

The anatomical world of Paolo Mascagni. Reasoned reading of the anatomy works of his library

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Abstract. Paolo Mascagni was a man with deep interests in various fields of knowledge. This explains the richness and diversity of his library, where alongside the volumes that treat of Medicine issues there are books of Physics, Chemistry, Natural Sciences, but also of Agriculture and Hydrology, without neglecting the Humanities. It is obvious, however, the strong preponderance of Anatomy volumes, subject of this paper. Mascagni was well aware of how necessary it was for an anatomist of that time to possess the textbooks of 'greats' that had traced the history of Anatomy until the eighteenth century. He bases his knowledge on the works of his predecessors to fundamentally innovate the methodology of Anatomy studies: an innovation that can be observed in his writings and in his approach of anatomical science analysis.

Key words: Paolo Mascagni, anatomy works, lymphatic system, anatomical charts

Introduction

Paolo Mascagni, universally remembered as the "prince of Anatomy Scholars" for his fundamental work in the study of Anatomy, was a man with deep interests in various fields of knowledge. Although inclined to develop the study of Medicine of his master Pietro Tabarrani (1), "Anatomy, Mineralogy, Chemistry and Agriculture were the scientific fields, which more than any other impressed him and were by him studied with more fervour" (2). This very statement taken from his autobiography demonstrates in a clear manner the complexity of him as a man of Science, necessarily involved in many areas of study, although not closely related to each other. Knowledge is unique, even in the eclecticism of the scholar, and the anatomist, in the broadest sense is a naturalist, the expert of life mechanisms. This explains the richness and diversity of his library, which was bought in 1927 by a consortium of Siena Institutions including the University of Siena and is now preserved at the Academy

of Fisiocritici, where alongside the volumes that treat of Medicine matters are books of Physics, Chemistry, Natural Sciences, but also of Agriculture and Hydrology, without neglecting the Humanities.

Paolo Mascagni's library

It is obvious, however, the strong preponderance of Anatomy volumes, subject of this paper: 201 works for a total of 210 volumes, which Paolo Mascagni acquired in the course of his life convinced him of the need to know what had been published on the discipline to which he had decided to devote his professional life. For this reason he bought the library of his Master, which he augmented with numerous other volumes. The importance of being able to possess the rich and extensive library of his Master is also well documented by a letter of 1782 from the University of Siena Superintendent, Guido Savini to the S.A.R. (His Royal Highness): "[Mascagni], educated for

several years among the many and rare books of his teacher, thought he was to make the purchase, and for this reason was forced to undergo a huge amount of interest-bearing debt of hundreds of florins” (3). And today, analysing the Mascagni Book Fund, makes it easy to identify those texts that come from the purchase made by the widow of Tabarrani, Marianna Bertagna and which expense amounted to 480 florins for the young Mascagni, which he paid for by obtaining a bank loan from Monte dei Paschi Siena with the exceptional guarantee of “a mortgage above said library” (1). Moreover, Mascagni was well aware of how necessary it was for an anatomist of that time to possess the textbooks of Galeno, Hippocrates, Avicenna, as well as Mesue and then Real Colombo, Leonhart Fuchs, Charles Estienne, Louis Vassé, Gabriele Falloppio, Jacopo Berengario, Giulio Casseri, Giovanni Filippo Ingrassia and other ‘greats’ that had traced the history of Anatomy until the eighteenth century. The works of these quoted authors are in fact all present in Tabarrani’s library, then passed on to the young student, already convinced in his perennial effort as a researcher and scholar of Anatomy that, while booting to experiment the human body as an independent operating machine, but without denying his past anatomical knowledge. From the Master’s Library, among the ‘big names’ of the Renaissance, one finds the first edition of *De dissectione* of Charles Estienne, that enhances the charts as expression of the author theoretical approach, unlike the texts-books of Louis Vassé, which limited the true scientific usefulness of the charts, considered pure embellishment of the text, or *De Re Anatomica* of Realdo Colombo, which strongly characterized them, as to assume the contribution of Michelangelo himself for their preparation (4). As it appears from the above lines, the peculiarity of his being anatomist can be understood precisely in his decisions made in favour of research and summarized as follows: the constant attention and conviction that “his primary duty was to educate young people and to make sure that they would acquire full knowledge of the human body structure” (2); the necessary full time commitment for anatomical investigation, so as to induce him to renounce working in the Clinic, that is, to professional medical practice. Lets retrace his activity with short biographical notes. With the

