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The "prince of anatomists" Paolo Mascagni and the modernity of his approach to teaching through the anatomical tables of his *Anatomia universa*. A pioneer and innovator in medical education at the end of the 18th century and the creator of unique anatomical collections

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Abstract

In the wake of the great anatomists, Paolo Mascagni introduced important innovations into the methods of studying anatomy, as revealed both by his writings and, especially, by his approach to the analysis of anatomical sciences. He devoted his whole life to the study of anatomy, which he considered a mainstay of medical education.
Mascagni's great originality in this field lay in the fact that he designed new, modern tools for the teaching of anatomy – tools that enabled students to gain greater understanding of the human body even in the absence of dissection, which was regarded as indispensable in those days.
His two most important results were the first description of the lymphatic system and the clear and precise anatomical tables of the Anatomia Universa. This "modern and evocative anatomical atlas" was the first to present precise, life-size drawings of the human body.
The present overview aims to illustrate the modernity of this great scientist, his approach to the study of anatomy, his meticulous attention to topographical anatomy, and the utility of his innovative methods, which were to mark the evolution of medical education for many years.

Keywords

Paolo Mascagni, dissection, medical education, teaching aids, collections of anatomical tables.

Introduction

Paolo Mascagni (1755-1815) graduated in Medicine in 1778 at Siena University[1]. In the same year, he became the assistant of Professor Pietro Tabarrani, who had been a pupil of Giovanni Battista Morgagni "the father of modern anatomical pathology".

On the invitation of Tabarrani, Mascagni had already begun studying the lymphatic vessels before graduating, succeeding in highlighting their evolution, organization, functions and alterations through mercury (Hydrargyrum) injections. Published

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in 1787, this study was entitled *Vasorum lymphaticorum historia et ichnographia*[2,3,4]. This work was praised by anatomists for its description and systematic identification of the lymphatic system.

Subsequently, Mascagni devoted all his activity to studying and teaching the anatomy of the human body.

At the beginning of the 16th century, Berengario da Carpi (1466-1530), lector at the University of Bologna[5], defined anatomy as the "alphabetum medicorum"[6]. Likewise, Mascagni regarded the teaching of anatomy as a fundamental part of medical education.

Mascagni's *Vasorum lymphaticorum historia et ichnographia* provided the first description of the pathways of the lymphatic system, accompanied by 27 tables drawn by the artist Ciro Santi. Immediately after the publication of this work, Mascagni began to conceive his project to "create a much more extensive work that would reveal the whole of the human body without neglecting anything"[7]. Thus, he started work on a new anatomical atlas that would "by means of new Tables, display the Parts of the Human Body and depict them precisely as they are in nature, allowing each one of them to conserve its order and respective position"[8]. Mascagni's objective was to create an innovative teaching aid that medical students could use when they did not have the opportunity to study directly on cadavers. He therefore drew up his *Anatomia Universa,* which was published in nine fascicles between 1823 and 1832 and which reproduced the dissection of a cadaver in a virtual manner.

In the preface to this work, the great anatomist asserted that, in the study of the human body, two methods of investigation were possible. The first was to utilise verbal descriptions of the individual parts of the body; the second utilised images in order to place the complete and organic form of the human body in front of the eyes, which would therefore not be deceived[9].

In Mascagni's view, this latter approach was the better. Indeed, his anatomical tables resulted from the observations that he himself made during the course of the dissections that he carried out on a large number of cadavers both for his own research and for teaching purposes.

The study of anatomy based on dissection

Dissection can be regarded as the anatomy lesson par excellence, at least since the beginning of the 14th century, when it became a fundamental element of the new system of education and the transmission of knowledge that gained sway following the foundation of universities.

Once common in the third century BC in the flourishing cultural life of the Alessandria of Ptolemy II[10], the dissection of human bodies was soon abandoned and, up to the end of the 13th century, medical knowledge was based exclusively on the study of the ancient texts.

