IJAE
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Firenze University Press
www.fupress.com/ijae

Citation: Martini, M., Orsini, D., Saverino, D., Aglianò, M., Franci, D., Lorenzoni, P., & Ottoboni, S. (2024). Representing the Body. From variety to the perfection of convention: the anatomical plates of the Leonetto Comparini Anatomy Museum, University of Siena. *Italian Journal of Anatomy and Embryology* 128(1): 137-143. doi: 10.36253/ijae-15393

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

Representing the Body. From variety to the perfection of convention: the anatomical plates of the Leonetto Comparini Anatomy Museum, University of Siena

Mariano Martini[1], Davide Orsini[2], Daniele Saverino[3,*], Margherita Aglianò[4], Daniela Franci[4], Paola Lorenzoni[4], Stefano Ottoboni[5]

[1] *Department of Health Sciences, University of Genoa, Genoa, Italy; UNESCO Chair "Anthropology of Health - Biosphere and Healing System, University of Genoa; President of section of History of Radiology of Italian Society of History of Medicine*
[2] *University Museum System of Siena (SIMUS), History of Medicine, University of Siena, Siena, Italy, President of section of Medical museology of Italian Society of History of Medicine*
[3] *Department of Experimental Medicine (DiMeS), Section of Human Anatomy, University of Genoa; IRCCS Ospedale Policlinico San Martino, Genoa, Italy*
[4] *Department of Medicine, Surgery and Neuroscience, University of Siena, Siena, Italy*
[5] *Department of Surgery Sciences and Integrated Diagnostics (DISC), University of Genoa, Viale Benedetto XV 6; IRCCS Ospedale Policlinico San Martino, Genoa, Italy*
*Corresponding author. Email: daniele.saverino@unige.it

Abstract. The history of Medicine has been passed down to us through the texts of Anatomy without images from the most ancient periods. Only in the 15th century was Mondino's work enriched with drawings that went on to explain the dissection methods that the great Bolognese anatomist had included in his book published in 1316. But it was in the 16th century that anatomical drawings assumed extraordinary importance when Andrea Vesalio recognized their extraordinary function in helping to understand the texts and make them accessible to an ever-wider audience interested in the study of Anatomy. The authors, in tracing the highest examples of the history of anatomical iconography for educational use, present the case of the collection of about 600 anatomical plates preserved in the Leonetto Comparini Anatomy Museum of the University of Siena: tables that were made specifically for educational use and that have been regularly used for the teaching of Anatomy throughout the 20th century.

Keywords: anatomical tables, teaching of Anatomy, innovative approach; medical education.

ANATOMY: A VISUAL SCIENCE

The study of anatomy requires the use of visual aids, whether it be a dissected body, a preparation, a model, or a table (1). Images remain at the heart of the anatomy teaching method even today, and the learning of anat-

omy, an objective science, cannot do without the use of "images" (2, 3).

The advice that every teacher gives to students even today in their first lesson is to equip themselves with a good anatomy atlas.

ILLUSTRATORS AND PRINTING TECHNIQUES BEHIND ANATOMICAL PLATES

The need to "see" in order to "learn" has obviously been addressed in different ways in each era. While in the 14th century Mondino de' Liuzzi (1275-1326) introduced the practice of dissection as a method of investigation and study of the human body, it was in the Renaissance that Andreas Vesalius (1514-1564) introduced a completely innovative method in anatomical teaching methodology and a different way of conceiving anatomical science with his *De humani corporis fabrica libri septem* (4).

The renewed importance of dissection prompted the creation of teaching aids to be used during periods when body dissection was not possible. In particular, anatomical plates, derived from direct observation of the body, were considered more effective than any written text or speech, allowing many people in different places to observe what could only be seen through dissection (5).

Anatomical drawing thus became the most used tool that aided the study and understanding of the human anatomy, which became established in the mid-16th century.

Vesalius's innovative work, *De humani corporis fabrica* is adorned with the exquisite engravings of the Dutch artist Jan Stephan van Calcar (1499-1546), a Flemish painter trained in Titian's workshop. These drawings not only exhibit anatomical precision but also stand as masterpieces of art. The human body is depicted in poses reminiscent of classical art, set against beautifully rendered landscapes.