motu proprio on April 4, 1780 and subsequent University of Siena Study Reform Decree, the teaching of Anatomy was awarded to Paolo Mascagni, a twenty-five year old university lecturer. Giovanni Niccolò Semensi helped him and replaced him as teacher in 1802, when by then Mascagni was away teaching in Florence. Instead, since the academic year 1789/90 the Siense Antonio Mattei was to assist the Master at the dissection table. But Giovanni Battista Vaselli has to be considered as the true follower of Mascagni, his pupil, active with dissections since 1803, when becoming his teaching successor during the time the Medical School was in activity, following the suppression of University of Siena, where, when reopened in 1815, he served as a teacher until 1851. These few elements help us to understand the greatness of Mascagni not only as a scholar but above all as a teacher. In fact, beyond the fame achieved for highlighting and then being the author of the first description of the lymphatic system, with its complex and rich mechanism, Mascagni was characterized by a fervent and constant activity research and especially on aspects not sufficiently highlighted, i.e. the prevailing commitment to teaching, the reading key to grasp its modernity and fully understand the dynamics of his life and his commitment as a man of science, but first of all as a teacher. Moreover, his posthumous works like the *Vasorum lymphaticorum* (1787), are to be interpreted just like his own willingness to contribute to education of Anatomy for young people, whether for medical students with his *Anatomia Universa* (1823-1831), or art students with the *Anatomia per uso degli studiosi di scultura e di pittura* (1816). These two atlases not only compensated the current anatomy textbooks with the presence of the lymphatic system, but introduced as innovative educational tools, thanks to modern iconographic pictures, which surpassed the traditional anatomic sketches patterns: one for all, the representation for the first time of the human body in natural real life-size charts, both front and rear perspectives with a stratigraphical criteria, that is from the most superficial muscular layer up to the skeleton. The man in Mascagni’s plates is the Cartesian body, living machine, device, mechanism to be explored and made recognizable when on the dissection table: this is why for anatomists of that time, Mathematics, Physics and

Geometry, “were necessary Sciences to judge the value of his anatomical studies”.

In anatomical sketches the *Corporis Fabrica* no longer depicts oneself ‘living’, in beautiful gardens and scenic spaces, albeit skeleton or ‘skinned’ posed in graceful positions, so as to remove from the image the impending sense of death (5). Mascagni in creating his plates differs completely from the examples, although still aesthetically very beautiful, of some of the authors of the past, available in his library: weeping skeletons, praying, leaning on the sickle, symbol of death, fixing a clepsydra in their hand as in the *Theatrum Anatomicum* (1605) of Gaspard Bauhin; “Skinned” inserted by Bernhard Siegfried Weiss, better known by the name of Albinus, in his *Tabulae sceleti et musculorum corporis humani* in gardens with statues and classical ruins where one can even see an exotic rhinoceros; assemblies of skeletons shown by Frederik Ruysch in *The-saurus anatomicus* (1737-38); in the seventeenth century, red charcoal sketches of skeletal figures that rise with pride and master the space by Pietro Berretini from Cortona, published in 1788 by Francesco Petraglia. Unlike these examples, the plates of Mascagni’s body are shown and made ‘alive’ by the wise and particular stretch of the designer, who wants to be that inquisitive eye, careful to reproduce anatomical exercises from life. This is when, the art of dissection becomes the mandatory knowledge and learning discipline for the young student who, in the absence of exercise practice, can always rely on real anatomical charts, perfect substitutes of dissection, tool that however still continues to be considered irreplaceable for experimental research.

Moreover, already since the Reform of 1590 in Siena, it is up to the “Anatomist to attend every year in a public place at least to one entire anatomy dissection of a Man or Woman”(6).

The lymphatic system

The first challenge of the anatomist Mascagni was, as well known, the description of the lymphatic system, always assumed, but never demonstrated in the human body due to methodological difficulties in choosing useful substances to enhance the prepa-