In 1316, Mondino de' Liuzzi (1275-1326), a teacher at the University of Bologna, published his *Anothomia*, a manual on the technique of dissection, which testifies to the re-emergence of interest in this practice. Dissection did not only have an educational purpose, however; it was also – in the case of public dissections – a kind of spectacle with a scientific value. Indeed, the manual was greatly appreciated by a vast readership.

That these "public displays" took place gives the lie to the belief that the Catholic Church had placed a ban on dissection. Indeed, the papal bull *De sepulturis* (also known as *Detestandae feritatis*) issued by Boniface VIII in 1299, which many cite as the basis of this ban, in reality targeted the custom of boiling the corpses of important persons who had died far from home – a practice that enabled the soft parts of the body to be separated from the skeleton, which could then be more conveniently repatriated.

According to this bull, anyone who boiled a corpse was liable to be excommunicated; it made absolutely no mention, either directly or indirectly, of the dissection of corpses for educational purposes. To settle any possible ambiguity regarding the interpretation of Boniface VIII's document, Pope Sixtus IV unequivocally stated in his *De cadaverum sectione* in 1472 that the study of anatomy was useful in medical and artistic practice.

As a result of Mondino's work, dissection was set to become a cornerstone of the teaching of anatomy. Indeed, it became not only a fundamental visual aid to understanding the ancient texts, but also, as stated by Berengario da Carpi in his *Commentaria,* it constituted an ongoing "open-body" verification of the assertions of the ancient anatomists: an *anatomia sensibilis* aimed at the senses through which the anatomist could and should explore the human body[11].

In this regard, Berengario wrote in his commentary on Mondino's *Anothomia*: *"Haec omnia ego vidi ad sensum in anatomiis"*[12, 13], concluding that *"Experientia* (in the sense of 'observation') *tamen in hoc est magistra cui credendum est"*[14].

Thus, anatomy is a form of knowledge that can be learnt and communicated above all through images[15]. This claim finds ample corroboration in Andreas Vesalius' (1514-1564) work *De humani corporis fabrica libri septem* (1543), which constitutes the basis of the scientific study of human anatomy by means of *manuum munus*[16] and defines the methodology and epistemology of the new medical education[17]. Indeed, this publication, which was magnificently illustrated by Johannes Stephan van Calcar, a pupil of Titian, constitutes a completely different approach from that of the previous anatomical treatises and from Galen's anatomical paradigm, in that it inverted the order of priority between text and dissection, between reading and observation.

In the preface, Vesalius scoffed at his predecessors and contemporaries who taught by repeating from memory what they had read in books written by others, without troubling to verify it or to draw upon new knowledge derived from the direct observation of human anatomy. At the same time, he assigned to dissection an investigative role as well as a didactic function.

Indeed, by opening, handling and observing the corpse, it was possible to acquire new information on the human body.

This enabled him not only to write a new chapter in the history of anatomy, but also to correct the erroneous descriptions of the ancients, who had not been able to study the body by means of the direct experience that only dissection could provide.

Vesalius explicitly stated these convictions in his book, beginning from the frontispiece, which depicted a dissection. In this dissection, the great anatomist was not preaching from a treatise on anatomy, as was customary at that time; rather, he was dissecting the corpse with his own hands, showing and explaining to the spectator the various anatomical parts. In this way, he brought together – as Mondino had done previously and Mascagni would do later – the three traditional figures of dissection: the *Lector*, the *Sector* and the *Demonstrator*.

In the centre of the illustration, a woman's body, in perspective, lies on the autopsy table, which is surrounded by a number of people: on one side stand the contemporary anatomists, who oppose Galen's theories; on the other, his supporters. All are gathered around Vesalius in a sort of ideal conciliation. The fact that Vesalius is depicted in the act of dissecting the corpse with his own hands, without the customary aid of the *Sector* and the *Demonstrator*, reveals his view that anatomical knowledge is gleaned from dissection performed personally by the anatomist. Moreover, the writing instruments and the sheet of paper seen on the side-table next to the body underline the idea of an anatomical text that is the result of the dissection and observation of the corpse, of direct perception through the senses. Thus, Vesalius fits into a school of thought that, while not repudiating the link with the traditional system of official teaching, began to emphasize the manual component of medical practice.