The plates were created using the woodblock printing technique (xylography). The matrix was carved onto a pear wood block. The artist worked on the wooden surface, and then an engraver cut away the areas around the drawing that were meant to remain white, leaving only the image to be printed in relief. The frontispiece and Vesalius's portrait, which grace the opening pages of *De humani corporis fabrica*, are prime examples of this technique. The frontispiece features the anatomist at the center of the scene, dissecting a female body with his own hands, surrounded by numerous figures of anatomists.

For his revolutionary work, *De Dissectione Partium Corporis Humani Libri Tres*, which features one of the most elaborate sets of illustrations of the era, Charles Estienne (1504-1564) assembled a team of esteemed illustrators. Among them was Perin del Vaga, a collaborator of Raphael, Rosso Fiorentino, and other masters of the School of Fontainebleau.

Also the famous senese anatomist, Paolo Mascagni (1755-1815), collaborated with highly skilled draftsmen and engravers to produce the exquisite illustrations that adorn his works. Among these artists were Ciro Santi (a Bolognese artist who prepared the copper plates for the illustrations in *Vasorum lymphaticorum historia et ichnographia* (6); Agostino Costa (a Florentine artist who contributed to Mascagni's works); and Antonio Serantoni (a close collaborator of Mascagni from 1801 to 1815). Serantoni played a pivotal role in creating the illustrations. He prepared the drawings, engraved them on copper plates for printing with etching, and, when necessary, hand-colored them.

The immense work involved in creating these anatomical plates is attested to by the names and signatures placed at the bottom of the plates, within the lower margin of the printed image. These inscriptions are engraved and typically include: the name of the draftsman followed by the term *delineavit* (drew), *delineavit et pinxit* (drew and painted), or in some cases, *delineavit et direxit* (drew and directed); the name of the engraver followed by *sculpsit* (carved) or *incidit* (engraved). In cases where the draftsman and engraver were the same person, the inscription would read *delineavit idemque incidit* (drew and engraved) (7).

These inscriptions serve as a testament to the collaborative nature of anatomical illustration, highlighting the contributions of artists and artisans in bringing scientific knowledge to life through visual imagery.

To produce his plates in a way that would "exhibit the parts of the Human Body by means of new Plates, and present them precisely as they are in nature, preserving the order and respective position of each," Paolo Mascagni employed a novel technique capable of yielding particularly impressive results: copperplate etching.

In this process, a copper plate was coated with black wax, upon which the image was drawn. Subsequent etching exposed the copper in correspondence with the drawing. Aquafortis, a mixture of nitric acid and water, was poured over the plate to corrode the areas that the etching had stripped of wax. The principle of this technique relies on the protective power of black wax and the corrosive action of a mordant, in this case, nitric acid. Once cleaned, the plate was ready for printing like any other intaglio print. Successive passes on the same plate allowed for further inkings with different colors predominating (7). The use of multiple colors further

enhanced the visual appeal and educational value of the illustrations. It enabled Mascagni to highlight different anatomical features and relationships, making it easier for viewers to understand the complex structures of the human body.

Between the late 18th century and the early 19th century, a new printing process emerged: lithography. This innovative technique utilized a limestone-based stone as the matrix. The artist would draw the image to be printed using greasy ink crayons. The lithographic stone, typically made from limestone, has a remarkable property of retaining a thin film of water on its surface. This water film adheres strongly to the undrawn areas of the stone. When ink is applied to the lithographic stone, it is repelled by the water-covered areas. The greasy ink, however, adheres to the drawn areas, which are free of water. The lithographic process allows for the production of multiple identical prints from the same stone matrix. This reproducibility is a significant advantage of lithography (7).

A FUNDAMENTAL SUPPORT FOR THE TEACHING OF SIENESE ANATOMY

Until few decades ago, the halls of the University of Siena's Institute of Anatomy proudly displayed the magnificent plates of Paolo Mascagni's *Anatomia Universa* (8, 9, 10). Mascagni (11, 12) was born in Siena, had studied at the university and became a young lecturer in anatomy following the death of his teacher, Pietro Tabarrani (1702-1780). *Anatomia Universa* is a life-size atlas that meticulously replicates a dissection, featuring anatomical plates meticulously crafted based on direct observation of the human body. In the preface to this monumental work, Mascagni emphasizes the value of both "verbal descriptions of individual parts" and "using images and representations" in the study of the human body, asserting that "the eyes do not deceive" (8).