ration of the methodological difficulties of choice in highlighting useful substances in the preparation. Not surprisingly, the choice of Mascagni was par excellence the bodies of dropsy, very appropriate for their abnormal dilation of vessels, filled with the substance that forms the dropsy. Nevertheless, hundreds of bodies were needed for the Master to adequately describe the complex route of the lymphatic system in the human body, traceable through *hydrargyrum*, namely mercury. Injected with a glass cannula of his invention, mercury, that only slowly slips by gravity into the vessels without changing them in their physiology, was admirably enhancing them in anatomical specimens such as silver rivulets (7). Certainly, before his effective experimentation, Mascagni has thought about the mysterious system, comparing it with the printed contributions of colleagues and anatomists still engaged in the difficult research, all textbooks today traceable in his library. From Falloppio, who had seen in the vivisection of prisoners who had suffered the death penalty “a yellowish substance streaming towards the liver and lung”, to Eustachio who studying in the course of the azygos vein in horses, had observed a large canal from the subclavian artery, which is the thoracic duct, the many research studies on the lymphatic system that characterized the seventeenth century and that we all find among the books of Mascagni. One can imagine him reading about “vasorum mesaraicorum” from which was dripping a liquid similar to milk that Gaspare Aselli had noticed during a vivisection of a dog (1640); verify in the work of Caspar Bartholin (1632) as the lymphatic system was distinct from that of the blood, while flowing in it; seeking comments on “vasis lymphaticis” for the first time described in mankind in the work of Johann Vesling (1666), of Pierre Dionis (1696 and 1706) or in *De Lymphae ortu et lymphaticorum vasorum causis ad viros clarissimos dn. Le Clerc & Manget medicos genevenses. Epistolica dissertatio* of Schelhammer Christoph Günter (1683). And, again, observing the incisions in *Corporis humani anatomiae Liber Primus* of Philippe Verheyen (1717) and the *Tabulae anatomicae* of Johann Adam Kulm (1732) that reported the lymphatic vessels in some parts of the body; browsing through *Riflessioni anatomiche sulle note di Mons. Gio. Maria Lancisi* of Gaetano Petrioli (1740) that suggested the “adenologie” (lymphatic systems),

the volumes of Albrecht von Haller, *Disputationum anatomicarum selectarum* (1746-52), in the sections dedicated to the lymphatic vessels, and *Institutiones anatomicae for placita et responsa digestæ* of Claude-François Atthalin (1753), with its unique questions and answers structure, in the chapter *De vasorum lymphaticorum origine et progressu*; confronting himself with the dissertation of Lorenzo Nannoni *Sulla rigenerazione delle parti similari costituenti il corpo umano* (1781), testing with mercury injections to highlight the lymphatic system; or with disquisitions on “vaisseaux lymphatiques” of William Hewson in his *Experimental inquiries* (1774), of William Cruickshank in *The anatomy of the absorbing vessels of the human body* (1786), with particular attention, therefore, to all study researches, both nationally and internationally, past and contemporary (8). And in the library of an anatomist devoted to research for the demonstration of the lymphatic system certainly could not miss the *Opera omnia anatomico-medico-chirurgica* (1737-38) of Frederik Ruysch, who had managed to get excellent preparations with wax added to cinnabar, rosin, tallow diluted with alcohol and turpentine, method by which he had discovered, and described the valves of lymphatic vessels (8), subject later taken over by Alexander Monro in its *Observations* (1758).

But the anatomical research, certainly not complete at that time, required, as indeed for all scientific disciplines, ongoing investments in books that could guarantee the update and participation in the disciplinary debate.

Dissection and Anatomy studies

Mascagni, among others, centred, as usual, all his activities on experimental dissection, research tool and essential exercise for the teaching of Anatomy. The student, obligated to remain in the hospital and attend the exercises on the dissection table, was the one that studied and then practised as a surgeon, as only the anatomical first hand knowledge of “man-muscle” was useful to the good surgeon and it was acquired by attending the Chair in which “Young students can more easily combine the precepts with practice”, as stated Mascagni (9). The Master performed dissections not

only during the winter period in the anatomical Amphitheatre of the University of Siena and then Florence, but it is credible that such activities continued even in the summer, in the cellars of his own villa in the province of Siena, in Castelletto, today renamed Castelletto Mascagni, near Chiusdino. The ability in dissection moreover was reached after “long practice, that is only acquired after having dissected hundreds of corpses” (9). The hospital was to provide the bodies, “in addition to those provided by the city, sufficient for achieving the preparation.” (5) With the help of simple and portable microscope lenses, and further- thanks also to the acquisition of the English manufacturing microscope Dollond, he managed to combine micro to macro observations with preparations on slides enabling him to expand the knowledge of tissues. Experimental dissection and microscope reading became indispensable tools for research. Now macroscopic Anatomy is flanked by microscopic Anatomy, that will later lead to Histology. Not surprisingly, Mascagni possessed the fundamental textbooks of the great Albrecht von Haller, both the *Bibliotheca anatomica* (1774) and the *Opera minora, emendata, aucta, et renovata* (1763), as well as the remarkable work in seven volumes *Disputationum anatomicarum selectarum* (1746-52), essential for the innovative findings obtained from three hundred and fifty autopsies. This is why he will not give up to add to his *Vasorum lymphaticorum* also a plate that well represented the microscopic observations of some tissues, thus obliging the same illustrator Ciro Santi, to embody, and further admirably reproduced them in an engraving included in the *Opera* (10). The adoption of anatomical charts, refined and basic kit of his own works, could not, therefore, refrain the Anatomist in finding the most recent textbooks of colleagues who were his contemporaries. The scholar today can really ‘enjoy’ to search in the well supplied library collection of Mascagni, among them could not miss the works of Antonio Scarpa *Anatomia* (1785), Eduard Sandifort (1784), Johann Ernst Neubauer (1786), Samuel Thomas Sommerring (1794), Ferdinand Leber (1808), Floriano Caldani (1803), Jakob Benignus Winslow (1774), Leopoldo Marco Antonio Caldani (1801), just to name a few. But the numerical richness of over 200 volumes on Anatomy that belonged to Mascagni, does also highlight the