That Vesalius distanced himself from the traditional anatomy lesson is testified, *in primis*, precisely by the difference between the frontispiece of his publication and those that appear in volumes published only a few decades earlier, such as that of the German Johannes de Ketham's *Fasciculus medicinae* (1491), which shows a *Lector* reciting *ex cathedra* from a text of Galenic tradition and a Demonstrator, who is pointing with a stick to where the Sector has to cut the corpse.

Mascagni's anatomical tables: perfect teaching aids

It was precisely this renewed importance of dissection that prompted the creation of teaching aids that could be used when no corpses were available. In particular, anatomical tables constructed on the basis of direct observation of the human body were deemed to be more efficacious than any written text or speech, as they enabled numerous people in different places to observe what could otherwise be seen only on the autopsy table[18]. This conviction was also held by Paolo Mascagni, as is testified by his publications, in which images were given the greatest priority. Indeed, his *Anatomia Universa,* an extraordinary work in terms of both conception and commitment, immediately became the foremost anatomical atlas of the time. Mascagni wanted to provide medical students with anatomical tables that could reproduce the human body in extremely fine detail: a galaxy of vessels, bones and organs, both whole and sectioned.

Mascagni's tables depict the human body seen from the front *(facie adversa)* and from the back (facie aversa), as on the dissecting table. Moreover, 24 tables (102 cm long, 75 cm wide) are designed in such a way that, when arranged 3 to 3 vertically, they form life-size pictures of human bodies.

The body is represented stratigraphically, *"per diversa strata a cute ad sceletum"* ("in different layers, from skin to skeleton")[19]: the first layer *("stratum primum")* illustrates the skinned human body (i.e. deprived of the skin) and shows superficial muscles, nerves and vessels; the second layer *("stratum secundum")* depicts deeper muscles, nerves and vessels; the third *("stratum tertium")* shows the muscles, arteries and veins of the deepest layer, while the fourth layer *("stratum quartum")* shows the skeleton. These representations of the human body are followed by 20 tables illustrating the viscera and various other organs, again in life size and with extreme precision. This ground-breaking project, on which Mascagni worked for about 30 years, constitutes the very first depiction of the lymphatic system in tables of natural size ("3 braccia tos-

