History of Medical Illustration

Francine Mary Netter BA, MA, MBA,
Gary E. Friedlaender MD

Introduction

In the introduction to his seminal volume, *Atlas of Human Anatomy* [7], Frank Netter wrote lightheartedly that he wondered what the truly outstanding and renowned anatomists from history—men like

Note from the Editor-in-Chief:

I am pleased to introduce our latest Art in Science column, written by Francine Mary Netter and Gary Friedlaender. Francine Mary Netter is the author of Medicine's Michelangelo: The Life & Art of Frank H. Netter, MD, a biography of her father, the renowned medical illustrator. Gary Friedlaender is the Chair of the Department of Orthopaedics and Rehabilitation at Yale School of Medicine. Together, they will share observations from a fascinating vantage point: the interface of art and medicine.

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Vesalius, Leonardo da Vinci, William Hunter, and Henry Gray—might have said about his atlas. Through the centuries, these and other major contributors to the advancement of science have skillfully illustrated their observations. “Anatomy of course does not change,” Netter wrote in the Introduction to *Atlas*, “but our understanding of anatomy and its clinical significance does change as do anatomical terminology and nomenclature” [7].

Incremental advances in knowledge have been inextricably linked through time with improvements in communication capabilities (in this case print media), forming a triangulation, from science, to artist, to printer. This article traces medical illustration from Leonardo da Vinci to Frank Netter, giving a brief introduction to these men, and describing their motivations and approaches to making illustrations, and the technical resources they had available to reproduce their pictures.

F. M. Netter BA, MA, MBA
Raleigh, NC, USA

G. E. Friedlaender MD (✉)
Yale University School of Medicine, P.O.
Box 208071, New Haven, CT, USA
e-mail: gary.friedlaender@yale.edu

Leonardo da Vinci (1452–1519)

Just west of Florence, Italy is the small town of Vinci, the birthplace of the great Leonardo. Hence he was known as Leonardo of Vinci, Leonardo da Vinci in Italian. The Leonardino Museum in Vinci houses a number of his drawings, and also models of his inventions. Nearby, the small house where he was born still stands and is now also a museum.

Leonardo had a brilliant mind coupled with an intense curiosity. He was not only one of the grand masters of the Italian Renaissance, but an engineer, inventor, architect, and an anatomist. As a young art student of Andrea del Verrocchio in Florence, Leonardo created studies of muscles, tendons, and more. Subsequently, in hospitals in Florence, Milan, and Rome, Leonardo performed at least 30 dissections, and made sketches, in pen and ink, or red or black chalk, of what he found. Of course, many of the great painters and sculptors of the time, including Michelangelo, Raphael, and Albrecht Durer, did their own dissections to learn what lay beneath the skin so as to better portray the human figure, but they were mostly concerned with the surface anatomy.

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Leonardo went deeper into the viscera, and sought to understand the function of the underlying structures, rather than merely their existence. His drawings of the muscles are accurate and detailed, but to better understand their pulling action he created a schema that represented the muscles with cords and strings. There being no anatomy atlas to guide him in his dissections, Leonardo was forced to blaze a trail, and made some beautiful illustrations of anatomy [13], including pictures of the skeleton, various organs, and even the pregnant uterus. His pictures of the limbs illustrate the dynamic relationships of the bones from different points of view, front, back, and sides.

Leonardo organized his notes and illustrations into manuscript form, but did not publish them in his lifetime. They passed to his heir, and then through a series of ownerships. His notebooks rediscovered in the collection at Windsor Castle in London were finally published in 1796 [1, 10, 15].