importance he gave to books, to have them on hand in his library, to search, compare, reread them. This is attested by the presence of both anatomical minor works and those of authors whose contributions are to be considered fundamental for the history of the discipline: William Harvey, Caspar Bartholin, Domenico Cotugno, Antonio Cocchi, Bernhard Siegfried Weiss, Girolamo Fabrizi d'Acquapendente and Pietro Tabarrani himself. In addition, with the presence of works of Valsalva and Morgagni, it appeared very obvious for Mascagni to own works on particular issues raised by anatomical research. Antonio Valsalva in Bologna was indeed interested by the anomalies found in autopsies, supporting the Vesalian thesis that corpses could not only teach the anatomy of a healthy person, but also that of a patient, thus highlighting the outcomes of his condition. So, more or less in the same years, Valsalva was trying to link the disease to which the patient was suffering in life with anatomy-pathological alterations detected at his death, and his disciple Giovanni Battista Morgagni described in detail the minor alterations of the disease detectable in nearly the 700 bodies he had examined. In terms of pathological Anatomy Mascagni held the writings of Eduard Sandifort, *Observationes anatomico-pathologicae* (1777-79), in sufficient consideration, as well as those of his Master and Morgagni's pupil Pietro Tabarrani, the *Observationes anatomicae* (1753), 44 stories about the necropsy of individuals who died from various diseases, debated and commented, in which he summarized his research on normal and pathological Anatomy, with a careful study of the correlation between disease, organ damage and subsequent disability. The disease began to be thought as an "anatomical key": symptom, disease, injury, in an innovative methodological consecutio of which Mascagni could not but be informed and involved for a modern notion of the anatomical and clinical disease, necessarily based on the experimental method.

Conclusion

Mascagni well is part of the medical scenery, that Jacobean period of time that so influenced the scientific world, where the necessary fusion of theoretical teaching of Medicine and its exercise, converged,

resulting in the definition of the modern teaching of Medicine, now far both from the philosopher-physician and empirical practice, in favour of a well-trained teacher in biological disciplines, like Physiology, pathological Anatomy, Materia Medica, Clinic, as clearly demonstrated by the multidisciplinary variety of volumes held in the Mascagni Fund. The construction of the renewed medical science of the eighteenth century and then even more during the nineteenth century, was to be based more and more on Anatomy with direct analysis of the body through its systematic anatomical investigations, which would explain the essence of the disease and no longer only its symptoms. An anatomical science that upheld the clinical reasoning, availing of the contributions of other disciplines all intended to create the modern curricula of schools of Medicine, in a close link between university and hospital.

Appendix: anatomical iconography

Figs. 1, 2. Pictures I and II show the skeletons of two embryos at different stages of growth: 42 days and three months of intrauterine life. Note in Picture I the presence of bregmatic fontanelle and ossified cells marked with letters. Picture II is the skeleton of an embryo in a more advanced stage of growth: to note the greater length of the limbs, the size of the cranium and thoracic cage in which one can notice the ribs with their cartilage and bone components. In Picture III, the skeleton is that of a child at birth, fully formed: please notice, compared to the previous plate, the well-built splanchnocranium. Being the plates from the early seventeenth century, the pictures are represented in a human like and almost 'alive' manner. Even the expression of each picture well underlines the different stages of growth. In the first two pictures, human-like appearance is expressed only by the act of abduction of the upper limbs, almost in an attempt to support the growth of the largest to the smallest. In the third picture the skeleton 'smiles' and firmly holds (please note the opposable thumb) the bow and arrow as a child holding a toy.