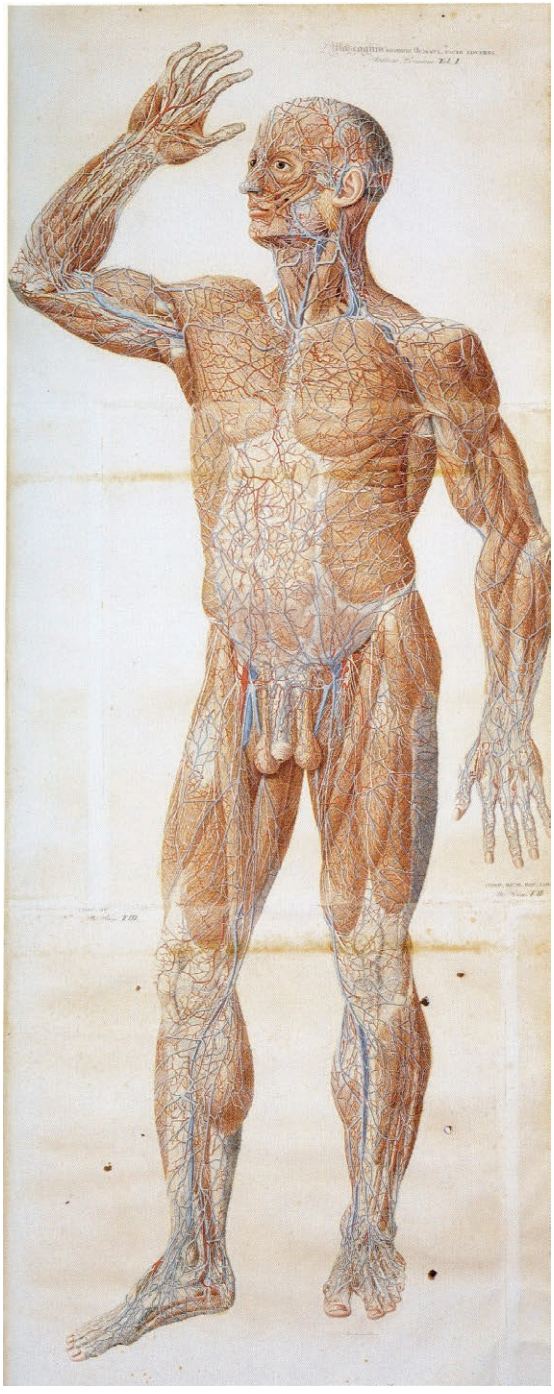

Figure 1. Paolo Mascagni, *Anatomia Universa*, stratum primum, facie adversa.