Paolo Mascagni's anatomical plates, including those in his *Vasorum Lymphaticorum historia et ichnographia* and *Anatomia Universa*, demonstrate his meticulous attention to detail and leading-edge approach to anatomical illustration. While maintaining a connection to classical iconographic traditions, Mascagni introduced several innovations that reflected a new era in anatomical research and teaching (13, 14).

Mascagni's illustrations are characterized by their clarity and precision. He meticulously depicted anatomical structures with remarkable accuracy, ensuring that students could easily identify and understand the intricate details of the human body. In line with their didactic purpose, Mascagni's illustrations were free from extraneous elements that might distract from the study of anatomy. He aimed to present the human body as it appeared on the dissection table, allowing students to focus on the essential structures. Mascagni's innovative approach to anatomical illustration marked a significant shift in the way anatomy was taught and understood. His detailed and accurate plates provided students with an unprecedented visual understanding of the human body, revolutionizing anatomical education.

Complementing the collection of antique and precious anatomical plates housed in ornate wood frames and protected under glass, which have been musealized since the late 1990s and can now be viewed in the Natural History Museum of the Sienese Academy of Fisiocritici (15), the University of Siena held within its legacy a substantial number of anatomical plates created by lesser-known draftsmen at the explicit request of professors throughout the institution's history. These drawings faithfully reproduce the systems and apparatuses of the human body as they were observed by the technical draftsmen in the Institute of Anatomy, either directly from cadavers or by referencing images from atlases.

These anatomical plates, now replaced in teaching by more modern images, have become part of the heritage of the University of Siena's Anatomical Museum (16, 17, 18). The museum houses a collection of approximately 600 anatomical plates dating from the late 19th century to the 1990s, spanning the period until manual drawing gave way to computer graphics.

This remarkable collection can be divided into two main groups: paper plates, (represent the majority of the collection and showcase the traditional technique of anatomical illustration on paper), and wooden plates (these are distinguished by their unique support material, wood, and provide a glimpse into an earlier era of anatomical illustration).

THE TREASURE TROVE OF ANATOMICAL TABLES

The first group consists of the anatomical tables of the late nineteenth century and are still preserved in their "cassone" (i.e. treasure trove), acquired by the university in 1908. The term "cassone" is a colloquial term for a large chest or trunk, often used to store valuable items (figure 1).

This historical furniture, commissioned *ad hoc*, is made of fir wood, closed by two doors and divided internally in six thematic shelves:

I: Histology and general physiology;

II: Embryology;

Figure 1. Furniture specially designed to contain the numerous anatomical tables of the ancient Institute of Normal Human Anatomy of the University of Siena (Museo Anatomico 'Leonetto Comparini', Siena).

III: Digestive system;
IV: Urogenital apparatus;
V: Respiratory system;
VI: Nervous system (19).

The paper tables were used by exposing them in the classroom on a support above the board. If we look at these artifacts we see that they mostly reproduce images of current anatomical atlases. Some have been made in black and white (figure 2) others are in colors (figure 3) often using the watercolor technique.

In any case, we note the artist's commitment the images a pleasant appearance and to use well-marked strokes in order to make possible remote viewing. In most of these drawings the captions are inserted directly next to the various parts of which the organ is composed (figure 4). Finally, plates are mostly anonymous.

THE ANATOMICAL TABLES OF THE SECOND HALF OF THE TWENTIETH CENTURY

After World War II, anatomy teachers used to prepare specific materials for their lessons, asking technicians to set up the classroom with preparations and anatomical tables depending on the topic they would cover in classrooms.

Many of the anatomical tables used in classrooms were made by the technicians of the Institute itself. Among these deserves to be mentioned Anna Maria D'Errico (20), who began to work in the sixties commissioned by Professor Elio Bagnoli, which was joined by many other teachers such as Sestini, Bertelli, Comparini and Bastianini.