Andreas Vesalius (1514–1564)

Born into a family of physicians, Andreas Vesalius of Brussels studied in France, and became a physician. He had no knowledge of Leonardo's anatomical studies and illustrations, and was himself not an artist, but he was a

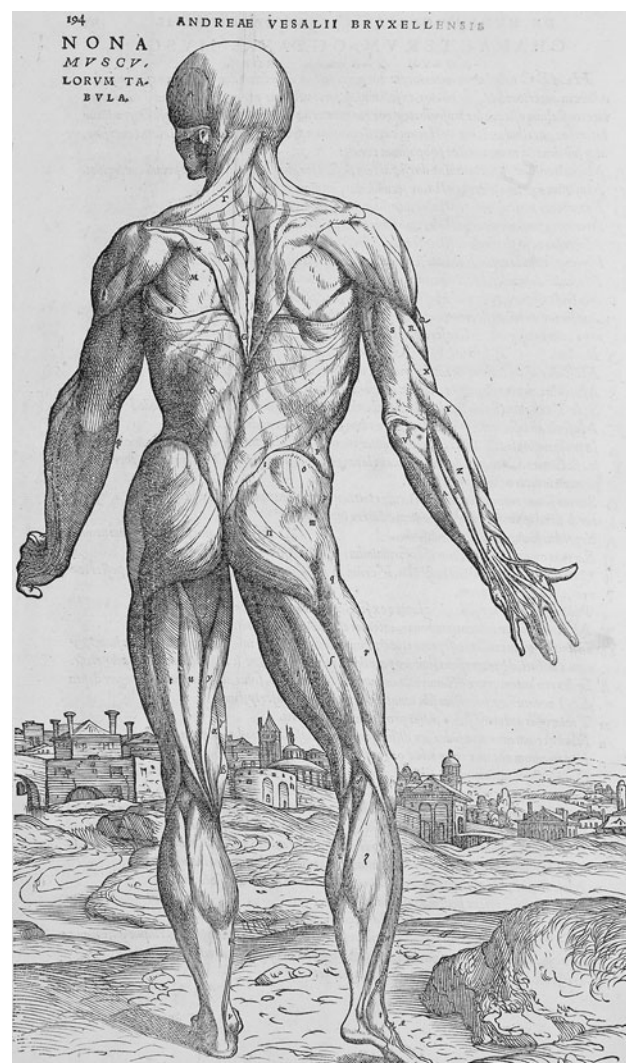


Fig. 1 This image by Andreas Vesalius shows "Nona Muscu, Lorum Tabvua," [Rear View of the Body Muscles]. This work can be found in *De Humani Corporis Fabrica* [On the Fabric of the Human Body]. Published courtesy of the Yale University, Harvey Cushing/John Hay Whitney Medical Library.

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great teacher of anatomy and received an appointment as Professor of Surgery at the University of Padua in Italy. Unlike his contemporaries, he would actually descend from his chair and perform dissections himself, instructing students and colleagues alike, and employing charts he had drawn to clarify the discussions and delineate the veins [14]. Soon, students began asking for the drawings. In 1538, Vesalius published his three charts of the vascular system together with three additional drawings of the skeletal system done by the artist Jan Stefan van Kalkar. This small collection of six plates was very popular and became known as the *Tabulae Anatomicae Sex (Six Anatomical Charts)* [14].

But it was Vesalius's *De Humani Corporis Fabrica (On the Fabric of the Human Body)* for which he is today best remembered. He employed several artists to make illustrations for this masterwork. Jan Stephen van Kalkar, pupil of the master Venetian painter Titian, most likely prepared a good number of the illustrations in Venice, and even Titian himself possibly did some. A number of the plates are complete pictures, portraits of figures posed standing or sitting with lovely landscapes in the background, very incongruous for a man with his muscles flayed and intestines exposed (Fig. 1). The artists may have been

inspired to include the landscapes by the manner Vesalius used to position the cadaver for the purpose of illustrating the muscles. He would thread a strong cord through the head of the cadaver and suspend it from the ceiling, so he could raise or lower, and turn it as needed for the artists to see all sides of the subject matter [14].

The printmaking was by woodcut, in which the original art is destroyed in making the blocks. The blocks were cut in Venice and transported across the Alps to Basel, which was then the center of European publishing, and where the volume was printed. Woodcut is a linear medium in which shade, texture, and contour can be shown only by hatch or crosshatch marks, so that quality of the reproductions was limited by the technology. Nevertheless, Vesalius's work was a milestone in medical illustration, and in the teaching of anatomy. He was not the first to publish anatomical pictures, but his was the most true to life and complete collection of reproductions up to that time, and the first major textbook of anatomy. To this day his name is synonymous with the beginning of modern study of anatomy [8, 9].