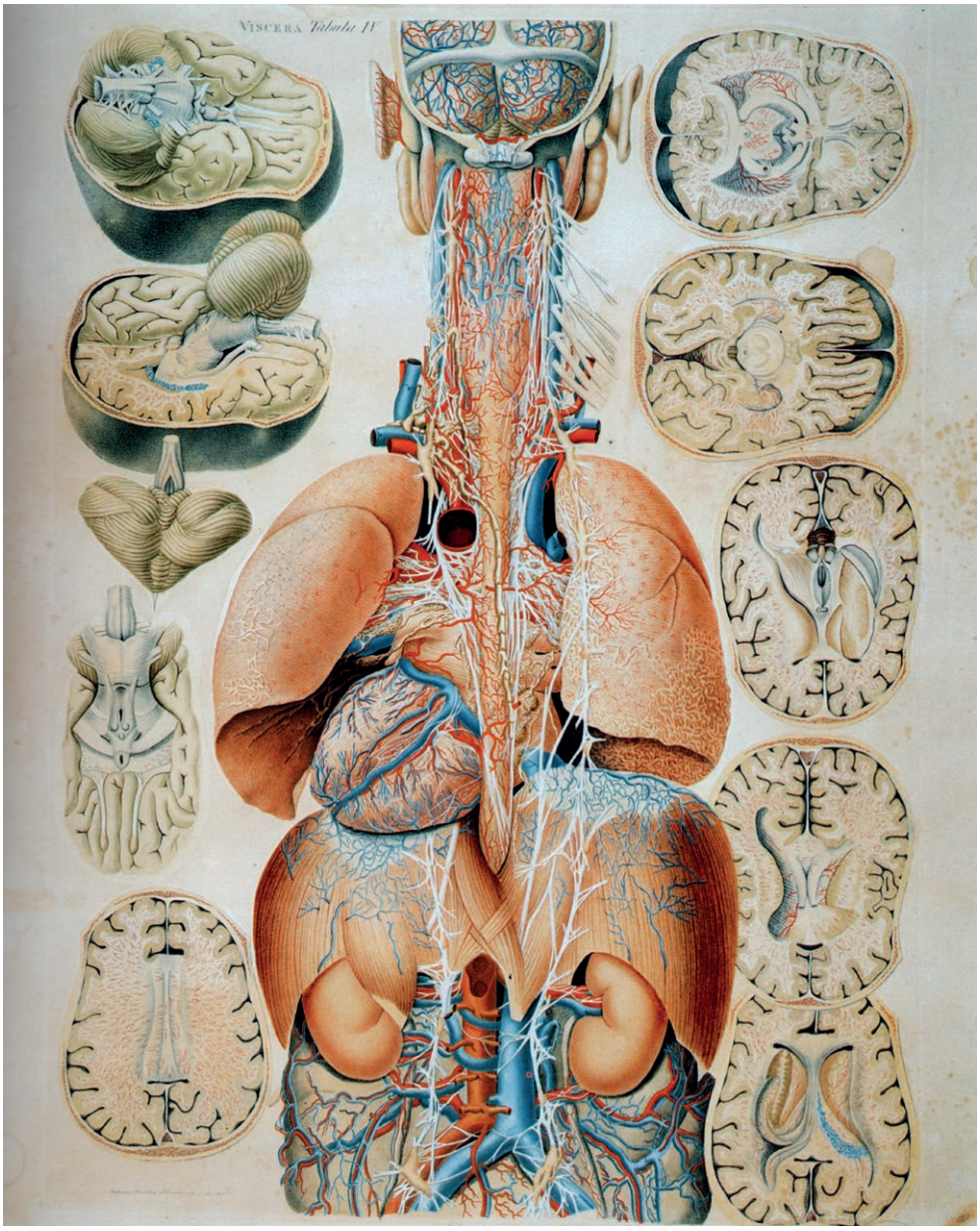

Figure 2. Paolo Mascagni, *Anatomia Universa*, Viscera, tavola IV.

cane", corresponding to 175 cm). Consequently, Mascagni is remembered not only for his fundamental work in the anatomical field, but also for his teaching methods and the high-quality materials that he produced in order to facilitate the study of anatomy.

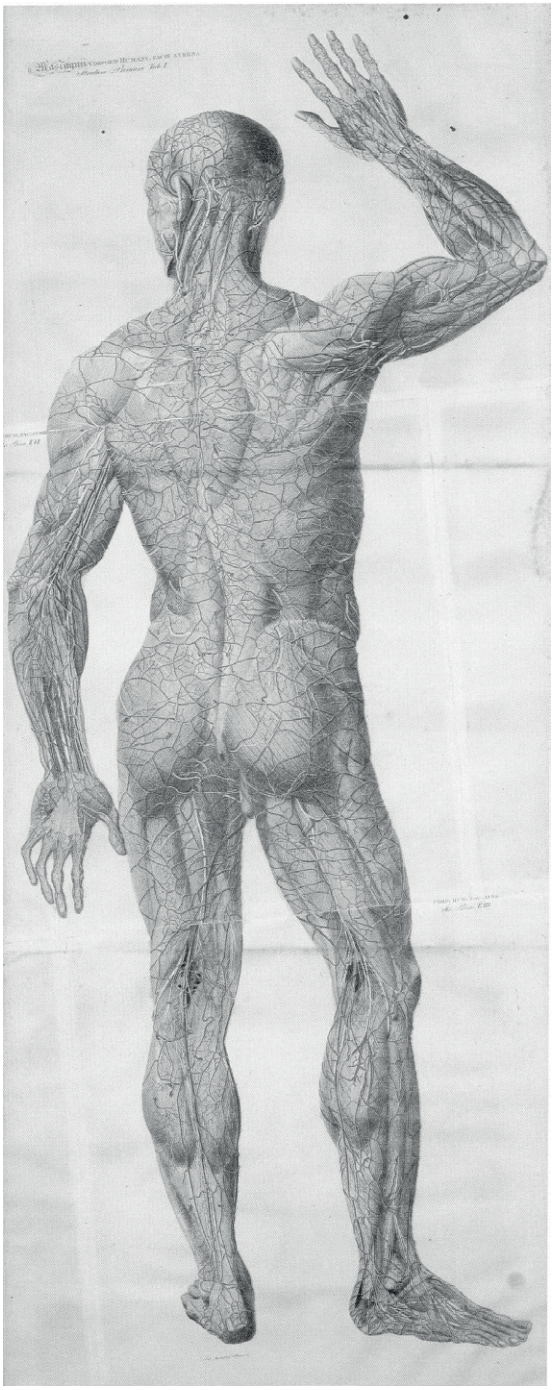

Figure 3. Paolo Mascagni, *Anatomia Universa*, stratum primum, facie aversa.