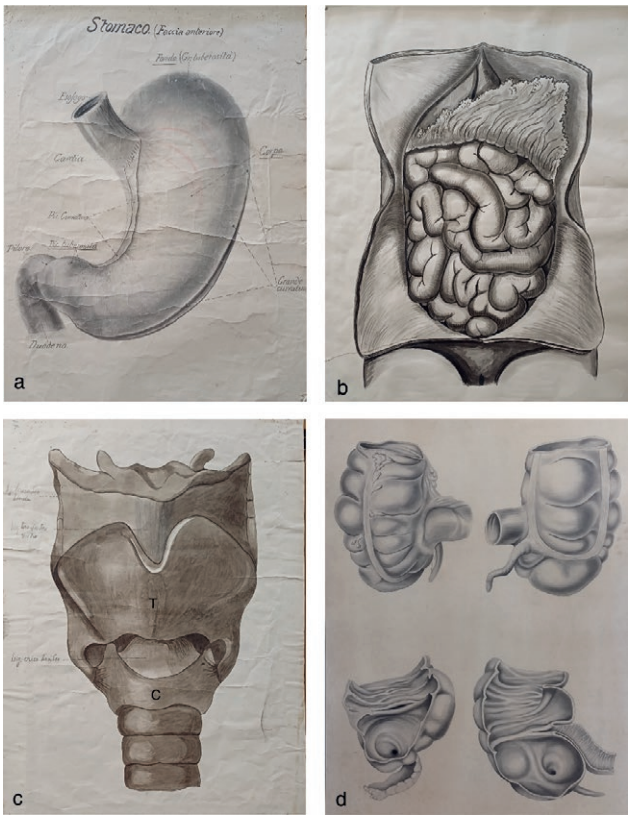

Figure 2. 2a) Stomach in front projection. The various parts that make it up are indicated (bottom and body), the two left and right margins (large and small curvature) and the two orifices, cardias and pylorus that put it in communication with the esophagus and duodenum respectively. 2b) Open abdominal cavity with greater omentum raised, making the mesenterial small intestine visible. 2c) Larynx in front projection. Visible are the thyroid (T) and cricoid (C) cartilages joined by the cricothyroid ligament shown in the table together with the lateral and middle thyroid ligaments connecting the larynx to the hyoid bone. 2d) Terminal part of the ileum that is thrown into the cecum. In the upper left anterior vision, on the right a posterior vision, in both it is possible to observe the humps typical of the large intestine and the ileocecal appendix extending downwards. In the lower part of the table is represented the open cecum, in sagittal section to the left and frontal to the right, where it is possible to observe the ileocecal valve and the opening of the appendix. (Museo Anatomico 'Leonetto Comparini', Siena).

In the era before computers, this scientist and artist meticulously has freehand drawing anatomical tables using watercolour, pastel, or tempera techniques. She quickly abandoned ink pens due to the fading of aniline colours over time, especially for exposure to light. As she recalled in a publication on anatomical tables, in her drawings she tried to give a pleasant chromatism and a easily readable illustrations, even from a distance. She performed the captions initially with normographs, later

Figure 3. 3a) Arterial cone of the right ventricle open at the point of origin of the pulmonary trunk with the semilunar valves. It is indicated the left pulmonary artery that originates from the trunk, also the ascending aorta and the superior vena cava are visible. 3b) In high, scheme of the structure of the hepatic lobule with the centrolobular vein blue colored, and the rich system of sinusoids that surround it. Below is a three-dimensional view of the hepatic venous system. 3c) Posterior wall of the thorax. Trachea with bifurcation of the main bronchi are represented. Below a segment of the esophagus. The table shows all the vascular structures surrounding these organs. 3d) Schematization of the course of the optical and acoustic ways with their interrupting nuclei. (Museo Anatomico 'Leonetto Comparini', Siena).

Figure 4. Representation of the retroperitoneal viscera of the upper abdominal cavity: duodenum, pancreas, kidneys with adrenal glands and spleen. (Museo Anatomico 'Leonetto Comparini', Siena).