Fig. 3. The Pietro da Cortona *Tabulae anatomicae*, achieved towards 1618, edited in Rome in 1741 by Gaetano Petrioli, a century after his death. It is one

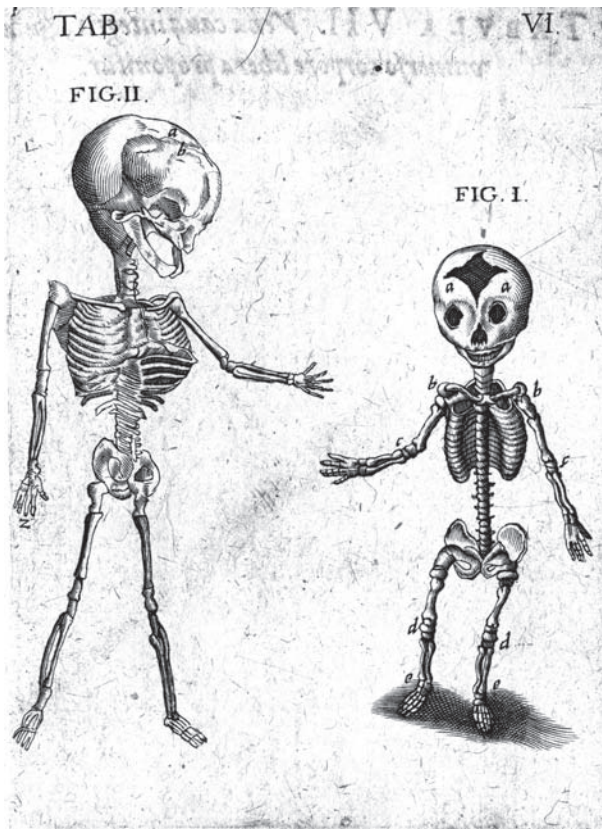


Figure 1. Gaspard Bauhin, *Theatrum Anatomicum*, Francofurti at Moenum, typis Matthaei Beckeri, 1605

of the major textbooks of anatomy and surgery, expression of the Roman pontifical medical background of the first half of the eighteenth century. The volume held in Mascagni Library is instead the edition of 1788, edited by Francesco Petraglia. The plates (red chalk carvings) depicting muscles, viscera and nerves. For a better viewing of specific parts of the body, the author uses, as a kind of magnifying glass, a mirror, in which the relative anatomical areas are explored with even greater richness of details and with specific depiction of methodologies, such as the muscle representation partially separated and folded down to allow the viewing of hidden parts, then resumed by Mascagni. The human body, even dissected and dismembered, is represented in an attitude of pride and composure that makes one think of a nobleman in various moments of his daily life, always located in a specific landscape.

Fig. 4. The water-coloured illustration from the book by Bernhard Siegfried Weiss, best known with

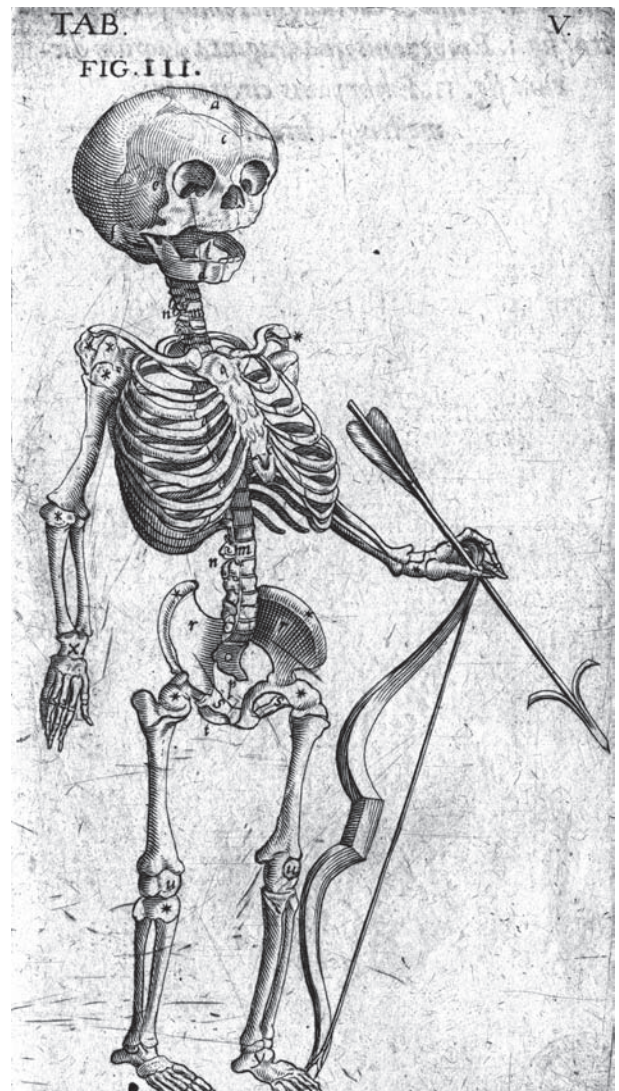


Figure 2. Gaspard Bauhin, *Theatrum Anatomicum*, Francofurti at Moenum, typis Matthaei Beckeri, 1605

the Latin name of Albinus (1697-1770), represents the mesenteric fold that covers the intestinal bends in an adult. The water-colouring confers to the reader the immediate legibility of arterial and venous “arteriae rubrae vessels, venae caeruleae” - and relative anastomoses. Particular attention to the imaging of the vascularization of this anatomical part, allows us to assume a crucial first attempt to focus on the importance of the mesenteric vessels in the spread of diseases to the abdominal viscera. The illustration carries the signature of J. Ladmiral, a skilled colour engraver who designed many pictures in the Netherlands for the work