William Hunter (1718–1783)

William Hunter was born near Glasgow, Scotland. He was a scholar, and studied at the University of Glasgow,

before moving to London and continuing his studies at St. George's Hospital. He took up the practice of what was then called man-midwifery, and eventually rose to fame as obstetrician to Queen Charlotte. He founded a school in London for the study of anatomy, where his lectures were exemplary. He employed his younger brother, the distinguished surgeon John Hunter (1728–1793), to perform careful dissections and prepare numerous specimens [5].

William Hunter was elected a Fellow of both the Royal and Antiquarian Societies, and was Professor of Anatomy at the newly formed Royal Academy of Arts (1768–1783). During that tenure, in 1774, his famous publication *Anatomy of the Human Gravid Uterus* appeared in large folio format with 33 life-like pictures, and utilizing little explanatory text.

The plates took many years to assemble, because of the difficulty in obtaining cadavers with a full term fetus to use for dissection/models. But the pictures are exquisite, engraving having replaced woodcut for the reproduction of art [3]. Several artists, including Jan van Rymdyk, made the drawings and the engraver Robert Strange oversaw the engravings, making two himself and having the others executed in Paris [4].

During the time that Hunter was compiling his atlas, the Royal

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Librarian Richard Dalton rediscovered, in the collection at Windsor, the lost and unpublished Leonardo da Vinci anatomical drawings. As Hunter was a great collector of 15th century art, Dalton may have shown them to Hunter, who in turn, may have modeled pictures in his atlas after those of the master [1, 4].

William Hunter bequeathed his extensive collections of books, coins, writings, and specimens to form the Hunterian Museum at the University of Glasgow. The red chalk drawings Jan van Rymdyk made for his atlas are now preserved there. Following John Hunter's death, his executor scandalously destroyed Hunter's writings. But his collection of specimens is housed in the Hunterian Museum at the Royal College of Surgeons in London. Unfortunately much of it was destroyed in the blitz [11].

Henry Gray (1827–1861)

Born in London, Henry Gray studied medicine and anatomy at St. George's Hospital. He was elected Fellow of the Royal Society at the young age of 25. His career progressed at St. George's, from student to demonstrator of anatomy, to curator of the museum, and lecturer of anatomy.

Gray published his magnum opus *Anatomy, Descriptive and Surgical* [2]

in 1858. He collaborated with Henry Vandyke Carter (1831–1897), a physician and artist, whom Gray knew

from St. George's, and who made 363 illustrations for the volume (Fig. 2). Although the book is more text than



Fig. 2 This image shows Gray and Vandyck's "Muscles of the Front of the Leg." This work can be found in *Anatomy, Descriptive and Surgical*. Published courtesy of the Yale University, Harvey Cushing/John Hay Whitney Medical Library.

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illustrations, and Gray was the impetus behind the volume, the pictures lend great clarity and appeal, and were responsible for much of the success of the publication. Carter had acquired skills as an artist at the knee of his father, Henry Barlow Carter, an accomplished marine artist. It is interesting that as part of Henry Carter's medical studies, he was awarded the Anatomical Studentship at the Royal College of Surgeons, which brought him to the Hunterian Museum in London, and the then intact extensive collection of specimens of John Hunter.

The master engravers at Butterworth and Heath made the wood engravings for reproducing the images in *Anatomy*. Wood engraving is a derivative of metal engraving; it allows fine detail but requires great skill to execute. A great advantage was that the images could be set on the same page as the text. A disadvantage was that the image drawn on paper had to be transferred in reverse to the block before being engraved. Carter made his meticulous line drawings accented by shadow to create the appearance of depth. At first he created the artwork on paper, which was then transferred to woodblock and engraved. Soon, he became his own draftsman, drawing the image directly on the woodblock surface, a skill he may have observed in his father's art studio [12].

Henry Gray contracted small pox at the age of 33 and died. Following publication of *Anatomy*, Carter spent

the next 30 years in the Indian Medical Service teaching anatomy in Bombay, after which he retired in England. But



Fig. 3 This image of a child's injured elbow by Frank Netter can be found in Conwell HE. Injuries to the elbow. *Clinical Symposia*. 1969;21;2:plate VIII. Netter illustration from www.netterimages.com. ©Elsevier Inc. All rights reserved.