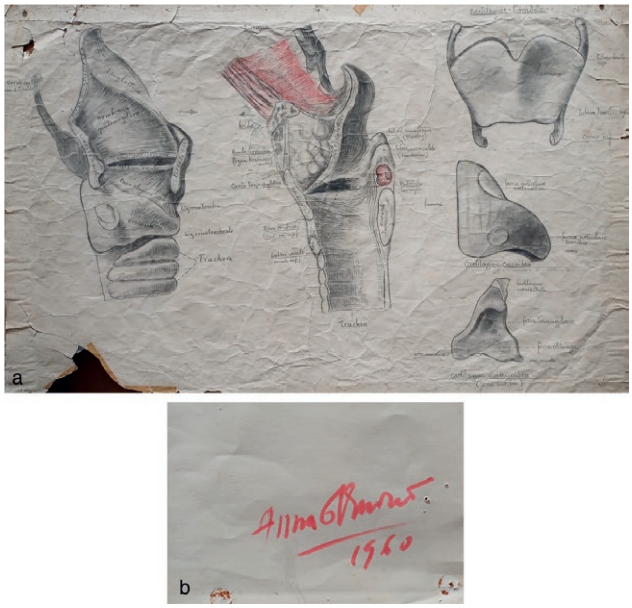

Figure 5. 5a) Median sagittal sections of the larynx. On the left is represented the upper part of the larynx, in the center the organ in full. On the right are the thyroid cartilages, in front projection, the cricoid and aritenoid cartilages in lateral vision. 5b) On the back of the table is the autograph of the author, Annamaria D'Errico. (Museo Anatomico 'Leonetto Comparini', Siena).

switching on to transferables that gave the work an even more professional look (20).

Her subjects were typically inspired by images from the most important anatomy manuals (Bairati, Pernkopf, Sobotta, Valenti Bertelli) or from teachers' own texts. These drawings were mainly used for classroom teaching but often also for scientific publications. Some of her tables bear her signature, as seen in the black and white illustration of the larynx (figure 5).

Over time, the constant use of the anatomical drawings led to signs of wear and tear. To preserve her work, Anna Maria D'Errico decided to have the drawings laminated and mounted on plywood boards, making them more durable and easier to use in the classroom.

A true professional, D'Errico embraced new technologies as they emerged. She began using a scanner to capture images and then digitally reinterpreted them to meet the specific needs of teachers. However, the arrival of the graphic tablet and Photoshop marked a turning

point for her. As she described, "*it was like going back to drawing with pencil and brush because even in computer graphics, you need to know how to draw, understand perspective, have a sense of colour, and perceive what is most pleasing to the eye and therefore effective for learning*".

Recent efforts have focused on accurately dating the anatomical tables, identifying missing specimens, and restoring damaged ones.

CONCLUSIONS

For centuries, anatomical tables and drawings have been a cornerstone of anatomy education. This article has explored the collections at the University of Siena, highlighting their enduring value. These meticulous illustrations, crafted by hand or with the aid of evolving technologies, have served as invaluable tools for both students and instructors.

These anatomical tables stand as a testament to the enduring role of visual aids in teaching anatomy. As a descriptive discipline, anatomy heavily relies on illustrations, and these tables have served as invaluable tools for centuries.

The authors, tracing the history of the anatomical didactic tables in use for centuries at the University of Siena, have also sought to highlight the expertise and techniques behind their creation. These tables, as the renowned anatomist Paolo Mascagni recognized, are fundamental instruments for the study of anatomy.

The importance of such a historical heritage also passes through an interpretative reading of the technical and technological evolution By examining these collections, we gain insights into the history of anatomy and its teaching methods.

The authors emphasize that while the anatomical drawings discussed here may be considered less significant than those of renowned figures like Antonio Scarpa and Paolo Mascagni (also preserved in The Museum of Siena), they nonetheless play a crucial role in anatomy education. Paradoxically, while the importance of dissection was stressed, anatomical teaching has historically achieved its most effective results through the use of visual aids.

Finally, despite the emergence of new technologies in anatomy teaching, the importance of visual aids remains undeniable. These collections offer a unique perspective on the history of the discipline and the artistic expertise required to create effective illustrations.

The story of the collection of the Museum of Siena collections underscores a fundamental truth: even among technologic advances, well-crafted anatomical tables and drawings continue to be a powerful resource for clear communication and effective learning in the fascinating field of anatomy.

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