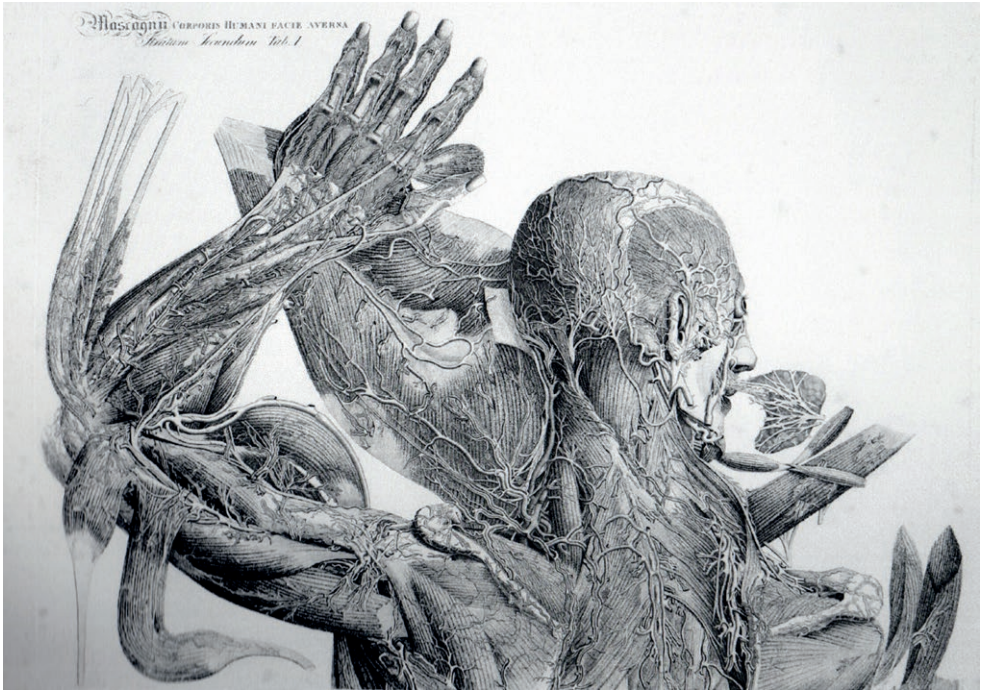

Figure 4. Paolo Mascagni, *Anatomia Universa*, stratum secondum, tav.

Mascagni's modernity and innovation in the teaching of anatomy

In their precise attention to proportions, movement and expressions, Mascagni's drawings fit into the academic tradition, indicating the extent to which he took into account the knowledge of those who had preceded him. At the same time, however, they distance themselves from this tradition.

Mascagni's vast culture was also based on the ancient texts, which abounded in his library. From the volumes of Andreas Vesalius to those of Gaspard Bauhin, Pietro da Cortona, Frederik Ruysc, Bernhard Siegfried Weiss – better known as Albinus – and Albrect van Haller, down to the most up-to-date Venetian edition of Antonio Scarpa, all the most important publications on anatomy were owned, read and annotated by him[20].

Likewise, he owned and studied texts on physiology. However, his tables clearly reveal the extremely detailed study that he conducted directly on cadavers through his continual dissections and observations. Thus, while maintaining a direct link with the classic iconographic tradition, Mascagni introduced innovations that are indicative of a new approach to research and teaching in the field of anatomy.

The tables of the *Vasorum lymphaticorum historia et ichnographia*, and especially those of the *Anatomia Universa*, display a further innovative feature; in keeping with their didactic purpose, the illustrations are not burdened by any extraneous finery, and the human body appears in its true dimensions, as it is seen on the autopsy table.

The above exposition clearly indicates the importance of Paolo Mascagni's contribution to medical education and, in particular, to the teaching of anatomy, a contribution that stemmed in no small part from his propensity to consider and to synthesise both past and contemporary knowledge, art and science.

Over the centuries, methods and technologies have evolved, but the understanding of anatomy is still based on the direct observation of the human body. Paolo Mascagni's *Anatomia Universa* is a perennial testimony to his ability as a scholar and a teacher and to his desire to contribute to the formation of a new medical class.