Figure 3. *Tabulae anatomicae ex archetypis egregii pictoris Petri Berettini Cortonensis expressae et aes in incisae opus*, edited by Francesco Petraglia, Romae 1788, impensis Venantii Monaldini

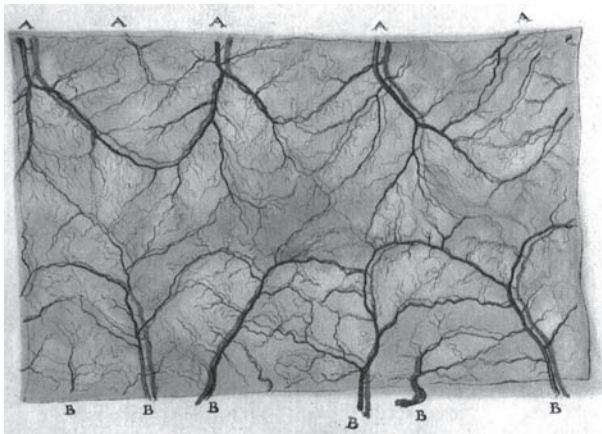


Figure 4. Bernhard Siegfried Weiss, *Dissertatio de arteriis et venis intestinorum hominis ajecta icon coloribus distincta*, Leidae Batavorum, Apud Theodorum Haak, Bibliop. Et prostat quoque Amstelaedami, Apud Jacobum Graal, & Henricum de Leth, 1736

of Frederik Ruysch. Unlike other Albinus illustrations, in which human bodies are placed in rich decorative settings – the renowned picture in the *Tabulae sceleti musculorum et corporis humani* skeleton next to a beautiful rhino exemplary – in this one, the need of real information seems to have the upper hand on the aesthetic aspects.

Figs 5, 6. This is the first edition of the atlas of Albrecht von Haller (1708-1777), a fundamental work for the study of Anatomy, characterized by anatomical illustrations designed with the intent of pure scientific rigour. This is testified by the two illustrations that are published here. To the left, the engraving on the external surface of the skull (cranium and splanchnocranium) shows the route and the external carotid subdivisions, the salivary glands, the mimic and skeletal muscles. On the right, the intra-cranial surface of the base, deprived of a large part of the brain mass, is represented in great detail in all its components: the frontal sinuses, the two eyeballs, the pituitary gland,

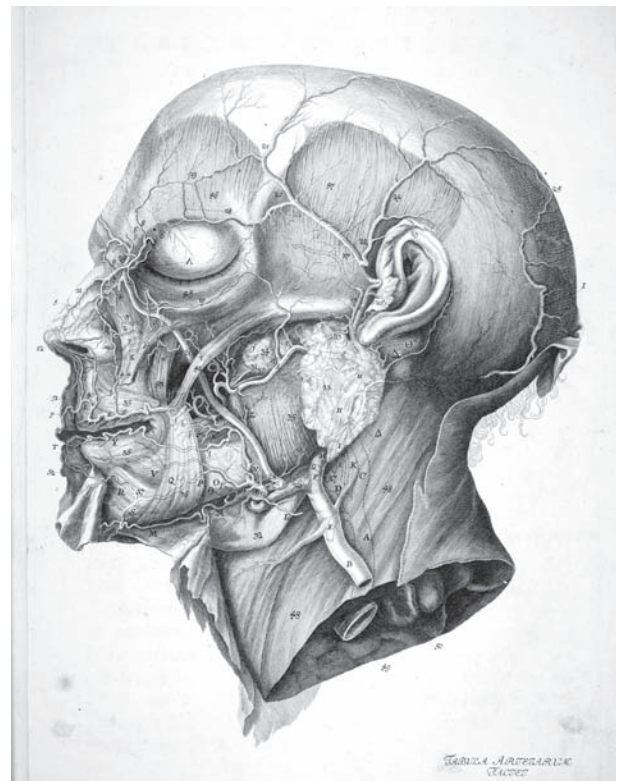


Figure 5. Albrecht von Haller, *Iconum anatomicarum quibus precipuae partes corporis humani exquisita cura delineatae continentur*, Goettingae, Typis Abrami Vandenhoeck, 1743