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both men were superb anatomists, and their work together was a fruitful partnership, having resulted in the most well known medical text, which is still in publication.

Frank H. Netter (1906–1991)

Frank H. Netter was both a physician and an artist. He was born in New York and studied at the National Academy of Design and the Art Students League. He went to New York University Medical College, as it was then called, interned at Bellevue Hospital, and joined the outpatient surgical service at Mt. Sinai Hospital. But there was more demand for his sable brush than for his scalpel, and he soon closed his practice to make medical illustrations full time.

The pharmaceutical companies were making great discoveries, and medical knowledge was advancing rapidly. Early in his career as a medical illustrator Netter created pictures published by several different companies, including Armour Laboratories, Winthrop Chemical Company, and Pfizer & Co. But it was the Ciba Pharmaceutical Company, seeking to provide a service to the medical community by publishing medical educational materials, that became Frank Netter's greatest patron. Between 1949 and 1991, Ciba

published 15 full color atlases, now known as the *Netter Collection of Medical Illustrations*, depicting the human organism in health and disease; more than 200 monographs under the title *Clinical Symposia* and featuring his pictures; as well as his *Atlas of Human Anatomy*, what Netter called

his “Sistine Chapel,” and the best-selling anatomy atlas in the world.

What also set Netter's art apart from his contemporaries are his portraits of patients (Fig. 3). These images are not simply those of a medical condition, as much as they illustrate a person with a medical condition. He often said that



Fig. 4 This image showing the anatomy of the hand by Frank Netter can be found in Lampe EW. Surgical anatomy of the hand. *Clinical Symposia*. 1951;3:8:figure 26. Netter illustration from www.netterimages.com. ©Elsevier Inc. All rights reserved.

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these are not machines we are repairing, but living, breathing human beings [6]. His pictures of children are especially poignant and reveal his deep empathy for these vulnerable patients.

Netter stood on the shoulders of predecessors in both his art and in medicine. He did not create his own specimens, as did the Hunter brothers. Unlike Leonardo, who had to discover for himself the anatomy he depicted, Netter had great practitioners and researchers teach him the latest thinking in medical practice and knowledge. He was the most prolific of medical illustrators, having created more than 4000 pictures for Ciba alone [6].

It was a great advantage also that he was both doctor and artist. He avoided the difficulties Vesalius must have faced working with his artists who insisted on painting pictures of cadavers set in lovely landscapes. And unlike Henry Vandyke Carter, who was cast as subordinate to Henry Gray, Netter was the team leader in the publication of his work. He was the one to plan the books and invite contributors to lend their knowledge, but he would single-handedly create the art.

Using opaque watercolor, what artists call gouache, he created his beautiful pictures (Fig. 4). He would sketch out the picture on thin tissue paper, often quickly, and using graphite transfer paper, transfer the image to illustration board. Then, with his

masterful brush strokes, he would lay down the paint, beginning with the next to darkest colors, adding the next-lighter tones and then the next-lighter, and continuing with the next-lighter, as the picture came into being. He created dramatic images, which are superb illustrations, and powerful teaching aides [6].

Printing too had progressed to a point where the technology to reproduce color was available and no longer prohibitively expensive. While the earlier Netter publications by Ciba were produced by using letterpress, Ciba moved to offset printing in 1973. One of the main advantages being that offset printing produced a sharper image at a more economical cost. While Netter never used a computer, he recognized the potential the technology offered as a new medium for creating illustrations and as a method for making reproductions [6].

Conclusions

The quest for knowledge and the art of observation are critical traits of the great artists who have historically served as documentarians of anatomy and surgery. While photography now can be used effectively to document the anatomy and clinical conditions, the camera cannot interpret what it sees. In contrast and in great departure

from what had gone before in medical illustration, Netter used not only his eyes and hands to make pictures, he used his mind to create pictures with a message. It was the coming together of his great artistry with his insight as a doctor and the advancement of color printing process that placed him at the pinnacle of what medical illustration has today become, a critical element in teaching the art and science of medicine to generations of health care professionals and scientists, and making the human condition accessible to all.

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