References

1. Orsini D, Aglianò M. Anatomy mourns the loss of her teacher, Paolo Mascagni. J Med Biogr. 2021 May;29(2):101-102. doi: 10.1177/0967772019848524.
2. Mascagni P. *Vasorum lymphaticorum historia et ichnographia auctore Paulo Mascagni in Regium Senarum Lyceo Publico Anatomes Professore*. Siena, Pazzini Carli, 1787.
3. Vannozzi, F. *La scienza illuminata. Paolo Mascagni nel suo tempo (1755-1815)*. Siena, Nuova Immagine editrice, 1996.
4. Natale G, Bocci G, Ribatti D. Scholars and scientists in the history of the lymphatic system. J Anat. 2017;231(3):417-429. doi:10.1111/joa.12644
5. Rossi M, Previdi T (a cura di). *Berengario da Carpi: il medico del Rinascimento*. Carpi, APM, 2018.
6. Berengario da Carpi. *Commentaria cum amplissimis additionibus super Anatomia Mundini una cum textu ejusdem in pristinum & verum nitorem redacto*. Bologna, Impressum per Hieronymum de Benedictis, 1521: 5v.
7. Carte della Famiglia Mascagni. Carte relative ad alcune opere di Paolo Mascagni, copia di lettera del 9 agosto 1821. Archivio Accademia delle scienze di Siena detta de' Fisiocritici.
8. Notizie bibliografiche. Grande Anatomia del Corpo Umano rappresentata in 44 Tavole dal Professore Paolo Mascagni. Prospetto. Nuovo Giornale de' Letterati, t. IV, Nistri, Pisa 1923: 336-342.
9. Mascagni, P. *Pauli Mascagni Anatomia Universa. XLIV tabulis aeneis juxta archetypum hominis adulti accuratissime repraesentata*. Pisa, Apud Micolaum Capurro, 1823-1831: II.
10. Longrigg, J. (1988). Anatomy in Alexandria in the Third Century B.C. The British Journal for the History of Science, 21(4), 455-488. http://www.jstor.org/stable/4026964
11. Berengario da Carpi. *Commentaria cum amplissimis additionibus super Anatomia Mundini una cum textu ejusdem in pristinum & verum nitorem redacto*. Bologna, Impressum per Hieronymum de Benedictis, 1521: 5v.
12. Berengario da Carpi. *Commentaria cum amplissimis additionibus super Anatomia Mundini una cum textu ejusdem in pristinum & verum nitorem redacto*. Bologna, Impressum per Hieronymum de Benedictis, 1521: 216r.
13. Di Matteo, B., Tarabella, V., Filardo, G., Mosca, M., Lo Presti, M., Viganò, A., Tomba, P., & Marcacci, M. (2017). Art in Science: Mondino de' Liuzzi: The Restorer of Anatomy. Clinical orthopaedics and related research, 475(7), 1791-1795. https://doi.org/10.1007/s11999-016-5213-5
14. Berengario da Carpi. *Commentaria cum amplissimis additionibus super Anatomia Mundini una cum textu ejusdem in pristinum & verum nitorem redacto*. Bologna, Impressum per Hieronymum de Benedictis, 1521: 248r.

15. Martini, M., Aglianò, M. Orsini, D. The educational value, both past and present, of an ancient scientific collection: the collection of anatomical preparations illustrating the various phases of bone development, from the second month of intrauterine life to adulthood. Italian Journal of Anatomy and Embriology.
16. Rippa Bonati M. Manuum munus: per una iconografia del toccar con mano. In Olivieri A. All'incrocio dei saperi: la mano. Atti del Convegno di studi (Padova, 29-30 settembre 2000). Padova, CLEUP, 2004: 326-336.
17. Premuda L. La rivoluzione vesaliana: le basi anatomiche della medicina moderna. Federazione medica 1986, 39: 891-897.
18. Kemp M. 'The mark of truth': looking and learning in some anatomical illustrations from the Reinassance and eighteenth century. In Medicine and the five senses. Cambridge, Bynum W.F.& Porter R. eds, 1993: 94.
19. Mascagni, P. *Pauli Mascagni Anatomia Universa. XLIV tabulis aeneis juxta archetypum hominis adulti accuratissime repraesentata*. Pisa, Apud Micolaum Capurro, 1823-1831: 7.
20. Orsini, D, Vannozzi, F, Aglianò, M. The anatomical world of Paolo Mascagni. Reasoned reading of the anatomy works of his library. Medicina Historica, 2017; 2: 84-93 http://hdl.handle.net/11365/1074310.