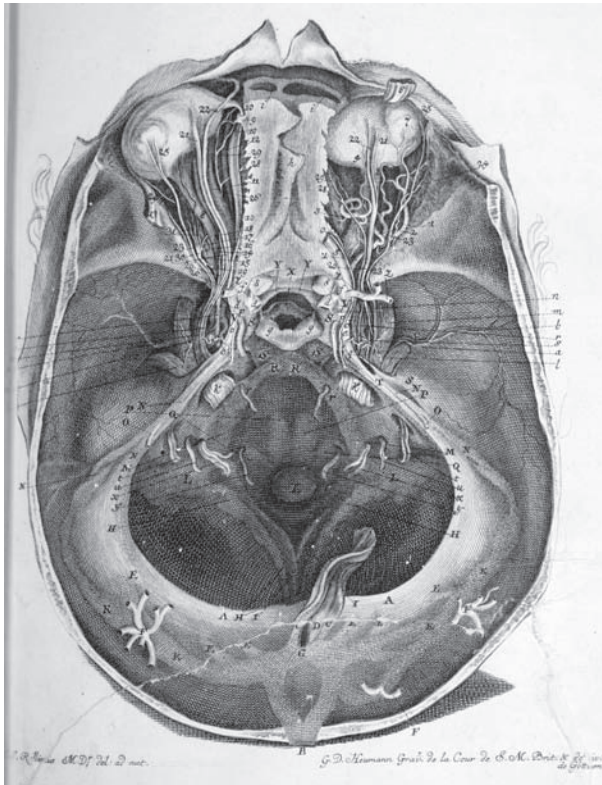


Figure 6. Albrecht von Haller, *Iconum anatomicarum quibus precipuae partes corporis humani exquisita cura delineatae continentur*, Goettingae, Typis Abrami Vandenhoeck, 1743

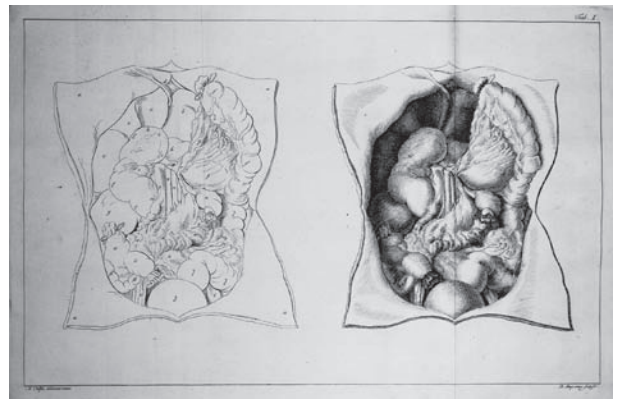


Figure 7. Eduard Sandifort, *Tabulae duodeni intestines*, Eduard Sandifort, anatomical Opuscula, Batavorum Lugduni, Apud S. et J. Luchtmans, P. v.d. Eyk et D. Vygh, 1784

the internal carotid artery, the great foramen occipital, the skull holes with the emergence of the respective nerves. To notice, as unique relief to the scientific rigour of Haller, that in the anterior cranial fossa, the horizontal plate of ethmoid bone is represented as a compact tissue, and not as cribriform plate: that is, the holes that give passage to the olfactory nerve are not shown.

Figs. 7, 8. The two illustrations, together with their relative framed numbered outlines, represent the

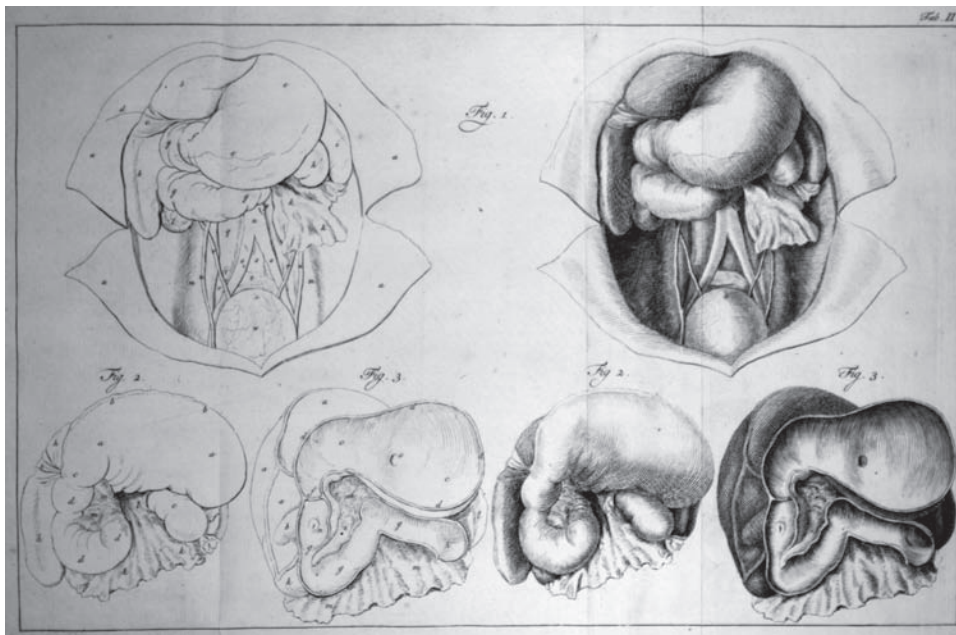


Figure 8. Eduard Sandifort, *Tabulae duodeni intestines*, Eduard Sandifort, anatomical Opuscula, Batavorum Lugduni, Apud S. et J. Luchtmans, P. v.d. Eyk et D. Vygh, 1784

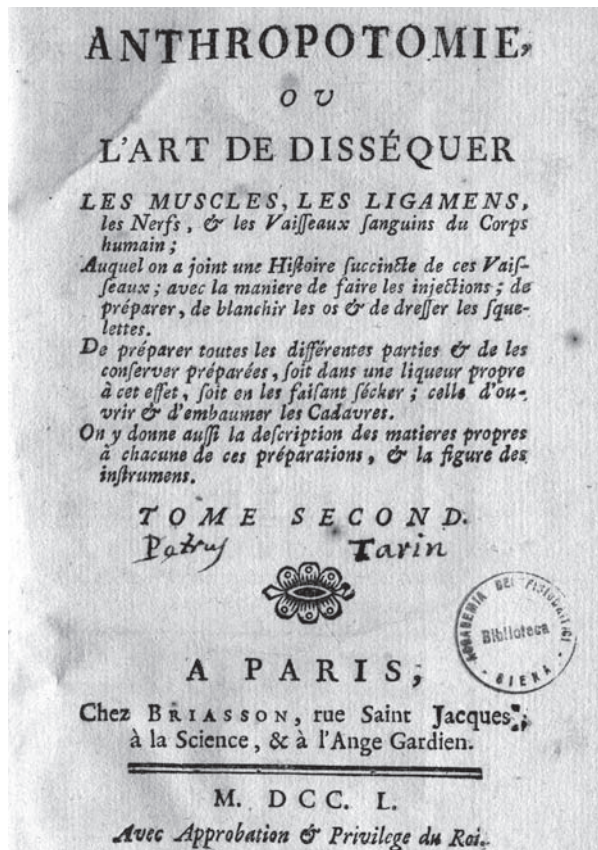


Figure 9. Pierre Tarin, *Anthropotomie, ou l'Art de disséquer les muscles, ligamens, les nerfs & les vaisseaux sanguins du corps humain*, Paris, chez Briasson, 1750, 2 volumes

viscera when opening the abdomen. Especially highlighted are shape, position and links of the duodenum with the stomach - pylorus - as well as with the liver and pancreas through the opening of the “ductus choledochi & Pancreatici”. The meticulous and careful description of these interchanges can be explained by the desire of Eduard Sandifort (1742-1814) to be supportive of the activity of the surgeon and pathologist. Student and successor of Bernhard Siegfried Weiss, Sandifort worked for a long time in Leiden, where the anatomical and clinical method was applied. He was called by Jean Cruveilhier ‘father of the pathological iconography’ for his stunning illustrations to his writings.

With his studies and especially with the collection of *Observationes anatomico-pathologicae*, richly illustrated, he placed himself among the scholars who enriched the Morgagni studies, first to correlate cer-

tain alterations of organs and tissues with specific diseases and thus considered to be the founder of the “organ pathology”.

Fig. 9. The work chosen by Pierre Tarin is motivated by the wish to show the charts that represent the instruments of anatomical dissection, starting from autopsy table.

Along with Diderot, Tarin signed the most detailed contribution to *Encyclopédie* on Anatomy, moving from historical summary to arguments related to the purposes and benefits of this science.

He also edited a *Dictionnaire anatomique* in 1753 structured in two sections: the first section offers ‘an explanation of the most used terms in anatomy’, the second is proposed as a “library” of anatomical textbooks until then edited in order to allow scholars “to trace the sources in the various investigations to be undertaken”, and to “examine everything that was said before them” [...] “so that their argumentation could become the point from which one must start to move to other discoveries” (Tarin, *Avertissement*).

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